FCD-155 Ver. 4.2,
FCD-155E Ver. 1.2

STM-1/OC-3 Terminal Multiplexer/ADM

RAD
data communications
The Access Company

FCD-155 Ver. 4.2, FCD-155E Ver. 1.2

STM-1/OC-3 Terminal Multiplexer/ADM

Installation and Operation Manual

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For further information contact RAD at the address below or contact your local distributor.

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Product Disposal

To facilitate the reuse, recycling and other forms of recovery of waste equipment in protecting the environment, the owner of this RAD product is required to refrain from disposing of this product as unsorted municipal waste at the end of its life cycle. Upon termination of the unit's use, customers should provide for its collection for reuse, recycling or other form of environmentally conscientious disposal.

General Safety Instructions

The following instructions serve as a general guide for the safe installation and operation of telecommunications products. Additional instructions, if applicable, are included inside the manual.

# Safety Symbols

⚠️ **Warning**	This symbol may appear on the equipment or in the text. It indicates potential safety hazards regarding product operation or maintenance to operator or service personnel.

⚡	Danger of electric shock! Avoid any contact with the marked surface while the product is energized or connected to outdoor telecommunication lines.

⏚	Protective ground: the marked lug or terminal should be connected to the building protective ground bus.
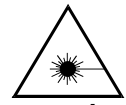
☀️ **Warning**	Some products may be equipped with a laser diode. In such cases, a label with the laser class and other warnings as applicable will be attached near the optical transmitter. The laser warning symbol may be also attached. Please observe the following precautions:

- Before turning on the equipment, make sure that the fiber optic cable is intact and is connected to the transmitter.
- Do not attempt to adjust the laser drive current.
- Do not use broken or unterminated fiber-optic cables/connectors or look straight at the laser beam.
- The use of optical devices with the equipment will increase eye hazard.
- Use of controls, adjustments or performing procedures other than those specified herein, may result in hazardous radiation exposure.

ATTENTION: The laser beam may be invisible!

In some cases, the users may insert their own SFP laser transceivers into the product. Users are alerted that RAD cannot be held responsible for any damage that may result if non-compliant transceivers are used. In particular, users are warned to use only agency approved products that comply with the local laser safety regulations for Class 1 laser products.

Always observe standard safety precautions during installation, operation and maintenance of this product. Only qualified and authorized service personnel should carry out adjustment, maintenance or repairs to this product. No installation, adjustment, maintenance or repairs should be performed by either the operator or the user.

Handling Energized Products

General Safety Practices

Do not touch or tamper with the power supply when the power cord is connected. Line voltages may be present inside certain products even when the power switch (if installed) is in the OFF position or a fuse is blown. For DC-powered products, although the voltages levels are usually not hazardous, energy hazards may still exist.

Before working on equipment connected to power lines or telecommunication lines, remove jewelry or any other metallic object that may come into contact with energized parts.

Unless otherwise specified, all products are intended to be grounded during normal use. Grounding is provided by connecting the mains plug to a wall socket with a protective ground terminal. If a ground lug is provided on the product, it should be connected to the protective ground at all times, by a wire with a diameter of 18 AWG or wider. Rack-mounted equipment should be mounted only in grounded racks and cabinets.

Always make the ground connection first and disconnect it last. Do not connect telecommunication cables to ungrounded equipment. Make sure that all other cables are disconnected before disconnecting the ground.

Connecting AC Mains

Make sure that the electrical installation complies with local codes.

Always connect the AC plug to a wall socket with a protective ground.

The maximum permissible current capability of the branch distribution circuit that supplies power to the product is 16A. The circuit breaker in the building installation should have high breaking capacity and must operate at short-circuit current exceeding 35A.

Always connect the power cord first to the equipment and then to the wall socket. If a power switch is provided in the equipment, set it to the OFF position. If the power cord cannot be readily disconnected in case of emergency, make sure that a readily accessible circuit breaker or emergency switch is installed in the building installation.

In cases when the power distribution system is IT type, the switch must disconnect both poles simultaneously.

Connecting DC Power

Unless otherwise specified in the manual, the DC input to the equipment is floating in reference to the ground. Any single pole can be externally grounded.

Due to the high current capability of DC power systems, care should be taken when connecting the DC supply to avoid short-circuits and fire hazards.

DC units should be installed in a restricted access area, i.e. an area where access is authorized only to qualified service and maintenance personnel.

Make sure that the DC power supply is electrically isolated from any AC source and that the installation complies with the local codes.

The maximum permissible current capability of the branch distribution circuit that supplies power to the product is 16A. The circuit breaker in the building installation should have high breaking capacity and must operate at short-circuit current exceeding 35A.

Before connecting the DC supply wires, ensure that power is removed from the DC circuit. Locate the circuit breaker of the panel board that services the equipment and switch it to the OFF position. When connecting the DC supply wires, first connect the ground wire to the corresponding terminal, then the positive pole and last the negative pole. Switch the circuit breaker back to the ON position.

A readily accessible disconnect device that is suitably rated and approved should be incorporated in the building installation.

If the DC power supply is floating, the switch must disconnect both poles simultaneously.

Connecting Data and Telecommunications Cables

Data and telecommunication interfaces are classified according to their safety status.

The following table lists the status of several standard interfaces. If the status of a given port differs from the standard one, a notice will be given in the manual.

Ports	Safety Status	
V.11, V.28, V.35, V.36, RS-530, X.21, 10 BaseT, 100 BaseT, Unbalanced E1, E2, E3, STM, DS-2, DS-3, S-Interface ISDN, Analog voice E&M	SELV	Safety Extra Low Voltage: Ports which do not present a safety hazard. Usually up to 30 VAC or 60 VDC.
xDSL (without feeding voltage), Balanced E1, T1, Sub E1/T1	TNV-1	Telecommunication Network Voltage-1: Ports whose normal operating voltage is within the limits of SELV, on which overvoltages from telecommunications networks are possible.
FXS (Foreign Exchange Subscriber)	TNV-2	Telecommunication Network Voltage-2: Ports whose normal operating voltage exceeds the limits of SELV (usually up to 120 VDC or telephone ringing voltages), on which overvoltages from telecommunication networks are not possible. These ports are not permitted to be directly connected to external telephone and data lines.
FXO (Foreign Exchange Office), xDSL (with feeding voltage), U-Interface ISDN	TNV-3	Telecommunication Network Voltage-3: Ports whose normal operating voltage exceeds the limits of SELV (usually up to 120 VDC or telephone ringing voltages), on which overvoltages from telecommunication networks are possible.

Always connect a given port to a port of the same safety status. If in doubt, seek the assistance of a qualified safety engineer.

Always make sure that the equipment is grounded before connecting telecommunication cables. Do not disconnect the ground connection before disconnecting all telecommunications cables.

Some SELV and non-SELV circuits use the same connectors. Use caution when connecting cables. Extra caution should be exercised during thunderstorms.

When using shielded or coaxial cables, verify that there is a good ground connection at both ends. The grounding and bonding of the ground connections should comply with the local codes.

The telecommunication wiring in the building may be damaged or present a fire hazard in case of contact between exposed external wires and the AC power lines. In order to reduce the risk,

there are restrictions on the diameter of wires in the telecom cables, between the equipment and the mating connectors.

Caution	To reduce the risk of fire, use only No. 26 AWG or larger telecommunication line cords.

Attention	Pour réduire les risques s'incendie, utiliser seulement des conducteurs de télécommunications 26 AWG ou de section supérieure.

Some ports are suitable for connection to intra-building or non-exposed wiring or cabling only. In such cases, a notice will be given in the installation instructions.

Do not attempt to tamper with any carrier-provided equipment or connection hardware.

Electromagnetic Compatibility (EMC)

The equipment is designed and approved to comply with the electromagnetic regulations of major regulatory bodies. The following instructions may enhance the performance of the equipment and will provide better protection against excessive emission and better immunity against disturbances.

A good ground connection is essential. When installing the equipment in a rack, make sure to remove all traces of paint from the mounting points. Use suitable lock-washers and torque. If an external grounding lug is provided, connect it to the ground bus using braided wire as short as possible.

The equipment is designed to comply with EMC requirements when connecting it with unshielded twisted pair (UTP) cables. However, the use of shielded wires is always recommended, especially for high-rate data. In some cases, when unshielded wires are used, ferrite cores should be installed on certain cables. In such cases, special instructions are provided in the manual.

Disconnect all wires which are not in permanent use, such as cables used for one-time configuration.

The compliance of the equipment with the regulations for conducted emission on the data lines is dependent on the cable quality. The emission is tested for UTP with 80 dB longitudinal conversion loss (LCL).

Unless otherwise specified or described in the manual, TNV-1 and TNV-3 ports provide secondary protection against surges on the data lines. Primary protectors should be provided in the building installation.

The equipment is designed to provide adequate protection against electro-static discharge (ESD). However, it is good working practice to use caution when connecting cables terminated with plastic connectors (without a grounded metal hood, such as flat cables) to sensitive data lines. Before connecting such cables, discharge yourself by touching ground or wear an ESD preventive wrist strap.

FCC-15 User Information

This equipment has been tested and found to comply with the limits of the Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the Installation and Operation manual, may cause harmful interference to the radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Canadian Emission Requirements

This Class A digital apparatus meets all the requirements of the Canadian Interference-Causing Equipment Regulation.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Warning per EN 55022 (CISPR-22)

Warning	This is a class A product. In a domestic environment, this product may cause radio interference, in which case the user will be required to take adequate measures.
Avertissement	Cet appareil est un appareil de Classe A. Dans un environnement résidentiel, cet appareil peut provoquer des brouillages radioélectriques. Dans ces cas, il peut être demandé à l'utilisateur de prendre les mesures appropriées.
Achtung	Das vorliegende Gerät fällt unter die Funkstörgrenzwertklasse A. In Wohngebieten können beim Betrieb dieses Gerätes Rundfunkströrungen auftreten, für deren Behebung der Benutzer verantwortlich ist.

Mise au rebut du produit

Afin de faciliter la réutilisation, le recyclage ainsi que d'autres formes de récupération d'équipement mis au rebut dans le cadre de la protection de l'environnement, il est demandé au propriétaire de ce produit RAD de ne pas mettre ce dernier au rebut en tant que déchet municipal non trié, une fois que le produit est arrivé en fin de cycle de vie. Le client devrait proposer des solutions de réutilisation, de recyclage ou toute autre forme de mise au rebut de cette unité dans un esprit de protection de l'environnement, lorsqu'il aura fini de l'utiliser.

Instructions générales de sécurité

Les instructions suivantes servent de guide général d'installation et d'opération sécurisées des produits de télécommunications. Des instructions supplémentaires sont éventuellement indiquées dans le manuel.

Symboles de sécurité

Avertissement

Ce symbole peut apparaitre sur l'équipement ou dans le texte. Il indique des risques potentiels de sécurité pour l'opérateur ou le personnel de service, quant à l'opération du produit ou à sa maintenance.

Danger de choc électrique ! Evitez tout contact avec la surface marquée tant que le produit est sous tension ou connecté à des lignes externes de télécommunications.

Mise à la terre de protection : la cosse ou la borne marquée devrait être connectée à la prise de terre de protection du bâtiment.

Certains produits peuvent être équipés d'une diode laser. Dans de tels cas, une étiquette indiquant la classe laser ainsi que d'autres avertissements, le cas échéant, sera jointe près du transmetteur optique. Le symbole d'avertissement laser peut aussi être joint.

Avertissement

Veuillez observer les précautions suivantes :

- Avant la mise en marche de l'équipement, assurez-vous que le câble de fibre optique est intact et qu'il est connecté au transmetteur.
- Ne tentez pas d'ajuster le courant de la commande laser.
- N'utilisez pas des câbles ou connecteurs de fibre optique cassés ou sans terminaison et n'observez pas directement un rayon laser.
- L'usage de périphériques optiques avec l'équipement augmentera le risque pour les yeux.
- L'usage de contrôles, ajustages ou procédures autres que celles spécifiées ici pourrait résulter en une dangereuse exposition aux radiations.

ATTENTION : Le rayon laser peut être invisible !

Les utilisateurs pourront, dans certains cas, insérer leurs propres émetteurs-récepteurs Laser SFP dans le produit. Les utilisateurs sont avertis que RAD ne pourra pas être tenue responsable de tout dommage pouvant résulter de l'utilisation d'émetteurs-récepteurs non conformes. Plus particulièrement, les utilisateurs sont avertis de n'utiliser que des produits approuvés par l'agence et conformes à la réglementation locale de sécurité laser pour les produits laser de classe 1.

Respectez toujours les précautions standards de sécurité durant l'installation, l'opération et la maintenance de ce produit. Seul le personnel de service qualifié et autorisé devrait effectuer l'ajustage, la maintenance ou les réparations de ce produit. Aucune opération d'installation, d'ajustage, de maintenance ou de réparation ne devrait être effectuée par l'opérateur ou l'utilisateur.

Manipuler des produits sous tension

Règles générales de sécurité

Ne pas toucher ou altérer l'alimentation en courant lorsque le câble d'alimentation est branché. Des tensions de lignes peuvent être présentes dans certains produits, même lorsque le commutateur (s'il est installé) est en position OFF ou si le fusible est rompu. Pour les produits alimentés par CC, les niveaux de tension ne sont généralement pas dangereux mais des risques de courant peuvent toujours exister.

Avant de travailler sur un équipement connecté aux lignes de tension ou de télécommunications, retirez vos bijoux ou tout autre objet métallique pouvant venir en contact avec les pièces sous tension.

Sauf s'il en est autrement indiqué, tous les produits sont destinés à être mis à la terre durant l'usage normal. La mise à la terre est fournie par la connexion de la fiche principale à une prise murale équipée d'une borne protectrice de mise à la terre. Si une cosse de mise à la terre est fournie avec le produit, elle devrait être connectée à tout moment à une mise à la terre de protection par un conducteur de diamètre 18 AWG ou plus. L'équipement monté en châssis ne devrait être monté que sur des châssis et dans des armoires mises à la terre.

Branchez toujours la mise à la terre en premier et débranchez-la en dernier. Ne branchez pas des câbles de télécommunications à un équipement qui n'est pas mis à la terre. Assurez-vous que tous les autres câbles sont débranchés avant de déconnecter la mise à la terre.

Connexion au courant du secteur

Assurez-vous que l'installation électrique est conforme à la réglementation locale.

Branchez toujours la fiche de secteur à une prise murale équipée d'une borne protectrice de mise à la terre.

La capacité maximale permissible en courant du circuit de distribution de la connexion alimentant le produit est de 16A. Le coupe-circuit dans l'installation du bâtiment devrait avoir une capacité élevée de rupture et devrait fonctionner sur courant de court-circuit dépassant 35A.

Branchez toujours le câble d'alimentation en premier à l'équipement puis à la prise murale. Si un commutateur est fourni avec l'équipement, fixez-le en position OFF. Si le câble d'alimentation ne peut pas être facilement débranché en cas d'urgence, assurez-vous qu'un coupe-circuit ou un disjoncteur d'urgence facilement accessible est installé dans l'installation du bâtiment.

Le disjoncteur devrait déconnecter simultanément les deux pôles si le système de distribution de courant est de type IT.

Connexion d'alimentation CC

Sauf s'il en est autrement spécifié dans le manuel, l'entrée CC de l'équipement est flottante par rapport à la mise à la terre. Tout pôle doit être mis à la terre en externe.

A cause de la capacité de courant des systèmes à alimentation CC, des précautions devraient être prises lors de la connexion de l'alimentation CC pour éviter des courts-circuits et des risques d'incendie.

Les unités CC devraient être installées dans une zone à accès restreint, une zone où l'accès n'est autorisé qu'au personnel qualifié de service et de maintenance.

Assurez-vous que l'alimentation CC est isolée de toute source de courant CA (secteur) et que l'installation est conforme à la réglementation locale.

La capacité maximale permissible en courant du circuit de distribution de la connexion alimentant le produit est de 16A. Le coupe-circuit dans l'installation du bâtiment devrait avoir une capacité élevée de rupture et devrait fonctionner sur courant de court-circuit dépassant 35A.

Avant la connexion des câbles d'alimentation en courant CC, assurez-vous que le circuit CC n'est pas sous tension. Localisez le coupe-circuit dans le tableau desservant l'équipement et fixez-le en position OFF. Lors de la connexion de câbles d'alimentation CC, connectez d'abord le conducteur de mise à la terre à la borne correspondante, puis le pôle positif et en dernier, le pôle négatif. Remettez le coupe-circuit en position ON.

Un disjoncteur facilement accessible, adapté et approuvé devrait être intégré à l'installation du bâtiment.

Le disjoncteur devrait déconnecter simultanément les deux pôles si l'alimentation en courant CC est flottante.

Declaration of Conformity

Manufacturer's Name:	RAD Data Communications Ltd.
Manufacturer's Address:	24 Raoul Wallenberg St., Tel Aviv 69719, Israel

declares that the product:

Product Names: **FCD-155, FCD-155E**

Conform to the following standard(s) or other normative document(s):

EMC:	EN 55022:1998 + A1:2000, A2:2003	Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement.
	EN 55024:1998 + A1:2001, A2:2003	Information technology equipment – Immunity characteristics – Limits and methods of measurement.
	EN 61000-3-2:2000 + A2:2005	Electromagnetic compatibility (EMC) - Part 3-2: Limits - Limits for harmonic current emissions (equipment input current up to and including 16A per phase).
	EN 61000-3-3:1995 + A1:2001	Electromagnetic compatibility (EMC) - Part 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤16A per phase and not subject to conditional connection.
Safety:	EN 60950-1:2001 + A11:2004	Information technology equipment – Safety – Part 1: General requirements.

Supplementary Information:

The products herewith comply with the requirements of the EMC Directive 2004/108/EC, the Low Voltage Directive 2006/95/EC and the R&TTE Directive 99/5/EC for wired equipment. The products were tested in a typical configuration.

Tel Aviv, 19 December 2007

Haim Karshen

VP Quality

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Quick Start Guide

If you are familiar with the FCD-155, use this guide to prepare it for operation, starting from its factory-default configuration.

Preliminary Preparations

Note   *If you need to select the network interface standard (SDH or SONET), contact your nearest authorized RAD business partner for information.*

FCD-155 Configuration Using a Supervisory Terminal

Starting a Preliminary Configuration Session

1. Connect a terminal to the CONTROL port on the FCD-155 front panel (use a straight cable).

   You may use any standard ASCII terminal (dumb terminal or personal computer emulating an ASCII terminal) equipped with an RS-232 communication interface. *Make sure to use VT-100 terminal emulation.*

2. Configure the terminal for **115.2 kbps, one start bit, eight data bits, no parity,** and **one stop bit**. Select the **full-duplex** mode, **echo off**, and **disable any type of flow control**.

3. Connect the FCD-155 to power.

4. Wait until the PWR indicator stops flashing, and then press **‹ Enter ›** once to obtain the log-in screen.

5. If the FCD-155 default user name and password have not yet been changed, log in as administrator using **su** as the user name and **1234** for password.

   If your password is accepted, you will see the FCD-155 main menu.

Note   • *If you cannot establish communication with the FCD-155 or the display is scrambled, you need to reset FCD-155 CONTROL port parameters to the factory defaults. Contact Your nearest authorized RAD business partner.*

   • *If the password has been changed and is lost, contact your nearest authorized RAD business partner.*

Preliminary Configuration

The purpose of preliminary configuration is to enable management access by management stations, for example, RADview, Telnet hosts and Web browsers.

Step	Action	Using
1	Perform quick setup	**Configuration>Quick Setup**
2	Configure the out-of-band management ports: • Configure CONTROL port communication parameters and supervisory terminal options • For FCD-155E: configure the Ethernet MNG port, when supported	**Configuration>System>Control Ports** *or* **Configuration>System>Control Ports>Serial Port** **Configuration>System>Control Ports>Terminal** **Configuration>System>Control Ports>ETH**
3	Configure management authorizations for FCD-155 (optional)	**Configuration>System>Control Ports>Terminal>Change Password**
4	Configure FCD-155 management agent (optional)	**Configuration>System>Management>Host IP**
5	Configure FCD-155 management access (optional)	**Configuration>System>Management>Management Access**
6	Configure specific management stations (optional)	**Configuration>System>Management>Manager List**
7	Set FCD-155 real-time clock (optional)	**Configuration>System>Date & Time Update**
8	Define FCD-155 logistics information (optional)	**Configuration>System>Management>Device Info**

Configuration of Transmission Characteristics

The purpose of transmission parameter configuration is to configure the services provided by the FCD-155. Skip steps not relevant to your FCD-155 version and/or to its application mode in your network.

Step	Action	Using
1	Reload the factory-default parameters.	**Configuration>System>Factory Default**
2	Use quick setup to define FCD-155 main characteristics. Skip configuration of parameters that you intend to configure manually, e.g., the number of ports to be enabled. If DHCP is used for management IP address assignment, use Step 4	**Configuration>Quick Setup**

Step	Action	Using
3	Configure the out-of-band management ports:	
	• Configure CONTROL port communication parameters and supervisory terminal options	**Configuration›System›Control Ports** *or* **Configuration›System›Control Ports›Serial Port** **Configuration›System›Control Ports›Terminal**
	• For FCD-155E: configure the Ethernet MNG port	**Configuration›System›Control Ports›ETH**
4	Configure the additional FCD-155 management agent parameters	**Configuration›System›Management›Host IP**
5	Configure FCD-155 management access	**Configuration›System›Management›Management Access**
6	Configure specific management stations	**Configuration›System›Management›Manager List**
7	Set FCD-155 real-time clock	**Configuration›System›Date & Time Update**
8	Define FCD-155 logistics information	**Configuration›System›Management›Device Info**
9	Configure FCD-155E station clock port, when in use	**Configuration›Physical Ports›Station Clock**
10	Configure FCD-155 STM-1 or OC-3 physical ports:	
	• Configure STM-1 or OC-3 physical port parameters	**Configuration›Physical Ports›STM-1** or **OC-3**
	• For FCD-155 with two network links, configure the physical layer protection parameters	**Configuration›Physical Ports›STM-1** or **OC-3 › Protection Mode, Wait to Restore**
	• Configure the master timing source for the SDH/SONET subsystem	**Configuration›Physical Ports›STM-1** or **OC-3 › Master Timing Source, Master RX Clock**
	• Configure the fallback timing source for the SDH/SONET subsystem	**Configuration›Physical Ports›STM-1** or **OC-3 › Fallback Timing Source, Fallback RX Clock**
	• Configure the DCC parameters, to enable inband management via DCC.	**Configuration›Physical Ports›STM-1** or **OC-3›DCC Configuration**
	or	
	Configure FCD-155E STM-1 or OC-3 physical ports:	
	• Configure separate physical port parameters for each link	**Configuration›Physical Ports›STM-1** or **OC-3›Link 1** and/or **Link 2**
	• Configure the DCC parameters for each link	**Configuration›Physical Ports›STM-1** or **OC-3›Link 1** and/or **Link 2›DCC Configuration**
	• Configure the timing mode for the SDH/SONET subsystem	**Configuration›Physical Ports›STM-1** or **OC-3›Clock Parameters**
	For FCD-155E only:	
	Configure the protection type,	**Configuration›Physical Ports›STM-1** or **OC-3 ›APS›Protection Type**
	and the protection parameters	**Configuration›Physical Ports›STM-1** or **OC-3›APS**
11	Configure physical LAN ports	**Configuration›Physical Ports› LAN** *or* **Configuration›Physical Ports›Ethernet**

Step	Action	Using
12	Configure FCD-155 physical PDH ports: • Configure the common parameters • Configure the individual port parameters (at this stage, you can also enable/disable ports configured by means of the **Quick Setup** screen)	**Configuration›Physical Ports›PDH›Common Parameters** **Configuration›Physical Ports›PDH›Port Parameters**
	Configure FCD-155E physical PDH ports: • Configure the common parameters • Configure the individual port parameters (at this stage, you can also enable/disable ports configured by means of the **Quick Setup** screen)	**Configuration›Physical Ports›E1/T1** or **E3/T3›Common Parameters** **Configuration›Physical Ports›E1/T1** or **E3/T3›Port Parameters**
13	When using PDH ports as timing reference, configure FCD-155 system timing (not supported by FCD-155E): • Main (master) timing source • Fallback timing source	 **Configuration›Physical Ports›STM-1** or **OC-3›Master Timing Source** and **Master Rx Clock** **Configuration›Physical Ports›STM-1** or **OC-3›Fallback Timing Source** and **Fallback Rx Clock**
14	Configure FCD-155 virtual STM-1 or STS-3 port	**Configuration›Virtual Ports›STM-1** or **STS-3**
15	Configure FCD-155 virtual concatenation groups	**Configuration›Virtual Ports›VCAT›VCG 1** to **VCG 8,** or **All VCG**
16	Configure FCD-155 GFP multiplexing (when function is used)	**Configuration›Virtual Ports›VCAT›GFP Mux** (type **a** to add a new GFP mux)

Step	Action	Using
17	Perform mapping:	
	• For FCD-155E: first select the link for mapping	**Configuration › System › Mapping › Link 1** or **Link 2**
	• Map the VCGs not processed by any GFP mux	**Configuration › System › Mapping › Link x** (select defined **VCG** entities) *or*
		Configuration › System › Mapping › (select defined **VCG** entities)
	• Map the primary group of the defined GFP mux	**Configuration › System › Mapping › Link x** (select **VCG** defined as primary group of the defined GFP mux)
		or
		Configuration › System › Mapping (select **VCG** defined as primary group of the defined GFP mux)
	• Map active PDH ports (option), and disconnect unused VCs/VTs	**Configuration › System › Mapping › Link x** (select **None** for each unused VC/VT) *or*
		Configuration › System › Mapping (select **None** for each unused VC/VT)
	• For FCD-155E: map protection ports for the active virtually concatenated groups and PDH ports	**Configuration › System › Mapping › Link x** (select **None** for each unused VC/VT)
	• For FCD-155E: map the cross-connections (bypass) between the two links	**Configuration › System › Mapping › Link x** (select **None** for each unused VC/VT)
18	Configure general bridge characteristics	**Configuration › Applications › Bridge**
19	Configure general bridge STP parameters, when STP or RSTP is enabledused	**Configuration › Applications › Bridge › Spanning Tree Protocol**
20	Configure bridge port characteristics and associated STP parameters	**Configuration › Applications › Bridge › Bridge Port**
21	Configure port-based VLANs (only for FCD-155 without GbE option)	**Configuration › Applications › Bridge › Port Membership ›**
22	Configure general QoS parameters	**Configuration › Applications › QoS**
23	Configure per-port QoS parameters	**Configuration › Applications › QoS › Port Mapping**
24	Configure layer 2 QoS (priority) parameters	**Configuration › Applications › QoS › Layer 2 Mapping**
25	Configure layer 3 QoS (DSCP/ToS) parameters	**Configuration › Applications › QoS › Layer 3 Mapping**
26	Configure link aggregation in accordance with system requirements:	
	• Select a link aggregation (trunk) ID	**Configuration › Applications › Link Aggregation,** and press **F** or **B** to scroll to the desired ID
	• Configure the LAN ports, or VCG ports, included in this trunk	**Configuration › Applications › Link Aggregation › LAN Ports** or **VCG Ports**
27	Save the updated database	Type **#** and confirm.

Contents

Chapter 1

Introduction

1.1   Overview

Purpose

The FCD-155/FCD-155E is a family of versatile multi-service STM-1/OC-3 terminal multiplexers (TM) and add-drop multiplexers (ADM) for use in SDH and SONET networks.

The FCD-155/FCD-155E can provide the following services over SDH/SONET networks:

- Layer 1 (transparent) transport of 10/100 Mbps Ethernet traffic, with configurable bandwidth

- Layer 2 switching of Ethernet traffic up to the GbE level, with configurable QoS

- Support for link aggregation to increase the bandwidth available to Ethernet traffic

- Transparent transport of legacy TDM (PDH) traffic at the E1, E3, T1, and T3 levels

Main Features

The FCD-155/FCD-155E provide Layer 1 and Layer 2 transport services for Ethernet traffic (10/100/1000 Mbps), together with PDH traffic.

Support for standard SFP optical transceivers for the GbE and network interfaces enables selecting the optimal interface for each application. High-performance SFPs available from RAD enable achieving ranges up to 80 km/50 miles.

For efficient bandwidth utilization, FCD-155/FCD-155E support LO and HO virtual concatenation, including GFP encapsulation per ITU-T Rec. G.7041 or LAPS per ITU-T Rec. X.85/X.86. For reliable transmission, FCD-155/FCD-155E also support LCAS per ITU-T Rec. G.7042.

Installing FCD-155/FCD-155E on customer's sites allows a cost-effective deployment of the SDH/SONET infrastructure for Internet access and LAN connectivity, while providing continued support for all legacy services. It also provides a cost-effective means for expanding and consolidating intra-organizational communication services over existing infrastructures.

Flexible timing options enable reliable distribution of timing, and flexible selections of timing sources.

A wide range of inband and out-of-band management options provide organizations with the means needed to integrate the equipment within the organizational management network, as well as transfer their management traffic seamlessly through the FCD-155/FCD-155E-based network.

Models

An FCD-155E or FCD-155 unit consists of a base unit that must be supplemented by ordering options in order to support the required set of services. Two types of base units are offered:

- **FCD-155E**: 1U, full-rack wide unit.

- **FCD-155**: 1U, half-rack wide unit.

Each base unit comprises a motherboard installed in a standard RAD case, with the following baseline components:

- Two SFP sockets for STM-1/OC-3 network interfaces that accept standard SFPs. On the base unit, only one interface is used.

- One Ethernet management port

- One serial RS-232 asynchronous configuration port with DCE interface

- One alarms interface port

- One AC or DC power supply.

A base unit does not include an Ethernet switch: the switch is added when some LAN interface options are installed (however, a software router for management traffic is always included).

The ordering options that can be added to the base unit cover each aspect of operations:

- Type and number of Ethernet LAN interfaces

- Type and number of TDM (PDH) interfaces

- Number and functionality of network interfaces (single or dual)

- Type of network physical interface (optical or copper SFP)

- Power supply type (AC or DC)

- Power supply redundancy (FCD-155E only).

Basic Model Features

The basic models of both FCD-155 and FCD-155E units are considered the STM-1/OC-3 terminal multiplexers that include the following capabilities:

- Two LAN ports with 10/100BASE-T interfaces (ordering option 2U), connected to a full-function internal Layer 2 Ethernet switch.

  The basic ports support user-configurable VLAN support, QoS, and link aggregation. Maximum frame size for the basic ports is 1536 bytes, thus enabling connection to MPLS (Multiple-Protocol Label Switched) networks.

- One network port for the basic FCD-155. Each network port has an STM-1/OC-3 optical or copper interface with field-replaceable SFP transceiver.

Notes

The selection between SDH and SONET is made by an internal jumper. Contact Your nearest authorized RAD business partner for details.

The basic FCD-155 and FCD-155E models support both high-order and low-order virtual concatenation for transporting the LAN traffic over SDH or SONET:

- With high-order virtual concatenation, the FCD-155 can transport LAN traffic over up to 3 VC-3/STS-1 concatenated containers, or one VC-4.

- With low-order concatenation, traffic from any LAN port can be mapped over a virtually concatenated group using up to 63 VC-12s/64 VC-11s/64 VT-1.5s per group. For the basic models, up to 4 independent virtually concatenated groups can be configured, provided the bandwidth available on the network link is not exceeded.

When allocating a single VC/VT/SPE to LAN traffic, the user can disable the use of virtual concatenation, and directly assign the traffic to any desired VC or VT/SPE in the SDH, respectively SONET, frame.

The FCD-155 and FCD-155E support the Link Capacity Adjustment Scheme (LCAS), and therefore enable dynamic adjustment of utilized bandwidth when one or more virtual containers (VCs or VTs) fail. The LAN traffic encapsulation type (LAPS or GFP) is also configurable. With GFP encapsulation, GFP multiplexing can be used to further improve bandwidth utilization.

Ordering Options

Table 1-1 lists the port options available for each FCD-155 model.

Table 1-1. Summary of TDM Port and Power Ordering Options for FCD-155/FCD-155E

Model	Link Interface Option	Dual PS Option	4 E1	4 T1	8 E1	8 T1	21 E1	28 T1	E3	T3	21E1 E3	28T1 E3	21E1 T3	28T1 T3
FCD-155	SDH		✠	✠	✠	✠			✠	✠				
FCD-155	SONET			✠		✠				✠				
FCD-155E	SDH	✠			✠	✠	✠	✠	✠	✠	✠	✠	✠	✠
FCD-155E	SONET	✠				✠		✠		✠				✠

Table 1-2. Summary of LAN Ordering Options for FCD-155/FCD-155E

Model	Link Interface Option	LAN Port Options			
		2 (Switch)	4 (Transparent)	6U (Switch	GbE
FCD-155	SDH	✠	✠		
					✠
	SONET	✠	✠		
					✠
FCD-155E	SDH	✠	✠		
		✠		✠	
					✠
	SONET	✠	✠		
		✠		✠	
					✠

Notes

1. All the FCD-155E models have ADM and APS functionality.

2. All the units have two SFP sockets, and can be equipped with two network interfaces.

As seen in *Table 1-1*, for each unit, the following options are available:

- No TDM port, or one TDM port option (one of the PDH options)

- No LAN port, 2 or 6 10/100BaseT LAN ports, or 1 GbE port

- One network link option

- Dual-power supply option for FCD-155E.

Considering the offered options, the maximum traffic capacity for FCD-155E is 2 × STM-1/OC-3. The maximum local user traffic is as follows:

- PDH: up to 21 VC-12, or 28 VC-11/VT-1.5, or one VC-3/STS-1

- LAN traffic:

  - With concatenation: up to 63 VC-12, or up to 84 VT-1.5, or up to 3 × VC-3/STS-1

  - Without concatenation: one VC-4, or one VC-3/STS-1 per LAN port.

Note

*In this manual, the generic term **FCD-155** is used when the information is applicable to all the FCD-155 and FCD-155E models. The complete equipment designation is used when information is applicable to a specific equipment version.*

PDH Options

The following PDH options are offered:

- **E1 ports**: either 4 (FCD-155 only), 8, or 21 (FCD-155E only) ports for unframed transport of independent E1 (2.048 Mbps) data streams. Have user-selectable balanced or unbalanced ITU-T Rec. G.703 interfaces.

- **T1 ports**: either 4 (FCD-155 only), 8, or 28 (FCD-155E only) ports for unframed transport of independent T1 (1.544 Mbps) data streams. Have balanced ITU-T Rec. G.703 interfaces.

- **E3 ports**: one E3 port for unframed transport of one E3 (34.368 Mbps) data stream. Has unbalanced ITU-T Rec. G.703 interface.

- **T3 port**: one T3 port for unframed transport of one T3 (44.736 Mbps) data stream. Has unbalanced ITU-T Rec. G.703 interface.

- **Hybrid module**: (for FCD-155E only) contains 21 ports for unframed transport of independent E1 (2.048 Mbps) data streams, or 28 ports for unframed transport of independent T1 (1.544 Mbps) data streams, and one E3 port for unframed transport of one E3 (34.368 Mbps) data stream or one T3 port for unframed transport of one T3 (44.736 Mbps) data stream.

Note

In this manual, the terms 4 E1, 8 E1, and 21 E1 are used to associate an E1 port with the corresponding E1 PDH ports options, and the terms 4 T1, 8 T1, and 28 T1 are used for the T1 options.

LAN Port Options

The following LAN port options are offered:

- 2 LAN ports with 10/100BASE-T interfaces connected to a full-function internal Layer 2 Ethernet switch. Their characteristics have been presented for the basic FCD-155 version on *page 1-2*.

- 4 "transparent" LAN ports (which are added to the 2 basic LAN ports to obtain the 6U option) with 10/100BASE-TX Ethernet interfaces. These ports that do not pass through the Ethernet switch, and support frame size up to 2 kB. This enables transparent transport of each LAN port traffic over the SDH/SONET network on a separate path, for increased security.

  - For FCD-155, the ports do not support automatic MDI/MDIX detection

  - For FCD-155E, the ports do support automatic MDI/MDIX detection.

  An FCD-155 with the transparent ports option supports a total of 8 virtually concatenated groups, where 4 are directly assigned to the corresponding transparent LAN port, and the other are available for the (optional) 2 LAN ports.

- 4 switched LAN ports with 10/100BASE-T interfaces connected to a full-function internal Layer 2 Ethernet switch. Their characteristics have been presented for the basic FCD-155E version on *page 1-2*.

- One GbE port with 10/100/1000BASE-T Ethernet interface and support for SFP plug-in module for operation over optical fibers. Includes GbE Ethernet switch, with user-configurable VLAN support.

Installing either the transparent or GbE LAN option increases the number of low-order virtually concatenated groups that can be configured to 8. Moreover, both the transparent and GbE LAN options support a maximum frame size of 2 kB, which improves performance in Storage Area Network (SAN) applications.

Network Link Options

As an option, FCD-155 can be ordered with two STM-1/OC-3 optical interfaces. An FCD-155 with dual network links supports 1+1 single-ended multiplex section protection (MSP unidirectional protection) for the connection to the SDH/SONET network. However, the total traffic capacity of the dual network link option is still one STM-1/OC-3, because at any time only one link interface is active.

FCD-155E is always equipped with two STM-1/OC-3 optical interfaces. FCD-155E supports automatic protection switching (APS), and it also has a high-order/low-order non-blocking cross-connect matrix that controls the mapping of payload and overhead to these interfaces. As a result, the FCD-155E supports the following operation modes toward the network:

- Two independent STM-1/OC-3 links (no protection), for doubling the total interconnection capacity. This permits using the FCD-155E as an ADM, because the payload sent on each link is independent of the payload sent on the other link.

- Dual-link operation with 1+1 single-ended multiplex section protection (unidirectional protection), with automatic protection switching. In this mode, the total capacity of the network connection is one STM-1/OC-3.

In ring applications, the FCD-155E supports path protection (SNCP).

Power Supply Redundancy

The FCD-155E unit has two slots for PS modules. RAD offers AC and DC powered modules. It is also allowed to install one AC and one DC PS module.

Only a single PS module is required to provide power to a fully equipped FCD-155E, and therefore installing a second module provides redundancy. As long as both modules operate normally, they share the load; in case one fails or does not receive power, the other continues providing power.

1.2   Typical Applications

Applications for Basic FCD-155

Figure 1-1 shows a typical application for a basic FCD-155 model that serves as a terminal multiplexer. In this application, FCD-155 units provide links to carry the LAN traffic among several sites, and enable access to IP networks (Internet or enterprise intranets). The links are provided over the SDH or SONET network.
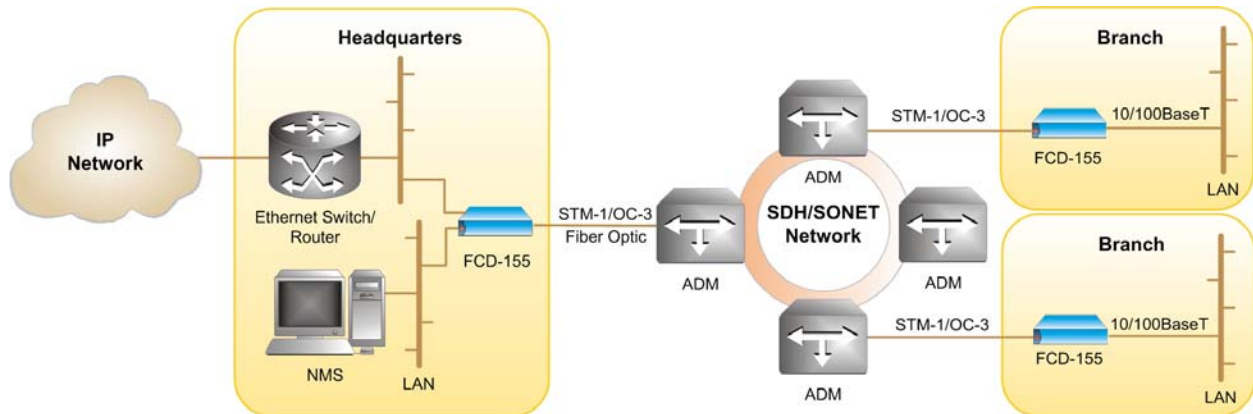
Figure 1-1. Typical Application for Basic FCD-155 Unit

The advanced Ethernet switch of the FCD-155 enables flexible routing of traffic among the various sites. For example:

- using appropriately configured port-based VLANs enhances security

- using tag-based VLANs enable both segregation of user's traffic in accordance with its source and control over the quality of service (QoS) for each type of traffic.

The whole network can be managed from a single location, using an SNMP-based network management station connected to one of the FCD-155 units. To avoid using link payload-carrying capacity, the management traffic can be carried within the SDH/SONET overhead, using the DCC.

Note

The DCC can only be used when the SDH/SONET network supports access and enables transparent connection to the DCC at the required locations.

Applications for FCD-155 with Transparent LAN Ports

Figure 1-2 shows a typical application for an FCD-155 unit equipped with 6 LAN ports (2 LAN ports connected to the internal Ethernet switch and 4 additional transparent LAN ports). The user can select the number of transparent LAN ports that are actually used (enabled).

Typically, each transparent LAN port can be used to serve a specific application, or a department within a larger organization.

The traffic passing through each transparent LAN port is routed to a specific virtually concatenated group (port 3 – to group 5, port 4 – to group 6, etc.). This means that each transparent LAN port can be independently routed through the SDH/SONET network, and can be allocated exclusive access to a user-selected fraction of the link bandwidth.

The traffic from each of the four transparent LAN port is transparently transported across the SDH/SONET network, with no processing except encapsulation (LAPS or GFP). Therefore, the FCD-155 link serves as a LAN extender: this means that a user-provided router or Layer 2 switch must be used when it necessary to prevent local traffic from flowing to the remote site through the SDH/SONET network.
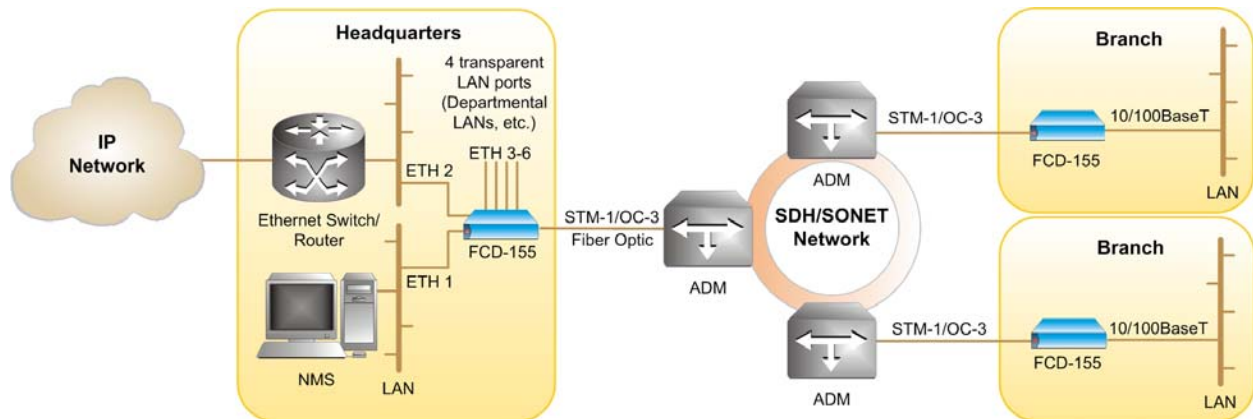
Figure 1-2. Typical Application for FCD-155 Unit with Transparent LAN Ports (6U Option)

Applications for FCD-155 with PDH Interfaces

Adding PDH interfaces to the basic FCD-155 version provides a complete solution for all the internal communication requirements of businesses.

Applications for E1/T1 PDH Interfaces

A typical application for an FCD-155 with E1 or T1 PDH interfaces is shown in *Figure 1-3*. This example shows an FCD-155 with quad PDH interfaces, however the same applications are also supported by the 8 and 21E1/28T1 PDH interfaces.

Note

Figure 1-3 illustrates equipment with SDH network interfaces, however T1 PDH interfaces can also be used with SONET network interfaces.

In this application, FCD-155 units provide broadband connectivity for both voice and LAN services between the headquarters and the branch offices:

- The headquarters' voice switch connects to the FCD-155 E1 or T1 interfaces. Its traffic is transparently transported over the network to each branch office. Separate trails can be defined for connection to the PBX of each branch office. Moreover, the branch offices can also connect to the PSTN through headquarters' voice switch, irrespective of their geographical location.

The total bandwidth needed is one VC-12 per E1 trunk (or one VC-11 per T1 trunk), therefore most of the STM-1 link bandwidth is free to carry LAN traffic.

* The remaining link bandwidth can be used to carry broadband LAN traffic, and management.
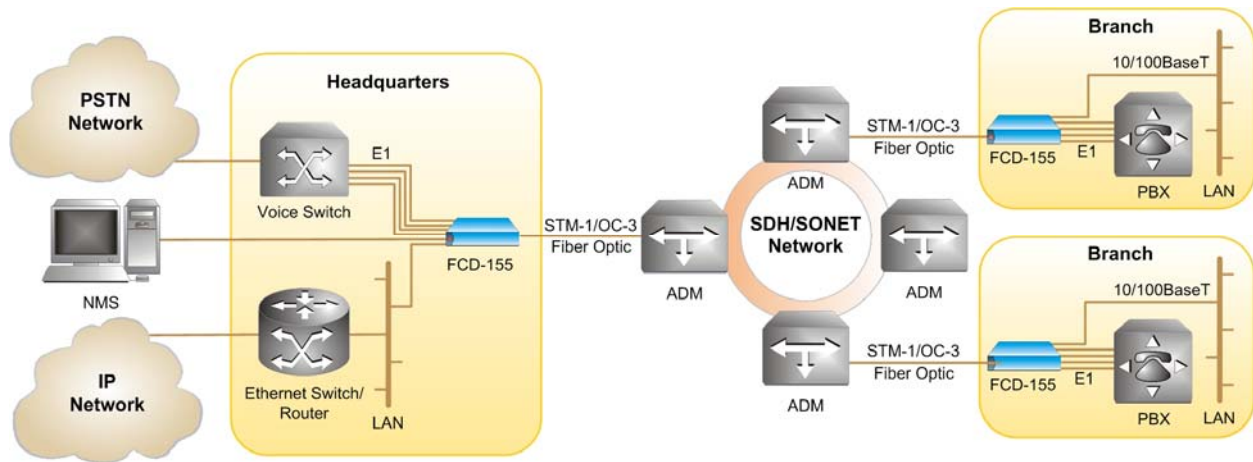
Figure 1-3. Typical Application for FCD-155 Unit with E1 or T1 PDH Interfaces

Applications for E3/T3 PDH Interfaces

The E3 or T3 PDH interface added to the basic FCD-155 version enables transparent transport of the PDH stream through the SDH/SONET network, in the desired VC-3 or STS-1 SPE. A typical application for an FCD-155 with E3 or T3 PDH interface is shown in *Figure 1-4*.

Note

Figure 1-4 illustrates equipment with SDH network interfaces, however the T3 PDH interface can also be used with SONET network interfaces.
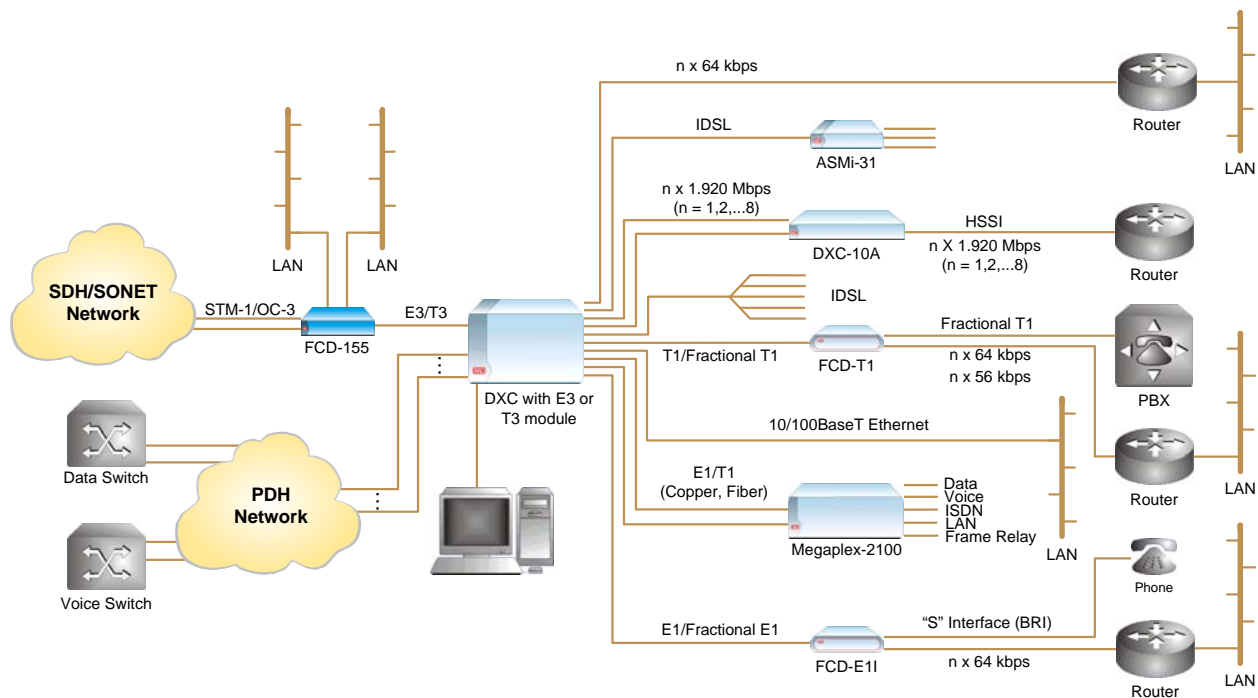
Figure 1-4. Typical Application for FCD-155 Unit with E3 or T3 PDH Interface

In this application, FCD-155 units provide broadband connectivity for the DXC multiservice access nodes offered by RAD. The DXC support a wide range of services, down to the level of the individual DS0, for example:

- Non-blocking DS0 cross-connect services for T1, E1 (frame and unframed), $n{\times}56$/$n{\times}64$ kbps services.
- E1 and T1 multiplexing services.
- Inverse multiplexing capabilities: DXC systems with an inverse multiplexing subsystem support transparent transmission of high-speed data over up to eight E1 or T1 links (equivalent to user rates up to 15.360 Mbps for E1 lines, or 11.776 Mbps for T1 lines).

These capabilities are in addition to the LAN services of the basic FCD-155.

Applications for FCD-155E Versions

The applications illustrated above for FCD-155 versions are also supported by the FCD-155E.

However, the FCD-155E provides full ADM capabilities, and therefore it can be used directly on the SDH/SONET ring, instead of being connected through an ADM unit.

A typical application for the FCD-155E is shown in *Figure 1-5*. The services that can be provided are similar to the services illustrated above for the FCD-155.
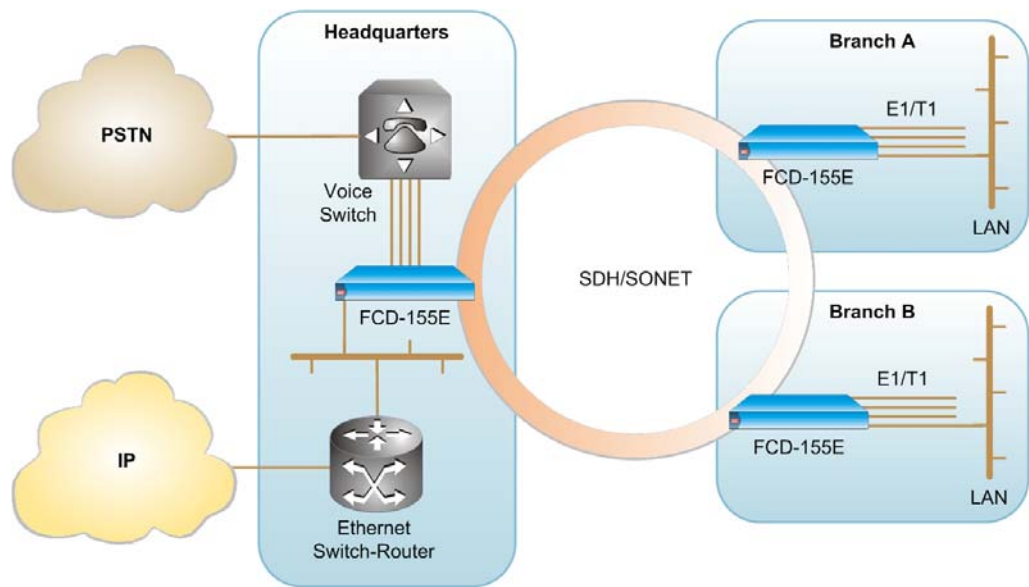
Figure 1-5. Typical FCD-155E Application

FCD-155E can also be used in SNCP applications, as shown in *Figure 1-6*. In this application, FCD-155E are inserted in the subnet ring, which provides SNCP for the main ring.
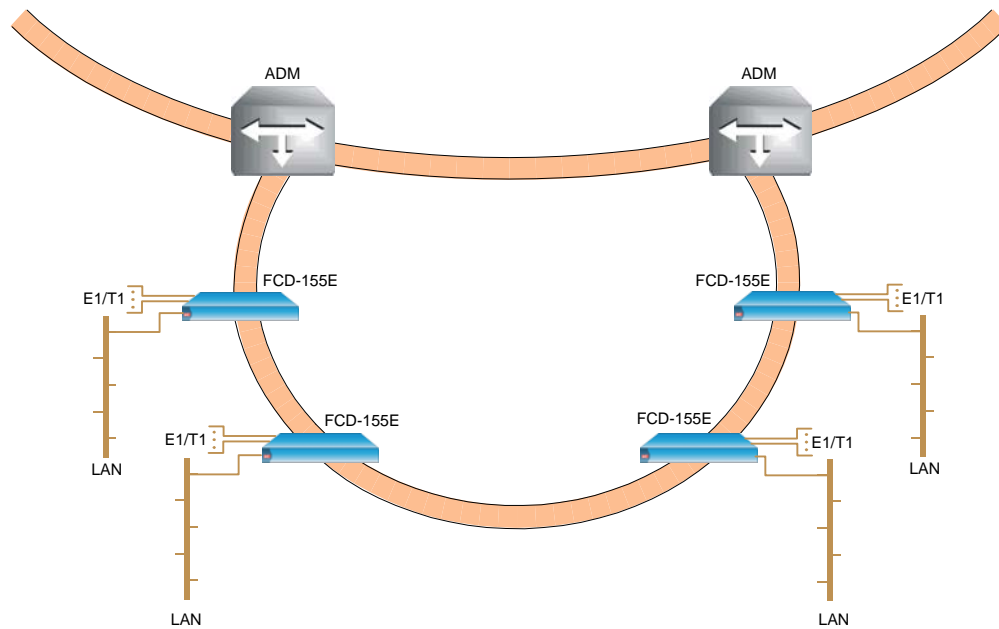
Figure 1-6. FCD-155E in Typical SNCP Application

1.3 Physical Description

FCD-155E

Figure 1-7 shows front and rear views of a typical FCD-155E unit. FCD-155E is a compact unit, intended for installation in 19" racks. The unit height is 1U (1.75 in). An optional rack-mount adapter kit enables installing an FCD-155E unit in a 19-inch rack.

All the connections are made to the rear panel. The FCD-155E rear panel also includes indicators that indicate its operating status, and the status of the various interfaces; some of the indicators are replicated on the front panel.

Air intake vents and discharge are located on the side walls.

Figure 1-7. Typical FCD-155E Front and Rear Panels

Optional Ports

The FCD-155E units supports various optional ports (the complete list is given in *Table 1-1*). Three types of optional ports (see *Figure 1-8*) are available:

- Optional LAN ports
- Optional TDM (PDH) ports
- Optional STM-1/OC-3 uplink ports and interfaces.

The network and GbE ports are equipped with SFP sockets.

The various port and interface options are identified in *Figure 1-8*.

LAN Port Options   **PDH and Sub Options**

No Option   No Option

4 Additional   8 E1 or T1
LAN Ports   CH.1-8 - G703   PDH Interfaces

1 GbE Port   CH.1-14 - G703   CH.15-21/28 G703   21 E1 or 28 T1
                                                                                               PDH Interfaces

                              TX   RX   E3 or T3
                              E3/T3   PDH Interfaces

                              LOS Rx Tx   1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28   E3 or T3 and 21 E1
                              E3/T3   or 28 T1 PDH Interfaces
                              E1/T1   E3/T3   CH.1-14 - G703   CH.15-21/28 G703

                                                                                               Sub STM-1
                              ON   Interface
                              LINE SUB LINK

FCD-155E   LINK 3   4   5   6 ACT

RAD

No Option   CONTROL   Alarm
                                                                  Port   Connector
                              Network Link
Basic LAN Ports   Interfaces

                              Station Clock   POWER   POWER   AC
                              Connector   — 100-240VAC   — 100-240VAC

                              Management   48V   48V   DC
                              Port   POWER   POWER
                              (MNG)

                                                                  Power Supply Options

Figure 1-8. FCD-155E, Identification of Port and Interface Options

FCD-155

Figure 1-9 shows a general view of a typical FCD-155 unit. FCD-155 is a compact unit, intended for installation in 19″ racks, on desktops or shelves. The unit height is 1U (1.75 in). An optional rack-mount adapter kit enables installing two FCD-155 units, side by side, in a 19-inch rack.

Figure 1-9. Typical FCD-155 Unit, General View

All the connections, except for the power connection, are made to the front panel. The FCD-155 front panel also includes indicators that indicate its operating status.

Air intake vents are located on the side walls, and an exhaust vent is located on the rear panel.

Optional Ports

The FCD-155 units supports various optional ports (the complete list is given in *Table 1-1*). Three types of optional ports (see *Figure 1-10*) are available:

- Optional LAN ports

- Optional PDH ports

- Optional STM-1/OC-3 uplink ports and interfaces.

The network and GbE ports are equipped with SFPs.

The various port and interface options are identified in *Figure 1-10*.
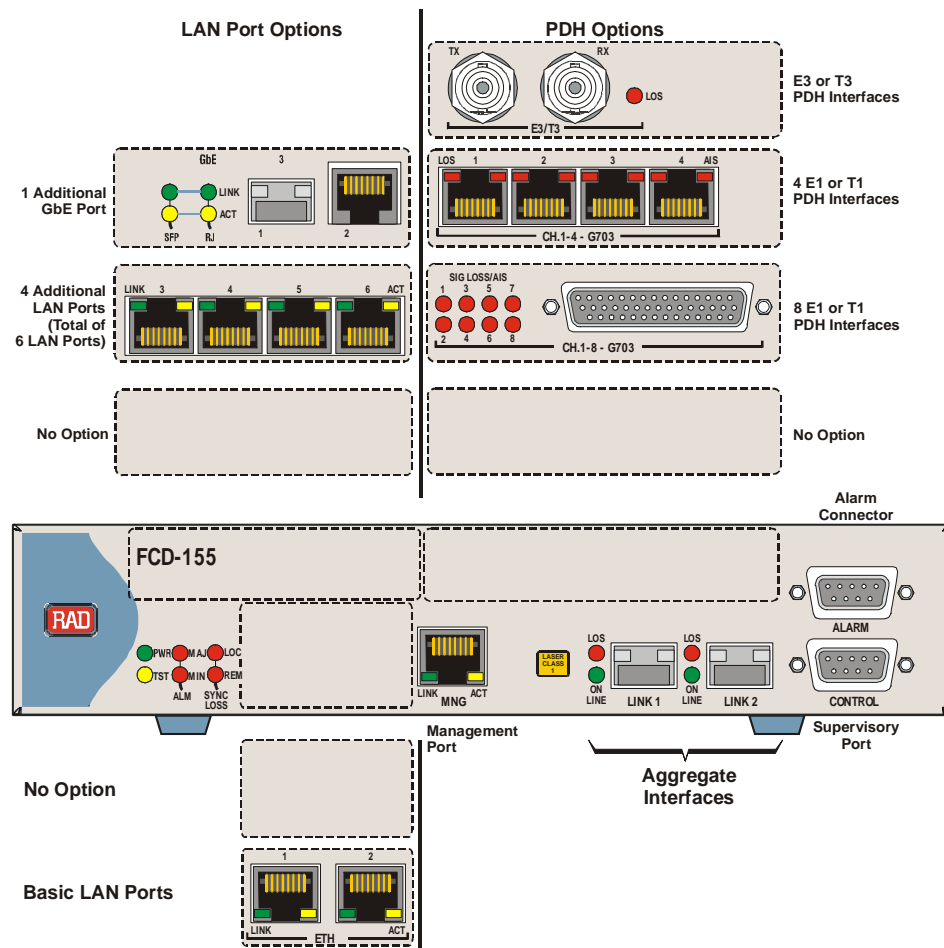
Figure 1-10. FCD-155, Identification of Port and Interface Options

1.4   Functional Description

Network Interfaces

As part of the SDH/SONET network, the optical line transmission subsystem of the various FCD-155 versions provides high quality, availability and performance monitoring of the traffic path down to the customer premises. The main characteristics of the various versions are described below.

FCD-155 Network Interfaces

The FCD-155 and FCD-155E are available with a wide range of optical interface options (see *Table 1-3*), supporting both short-haul and long-haul applications. The interfaces are located on field-replaceable SFPs.

As an option, FCD-155 can be ordered with two STM-1/OC-3 optical interfaces.

Note   *For intra-office applications, RAD also offers SFPs with copper interface.*

Dual-link FCD-155 versions support the 1+1 MSP (multiplex section protection with automatic protection switching) physical layer protection mechanism. This mechanism provides single-ended (also called unidirectional protection), for the connection to the SDH/SONET network. The reason this protection mode is called unidirectional protection is that each of the two units at the end of the multiplex section can switch to protection after detecting a signal failure or degradation without any handshaking. Therefore, switching to protection is fast.

The total traffic capacity of the dual link option is one STM-1/OC-3, because at any time only one link interface is active.

FCD-155E Network Interfaces

FCD-155E has automatic protection switching (APS). The FCD-155E is equipped with two subsystems:

- Dual STM-1/OC-3 optical interfaces

- Non-blocking cross-connect matrix that controls the mapping of payload and overhead to the network interfaces. The matrix supports both low-order VC-12/VC-11/VT-1.5 cross-connections, and high-order VC-3/STS-1 and VC-4 cross-connections.

The FCD-155E supports the following operation modes toward the network:

- Two independent STM-1/OC-3 links (no protection), for doubling the total interconnection capacity. This permits using the FCD-155E as an ADM, because the payload sent on each link is independent of the payload sent on the other link.

- Dual-link operation with 1+1 single-ended MSP protection. In this mode, the total capacity of the network connection is one STM-1/OC-3.

  Subnetwork connection protection (SNCP) is also supported.

The cross-connect matrix provides full flexibility in the internal payload routing, and therefore it can also be configured to provide path (trail) protection for both high-order and low-order cross-connections.

LAN Ports

All the LAN ports support auto-negotiation for plug-and-play Ethernet connectivity. Alternatively, each port can be configured by the user to operate at the desired rate and mode.

The services provided by the various types of ports are as follows:

- **Ethernet ports 1 and 2**: these ports (the basic ports), located on the motherboard, are served by an Ethernet switch with support for QoS, in full compliance with the IEEE 802.3/Ethernet V.2 standards. The switch supports port-based and IEEE 802.1Q tag-based VLANs, with characteristics configurable on a per-port basis. The switch operates in the IEEE 802.1Q shared VLAN learning mode (SVL): this means that any MAC address learned in one VLAN is also used for forwarding decisions affecting that address in all the other defined VLANs (the total number of VLANs that can be defined is 64).

The switch may also be configured as VLAN-unaware (that is, configured to ignore the VLAN information carried by the Ethernet frames).

In the basic FCD-155, the Ethernet switch supports up to 4 independent WAN ports (groups).

Each WAN port can be connected to any desired combination of virtually concatenated groups. The maximum number of virtually concatenated groups is 4.

The algorithm used for frame forwarding can be configured in accordance with the application requirements:

▪ Bridge only

▪ Bridge and Spanning Tree Protocol (STP), with selection between standard STP and Rapid STP (RSTP).

Note

FCD-155 versions without any optional LAN port have one Ethernet port. This port is used only for management, and therefore it does not carry traffic, and the Ethernet switch is not used.

● **Transparent Ethernet ports (ports 3 to 6)**. When an FCD-155 is equipped with the 4 transparent ports option (the 6U option), the 4 transparent Ethernet ports are handled differently: each of these ports is directly routed to a virtually concatenated group. Any traffic reaching the port is transparently transferred to the associated virtually concatenated group.

For the 6U option, Ethernet ports 1 and 2 continue providing the services described above, and the total number of virtually concatenated groups supported by the unit is 8.

● **Switched Ethernet ports (ports 3 to 6)**. When an FCD-155E is equipped with the 4 switched ports option (the 6U switch option), the 4 switched Ethernet ports can be switched to a different virtually concatenated group. Any traffic reaching the port can be switched to any of the associated virtually concatenated group.

For the 6U switched option, Ethernet ports 1 and 2 continue providing the services described above, and the total number of virtually concatenated groups supported by the unit is 8.

● **GbE Ethernet port**. When the FCD-155 or FCD-155E is equipped with the GbE port option, the FCD-155 uses an additional high-bandwidth Ethernet switch, which is installed together with the GbE port.

Note

*In this manual, the terms **basic Ethernet switch** and **GbE switch** are used when it is necessary to differentiate between the Ethernet switch serving ports 1 and 2, and the Ethernet switch serving the GbE port.*

The GbE switch has the following ports:

▪ One GbE port: this port connects to the external 10/100/1000BASE-T copper port. When an SFP plug-in module is installed and connected – the switch uses instead the optical port (located on the SFP module).

▪ 9 internal 100 Mbps Ethernet ports. 8 of these ports are used as WAN ports that connect to the user-configured virtually concatenated groups.

Port 9 provides an internal link to the Ethernet switch serving the management subsystem and external ports 1 and 2.

When the FCD-155 is equipped with a GbE port, the total number of virtually concatenated groups supported by the FCD-155 is 8.

The GbE switch does not support port-based VLANs, but only tag-based VLANs. It allows traffic prioritization only in accordance with VLAN priority. However, the switch may also be configured as VLAN-unaware (that is, configured to ignore the VLAN information carried by the Ethernet frames).

Ethernet Link Aggregation

All the FCD-155 Ethernet switch ports that can connect to virtually concatenated groups operate at 100 Mbps. When it is necessary to increase the maximum bandwidth that be carried by a virtually concatenated group beyond 100 Mbps, trunking (link aggregation) is used.

Note

Ethernet ports 1 and 2 can also participate in trunking.

With link aggregation, several switch ports can be defined as one logical port and the switch will distribute the traffic load in a balanced way among these ports. The maximum number of Ethernet trunks that can be configured is 8.

A trunk can include either physical Ethernet ports, or virtually concatenated groups.

Handling the Ethernet Traffic

The Ethernet traffic is encapsulated for transmission over SDH/SONET network using one of the following link layers protocols:

- Generic Framing Procedure (GFP) in accordance with ITU-T Rec. G.7041, framed mode, including support for GFP multiplexing

- Link Access Procedure for SDH/SONET (LAPS) protocols – per ITU-T Rec. X.85/X.86 draft recommendations.

The WAN side traffic groups from the Ethernet switch (4 groups for the basic FCD-155 configuration, or 8 groups when one of the LAN options is installed) are mapped into SDH/SONET containers using virtually concatenated groups. Mapping is flexible, and enables using any combination of virtually concatenated groups.

Unlike the traffic from the Ethernet switch (either the basic unit switch or the GbE switch), which can be switched according to various criteria (which may include predefined VLAN groups) to various virtually concatenated groups, the Ethernet traffic from the four optional transparent ports are always connected to a fixed group (port 3 to group 5, port 4 to group 6, etc.).

The fraction of network link bandwidth allocated to each virtually concatenated group can be configured. In addition, LCAS can be used on any virtually concatenated group with more than one VC/VT to hitlessly increase or decrease the capacity in accordance with the application requirements, and remove component VCs/VTs that failed.

PDH Ports

E1 Ports

The PDH E1 ports available as the 4 E1 (FCD-155 only), 8 E1, or 21 E1 (FCD-155E only) option for the FCD-155 have selectable balanced or unbalanced copper interfaces per ITU-T Rec. G.703, with support for short-haul and long-haul applications. The ports support unframed E1 streams in compliance with ITU-T Rec. G.703. Each E1 port provides loss of signal and AIS indications.

Note

E1 ports can be used only on FCD-155 with SDH network interfaces.

The E1 multiplex structure is VC-12, TU-12, TUG-2, TUG-3, AU-4, where each E1 port can be placed in any VC-12 inside the STM-1 bandwidth.

T1 Ports

The PDH T1 ports available as the 4 T1 (FCD-155 only), 8 T1 or 28 T1 (FCD-155E only) option for the FCD-155 have balanced copper interfaces. The ports support unframed T1 streams in compliance with ITU-T Rec. G.703, and comply with the applicable requirements of AT&T TR-62411, ANSI T1.403.

The interfaces include an integral CSU and can also emulate DSU interfaces. Each T1 port provides loss of signal and AIS indications.

- In an FCD-155 with SDH network interface, the T1 multiplex structure is VC-11, TU-11, TUG-2, TUG-3, AU-4, where each T1 port can be placed in any VC-11 inside the STM-1 bandwidth.

Note

When a T1 port is mapped within the SDH frame structure, the structure of the whole TUG-3 containing the corresponding TU-11 is changed: instead of the default structure (7 TUG-2 each comprising 3 TU-12, for a total of 21 VC-12), the structure changes to 7 TUG-2 each comprising 3 TU-11, for a total of 28 VC-11. The structure of any TUG-3 handling VC-12 remains unchanged.

- In an FCD-155 with SONET network interface, the T1 multiplex structure is VT-1.5, VT group, STS-1, STS-3, where each T1 port can be placed in any VT-1.5 inside the STS-3 bandwidth.

E3 Port

The PDH E3 port available as an option for the FCD-155 has an unbalanced copper interface per ITU-T Rec. G.703. The port supports an unframed E3 stream in compliance with ITU-T Rec. G.703. The port provides a loss of signal indication.

Note

E3 ports can be used only on FCD-155 with SDH network interfaces.

The E3 port can be placed in any VC-3 inside the STM-1 bandwidth.

T3 Port

The PDH T3 port available as an option for the FCD-155 has an unbalanced copper interface per ITU-T Rec. G.703. The port supports an unframed T3 stream in compliance with ITU-T Rec. G.703.

The port provides a loss of signal indication.

The T3 multiplex structure is as follows:

- In an FCD-155 with SDH network interface, the T3 port can be placed in any VC-3 inside the STM-1 bandwidth

- In an FCD-155 with SONET network interface, the T3 port can be placed in any STS-1 inside the STS-3 bandwidth.

Hybrid PDH Ports

FCD-155E supports an optional hybrid PDH card that contains all combinations of 28E1/28T1/E3/T3 interfaces with the same characteristics as noted above.

Timing

FCD-155 uses separate and independent system clocks for the various subsystems: one for the SDH/SONET subsystem, and another for the optional PDH subsystem.

The LAN ports timing is derived from a local free-running clock, which is not locked to the other clock signals in the unit.

FCD-155 SDH/SONET Timing Options

For redundancy, the timing subsystem includes two similar sections, one for selecting the master SDH/SONET clock reference and the other for the fallback clock. In case of a failure, FCD-155 automatically switches from the master clock source to the fallback one. Therefore, different sources must be configured for the master and fallback clocks.

The user can specify the SDH/SONET clock reference source from the following options (the designations appearing below use the terms displayed on the supervisory terminal):

- **Locked to a recovered clock (RX clock option)**. The reference source of the recovered clocks can be selected in accordance with the desired method of clock dissemination in the user's network:

  - **RX SDH** or **RX SONET** – reference source locked to the receive clock recovered from the line signal by the STM-1/OC-3 interface. This timing mode is also called *loopback timing*.

  - **RX PDH** – reference clock locked to the receive clock recovered from the PDH line signal received by the desired PDH interface. This timing mode is also called external timing.

- **Internal clock**: in this mode, the internal oscillator of one of FCD-155 units provides the timing reference for FCD-155 units used in a private network.

The reference timing source used by the SDH/SONET side is reflected in the Synchronization Source Message (SSM) inserted in the S1 byte of the transmit SDH/SONET overhead:

- When the network timing is derived from the FCD-155 internal oscillator, the S1 byte is 0 (corresponding to the *unknown* value).

- When the timing reference is a recovered clock signal, the S1 byte inserted by the FCD-155 is F (hexa), corresponding to the *do not use (DNU)* value.

FCD-155E SDH/SONET Timing Options

The FCD-155E has the timing options described above for the FCD-155, except for the RX PDH option. In addition the FCD-155E may also use a station clock as reference. The station clock interface accepts 2048 kHz, 2048 kbps and 1544 kbps signals, and has user-selectable interface (balanced/unbalanced) and sensitivity (long or short range).

The station clock can also be supplied to other equipment. The source of the output clock is selectable:

- FCD-155E nodal clock

- External clock signal applied to the station clock interface

- External clock after regeneration and filtering by a jitter attenuator.

Before selecting a reference source, the system checks that it is within the allowed range, to ensure that an unstable or inaccurate source will not be used.

In the FCD-155E, the timing subsystem also supports automatic selection of best timing source in accordance with the contents of the SSM message received from that source (the station clock SSM is configured by the user). The selection is among the SDH/SONET recovered clock signals, and the station clock signal. For clock traceability, the FCD-155E inserts the SSM value corresponding to the selected source in the transmit SDH/SONET overhead.

PDH Subsystem Timing

The available timing options for the PDH subsystem are as follows (the designations appearing below use the terms displayed on the supervisory terminal):

- **RX SDH/RX SONET** – PDH reference source locked to the receive clock recovered from the line signal by the STM-1/OC-3 interface. This option is not supported by the 21 E1 and 28 T1 options.

  Note that the user's PDH equipment must use loopback timing.

- **RX VC12, RX VC11, RX VT1.5** or **RX VC3** – PDH reference source locked to the receive clock recovered from the corresponding VC-12, VC-11, VT-1.5 or VC-3 timing. This mode locks the local timing of the PDH port to the timing of the PDH signal received by the remote equipment. Therefore, in this mode the SDH/SONET transmission link is simply a pipe that transparently conveys the remote timing reference to the local equipment.

  Note that the remote user's PDH equipment must use internal timing, and the local user's PDH equipment must use loopback timing.

Management Support

Setup, control and monitoring of status and diagnostics information can be performed using one of the following methods:

- ASCII terminal connected to the V.24/RS-232 control port

- Telnet host, Web browsers and SNMP-based network management stations for example, RADview – RAD's network management application. The following access options are supported:

  - Out-of-band access via one of the LAN ports connected to the internal Ethernet switch (that is, Ethernet ports 1 and 2), or through the dedicated Ethernet management (MNG) port

  - Inband access through the SDH/SONET network, through one of the WAN ports of the internal Ethernet switch, or through the DCC carried in the STM-1/OC-3 link overhead.

  The management subsystem can use a single host IP address; for FCD-155E, each interface can also be assigned its own IP address, subnet mask and default gateway.

The management subsystem supports TFTP for remote software updating and downloading, in addition to cold software downloading using an ASCII terminal directly connected to the FCD-155.

TFTP can also be used to upload and download the FCD-155 configuration database. Network administrators can use the download capability to distribute verified configuration files to all the managed FCD-155 units in the network from a central location. To further expedite the process, it is also possible to upload the configuration data stored by an FCD-155 unit to the management station as a disk file, and then distribute this file to other units which use a similar configuration.

FCD-155 has comprehensive diagnostics capabilities including:

- Real-time alarms to alert user on fault conditions. Alarms are reported to the management station and simultaneously relayed via dry contact port

- Ethernet, PDH and SDH/SONET link performance statistics and monitoring.

1.5 Technical Specifications

FCD-155E Main Characteristics

General

Function STM-1/OC-3 add-drop multiplexer/terminal multiplexer

Interface Options

- 2 × 10/100BaseT ports
- 6 × 10/100BaseT ports
- 1 × 10/100/1000BaseT port

- 8 × E1 G.703 ports
- 8 × T1 G.703 ports
- 21 × E1 G.703 ports
- 28 × T1 G.703 ports
- 1 × E3 G.703 ports
- 1 × T3 G.703 ports
- 21 × E1 G.703 ports and 1 × E3 G.703 ports
- 28 × T1 G.703 ports and 1 × E3 G.703 ports
- 21 × E1 G.703 ports and 1 × T3 G.703 ports
- 28 × T1 G.703 ports and 1 × T3 G.703 ports

Protection APS

STM-1/OC-3 Main Link (Network)

Number of Ports 1 (second link available for 1+1 unidirectional MSP protection and full ADM support)

Bit Rate 155.52 Mbps ±4.6 ppm

SFP Socket See *Table 1-3*

Timing
- Internal clock
- Recovered from the STM-1/OC-3 interface
- Station clock

Compliance
- SDH: ITU-T G.957
- SONET: GR-253-core

Framing
- SDH: ITU-T G.707, G.708, G.709
- SONET: ANSI T1.105-1995, GR-253-core

	Line Code	NRZ
LAN Interface (option)	*Number of Ports*	• 2 or 6 10/100BASET ports • 1 GbE
	Compatibility	Relevant sections of IEEE 802.3u, 802.3x, 802.1p, and 802.1Q
	LAN Table	• 2U: 2048 MAC addresses • 4U: transparent, no MAC table • GbE: 8192 MAC addresses
	Data Rate	• 10BASET: 10 Mbps • 100BASET: 100 Mbps • 1000BASET: 1000Mbps (GbE) • Autonegotiation
	Connectors (per Port)	• RJ-45, shielded • SFP module (optical) for GbE port

Table 1-3. STM-1/OC-3 Interface Characteristics

Ordering Name	Wavelength, [nm]	Fiber Type [µm]	Transmitter Type	Connector Type	Input Power [dBm] min	max	Output Power [dBm] min	max	Typical Max. Range km	miles
SFP-1	1310	62.5/125 multimode	VCSEL	LC	-30	-14	-20	-14	2	1.2
SFP-2	1310	9/125 single mode	Laser	LC	-28	-8	-15	-8	15	9.3
SFP-3	1310	9/125 single mode	Laser	LC	-34	-10	-5	0	40	24.8
SFP-4	1550	9/125 single mode	Laser	LC	-34	-10	-5	0	80	49.7
SFP-11	Copper	75 Ω Coxial Cable	–	Mini-BNC	–	–	–	–	0.135*	0.08*

* Using RG-59B/U

Table 1-4. Gigabit Ethernet Interface Characteristics

Ordering Name	Wavelength, [nm]	Fiber Type [µm]	Transmitter Type	Connector Type	Input Power [dBm] min	max	Output Power [dBm] min	max	Typical Max. Range km	miles
SFP-5	850	50/125 multimode	VCSEL	LC	-17	0	-9.5	0	0.55	0.3
SFP-6	1310	9/125 single mode	Laser	LC	-20	-3	-9.5	-3	10	6.2
SFP-7	1550	9/125 single mode	Laser	LC	-22	-3	0	+5	80	49.7
SFP-8D	1310	9/125 single mode	Laser	LC	-21	-3	0	-4	40	24.8

E1/T1 PDH Interface (option)	*Number of Ports*	8 or 21 E1, 8 or 28 T1
	Compatibility	ITU-T Rec. G.703, unframed
	Nominal Data Rate	
		2.048 Mbps
		1.554 Mbps
	Line Code	
		HDB3
		B8ZS
	Interface Type	8E1, 8T1, 21E1, 28T1
		120Ω balanced or 75Ω unbalanced (with optional adaptor cables)
		100Ω balanced
	Maximum Line Attenuation	
		36 dB
		12 dB
	Timing	
		Source clock is recovered from the receive signal coming from the remote E1/T1 side, or locked to the SDH/SONET interface clock (not supported by 21 E1/28 T1 option)
E3/T3 PDH Interface (option)	*Number of Ports*	1
	Compatibility	ITU-T Rec. G.703, unframed
	Data Rate	
		34.368 Mbps
		44.736 Mbps
	Framing Option	Unframed
	Line Code	
		HDB3

		B3ZS
	Line Impedance	75Ω
	Connector	Two BNC female
	Timing	• Source clock is recovered from the receive signal from the remote E3/T3 side • Locked to the SDH/SONET interface clock
Station Clock	*Bit Rate*	1.544 Mbps (T1)/2.048 MHz/2.048 Mbps (E1)
	Line Code	• AMI/B8ZS for 1.544 Mbps • HDB-3 for 2.048 MHz/2.048 Mbps (E1)
	Nominal Impedance	120Ω balanced or 75Ω unbalanced, user-selectable
	Connector	RJ-45 shielded
Indicators	*General System Indicators*	• PWR (green) – Power • TST (yellow) – Test • MAJ ALM (red) – Major alarm • MIN ALM (red) – Minor alarm • LOC SYNC LOSS (red) – Local loss of synchronization on the STM-1/OC-3 links • REM SYNC LOSS (red) – Remote loss of synchronization on the STM-1/OC-3 links
	Station Clock Port Indicators	• ON (green) – Port is connected • LOS (red) – Signal loss on the port
	LAN (per port)	• LINK (green) – LAN link integrity • ACT (yellow) – LAN data activity
	E1/T1 PDH Interface (per port)	• SIG LOSS (red) – E1 link signal loss • AIS (red or yellow) – AIS on E1 link
	E3/T3 PDH Interface	SIG LOSS (red) – E3/T3 link signal loss
	Hybrid PDH Interface	• LOS E1/T1 – E1/T1 link signal loss • LOS E3/T3 – E3/T3 link signal loss
	STM-1/OC-3 Main Links	• SIG LOSS (red) – STM-1/OC-3 link signal loss • ON LINE (green) – STM-1/OC-3 link is active (indicator is on) or on standby (indicator is blinking)

Power	*Supply Voltage*	
		100 to 240 VAC, 50/60 Hz
		-48 VDC (-40 to -72 VDC)
	Power Consumption	30W
Alarm Collection and Monitoring	*Alarms*	Last 100 alarms are time stamped, stored, and available for retrieval
	Alarm Relay Port	• Operation: normally open, normally closed, using different pins
		• Connector: 9-pin, D-type, female
Physical	*Height*	4.4 cm (1.7 in)
	Width	44.0 cm (17 in)
	Depth	24.0 cm (9.4 in)
	Weight	Typically 4 kg (8.8 lb), varies with the installed options
Environment	*Operating Temperature*	-10° to 70°C (14° to 158°F)
	Relative Humidity	Up to 90%, non-condensing

FCD-155 Main Characteristics

General	*Function*	STM-1/OC-3 terminal multiplexer

> **Note**
>
> *An FCD-155 with APS option is offered for 8 E1 ports (no Ethernet traffic port).*

	Interface Options	
		• 2 × 10/100BASET ports
		• 6 × 10/100BASET ports
		• 1 × 10/100/1000BASET port

		• 4 × E1 G.703 ports
		• 4 × T1 G.703 ports
		• 8 × E1 G.703 ports
		• 8 × T1 G.703 ports
		• 1 × E3 G.703 ports
		• 1 × T3 G.703 ports
STM-1/OC-3 Main Link (Network)	*Number of Ports*	1 (second link available for 1+1 unidirectional MSP protection)
	Bit Rate	155.52 Mbps ±4.6 ppm
	SFP Socket	See *Table 1-3*
	Timing	• Internal clock
		• Recovered from the STM-1/OC-3 interface
		• External clock from PDH tributary
	Compliance	• SDH: ITU-T G.957
		• SONET: GR-253-core
	Framing	• SDH: ITU-T G.707, G.708, G.709
		• SONET: ANSI T1.105-1995, GR-253-core
	Line Code	NRZ
LAN Interface (option)	*Number of Ports*	• 2 optional, with VLAN support
		• 6 optional, 2 with VLAN support and 4 without VLAN support
		• 1 GbE optional, with VLAN support
	Compatibility	Relevant sections of IEEE 802.3u, 802.3x, 802.1p, and 802.1Q
	LAN Table	• 2U: 2048 MAC addresses
		• 4U: transparent, no MAC table
		• GbE: 8192 MAC addresses
	Data Rate	• 10BASET: 10 Mbps
		• 100BASET: 100 Mbps
		• 1000BASET: 1000 Mbps (GbE)
		• Autonegotiation
	Connectors (per Port)	• RJ-45, shielded
		• SFP module (optical) for GbE port

E1/T1 PDH Interface (option)	*Number of Ports*	4 or 8
	Compatibility	ITU-T Rec. G.703, unframed
	Nominal Data Rate	
		2.048 Mbps
		1.554 Mbps
	Line Code	
		HDB3
		B8ZS
	Interface Type	4E1/T1, 8E1/T1
		120Ω balanced or 75Ω unbalanced (with optional adapter cables)
		100Ω balanced
	Maximum Line Attenuation	• 36 dB (LTU mode)
		• 12 dB (DSU mode)
	Timing	
		Source clock is recovered from the receive signal coming from the remote E1/T1 side, or locked to the SDH/SONET interface clock
E3/T3 PDH Interface (option)	*Number of Ports*	1
	Compatibility	ITU-T Rec. G.703, unframed
	Data Rate	
		34.368 Mbps
		44.736 Mbps
	Framing Option	Unframed
	Line Code	
		HDB3
		B3ZS
	Line Impedance	75Ω

	Connector	Two BNC female
	Timing	Source clock is recovered from the receive signal from the remote E3/T3 side, or locked to the SDH/SONET interface clock
Indicators	*General*	• PWR (green) – Power • TST (yellow) – Test • MAJ ALM (red) – Major alarm • MIN ALM (red) – Minor alarm • LOC SYNC LOSS (red) – Local loss of synchronization on the STM-1/OC-3 links • REM SYNC LOSS (red) – Remote loss of synchronization on the STM-1/OC-3 links
	LAN (per port)	• LINK (green) – LAN link integrity • ACT (yellow) – LAN data activity
	E1/T1 PDH Interface (per port)	• SIG LOSS (red) – E1 link signal loss • AIS (red) – AIS on E1 link
	E3/T3 PDH Interface	SIG LOSS (red) – E3/T3 link signal loss
	STM-1/OC-3 Main Links	• SIG LOSS (red) – STM-1/OC-3 link signal loss • ON LINE (green) – STM-1/OC-3 link is active (indicator is on) or on standby (indicator is blinking)
Power	*Supply Voltage*	100 to 240 VAC, 50/60 Hz -48 VDC (-40 to -72 VDC)
	Power Consumption	30W
Alarm Collection and Monitoring	*Alarms*	Last 100 alarms are time stamped, stored, and available for retrieval
	Alarm Relay Port	• Operation: normally open, normally closed, using different pins • Connector: 9-pin, D-type, female
Physical	*Height*	4.4 cm (1.7 in)
	Width	21.5 cm (8.5 in)
	Depth	30.0 cm (11.8 in)

	Weight	Typically 2.4 kg (5.3 lb), varies with the installed options
Environment	*Operating Temperature*	0 to 50°C / 32 to 122°F
	Relative Humidity	Up to 90%, non-condensing

Chapter 2

Functional Description

This chapter provides a functional description of the FCD-155 system that supplements the information presented in *Chapter 1*, and describes its main features.

2.1   Functional Description

Figure 2-1 shows a functional block diagram that covers all the options available on the various FCD-155 versions.

This block diagram is supplemented by block diagrams that provide details on the following subsystems:

- Network interfacing subsystem – *Figure 2-3*

- Ethernet payload processing subsystem for the GbE option – *Figure 2-4*

In addition, *Figure 2-5* shows the functional block diagram of a FCD-155 version with PDH ports and a single Ethernet port (same configuration is also available for FCD-155E, except that it can also be equipped with dual PS modules). Since this version is dedicated to E1 or T1 access applications, it does not include the functionality needed to process Ethernet traffic for transport over SDH/SONET networks.
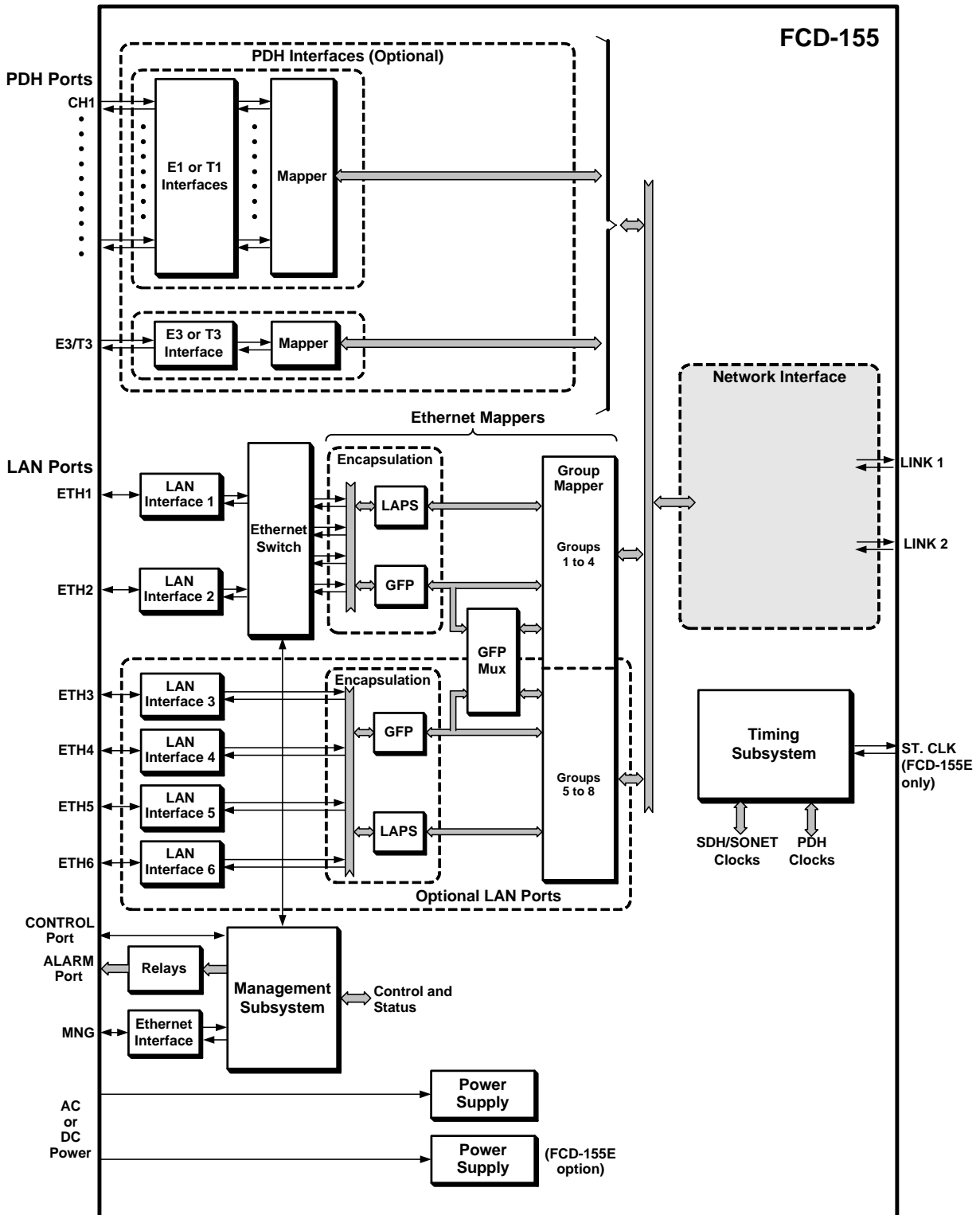
Figure 2-1. FCD-155, Functional Block Diagram (All Versions)
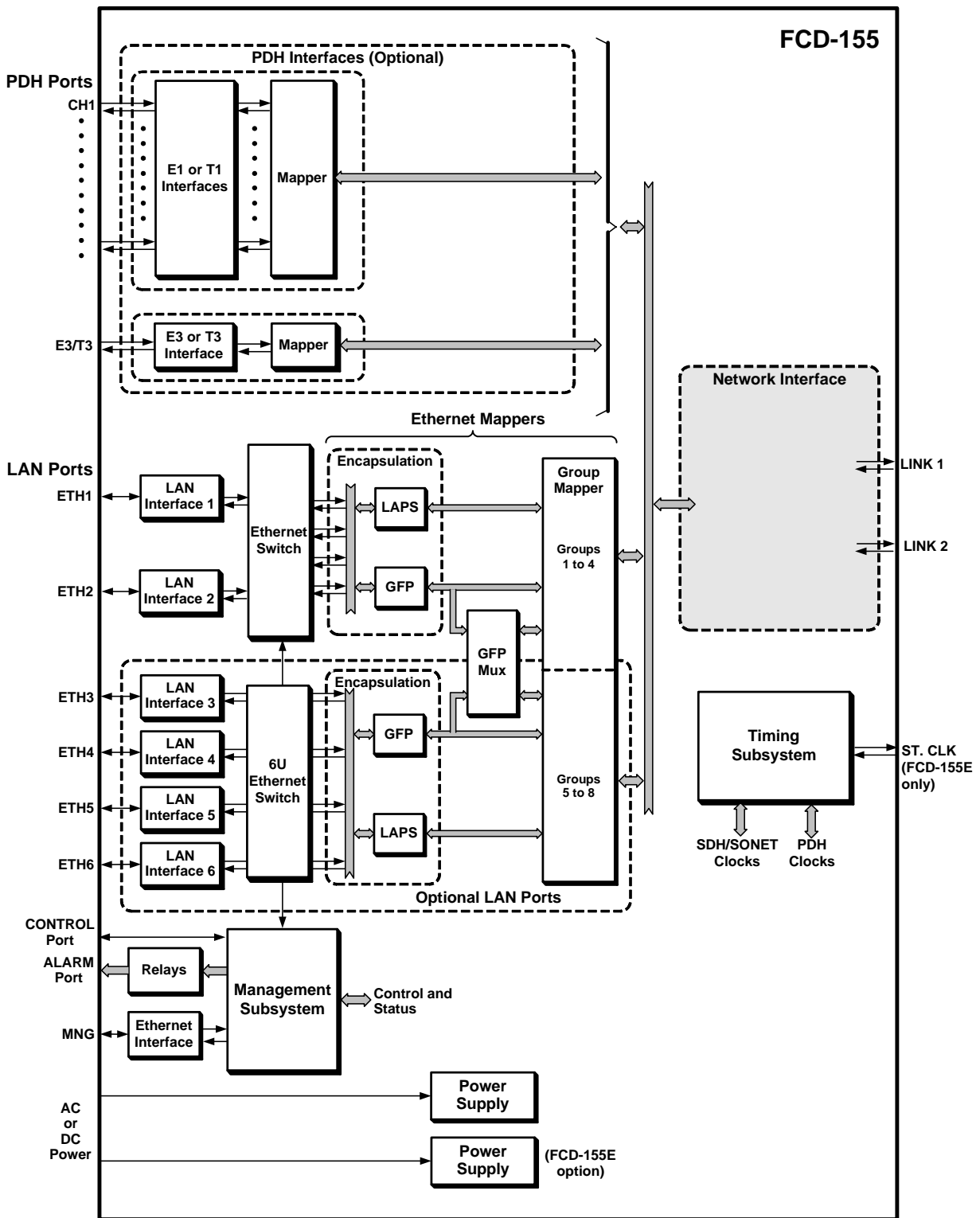
Figure 2-2. FCD-155, Functional Block Diagram (6U Switch Version)

A. FCD-155 Single Link
   Option

Network Interface

**Framer
(STM-1
or
STS-3)**

**STM-1
or OC-3**

Port 1
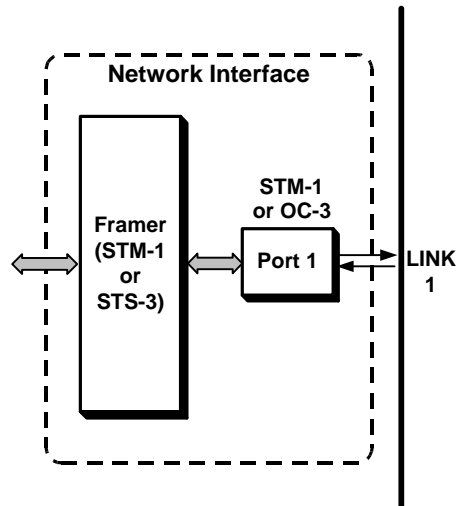
**LINK
1**

B. FCD-155 Dual Link
   Option

Network Interface

**Framer
(STM-1
or
STS-3)**

**Protection
Switching**

**STM-1
or OC-3**

Port 1

**LINK
1**

Port 2

**LINK
2**

C. FCD-155E

Network Interface

**HO/LO
Cross-Connect
Matrix**

**Dual
Framer
(STM-1
or
STS-3)**

**STM-1
or OC-3**

Port 1

**LINK
1**

Port 2

**LINK
2**
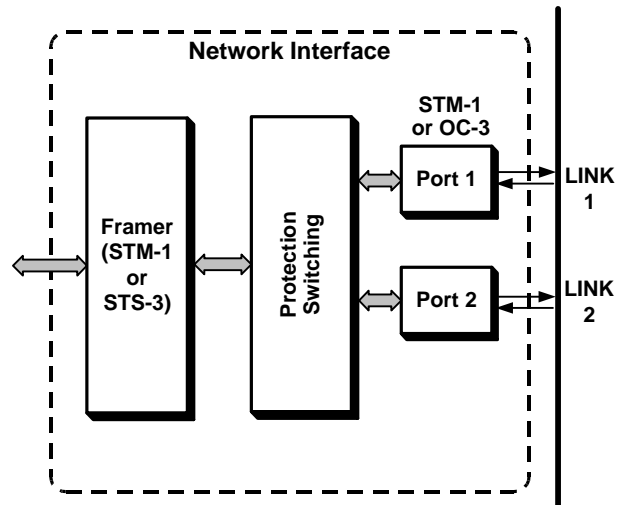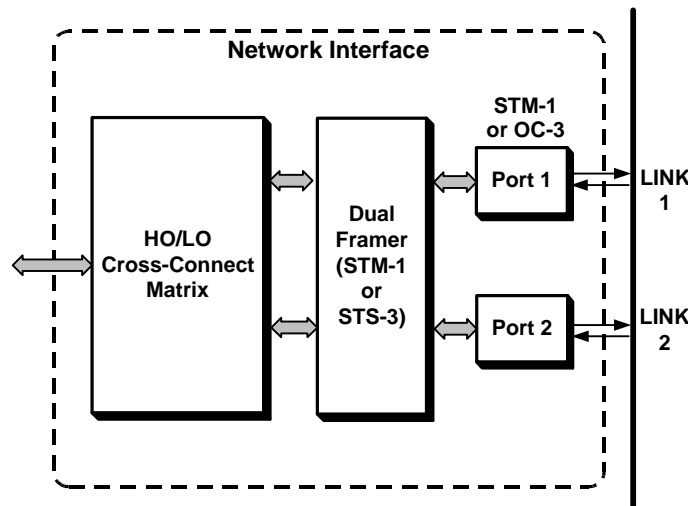
Figure 2-3. Network Interfacing Options
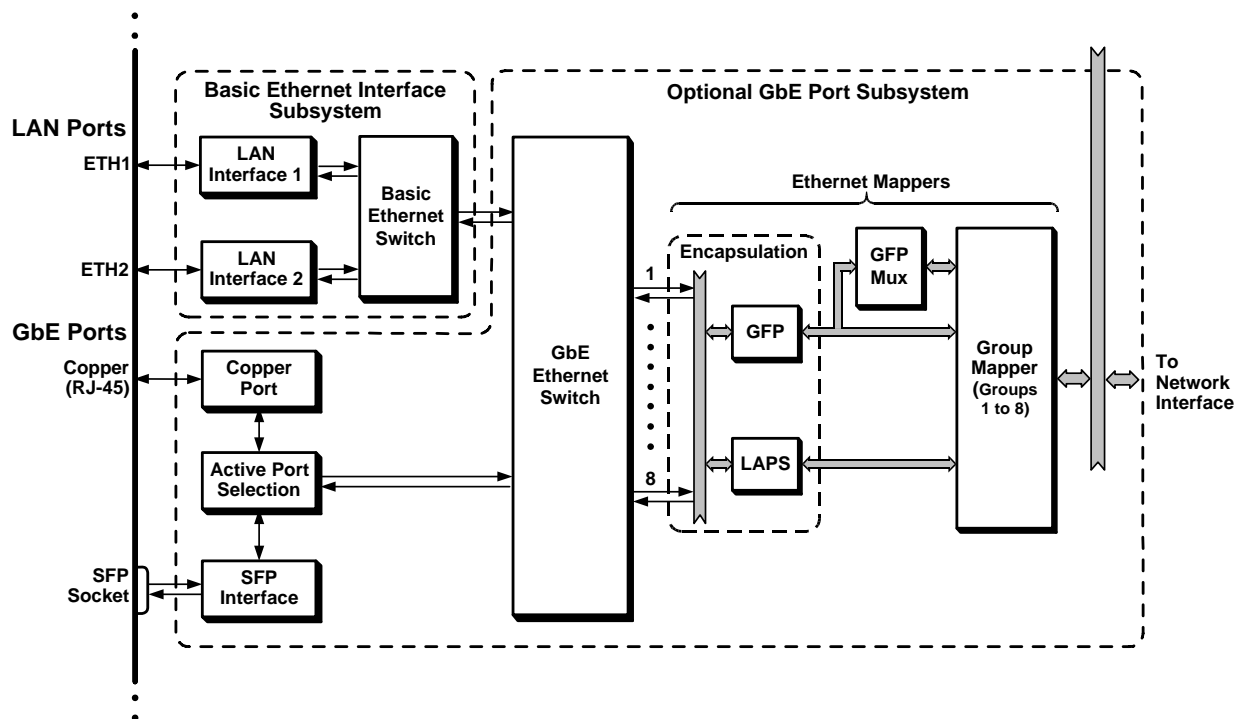
Figure 2-4. LAN Processing Subsystem for GbE Option
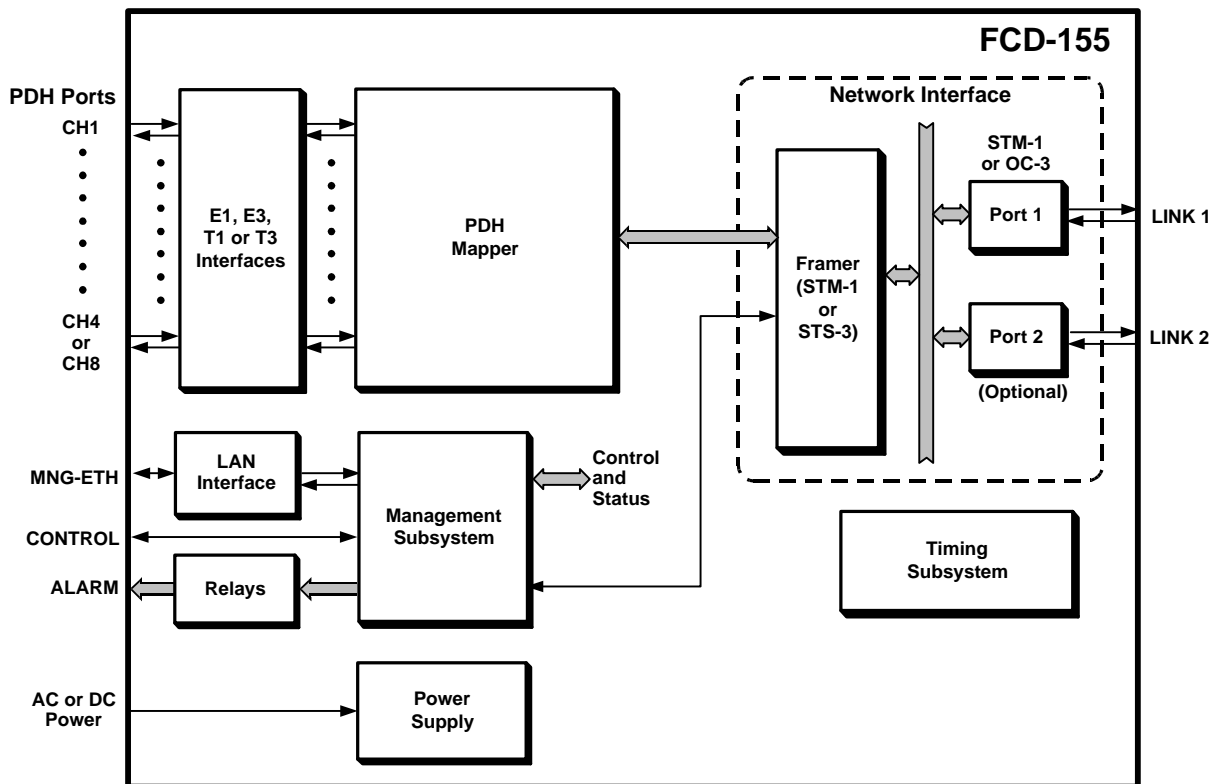
Figure 2-5. FCD-155 with PDH Ports and Single Ethernet Port, Functional Block Diagram

The FCD-155 includes the following main subsystems:

- Network interface subsystem, comprising:
    - Network link interfaces
    - SDH/SONET framer subsystem
    - High-order/low-order cross-connect matrix (FCD-155E only)
- Basic LAN port subsystem, comprising:
    - LAN interfaces
    - Ethernet switch (with 2U options)
    - Ethernet mapper for groups 1 to 4
- Optional transparent LAN port subsystem, comprising:
    - 4 LAN interfaces
    - Ethernet mapper for groups 5 to 8

      or

      Optional GbE port subsystem (see *Figure 2-4*), comprising:
        - GbE port
        - GbE Ethernet switch
        - Ethernet mapper for groups 1 to 8
- Optional switched LAN port subsystem (6U switched), comprising:
    - 4 switched LAN interfaces
    - Ethernet mapper for groups 5 to 8
- Optional PDH subsystem, comprising:
    - PDH interfaces (depending on order)
    - Mapper
- Timing subsystem
- Management subsystem
- Power supply subsystem.

2.2   Network Interfacing Subsystem

The various options of the network interfacing subsystem are shown in *Figure 2-3*.

Network Link Interfaces

The FCD-155 can be ordered with one or two STM-1/OC-3 ports, in accordance with order. The ports have two SFP sockets for the network port interfaces. RAD offers a wide range of SFPs covering requirements from short-range low-cost

optical interfaces to long-range, high-performance interfaces. Optical SFPs are terminated in LC connectors.

For safety, FCD-155E has a user-configurable automatic laser shut-down (ALS): when enabled, it protects against accidental exposure to laser radiation in case of fiber breaks or disconnection.

RAD also offers SFPs with electrical interfaces for intra-office applications.

The port interfaces support the enhanced digital diagnostic monitoring interface per SFF-8472, which enables collecting status and performance data from the SFPs, as well as alerting in case abnormal conditions may cause damage or performance degradation.

FCD-155 versions with two network ports support line protection, i.e., at any time, only one port is active and the other is in standby. The protection is implemented by means of the standard multiplex section protection (MSP 1+1) physical layer protection mechanism, which allows the service to the customer to be protected against link failure.

SDH/SONET Framer Subsystem

The SDH/SONET framer subsystem for the network interface provides the frame assembly/disassembly services and SDH/SONET overhead processing for the link to the network. The operating mode of the framer, SDH or SONET, is selected by means of an internal switch that can be set in the field to the required standard.

FCD-155E has two independent frames, whereas FCD-155 has a single framer that serves both network interfaces. Therefore, for FCD-155, the position of the various VCs/VTs within the link frame is determined by the Ethernet and PDH mappers.

High-Order/Low-Order Cross-Connect Matrix (FCD-155E only)

FCD-155E supports MSP 1+1 unidirectional protection and path protection with automatic protection switching (APS). FCD-155E has two independent STM-1/OC-3 ports, each having its own framer and optical interface subsystem, and with a high-order/low-order non-blocking cross-connect matrix that controls the mapping of payload and overhead to these interfaces. The matrix supports both low-order VC-12/VC-11/VT-1.5 cross-connections, and high-order VC-3/STS-1 and VC-4 cross-connections.

FCD-155E supports the following operation modes toward the network:

- Two independent STM-1/OC-3 links (no protection), for doubling the total interconnection capacity. This permits using a FCD-155E as an ADM, because the payload sent on each link is independent of the payload sent on the other link.

  Although in this mode no protection is offered for the whole traffic, path (trail) protection is available for user-specified payload units (VC-12/VC-11/VT-1.5 or VC-3/STS-1). When path protection is enabled, the protected payload unit is assigned bandwidth on both network links. By provisioning appropriate alternative paths through the network, it is possible to ensure that in case of a fault anywhere along the active path the traffic is

automatically switched to the standby path. Two mapping modes are supported for path protection:

- ▪ Automatic: the positions assigned to the payload unit on the main link are automatically copied to the second link

- ▪ Manual: the positions are manually configured on each link, and therefore may be different.

- • Dual-link operation with 1+1 single-ended multiplex section protection (unidirectional protection), with automatic protection switching (unidirectional linear protection for SONET). In case of a fault, all traffic is switched to the protection link. In this mode, the total capacity of the network connection is one STM-1/OC-3.

2.3   Ethernet Processing Subsystem

The various options offered for Ethernet traffic are illustrated in *Figure 2-6*.

Basic LAN Port Interfaces

The basic FCD-155 can be equipped with two identical LAN ports, ETH 1 and ETH 2, with 10/100BASE-TX Ethernet interfaces for connection to user's LANs. These ports are connected to the basic Ethernet switch subsystem.

Each Ethernet interface supports auto-negotiation. The user can configure the advertised data rate (10 or 100 Mbps) and operating mode (half-duplex or full-duplex). Alternatively, auto-negotiation can be disabled, and the rate and operating mode be directly specified.

Each port is terminated in an RJ-45 connector. The interface supports automatic polarity and crossover detection (MDI/MDIX), and polarity correction. Therefore, it can always be connected through a "straight" (point-to-point) cable to any other type of 10/100BASE-T Ethernet port (hub or station). The MDI/MDIX automatic cross-over option can be enabled/disabled independently of the auto-negotiation option.
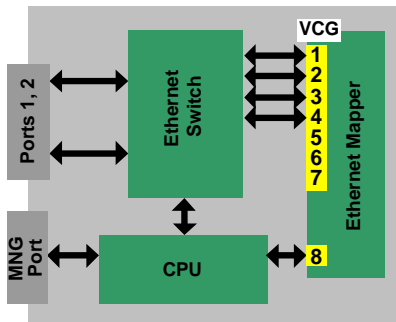
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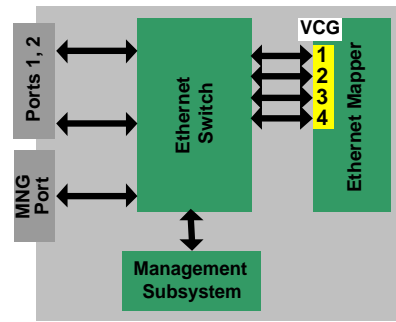
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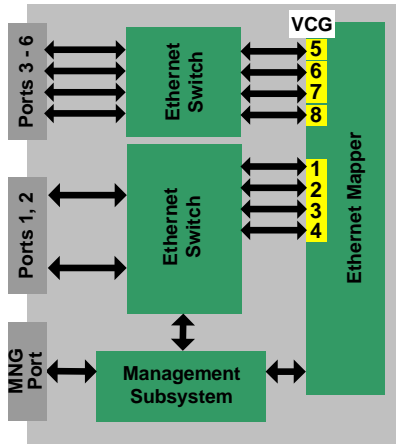
*FCD-155E with
Transparent LAN Port Option (6U)*
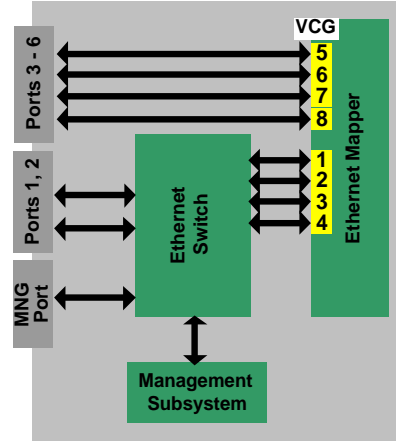
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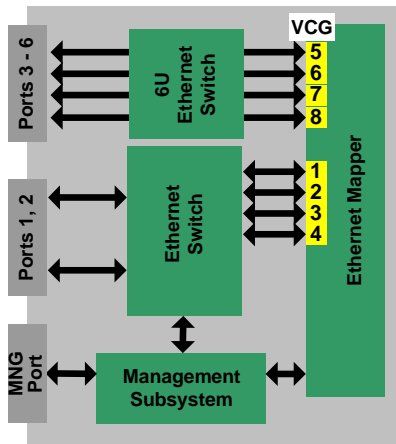
*FCD-155E with
Switched LAN Port Option (6U)*

FCD-155E with GbE Option   FCD-155 with GbE Option
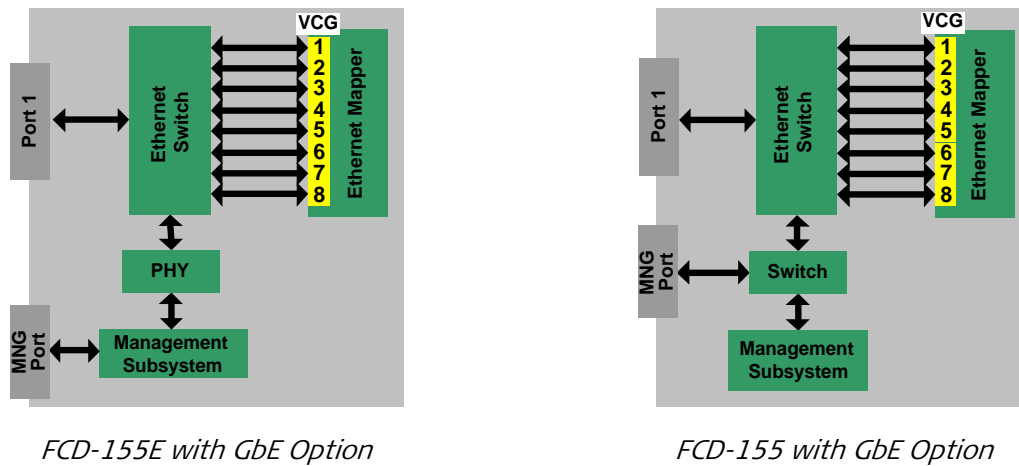
Figure 2-6. Ethernet Processing Subsystem Options

Transparent LAN Port Interfaces

The optional transparent LAN ports, ETH 3 to ETH 6, have 10/100BASE-TX Ethernet interfaces.

- For FCD-155, the ports do not support automatic MDI/MDIX detection. Each port is terminated in an RJ-45 connector wired as hub port. Therefore, it can be connected through a "straight" (point-to-point) cable to an Ethernet station port; a crossed cable is needed for connection to another hub port.

- For FCD-155E, the ports do support automatic MDI/MDIX detection, and therefore can be connected through any type of cable to any type of port.

Each interface supports auto-negotiation. The user can configure the advertised data rate (10 or 100 Mbps) and operating mode (half- or full-duplex). Alternatively, auto-negotiation can be disabled and the rate and operating mode be directly specified.

The transparent LAN ports connect directly to the encapsulation function (see the *Encapsulation Functions* section), and are connected to fixed virtually concatenated groups (ETH 3 to group 5, and so on up to group 8 for ETH 6).

GbE LAN Port Interfaces

The optional GbE port has an external 10/100/1000BASE-T copper port. This port supports auto-negotiation, with user-specified advertised data rate (10, 100 or 1000 Mbps) and operating mode (half- or full-duplex). Alternatively, auto-negotiation can be disabled and the rate and operating mode be directly specified. The port also supports automatic polarity and crossover detection, and polarity correction, for connection through any type of cable to any type of Ethernet port (hub or station).

The GbE interface also has an SFP socket for installing an SFP plug-in module. The SFP interface has priority: when this module is installed and connected to an active LAN, the switch uses instead the optical port (located on the SFP module). The copper port is then disconnected.

The active GbE port is connected to a separate Ethernet switch.

2.4   Basic Ethernet Switch Subsystem

Note

If your FCD-155 includes the GbE port option, refer to the

The Gigabit Ethernet port does not support VLAN stacking (double VLAN tagging).

GbE Ethernet Switch Subsystem section starting on page 2-16.

Basic Ethernet Switch Description

The basic Ethernet switch used by all the FCD-155 versions (see *Figure 2-1*), except the version with a single Ethernet port, is a switch with VLAN support that fully complies with the IEEE 802.3/Ethernet V.2 standards, has user-selectable forwarding algorithms, and provides extensive support for QoS features. The switch has memory-based switch fabric with true non-blocking switching performance.

The switch collects a wide range of performance monitoring parameters, which can be read by management.

The Ethernet switch has the following ports:

- Two external ports, one connected to ETH 1 LAN interface and the other to the ETH 2 LAN interface.

- Four WAN ports for FCD-155E, six for FCD-155. These ports connect to the encapsulation function, part of the Ethernet mapper subsystem (see *Figure 2-6*), which processes the traffic for transmission through SDH/SONET network using virtual concatenation. Each port connects to one of the virtually concatenated groups 1 to 4.

- Management port, connected internally to the FCD-155 or FCD-155E management subsystem.

All the ports connected to external ports operate at 100 Mbps.

The Ethernet switch supports link aggregation: the user can configure the two external ports, or any set of WAN ports, as a trunk: in this case, they are handled by the switch as one logical port, with automatic load balancing, which enables increasing the throughput. The FCD-155 supports several link aggregates.

Each switch port is supported by an independent MAC controller that performs all the functions required by the IEEE 802.3 protocol. The maximum frame size supported by the basic Ethernet switch is 1536 bytes, and therefore enables connection to MPLS-based networks.

The frames passed by the MAC controller are analyzed by the ingress policy controller of the corresponding port before being transferred to an internal queue controller, which controls the frame egress priorities and inserts them in four separate queues. The queues are connected to the ports through the port egress policy controllers. This approach provides full control over traffic flow, and ensures that congestion at one port does not affect other ports.

Flow Control Options

The user can enable flow control for the switch ports. When flow control is enabled, it is always activated only on the port (or ports) involved in congestion: other ports are not affected.

Flow control is available in both the half-duplex and full-duplex modes:

- In the half-duplex mode, flow control uses a collision-based scheme to throttle the connected stations when the free buffer space of the corresponding port is too low, to avoid discarding frames during network congestion (this approach is called *back pressure*). When the buffer space of a port is almost full, its MAC controller forces a collision in the input port when an incoming frame is sensed (the alternative, without flow control, is to discard the incoming frame).

- In the full-duplex mode, the standard flow control method defined in IEEE 802.3x is used, which is based on *pause* frames and enables stopping and restoring the transmission from the remote node. However, this method can only be used when auto-negotiation is enabled on the port, and the node attached to the port supports *pause* frames.

The Ethernet switch internal MAC controllers discard all the received IEEE 802.3x *pause* frames, even when full-duplex flow control is disabled or the port is in the half-duplex mode.

Forwarding Algorithms

The Ethernet switch operates as a MAC bridge, that automatically learns the MAC addresses located on the local LAN, and the port through which frames addressed to a foreign destination are to be transmitted.

The Ethernet switch LAN table can store up to 2048 MAC address/port number mappings. Only active MAC address/port number mappings are actually stored: after a user-defined aging interval, inactive mappings are removed from the switch memory. However, the user can also add static entries, which are not automatically removed.

When used in more complex networks, the forwarding algorithm can be extended to include Spanning Tree Protocol (STP), where the user can select between the basic STP version and the Rapid STP (RSTP) version. The selection is separately made for each switch port.

The STP parameters, which are used in common by the whole switch, can also be selected by the user, to fine-tune the performance. To help locating forwarding problems, the user can read the STP algorithm status and current parameter values.

VLAN Support

Note   *The GbE option does not support VLAN stacking.*

The Ethernet switch can use VLAN information to select the ports among which traffic can be forwarded (this is called the *VLAN-aware* mode). This is however a

configurable option that can be selected by the user, in accordance with the specific application requirements:

There are two basic methods:

- Port-based VLANs, supported only in the *VLAN-unaware* mode. See description in the *Support for Port-Based VLAN* section starting on page *2-14.*

- Tag-based VLAN switching per IEEE 802.1Q, requires the *VLAN-aware* mode. This mode is used to handle traffic in accordance with user-defined forwarding rules that are based on the IEEE 802.1Q tags of the frames. For the external LAN ports (ETH 1 and ETH 2), the user can also select whether to discard untagged frames, or process them. See description in the *Support for 802.1Q Tag-Based VLAN Switching* section starting on page *2-15*.

Note

The switch operates in the IEEE 802.1Q SVL mode.

QoS Support

The switch provides support for quality-of-service (QoS) features. Four traffic classes are supported, where each class is typically assigned to a type of prioritized frame stream.

The user can specify the QoS criteria, or alternatively, can disable the QoS functionality. To achieve the desired QoS, the user can configure the handling priority of a frame. This priority is determined, in the following priority order, by the following parameters:

1. The IEEE 802.1p (Layer 2) priority information carried in the VLAN tag, when enabled on the port. This option can be configured on a per-port basis.

2. The Layer 3 IPv4 Type of Service (TOS) or DSCP field (the Differentiated Services Codepoint, specified in RFC2474), when enabled on the port. IPv4 priority classification can be configured on a per port basis to have a higher priority than the IEEE tag.

3. The user-specified port default priority.

Each priority classification can be separately enabled or disabled, on a per port basis. These settings allow each port to be configured for different rules for priority classification, giving the user any combination that is needed.

In addition, the priority classification 2 (Layer 2 priority) and 3 (IP – Layer 3 priority) can be reversed on a per port basis as well. This allows the priority to be selected for frames that are both Tagged and IP.

At each level, the priority is configured by specifying its traffic class: each traffic class is assigned to one of the egress queues of the Ethernet switch.

The number of egress queues depends on the installed LAN option: for FCD-155 without GbE port, the Ethernet switch has four egress queues, whose priorities are identified as 0 (low) to 3 (high priority), whereas the range of priorities supported by IEEE 802.1p tags is 0 to 7, and the range of DSCP/TOS values is 0 to 63.

Note

As an alternative to using the information carried by each frame to determine the QoS during its forwarding by the switch, the user can assign a fixed priority to any port. Therefore, when the QoS feature is not enabled, the egress priority of any frame received through a certain port is determined only by the user-configured priority of the frame ingress port. This fixed priority can be independently selected for each port.

For more information regarding the use of VLAN tags, see the *Support for 802.1Q Tag-Based VLAN Switching* section starting on page *2-15*.

The switch also enables the user to configure the egress scheduling mode:

- Strict priority mode: all top priority frames are egressed out of a port until that priority's queue is empty, then the next lower priority queue's frames are egressed. In other words, whenever a queue has a frame to transmit, it goes out to the link before any frame in any lower-priority queue.

  The strict priority mode guaranties minimum latency for the traffic assigned to a queue, but can cause the lower priority queues to be starved out, because it may prevent them from transmitting any frames, but on the other hand ensures that all the high priority frames egress the switch as soon as possible.

- Weighted fair queue mode: 8, 4, 2, 1 weighting is applied to the four priorities. This approach prevents the lower priority frames from being starved out with only a slightly increased delay to the higher priority frames.

  However, only idle bandwidth is used for lower priority frames: to ensure that the bandwidth assigned to a certain traffic class does not decrease below the assigned value, when congestion occurs any class cannot more than the assigned bandwidth.

Support for Port-Based VLAN

The Ethernet switch supports user-defined port-based VLANs. A port-based VLAN is a logical group of ports defined by the user: traffic within the VLAN is forwarded only to the VLAN member ports. Therefore, in addition to their functional value as tools for controlling traffic flow, port-based VLANs are an important security tool.

The basic Ethernet switch enables defining port-based VLANs that include any of its four WAN ports (which are connected to user-defined virtually concatenated groups in the range of 1 to 4), as well as the port connecting to the FCD-155 management subsystem. However, any VLAN should include only one external LAN port out of the two connected to the Ethernet switch, that is, either ETH 1 or ETH 2. This ensures that traffic received through one of the LAN ports cannot reach the other port, although it can be forwarded through any desired group connected to the switch, and/or to the internal management port.

See for example *Figure 2-7*, which illustrates the functionality of the two port-based VLANs that are defined in the FCD-155 factory-default configuration:

- One port-based VLAN, designated VLAN Port 1, includes the FCD-155 external port designated ETH 1, the management port, and groups 1 and 3

- The other port-based VLAN, designated VLAN Port 2, includes the FCD-155 external port designated ETH 2, the management port, and groups 2 and 4.

The factory-default configurations described above ensure that the management subsystem can communicate through the external LAN ports ETH 1 and ETH 2, and through any of the virtually concatenated groups 1 to 4.
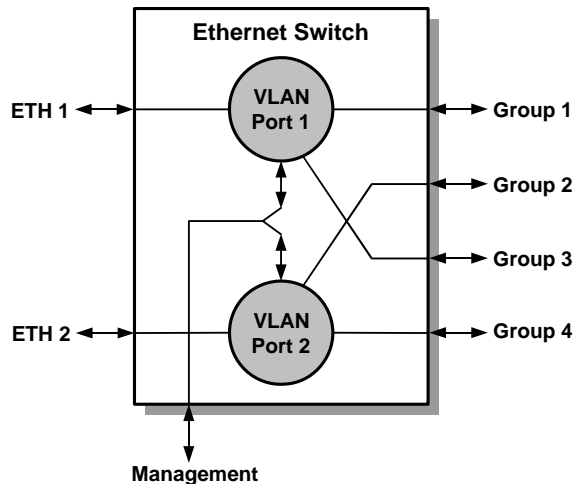
Figure 2-7. Example of Port-Based VLAN Functionality

Note   *The factory-default configuration has been designed to separate between even and odd groups, but this is an arbitrary decision: an external port can connect to any, or all of the virtually concatenated groups connected to the Ethernet switch ports.*

The maximum number of port-based VLANs that can be defined is 20. For convenience, the user can also assign a logical name to each VLAN.

Support for 802.1Q Tag-Based VLAN Switching

VLAN tags carry additional information that can be used to identify VLAN membership and priority (see *Appendix C* for additional details). When using the VLAN-aware mode, such tags can therefore be used to differentiate among various types of traffic in accordance with the VLAN number (identifier – ID) and Layer 2 priority (desired QoS).

The information needed to specify the handling of frames in accordance with their VLAN ID is prepared by defining a VLAN membership table, which contains forwarding rules.

One rule must be defined for each VLAN ID to be processed: any frames with VLAN IDs not appearing in the table are ignored (discarded upon ingress). The maximum number of rules that can be defined is 64.

A forwarding rule specifies two types of information:

- The ports that participate in the forwarding of frames with the corresponding VLAN ID. Any rule should include a single external (LAN) port. Rules must also be defined to include VLANs switched only among WAN ports, and for the management VLAN (when management VLAN tagging is enabled.

Management VLAN tagging is not supported by the FCD-155 with single Ethernet port.

- The handling of frame tags. The available selections, which can be separately configured for each port participating in the VLAN handling, include:

  - Unmodified: the port transfers the tags of the frames forwarded to it without change. Therefore, untagged frames egress the port as untagged frames, and tagged frames egress the port as tagged frames.

  - Untagged: all the frames egress the port as untagged frames. Therefore, untagged frames egress the port unmodified, whereas tagged frames are converted to untagged frames before egressing the port (this is performed by removing their tag and recalculating the frame CRC)..

  - Tagged: all the frames egress the port as tagged frames. Therefore, tagged frames egress the port unmodified, whereas untagged frames are converted to tagged frames before egressing the port (this is performed by adding a tag with the VLAN ID defined for the corresponding port, and recalculating the frame CRC).

  The switch can also be configured to reject untagged frames.

Note   *The Gigabit Ethernet port does not support VLAN stacking (double VLAN tagging).*

2.5   GbE Ethernet Switch Subsystem

GbE Ethernet Switch Description

The GbE Ethernet switch, installed only on the FCD-155 with the GbE port option (in addition to the basic Ethernet switch described above), is similar in many respects to the basic Ethernet switch but supports higher data rates (up to 1000 Mbps).

The GbE Ethernet switch has the following ports (see *Figure 2-4* and *Figure 2-6* for its integration with the other FCD-155 subsystems):

- One external GbE port connected to the external LAN port (see page *2-10*). This port supports the 1000 Mbps rate.

- Nine 100 Mbps ports, used as follows:

  - Eight WAN ports that connect to the encapsulation function, part of the Ethernet mapper subsystem, which processes the traffic for transmission through SDH/SONET network using virtual concatenation. Each port can connect to one of the virtually concatenated groups 1 to 8.

    Any two or more ports can be configured as an Ethernet trunk (link aggregation). In this case, the ports combined to form a trunk are handled by the switch as one logical port, with automatic load balancing. The maximum number of trunks that can be defined on the FCD-155 is 8.

  - One additional port is used to connect to the WAN side of the basic Ethernet switch. As a result, the two switches operate as one subsystem

whose characteristics are configured in one step and its capabilities are determined mainly by the GbE switch capabilities.

- Management port, connected internally to the FCD-155 management subsystem.

Within the switch, each port is supported by an independent MAC controller that performs all the functions required by the IEEE 802.3 protocol. The maximum frame size supported by the switch 2 kB.

The frames passed by the MAC controller are analyzed by the ingress policy controller of the corresponding port before being transferred to an internal queue controller, which controls the frame egress priorities and inserts them in two separate queues (low-priority and high-priority queue, versus the four queues of the basic switch). The queues are connected to the ports through the port egress policy controllers. This approach provides full control over traffic flow, and ensures that congestion at one port does not affect other ports.

Flow Control Options in FCD-155 with GbE Option

The user can enable flow control for the GbE switch ports in the same way as for the basic Ethernet switch (see page *2-12*).

Forwarding Algorithms in FCD-155 with GbE Option

The GbE Ethernet switch operates as a MAC bridge in a way similar to the basic Ethernet switch, but it has 8192 MAC entries (see page *2-12*).

VLAN Support in FCD-155 with GbE Option

The GbE Ethernet switch has two operating modes, which are selected by the user in accordance with the application requirements:

- **VLAN-unaware mode**. In this mode, the switch ignores the VLAN information when making forwarding decisions.

Note

Selecting the VLAN-unaware mode also disables VLAN handling by the basic Ethernet switch.

Note

The GbE option does not support port-based VLANs.

- **VLAN-aware mode**. In this mode, the switch uses the VLAN information that may be present in the processed frames to select the ports among which traffic can be forwarded. The GbE switch supports only tag-based VLAN switching per IEEE 802.1Q. See general description of this mode in the *Support for 802.1Q Tag-Based VLAN Switching* section, starting on page *2-15*.

QoS Support in FCD-155 with GbE Option

The GbE switch does not directly support quality-of-service (QoS) features, but determines handling and forwarding priorities only in accordance with the priority indicated in the IEEE 802.1p VLAN tag: this means that it does not use the information in the DSCP field (the Differentiated Services Codepoint per RFC2474), nor supports manually-configured egress priorities.

Two traffic classes are supported, where each class is typically assigned to a type of prioritized frame stream. The switch also enables the user to configure the egress scheduling mode (strict priority or weighted 2:1 fair queue mode), as for the basic Ethernet switch.

2.6   Ethernet Mapper Subsystem

The Ethernet mapper subsystem handles all the functions related to the use of virtual concatenation (see *Appendix C* for additional details on virtual concatenation), and the preparation of LAN traffic for efficient transport over the SDH/SONET network. See *Figure 2-6* for its integration with the Ethernet processing subsystem.

The Ethernet mapper subsystem includes the following functions:

- LAPS encapsulation

- GFP encapsulation

- Group mapper. The basic FCD-155 units support only the groups 1 to 4 (see *Figure 2-6*). Groups 5 to 8 are available only for FCD-155 with the transparent LAN or GbE ports option.

- GFP multiplexer.

FCD-155 also supports the Link Capacity Adjustment Scheme (LCAS), covered by ITU-T Rec. G.7042.

Encapsulation Functions

Ethernet frames must be encapsulated before transport over the SDH/SONET network. Two types of encapsulation are supported (see *Appendix C* for additional details):

- LAPS (Link Access Protocol – SDH) encapsulation in accordance with ITU-T Rec. X.86

- GFP (Generic Framing Procedure) encapsulation in accordance with ITU-T Rec. G.7041, using the framed mode.

The user can select the desired encapsulation mode, independently, for each virtually concatenated group. The encapsulation parameters can also be configured, for best performance in specific applications.

The encapsulated frames of each group are applied to the corresponding group mapper.

Group Mapper Functions

The group mappers map the LAN traffic for transmission over the SDH/SONET network. The mappers also create the virtually concatenated groups that enable the user to control the utilization of the bandwidth available on the link to the SDH/SONET network.

Note

For compatibility with equipment from other vendors, the user can configure the group mappers to simulate the use of virtual concatenation even when the group includes a single virtual container/SPE.

Alternatively, when a group includes a single virtual container/SPE, the virtual concatenation can be disabled: in this case, the Ethernet traffic from the port connected to the mapper is assigned a whole TU/TUG on the network link.

The mapper serving the basic Ethernet switch can handle up to four groups (these are always groups 1 to 4. When one of the LAN options is installed, the total number of groups is increased:

- The additional groups 5 to 8 are supported when the FCD-155 is equipped with transparent LAN ports)

- With the GbE option, one mapper is used for all the 8 groups.

Link bandwidth utilization is configured in two steps:

1. Define the bandwidth allocated to each group: this is made by selecting the type and the number of VCs/VTs allocated to each group. The bandwidth is allocated using virtual concatenation (see *Appendix C* for details). Following are several examples of bandwidth allocation enabled by virtual concatenation:

    ▪ When using VC-3: maximum of two virtually concatenated groups per FCD-155. For example, a group using two VC-3 can be used to used to carry the maximum traffic load of one 100BASE-TX Ethernet port.

    ▪ When using VC-12: the 63 VC-12s can be divided as required to create up to 4, respectively 8, groups. For example, a group using 5 VC-12 can be used to used to carry the full traffic load of a 10BASE-T Ethernet port over SDH; 50 VC-12 are needed to carry the full traffic load of a 100BASE-TX Ethernet port.

    ▪ When using VT-1.5: the 84 VT-1.5s can be divided as required to create up to 4, respectively 8, groups. For example, a group using 7 VT-1.5 can be used to used to carry the full traffic load of a 10BASE-T Ethernet port over SONET. However, the maximum number of VT-1.5s in any group cannot exceed 64, the number required to carry the full traffic load of a 100BASE-TX Ethernet port.

    When virtual concatenation is not used, one group can be assigned the full VC-4 bandwidth.

    It is allowed to build virtually concatenated groups using different types of VCs/VTs: for example, when using VC-12 to carry PDH traffic, one or two groups can use VC-3s, and the remaining bandwidth (17 VC-12) can be assigned to one or two additional virtually concatenated groups.

Note

When an FCD-155 is equipped with PDH interfaces, the number of VC-12s or VT-1.5s available for carrying Ethernet traffic is reduced. The reduction is explained in the Bandwidth Occupied by PDH Traffic section.

2. Route the groups. The routing is defined by means of mapping (*mapping* is the selection of specific VCs/VTs to be used to carry each group, in the number needed to carry the bandwidth selected in *Step 1* above). This operation creates the trails that are needed to connect the local users to remote locations through the SDH/SONET network.

Support for LCAS

Each virtually concatenated group with two or more VCs/VTs can be configured to support LCAS.

With LCAS, the capacity of a virtually concatenated group can be hitlessly decreased when one of the VCs/VTs fails; when the failure is no longer present, the group will automatically and hitlessly recover to return to the normal capacity.

The user can configure various LCAS protocol parameters, and can also specify a minimum number of VCs/VTs for the group capacity: if the number of VCs/VTs decreases below this minimum, an alarm will be generated.

GFP Multiplexer Function

Virtual concatenation provides the means to transport payloads at rates differing from those available in the standard SDH or SONET hierarchy. Therefore, virtual concatenation is always used by the FCD-155 to carry the LAN traffic (unless a single VC or VT is used).

Although virtual concatenation leads to improved utilization of available bandwidth, better utilization would be achieved by taking into consideration the statistical distribution of traffic generated by multiple Ethernet nodes, and reserving bandwidth only for the average load. This capability is provided by the FCD-155 GFP multiplexer function.

Note

To use GFP multiplexing, all of the multiplexed groups must use GFP encapsulation. Groups not connected to the GFP multiplexer may use LAPS encapsulation.

To use GFP multiplexing, the groups to be multiplexed are routed, after GFP encapsulation, to the multiplexer, instead of directly to the group mapper. All the virtually concatenated groups to be multiplexed must use the same type of VCs/VTs.

The GFP multiplexer is configured in the following steps:

1. Select the virtually concatenated groups to be multiplexed. For an FCD-155 with only two LAN ports, the maximum number of virtually concatenated groups is 4, and therefore 2 multiplexing options (referred to as *GFP multiplexers*) are available:

    ▪ One multiplexing group of 2, 3 or 4 virtually concatenated groups. All these groups must use the same type of VCs/VTs.

- ▪ Two multiplexing groups, each consisting of 2 virtually concatenated groups.

    When the FCD-155 has GbE or transparent LAN ports, the maximum number of virtually concatenated groups is 8, and therefore the maximum number of GFP multiplexers that can be defined is 4.

2. Allocate the guaranteed bandwidth to each multiplexed group, in 12.5% increments.

3. Assign an individual channel identifier (ID) to each group.

4. Select the *primary* group. The primary group is the only virtually concatenated group that is actually mapped as a regular virtually-concatenated group (as explained in the *Group Mapper* section above, this mapping defines the bandwidth and routing within the SDH/SONET network).

    Therefore, by specifying the primary group bandwidth in *Step 2* above you actually specify the bandwidth that is allocated to the multiplexed stream. The bandwidth guaranteed to each of the other multiplexed groups (referred to as *secondary* groups) is then calculated as the fraction of the primary group bandwidth.

Note

Only secondary groups that are not mapped can be connected to a GFP multiplexer. For convenience, when a group is added as secondary group to a GFP multiplexer, its encapsulation mode is automatically changed to GFP.

The GFP multiplexer output is processed by the group mapper, instead of the member groups (the member groups are not connected to the mapper). The mapper output is then inserted into the SDH/SONET frames in accordance with the mapping defined for the primary group.

The main advantage of GFP multiplexing is the way bandwidth allocation is handled:

- • The minimum bandwidth provided to any multiplexed group is guaranteed: it is always the fraction of primary group bandwidth specified in *Step 2*.

- • If temporarily one of the member groups does not utilize the guaranteed bandwidth, for example, because of low traffic load, the unutilized bandwidth is used to carry the traffic of the other groups. Therefore, no bandwidth is wasted if another user needs it.

The use of GFP multiplexing does not detract in any way from the security conferred by the use of port-based VLANs (when supported by the FCD-155). Moreover, only the end points at which the GFP multiplexing/demultiplexing takes place are aware of the multiplexed group structure.

2.7   PDH Interface Subsystem

E1 PDH Ports

FCD-155 operating in SDH networks can be equipped with 4 (FCD-155 only), 8 (FCD-155E only), or 21 independent E1 ports. The ports process the signals as unframed streams.

The E1 interfaces comply with ITU-T Rec. G.703 and support two line interfaces:

- 120Ω balanced line interface, with nominal transmit level of ±3V.

- 75Ω unbalanced interface, with nominal transmit level of ±2.37V. Requires adapter cable.

Only one of these interfaces can be active at any time. The active interface is configured by software. To prevent incorrect connections to the port interfaces, a special arrangement is made to sense the type of adapter cable connected to the PDH interface: cable terminated in RJ-45 connectors for balanced interfaces, or cable terminated in BNC plugs, for the unbalanced interfaces. An alarm is generated if the incorrect cable is used.

The user can select the maximum line attenuation that may be compensated for by each interface while still meeting the BER objectives:

- Maximum line attenuation of 36 dB: this attenuation corresponds to that required of LTU interfaces. This value should be selected only for the balanced interface.

- Maximum line attenuation of 12 dB: this attenuation corresponds to that required of DSU interfaces. This value should be selected whenever the line attenuation does not exceed 12 dB, because it may provide better performance on noisy lines than the 36 dB setting.

T1 PDH Ports

FCD-155 operating in SDH and SONET networks can be equipped with 4 (FCD-155 only), 8, or 28 (FCD-155E only) independent T1 ports. The ports process the signals as unframed streams.

The T1 line ports comply with the applicable requirements of AT&T TR-62411, ANSI T1.403, and ITU-T Rec. G.703. B8ZS zero suppression is used. Jitter performance complies with the requirements of AT&T TR-62411. The ports have a 100Ω balanced line interface, terminated in an RJ-45 eight-pin connector (adapter cables are necessary for the 8 and 28 T1 ports option).

The nominal transmit level is ±3V. The user can select the maximum line attenuation that may be compensated for by each interface while still meeting the BER objectives:

- Maximum line attenuation of 36 dB, for long-haul applications

- Maximum line attenuation of 12 dB, for short-haul applications. This value should be selected whenever the line attenuation does not exceed 12 dB, because it may provide better performance on noisy lines than the 36 dB setting.

The user can also configure the operation mode of each interface, CSU or DSU:

- In the CSU mode, the transmit level can be attenuated by 7.5, 15, or 22.5 dB, for compliance with FCC Rules Part 68A.

- In the DSU mode, the line transmit signal is user-adjustable for line lengths of 0 to 655 feet in accordance with AT&T CB-119. The user can enable the activation of the network-initiated line loopback (LLB), and can also cause each interface to send the LLB activation/deactivation code, thereby permitting the activation of the LLB on the equipment connected to the interface.

E3 PDH Port

FCD-155 operating in SDH networks can be equipped with an E3 PDH port. The port processes the signals as an unframed stream.

The E3 interfaces complies with ITU-T Rec. G.703 and has a 75Ω unbalanced interface terminated in two BNC connectors.

T3 PDH Port

FCD-155 operating in SDH and SONET networks can be equipped with a T3 PDH port. The port processes the signals as an unframed stream.

The T3 line interface complies with the applicable requirements of ANSI T1.102 and ITU-T Rec. G.703, and has a 75Ω unbalanced interface terminated in two BNC connectors.

Bandwidth Occupied by PDH Traffic

When the FCD-155 is equipped with PDH interfaces, some of the bandwidth available on the network link must be assigned to PDH traffic. This reduces the number of VC-12s or VT-1.5s available for carrying Ethernet traffic.

For FCD-155, the reduction in bandwidth available for LAN traffic is as follows:

- **E1 PDH interfaces**:

  - For the 4 E1 ports option, the number of VC-12s is reduced by 4, from 63 to 59

  - For the 8 E1 ports option, the number of VC-12s is reduced by 8, from 63 to 55.

  - For the 21 E1 ports option, the number of VC-12s is reduced by 21, from 63 to 42.

- **T1 PDH interfaces**:

  - With SONET network interface and 4 T1 ports option, the number of VT-1.5s is reduced by 4, from 84 to 80. With the 8 T1 ports option, the number of VT-1.5s is reduced by 4, from 84 to 76, and with the 28 T1 ports option, the number is reduced by 28, from 84 to 56.

- ▪ With SDH network interface and either the 4 or 8 T1 ports option, the number of VC-12s is decreased by 21 (all located in one TUG-3), because the utilization of the TUG-3 is changed from VC-12s to VC–11s.

- • **E3 PDH interface**: the number of VC-12s is decreased by 21 (all located in one TUG-3).

- • **T3 PDH interface**:

  - ▪ With SONET network interface, the number of VT-1.5s is reduced by 28, from 84 to 56 (all of them located in one STS-1)

  - ▪ With SDH network interface, the number of VC-12s is decreased by 21, from 63 to 42 (these VC-12s are converted to 28 VC-11s, all of them located in one TUG-3).

In all these cases, only two groups can use VC-3s or STS-1s.

For FCD-155E, the local traffic can be distributed between the two network links, and therefore the LAN traffic can use a separate link.

2.8   Mappers for PDH Subsystem

The functions provided by the mappers serving the various PDH interface options are described below.

Functions of E1 Mapper for SDH Network Interface

The E1 mapper enables mapping the data stream of each E1 port to any of the 63 VC-12 in the STM-1 signal.

To enable rapid service start-up, default mappings are used:

- • When no groups are used, the signal from each E1 port is inserted in the VC-12 with the same number, that is, E1 port No. 1 is inserted in VC-12 No. 1, E1 port No. 2 is inserted in VC-12 No. 2, etc.

- • When groups are used, the groups are mapped first, followed by the E1 ports, in the following order:

  - ▪ All the defined groups (starting with the group 1 and up the maximum defined) are assigned the first VC-12s

  - ▪ The signal from the E1 port is inserted in the first free VC-12 after the last VC-12 assigned to a group, and so on.

- • For FCD-155E, when path protection is enabled, the configuration of link 1 is copied to link 2, as protected VCs.

In most applications, these defaults need not be changed:

- • When the FCD-155 operates as a terminal multiplexer which connects to the transport backbone through an ADM, the ADM can always be configured to perform any cross-connection that may be required

- In a point-to-point connection between two FCD-155, the only reason to change the defaults is to adapt the FCD-155 to changes in the original utilization of its ports.

For the FCD-155E, which includes a cross-connect matrix, full flexibility is available in the routing to network links.

Functions of T1 Mapper for SDH Network Interface

The T1 mapper enables mapping the data stream of each T1 port to any VC-11 in the STM-1 signal.

When using VC-11, the structure of the TUG-3 to which a VC-11 is mapped is changed from 21 TU-12 (arranged in 3 TUG-2 of 7 TU-12 each), to 28 TU-11 (arranged in 4 TUG-2 of 7 TU-11 each). The structure of other TUG-3 remains unchanged.

To enable rapid service start-up, default mappings are used, similar to those used for E1 ports (see description above). For example, when no groups are defined, the four T1 ports are mapped to TUG 2-1 of TUG-3 No. 1, and the other two TUG-3 remain available for LAN and management traffic.

Functions of T1 Mapper for SONET Network Interface

The PDH mapper enables mapping the data stream of each T1 port to any of the 84 VT-1.5 in the STS-3 signal.

To enable rapid service start-up, the signal from the each T1 port is inserted, by default, in the VT-1.5 with the same number, that is, T1 port No. 1 is inserted in VT-1.5 No. 1, T1 port No. 2 is inserted in VT-1.5 No. 2, etc.

Functions of E3 Mapper

The E3 port can be inserted into any VC-3 inside the STM-1 bandwidth.

Functions of T3 Mapper

- FCD-155 with SDH network interface: the T3 port can be inserted into any VC-3 inside the STM-1 bandwidth.

- FCD-155 with SONET network interface: the T3 port can be inserted into any STS-1 inside the STS-3 bandwidth.

2.9 Timing Subsystem

FCD-155 uses separate and independent system clocks for the various subsystems: one for the SDH/SONET subsystem, and another for the optional PDH subsystem. The LAN ports timing is derived from a local free-running clock, which is not locked to the other clock signals in the unit.

Timing Subsystem for FCD-155

SDH/SONET Timing Subsystem for FCD-155 with PDH Ports

Figure 2-8 shows the functional block diagram of the SDH/SONET timing subsystem for an FCD-155 with PDH ports.
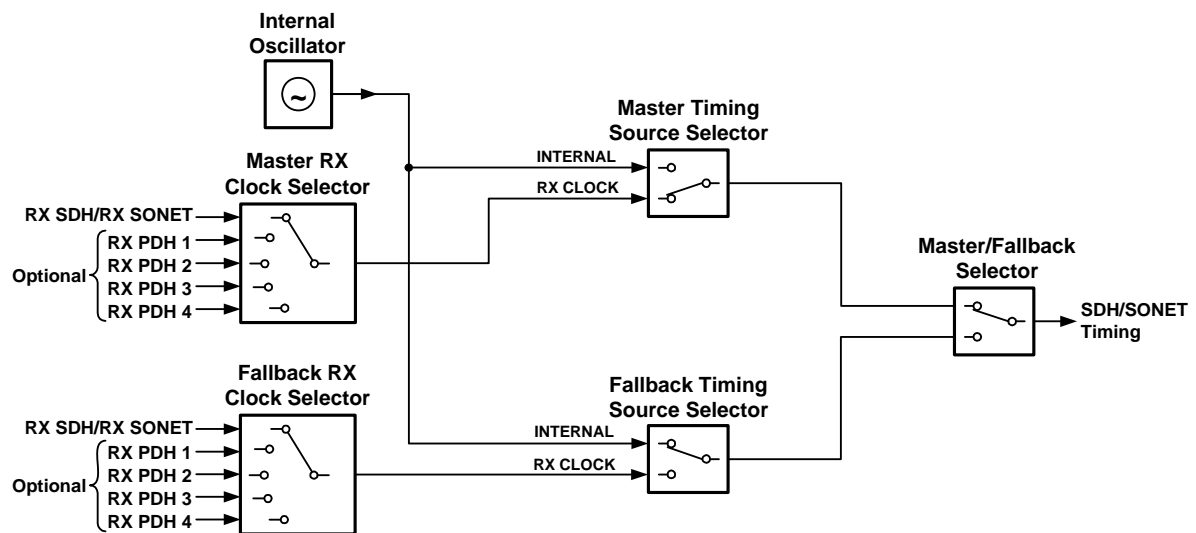
Figure 2-8. SDH/SONET Timing Subsystem (FCD-155 with PDH Ports), Functional Block Diagram

Notes

- *All the following figures represent FCD-155 units with 4 E1 or T1 PDH ports. However, the same options are available for units with 8 E1 or T1 PDH ports (in which case eight PDH ports, 1 to 8, can be selected), or with E3 or T3 PDH ports (in which case only PDH port 1 is available).*

- *When the FCD-155 does not include PDH ports, only the INTERNAL and RX SDH or RX SONET timing options are available.*

For redundancy, the timing subsystem includes two similar sections, one for selecting the master SDH/SONET clock reference and the other for the fallback clock. In case of a failure, FCD-155 automatically switches from the master clock source to the fallback one. Therefore, different sources must be configured for the master and fallback clocks.

The user can specify the SDH/SONET clock reference source from the following options (the designations appearing below use the terms displayed on the supervisory terminal):

- **Locked to a recovered clock (RX clock option)**. The reference source of the recovered clocks can be selected in accordance with the desired method of clock dissemination in the user's network:

  - **RX SDH** or **RX SONET** – reference source locked to the receive clock recovered from the line signal by the STM-1/OC-3 interface. This timing mode is also called *loopback timing*. A typical application for this timing mode is shown in *Figure 2-9*. In this application, the SDH/SONET timing of the FCD-155 units is locked to the highly accurate master clock of the SDH/SONET network.
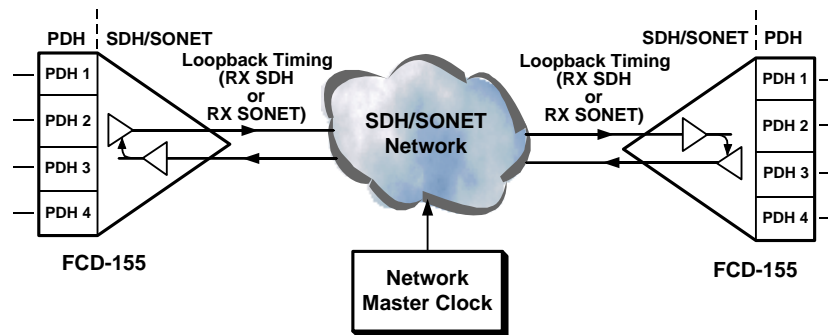
Figure 2-9. Using RX SDH/RX SONET Timing Mode for SDH/SONET Side

  - **RX PDH** – reference clock locked to the receive clock recovered from the PDH line signal received by the desired PDH interface. This timing mode is also called external timing.

    A typical application for this timing mode is shown in *Figure 2-10* (in this figure, the reference clock is supplied by PDH port 2). This timing mode enables locking the SDH/SONET timing of the FCD-155 units used in a private network to the timing of the PDH network.
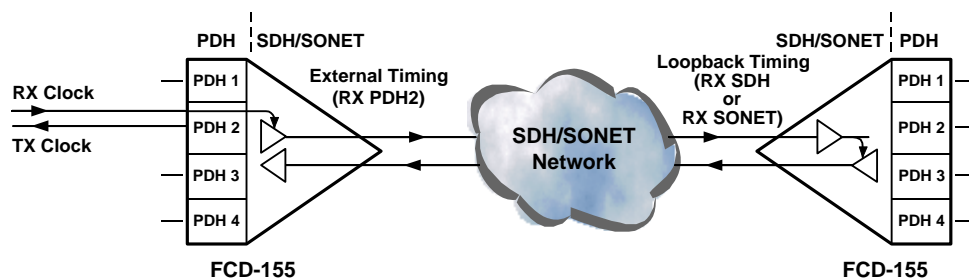
Figure 2-10. Using RX PDH Timing Mode for SDH/SONET Side

- **Internal clock**: in this mode, the internal oscillator of one of FCD-155 units provides the timing reference for FCD-155 units used in a private network. A typical application for this timing mode is shown in *Figure 2-11.*

The reference timing source used by the SDH/SONET side is reflected in the S1 byte inserted in the transmit SDH/SONET overhead:

- When the network timing is derived from the FCD-155 internal oscillator, the S1 byte is 0 (corresponding to the *unknown* value)

- When the timing reference is a recovered clock signal, the S1 byte is F (hexa), corresponding to the *do not use (DNU)* value.
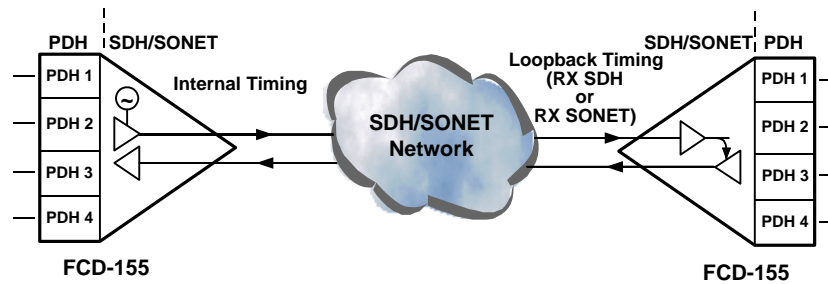
Figure 2-11. Using Internal Timing Mode for SDH/SONET Side

PDH Timing Subsystem

The available timing options for the PDH subsystem are as follows (the designations appearing below use the terms displayed on the supervisory terminal):

- **RX SDH/RX SONET** – PDH reference source locked to the receive clock recovered from the line signal by the STM-1/OC-3 interface.

  A typical application for this timing mode is shown in *Figure 2-12*. In this application, the PDH ports send the received data to the connected equipment at a timing locked to the highly accurate master clock of the SDH/SONET network, and therefore enable locking the timing of the PDH equipment to the SDH/SONET timing.

  Note that the user's PDH equipment must use loopback timing.
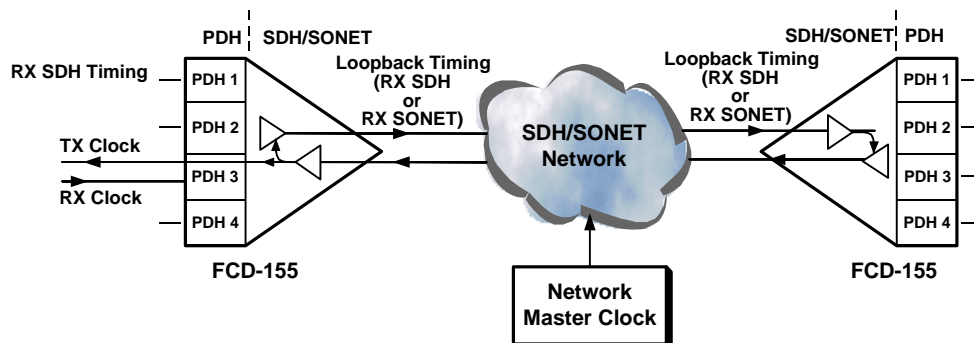
Figure 2-12. Using RX SDH/SONET Timing Mode for PDH Side

- **RX VC12, RX VC11, RX VT1.5** or **RX VC3** – PDH reference source locked to the receive clock recovered from the corresponding VC-12, VC-11, VT-1.5 or VC-3 timing. This mode locks the local timing of the PDH port to the timing of the PDH signal received by the remote equipment. Therefore, in this mode the SDH/SONET transmission link is simply a pipe that transparently conveys the remote timing reference to the local equipment.

  A typical application for this timing mode, using RX VC12 as an example, is shown in *Figure 2-13*.

  Note that the remote user's PDH equipment must use internal timing, and the local user's PDH equipment must use loopback timing.
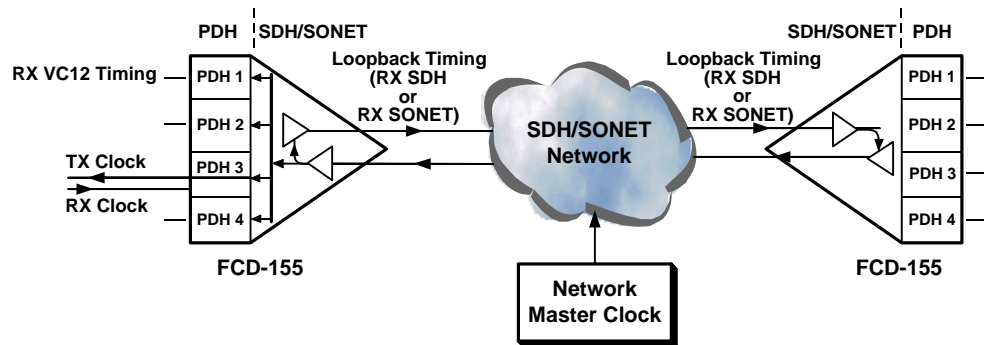
Figure 2-13. Using RX VC12, RX VC11, RX VT1.5 or RX VC3 Timing Mode for PDH Side

FCD-155E Timing Subsystem

FCD-155E timing subsystems have timing options similar to those described above for the other FCD-155 versions, with two additional capabilities:

- Support for automatic clock reference selection, based on the use of the Synchronization Source Message (SSM)

- External station clock interface.

The main differences between the timing subsystem of FCD-155E and that of the other versions are as follows:

- FCD-155E cannot use PDH interfaces as timing reference source.

- The RX_SDH clock cannot be used as timing reference for the 21 E1/28 T1 PDH ports.

- When the PDH system is configured to use the RX_SDH as its transmit timing reference, it actually uses the nodal clock of the FCD-155E.

Automatic Clock Reference Selection Based on SSM

In FCD-155E, the timing subsystem can be configured to automatically select the best timing source in accordance with the contents of the SSM message received from that source (the station clock SSM is configured by the user).

The selection is among the SDH/SONET recovered clock signals, and the station clock signal.

The SSM sent by the FCD-155E to the network reflects the quality of the selected source. This provides clock traceability.

External Station Clock Interface

The FCD-155E timing system can use an external signal connected to the dedicated station clock interface.

The station clock interface has an ITU-T Rec. G.703 interface that accepts user-selectable frequencies and signal formats (2048 kHz, 2048 kbps and 1544 kbps). The clock interface (balanced/unbalanced) and sensitivity (long or short range) are also user-selectable.

The station clock can also be supplied to other equipment. The source of the output clock is selectable:

- The FCD-155 nodal clock
- The external clock signal applied to the station clock interface
- The external clock after regeneration and filtering by a jitter attenuator.

To protect the other equipment, the station clock interface has a bypass relay that connects directly the input line to the output when the FCD-155E is not powered.

2.10   Management Subsystem

The FCD-155 management subsystem provides all the functions needed to configure, control and monitor the operation of the FCD-155. The activities that can be performed include:

- Configure the FCD-155.
- Monitor the FCD-155 status and read its performance monitoring statistics.
- Perform FCD-155 tests and diagnostics.
- Display alarms and events detected during FCD-155 operation.

In addition, the management system also enables signaling the FCD-155 alarm status to bay alarm panels or remote operator consoles by means of two sets of dry relay contacts (one for major alarms, the other for minor alarms) included in the dedicated front-panel ALARM connector.

The FCD-155 supervision and configuration activities can be performed using supervision terminals, SNMP-based network management stations, IP hosts using the Telnet protocol, and Web browsers.

FCD-155 units can also be managed by the RADview EMS, a client-server CORBA-based Element Management System offered by RAD.

Supervisory Port Capabilities

All the FCD-155 supervision and configuration functions, and in particular the preliminary configuration activities, can be performed using a "dumb" ASCII terminal (or a PC running a terminal emulation program) directly connected to the FCD-155 serial RS-232 asynchronous supervisory port, located on its front panel. the terminal is controlled by the program stored in the FCD-155. No information has to be stored in the terminal.

After the preliminary configuration is completed, the FCD-155 can also be managed by the other means, for example, Telnet hosts, Web browsers and SNMP network management stations.

The supervisory port has a DCE interface, and supports data rates in the range of 300 bps to 115.2 kbps. The data rate and the word format are user-configurable.

Out-of-Band Management through Ethernet Ports

After preliminary configuration, the management subsystem of the FCD-155 can also be accessed through the dedicated MNG port, or through the ETH 1 or 2 LAN ports, using Telnet, SNMP or HTML (for Web browsers).

For FCD-155 versions with 2 or more LAN ports, the connection from the ETH 1 or ETH 2 port to the internal management subsystem is made through an Ethernet switch (see *Figure 2-6*).

Note	The optional transparent LAN ports cannot be used for management access, because they do not pass through an Ethernet switch.

For FCD-155 units with 2 or 6 LAN ports, the management traffic can be routed using port-based VLANs, as explained in the *Support for Port-Based VLAN* section above; this option is not available for FCD-155 units with GbE ports.

Alternatively, when tag-based VLAN switching is used, and VLAN tagging is enabled for the internal management port, a forwarding rule must be defined for the management VLAN.

Remote Management through SDH/SONET Network

SNMP-based network management stations connected to one of the FCD-155 units in the user's network can also manage remote units, using inband communication over some of the network link bandwidth. This capability is illustrated in *Figure 2-14*.

The management station is connected to a LAN port (ETH 1 or ETH 2) of the local FCD-155 unit, and its traffic is handled by the Ethernet switch of the FCD-155.
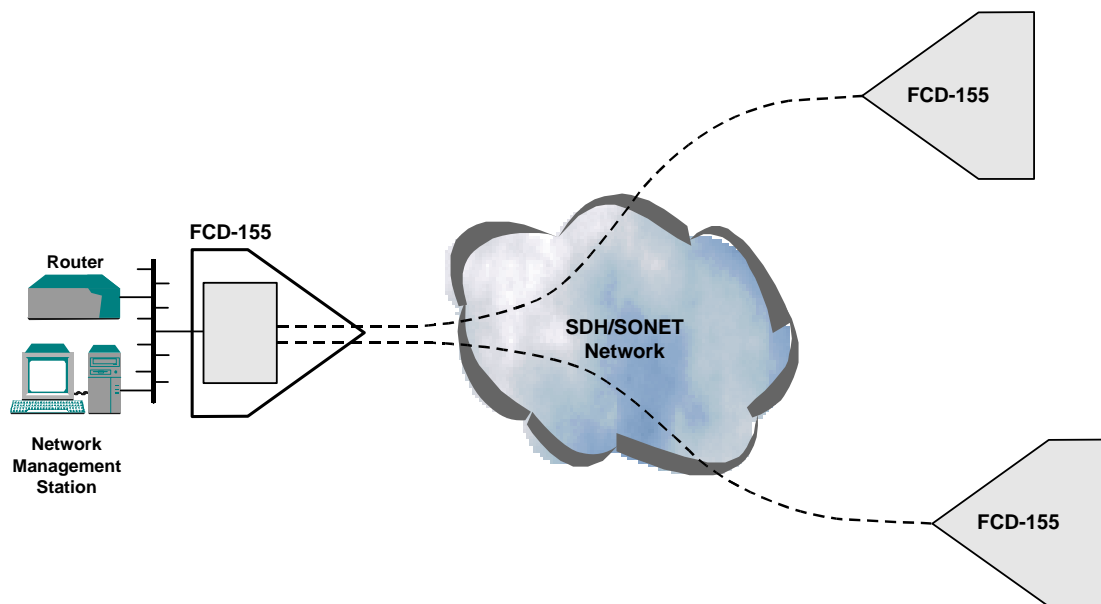
Figure 2-14. Remote Management of FCD-155 Units through SDH/SONET Network

To enable remote management, the management station traffic is directed not only to the internal management subsystem, but is also connected to a dedicated group by defining an appropriate port-based VLAN for management purposes.

The dedicated management group is then mapped to one VC-12/VC-11 or VT-1.5 on the SDH/SONET link.

Note

The port-based VLANs are supported only by FCD-155 units with 2 or 6 LAN ports,

At the remote FCD-155 units, port-based VLANs are used to connect the VC-12/VC-11 (or VT-1.5) carrying the management traffic to the local unit management subsystem. This arrangement enables the management station to manage each remote FCD-155 unit.

Moreover, at each remote FCD-155 unit, the management traffic may also be connected through the Ethernet switch to one of the ETH 1 or ETH 2 ports. This will enable the management station to manage equipment attached to the LAN connected to that port.

The bandwidth needed for management traffic is normally rather low compared with VC-12/VC-11 or VT-1.5 bandwidth. Therefore, assigning a full VC-12/VC-11 or VT-1.5 to management traffic is justified only when free bandwidth is available on the links.

To avoid wasting bandwidth, GFP multiplexing can be used: in this case, the dedicated management group is connected to the GFP multiplexer (see the *GFP Multiplexer Function* section) together with a group carrying payload traffic. The management group is then defined as secondary group and assigned minimal bandwidth (12.5% is often sufficient). The result is that payload traffic gets additional bandwidth whenever the management link is idle.

Inband Management through SDH/SONET Network

FCD-155 supports inband management through the Data Communication Channel (DCC) carried in the SDH/SONET overhead. For FCD-155E, each SDH/SONET link can have its DCC used for management. Moreover, the user can assign different IP addresses to each DCC port (alternatively, the interfaces can use the management IP address of the FCD-155).

Therefore, in point-to-point applications, a Telnet host or an SNMP-based network management station connected to one of the FCD-155 units can also manage the remote unit, using inband communication but without occupying bandwidth that may be used to carry payload.

Note

Inband management can also support more complex topologies, for example, rings. However, this is possible only if the carrier's SDH/SONET network provides access to the DCC and enables transparent transfer of user's data through the DCC. In this case, a Telnet host or an SNMP-based network management station connected to one of the FCD-155 units in the network can manage all the other units, inband.

Typically, the Telnet host or management station is connected to a LAN port (MNG, ETH 1 or ETH 2) of the local FCD-155 unit, and its management traffic is handled by the Ethernet switch of the FCD-155. The other LAN port can be used to connect the management traffic to other local equipment units.

To enable remote management, the management traffic not addressed to the internal management subsystem of the FCD-155 is also connected by this subsystem to the Data Communication Channel (DCC) carried in the SDH/SONET overhead.

At the remote FCD-155 units, the management traffic is extracted from the DCC and connected to the local unit management subsystem. This arrangement enables the management station to manage each remote FCD-155 unit.

Moreover, at each remote FCD-155 unit, the management traffic may also be connected through the Ethernet switch to one of the ETH 1 or ETH 2 LAN ports. This will enable the management station to manage equipment attached to the LAN connected to that port.

The user can configure the FCD-155 for static routing, by specifying the IP address of the host or subnet to which the management traffic is to be sent when using the DCC.

As mentioned above, the inband management traffic is carried in the DCC bytes, part of the SDH/SONET overhead. The user can select the DCC bytes to carry the traffic:

- Regenerator section DCC bytes (D1, D2, D3), which provide a 192 kbps channel terminated at SDH/SONET regenerator section terminating equipment

- Multiplex section DCC bytes (D4 to D12), which provide a 576 kbps channel terminated at SDH/SONET multiplex section terminating equipment.

The user can also select the encapsulation and routing protocols used for inband management parameters:

- Three encapsulation options are available: HDLC, PPP over HDLC in accordance with RFC1661 and RFC1662, and IP Tunneling using ES-IS Protocol in accordance with G.7712.

  For compatibility with particular implementations of the HDLC encapsulation protocol for management purposes, the user can select the Type 1 flavor (for this flavor, the LCP (Link Control Protocol) packets do not include address and control fields in their overhead).

- Two options are also available for the management traffic routing protocol:

  - RAD proprietary protocol. This protocol is sufficient for managing any RAD equipment and should always be used with HDLC encapsulation.

  - RIP2: the FCD-155 transmits RIP2 routing tables. This permits standard RIP routers to reach the FCD-155 SNMP agent through the inband (DCC) channel.

Automatic Configuration (Plug & Play)

The FCD-155 is designed to enable automatic configuration from a remote location (plug & play functionality). This is achieved using DHCP in conjunction with TFTP; to apply this method, the using organization must configure a DHCP server, located at an appropriate location within the operator's network management center.

To use plug & play, the FCD-155 management subsystem can be configured to operate as a DHCP client. In this case, the following process takes place:

1. When the FCD-155 is powered up, it automatically broadcasts a DHCP server discovery message over the out-of-band interfaces.

2. When the dedicated DHCP server answers, it provides the IP address to be configured as the FCD-155 management address. This is sufficient for Telnet access, as well as for TFTP.

3. After the IP address is configured, TFTP is used to download the appropriate configuration file to the new FCD-155.

4. After configuration downloading, the FCD-155 starts using the downloaded configuration.

Software Updating

The operation of the FCD-155 management subsystem and of its other circuits is determined by software stored in flash memory.

The FCD-155 application software can be downloaded and updated using an ASCII terminal directly connected to the FCD-155 serial CONTROL port, using the Xmodem protocol.

However, the software can also be updated using TFTP through any of the management access options described above. Using remote downloading enables network operators to distribute software from a central location rapidly and efficiently.

2.11   Power Supply Subsystem

FCD-155 can be ordered with either 100 to 240 VAC, 50/60 Hz or -48 VDC power supply. The unit does not have a power ON/OFF switch and therefore starts operating as soon as power is connected.

FCD-155E has two PS modules, with load sharing. Only one PS module is required to provide power to a fully equipped FCD-155E, and therefore installing a second module provides redundancy. While both modules operate normally, they share the load; in case one fails or does not receive power, the other continues providing power.

2.12   Supervision, Diagnostics and Performance Monitoring

The FCD-155 supports comprehensive diagnostics, performance monitoring, supervision and maintenance capabilities, for easy maintenance and rapid detection and location of faults.

Alarm Reporting

FCD-155 generates time-stamped alarm messages that cover all the system events. The time stamp is provided by an internal real-time clock. Up to 255 of the most recent alarms can be stored in an internal buffer; in case the FCD-155 is powered down, up to 100 of the most recent alarms are stored in non-volatile memory, and remain available for display and analysis after the FCD-155 is powered up again.

The alarm messages stored in the buffer can be read on-line by means of the local supervisory terminal, a Telnet host or Web browser, and can also be automatically sent as traps to selected management stations.

Performance Monitoring

Performance monitoring capabilities includes collection of statistics for the application layer, as well as for the physical layer for the user and network ports.

Diagnostic Tests

Maintenance capabilities include various types of user-activated local and remote loopbacks.

- STM-1/OC-3 network links: local and remote loopbacks. The laser shut down function can also be tested.

   For FCD-155E, local and remote loopbacks can also be activated on a VC-12, VC-11, VT-1.5, VC-3 or STS-1.

- PDH tributaries:

   - Local loopback

   - Local loopback with upstream AIS (not supported by E3 and T3 ports)

   - Remote loopback

   - For T1 tributaries: network-activated local loopback (LLB) and sending of LLB activation command.

   - For PDH ports: BER testing, enables checking the transmission performance of the connection to the local user's equipment connected to the port.

   The duration of the loopbacks can be limited, by specifying a time-out interval after which the loopback is automatically disconnected.

- *Ping* for IP connectivity testing. FCD-155E also supports the *traceroute* function, which helps troubleshooting IP connectivity.

These loopbacks enable rapid and efficient isolation of the equipment unit causing the problem, thereby enabling rapid restoration of service.

Chapter 3

Installation and Setup

3.1 Introduction

This chapter provides installation instructions for the various FCD-155 versions.

The chapter presents the following information:

- Safety precautions for installation personnel and users, and site requirements that are common to all of the FCD-155 versions

- Two separate sections, one for the FCD-155E and the other for FCD-155. Each section presents a general description of equipment panels, and mechanical and electrical installation instructions.

After installing the system, it is necessary to configure it in accordance with the specific user's requirements. The preliminary system configuration, performed by means of a supervision terminal directly connected to the FCD-155 (procedures for using the terminal are given in *Chapter 4*). The software necessary for using the terminal is stored in the FCD-155.

Note
If the FCD-155 software must be updated, refer to Appendix B for detailed software installation instructions.

After the preliminary configuration and during routine operations, the FCD-155 can also be managed by means of Telnet hosts, Web browsers or SNMP-based network management stations, e.g., RADview. Refer to the User's Manual of the network management station for operating instructions; Telnet hosts use the supervision terminal procedures.

3.2 Safety Precautions

General Safety Precautions

⚠️
Warning
No internal settings, adjustment, maintenance, and repairs may be performed by either the operator or the user; such activities may be performed only by skilled service personnel who are aware of the hazards involved.

Always observe standard safety precautions during installation, operation, and maintenance of this product.

Grounding

For your protection and to prevent possible damage to equipment when a fault condition, e.g., a lightning stroke or contact with high-voltage power lines, occurs on the cables connected to the equipment, the case of the FCD-155 unit must be properly grounded at any time. Any interruption of the protective (grounding) connection inside or outside the equipment, or the disconnection of the protective ground terminal can make this equipment dangerous. Intentional interruption is prohibited.

Warning

Dangerous voltages may be present on the cables connected to the FCD-155.

* Never connect cables to an FCD-155 unit if it is not properly installed and grounded.
* Disconnect all the cables connected to the FCD-155E electrical connectors before disconnecting the FCD-155 power cable.

Note

Before installing the product, review Handling Energized Products *at the beginning of the manual.*

Before switching on this equipment and before connecting any other cable, the protective ground terminal of the FCD-155 must be connected to a protective ground:

* For the FCD-155 version, the grounding connection is made through the power cable, which must be connected to a power socket (outlet) with protective ground contact. Therefore, the power cable plug must always be inserted in a socket outlet provided with a protective ground contact, and the protective action must not be negated by use of an extension cord (power cable) without a protective conductor (grounding).

* For the FCD-155E version, the grounding connection is made to the grounding terminal located on the rear panel. In addition, grounding is also available through the power cable, as for the other FCD-155 versions.

Whenever FCD-155 units are installed in a rack, make sure that the rack is properly grounded and connected to a reliable, low-resistance grounding system.

Make sure that only fuses of the required rating are used for replacement. The use of repaired fuses and the short-circuiting of fuse holders is forbidden. Whenever it is likely that the protection offered by fuses has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

Laser Safety Classification

FCD-155 units equipped with laser devices comply with laser product performance standards set by government agencies for Class 1 laser products. FCD-155 units do not emit hazardous light, and the beam is totally enclosed during all operating modes of customer operation and maintenance.

FCD-155 units are shipped with protective covers installed on all the optical connectors. Do not remove these covers until you are ready to connect optical cables to the connectors. Keep the covers for reuse, to reinstall the cover over the optical connector as soon as the optical cable is disconnected.

⚠ *Warning*

When installing an SFP in an operating unit, be aware that it may immediately start generating laser radiation.

Laser Safety Statutory Warning and Operating Precautions

All the personnel involved in equipment installation, operation, and maintenance must be aware that the laser radiation is invisible. Therefore, the personnel must strictly observe the applicable safety precautions and in particular must avoid looking straight into optical connectors, neither directly nor using optical instruments.

In addition to the general precautions described in this section, be sure to observe the following warnings when operating a product equipped with a laser device. Failure to observe these warnings could result in fire, bodily injury, and damage to the equipment.

⚠ *Warning*

To reduce the risk of exposure to hazardous radiation:
• Do not try to open the enclosure. There are no user-serviceable components inside.
• Do not operate controls, make adjustments, or perform procedures to the laser device other than those specified herein.
Allow only authorized RAD service technicians to repair the unit.

Protection against Electrostatic Discharge (ESD)

An electrostatic discharge occurs between two objects when an object carrying static electrical charges touches, or is brought near enough, the other object. Static electrical charges appear as result of friction between surfaces of insulating materials, separation of two such surfaces and may also be induced by electrical fields.

Routine activities such as walking across an insulating floor, friction between garment parts, friction between objects, etc. can easily build charges up to levels that may cause damage, especially when humidity is low.

Whenever feasible, during installation works use standard ESD protection wrist straps to discharge electrostatic charges. It is also recommended to use garments and packaging made of antistatic materials or materials that have high resistivity, yet are not insulators.

Caution FCD-155 internal boards contain components sensitive to ESD. To prevent ESD damage, do not touch internal components or connectors.

If you are not using a wrist strap, before touching an FCD-155 unit or performing any internal settings on the FCD-155, it is recommended to discharge the electrostatic charge of your body by touching the frame of a grounded equipment unit.

3.3 Site Requirements

Physical Requirements

FCD-155 Units

FCD-155 are half-rack wide units, and can be installed in racks, on desktop and shelves. All the connections, except for the power connection, are made to the front panel.

For installation in 19in. racks, RAD offers dedicated rack mount kits, RM-35, that enable installing one, respectively two FCD-155 units side-by-side. FCD-155 units installed with the rack mount kit occupy a height of 1U.

FCD-155 can also be installed on walls, using the wall mount kit, WM-35, offered by RAD.

FCD-155E Units

FCD-155E are 1U high units that can be installed in racks, on desktop and shelves. All the connections are made to the rear panel.

For installation in racks, RAD offers the following dedicated rack mount kits:

- RM-34 – for 19 in. racks

- RM-34-23 – for 23 in. racks

- RM-34-ETSI – for ETSI racks.

For installation on the wall, RAD offers the following wall mount kit:

- WM-34.

Power Requirements

AC-powered FCD-155 units should be installed within 1.5m (5 feet) of an easily-accessible grounded AC outlet capable of furnishing the required AC supply voltage, in the range of 100 to 240 VAC, 47 to 63 Hz.

DC-powered FCD-155 units require a -48 VDC power source with positive terminal grounded. In addition, the DC power connector contains the chassis (frame) ground terminal.

Network and User Connections

This section presents general requirements regarding the connections to the various FCD-155 interfaces. For specific information regarding pin allocations in the FCD-155 connectors and cable wiring, refer to *Appendix A*.

Network Connections

The network connections have two sockets for installation of SFP transceivers. The optical SFPs offered by RAD have LC connectors.

Note   *RAD also offers SFPs with copper interface.*

The optical cables to be connected to the optical ports should use 2 mm optical fibers terminated in the corresponding type of connectors.

When routing fibers, make sure to observe the minimum bending radius (35 mm). RAD recommends installing plastic supports on each cable connector: these supports determine the fiber bending radius at the connector entry point and also prevent stress at this point.

Station Clock Connections

The station clock port located on the FCD-155E can accept 2.048 MHz or 1.544 MHz signals (framed 2.048 Mbps or 1.544 Mbps signals are also accepted). The port can also output the clock signal: this output provides a convenient means for distributing clock signals to other equipment.

The station clock port is terminated in one RJ-45 connector, which supports two interfaces:

- 100 Ω/120 Ω balanced interface for operation over twisted pairs

- 75 Ω unbalanced interface for operation over coaxial cables. This interface can be used only for 2.048 MHz or 2.048 Mbps clock signals.

At any time, only one interface is active. The port interface senses the cable type connected to the port (one of the contacts in the station clock connector is used to sense the connection of the unbalanced adapter cable (see below). Therefore, do not connect cables with more than two pairs when you want to use the balanced interface.

To connect to equipment with unbalanced interface, it is necessary to convert the RJ-45 connector to a pair of BNC female connectors . For this purpose, RAD offers a 15-cm long adapter cable, CBL-RJ45/2BNC/E1/X. This cable has one RJ-45 plug for connection to FCD-155E station clock connector, and two BNC female connectors at the other end.

PDH E1 and T1 Port Connections

Each FCD-155 E1 port can use one of the following interfaces (only one can be active at any time):

- 120 Ω balanced interface for operation over two twisted pairs

- 75 Ω unbalanced interface for operation over coaxial cable.

The number of E1 ports on the FCD-155 depends on order:

- **4 E1 G.703 ports option (FCD-155 only)**: each port has its own RJ-45 eight-pin connector. To connect to equipment with balanced interfaces, use a standard RJ-45/RJ-45 cable.

   To connect a port to equipment with standard unbalanced interface, use the CBL-RJ45/2BNC/E1/X adapter cable, with one RJ-45 plug at one end and two BNC female connectors at the other end. This cable support automatic detection of cable type.

- **8 E1 G.703 ports option**: all the ports are terminated in one 44-pin D-type female connector. The ports support automatic detection of cable type: the

same interface must be selected for all the 8 ports. Adapter cables are offered by RAD to enable direct connection to equipment with standard interfaces, or to distribution panels:

- CBL-G703-8/RJ45: 2-meter long cable for use with balanced interfaces, terminated in 8 RJ-45 connectors, one for each port

- CBL-G703-8/COAX: 2-meter long cable for use with unbalanced interfaces, terminated in 8 pairs of BNC connectors (one transmit and one receive connector per port).

- CBL-G703-8/OPEN/2M and CBL-G703-8/OPEN/8M: 2-meter, respectively 8-meter long cable, terminated in labeled pairs, for connecting to terminal blocks or for assembling your own connector. Can be used for both balanced and unbalanced interfaces.

- **21/28 G.703 ports option (FCD-155E only)**: all the ports are terminated in two 62-pin D-type female connectors. The ports support automatic detection of cable type: the same interface must be selected for all the 14 ports. Adapter cables are offered by RAD to enable direct connection to equipment with standard interfaces, or to patch panels:

  - CBL-G703-14/RJ45: 2-meter long cable for use with balanced interfaces, terminated in 14 RJ-45 connectors, one for each port

  - CBL-G703-14/COAX: 2-meter long cable for use with unbalanced interfaces, terminated in 14 pairs of BNC connectors (one transmit and one receive connector per port).

  - CBL-G703-14/OPEN/2M and CBL-G703-14/OPEN/8M: 2-meter, respectively 8-meter long cable, terminated in labeled pairs, for connecting to terminal blocks or for assembling your own connector. Can be used for both balanced and unbalanced interfaces.

- **Patch panels (FCD-155E with 21/28 ports option only)**: RAD offers special patch panels, suitable for installation in standard 19 in. racks, which simplify the connection of user's equipment to the FCD-155E E1 and T1 ports (the CH.1-14 G.703 and CH.15-21/28 G.703 connectors). These patch panels serve as adapters that provide separate connectors for each port that is, have RJ-45 connectors for balanced E1 and T1 interfaces, or BNC connectors for unbalanced E1 interfaces. Standard cables can then be used to connect the user's equipment to the patch panel connectors.

  Two types of patch panels are offered:

  - **OP-A/ADAPTOR/28RJ**: 1U-high patch panel for balanced interfaces. Has 28 RJ-45 connectors, one for each port

  - **OP-A/ADAPTOR/21BNC/1551**: 2U-high patch panel for unbalanced interfaces. Has 28 pairs of BNC connectors, one pair for each port.

  The panels provide only transparent connections: they do not provide any impedance matching, and therefore it is necessary to use the panel type corresponding to the selected port interface.

  Both patch panels have two 64-pin TELCO connectors on their rear panels, for connection via adapter cables to the FCD-155E connectors. The panels are supplied with two CBL-TELCO-TELCO cables. RAD offers suitable adapter

cables, designated CBL-G703-14/PATCH, having a length of 2 meter, for connecting the FCD-155E to the patch panel.

Each panel serves one FCD-155E unit with the 21/28 ports option, and requires two adapter cables.

T1 ports have only 100 Ω balanced interfaces, terminated in the same type of connectors (depending on option ordered).

Caution

The FCD-155 E1 and T1 interfaces must not be directly connected to unprotected public telecommunication networks. The connection must be made through a network termination unit that provides separation between the interface conductors and the telecommunication network conductors in accordance with the applicable local regulations.

PDH E3 and T3 Port Connections

The FCD-155 E3 or T3 port has a 75 Ω unbalanced interface in accordance with ITU-T Rec. G.703, for operation over coaxial cable. The port is terminated in two mini-BNC connectors, one for the receive input and the other for the transmit output.

LAN Port Connections

The FCD-155 LAN ports depend on the ordered options. The port connection requirements are described below:

- **10/100BASE-TX LAN ports 1 and 2**. Each 10/100BASE-TX LAN port has a 10/100BASE-TX Ethernet interface terminated in an RJ-45 connector, designated ETH1 or ETH2, for connection to LANs operating on UTP media. The interface connector supports the MDI/MDIX, automatic crossover detection and correction function (this function can be enabled/disabled, independently of the autonegotiation function). The ports also correct for polarity reversal in the 10BASE-T mode. Therefore, the port can always be connected through any type of cable (straight or crossed) to any type of 10/100BASE-TX Ethernet port (hub or station).

- **Transparent LAN ports**. Each LAN port has a 10/100BASE-TX Ethernet interface terminated in an RJ-45 connector, designated ETH 3 to ETH 6, respectively, for connection to LANs operating on UTP media:

  - The interface connectors of FCD-155 is wired as a hub port. Therefore, it can be connected through a "straight" (point-to-point) cable to an Ethernet station port; a crossed cable is needed for connection to another hub port.

  - For FCD-155E, the ports support automatic MDI/MDIX, and therefore can be connected through any type of cable (straight or crossed) to any type of port.

- **GbE LAN port**. The FCD-155 can be ordered with one GbE LAN port. This port has two types of interfaces:

  - Built-in copper 10/100/1000BASE-T interface, terminated in an RJ-45 connector. This interface supports the MDI/MDIX crossover function, and therefore it can be connected by any type of cable (straight or crossed)

to any type of 10/100/1000BASE-TX Ethernet port. The ports also correct for polarity reversal in the 10BASE-T mode.

- Interface for standard SFP fiber-optic plug-in module. The SFP plug-in can be inserted in the field by the user, in accordance with the desired GbE interface characteristics.

Management Connections

Out-of-Band Ethernet Connections

FCD-155 has a 10BASE-T/100BASE-TX Ethernet interface terminated in RJ-45 connectors, designated MNG or MNG.

This interface supports MDI/MDIX crossover and therefore the ports can always be connected through any type of cable (straight or crossed) to any other type of 10/100BASE-T Ethernet port (hub or station).

Connection to Serial Port

The FCD-155 supervisory port has a serial RS-232 asynchronous DCE interface terminated in a 9-pin D-type female connector, designated CONTROL.

This port can be directly connected to terminals using a straight cable (wired point-to-point). RAD offers a suitable cable, CBL-DB9F-DB9M-STR, which has a female connector at the FCD-155 side, and a male connector at the other side.

A cross cable is required to use the DTE mode, for example, for connection through modems or digital multiplexer channels.

Caution

Terminal cables must have a frame ground connection. Use ungrounded cables when connecting a supervisory terminal to a DC-powered unit with floating ground. Using an improper terminal cable may result in damage to the supervisory terminal port.

Dry-Contact Alarm Relays Connections

The dry-contact alarm interface is included in the ALARM connector (see *Appendix A*).

The interface includes two relays, one for the major alarm and the other for the minor alarm, with floating change-over contacts.

The relay contacts are rated at maximum 60 VDC across open contacts, and maximum 1 ADC through closed contacts. Protection devices must be used to ensure that these ratings are not exceeded: when necessary, use current limiting resistors in series with the contacts, and place surge absorbers across the contacts.

Front and Rear Panel Clearance

Allow at least 90 cm (36 inches) of frontal clearance for operator access.

Allow at least 10 cm (4 inches) clearance at the rear of the unit for interface cable connections, however during installation and replacement and cable connections a larger clearance (at least 90 cm (36 inches)) is needed.

Ambient Requirements

The ambient operating temperature of the FCD-155 is 0 to 50°C (32 °F to 122 °F), at a relative humidity of up to 90%, non-condensing.

- FCD-155E has internal cooling fans. *Figure 3-1* shows the position of the air intake and discharge vents, and the direction of the air flow. Do not obstruct these vents.
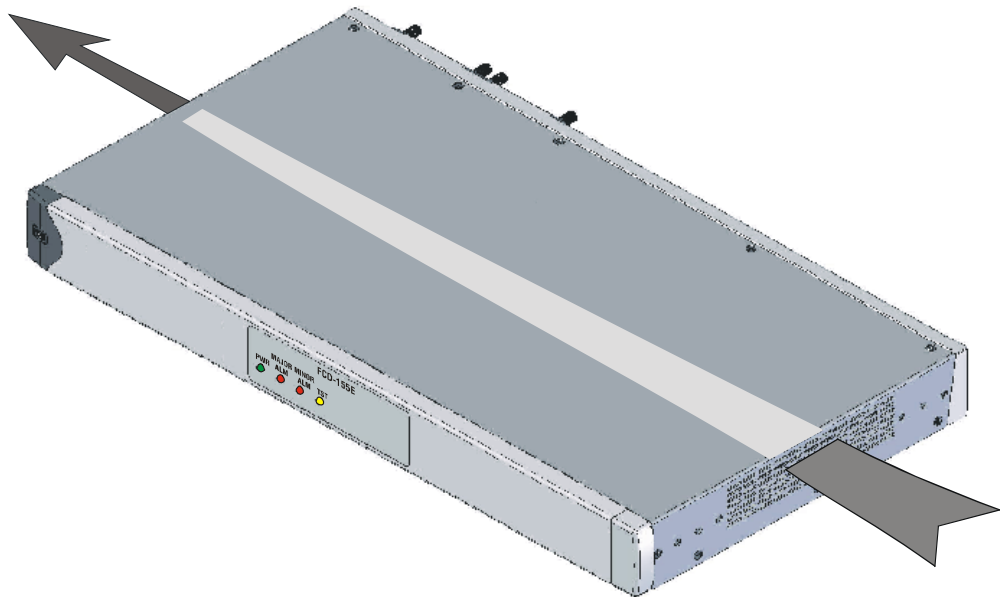
Figure 3-1. Cooling Air Flow through FCD-155E

- FCD-155 units are cooled by free air convection, and in addition have miniature internal cooling fan. The air intake vents are located on the side walls, and the discharge vent is located on the rear panel. Do not obstruct these vents.

When the FCD-155 is installed in a 19in. rack, allow at least 1U of space below and above the unit.

Electromagnetic Compatibility Considerations

The FCD-155 is designed to comply with the electromagnetic compatibility (EMC) requirements of Sub-Part J of FCC Rules, Part 15, for Class B electronic equipment, and additional applicable standards. To meet these standards, it is necessary to perform the following actions:

- Connect the FCD-155 to a low-resistance grounding system.

- For the FCD-155E, install blank panels to cover an empty PS slot. Appropriate blank panels can be ordered from RAD.

- Whenever feasible, use shielded cables. Always use shielded cables for Ethernet connections.

⚠
Warning

Covering empty slots is required for reasons of personal safety.

3.4   Package Contents

The FCD-155 package includes the following items:

- FCD-155 or FCD-155E unit

- Power cord for AC power supply option, or terminal block for DC power supply option

- Kit for rack installation (when ordered)

- Technical Documentation CD.

3.5   Equipment Needed

The cables you need to connect to the FCD-155 depend on the FCD-155 application. You can use standard cables or prepare the appropriate cables yourself in accordance with the information given in *Appendix A.*

Contact your nearest authorized RAD business partner if other interface cables are necessary.
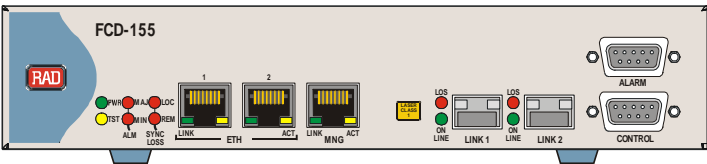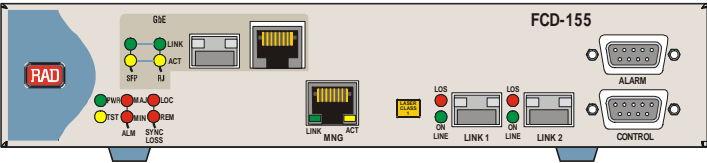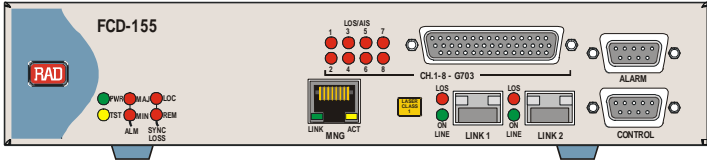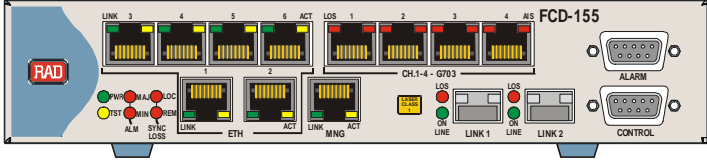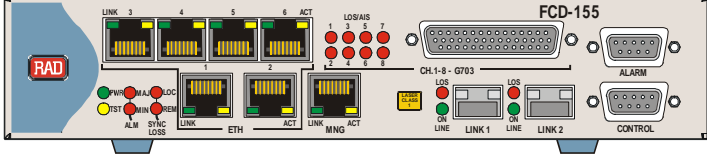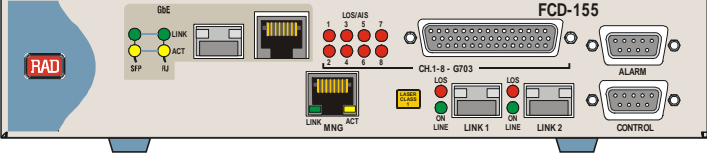
Section I FCD-155 Installation

3.6   FCD-155 Enclosures

This section presents a physical description of the various FCD-155 versions.

FCD-155 Front Panels

Figure 3-2 shows typical front panels for FCD-155. These panels illustrate typical configurations, and together cover all the port types.

A.	Basic version with 2 Ethernet LAN ports, no PDH ports

B.	Version with GbE port, no PDH ports

C.	Basic PDH transport version (8 E1/T1 PDH ports, no LAN ports)

D.	PDH and Ethernet version (4 E1/T1 PDH ports, 6 LAN ports)

E.	PDH and Ethernet version (8 E1/T1 PDH ports, 6 LAN ports)

F.	PDH and Ethernet version (8 E1/T1 PDH ports, GbE port)

G. PDH and Ethernet version (E3/T3 PDH ports, GbE port)
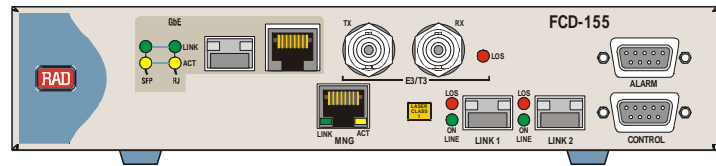
Figure 3-2. FCD-155, Typical Front Panels

FCD-155 Front Panel Components

The components located on the FCD-155 front panel are arranged in several functional groups:

1. System status indicators: the group of indicators located in the lower left-hand corner of the panel display the system status.

2. Middle area:

    ▪ The lower section includes the basic system interfaces: LAN ports 1, 2 and where applicable – the MNG (management) Ethernet interface, and the aggregate (network) interfaces:

        ▫ The LAN 1 and 2 ports area (at the left-hand side) includes two 10/100BASE-TX Ethernet interfaces terminated in the ETH 1 and ETH 2 connectors. Each connector has a pair of built-in indicators.

        ▫ The aggregate interfaces area (at the right-hand side) includes optical interfaces. The optical interfaces are located on SFPs inserted in the two sockets identified as LINK 1 and LINK 2. The maximum range depends on the characteristics of the SFP installed and the fiber type, and can reach many kilometers.

    ▪ The upper section is intended for the optional user interfaces (two positions, one at the left and the other at the right):

        ▫ The left-hand options area may include additional Ethernet ports. Two options are offered: four 10/100BASE-TX Ethernet ports, designated ETH 3 to ETH 6, each with its pair of built-in indicators, or one GbE interface, designated GbE 3.

        The GbE interface has an RJ-45 connector for the internal copper interface (10/100/1000BASE-T), and a position for installing an optical SFP plug-in module. The GbE area has two sets of indicators, one for the copper interface and the other for the optical interface.

        With an SFP module installed, the connection to the GbE port is made over optical fiber (the copper port is automatically disabled). The maximum range depends on the characteristics of the SFP installed and the fiber type, and can reach many kilometers.

        ▫ The right-hand options area may include additional PDH ports.

        One option is to install a 4 E1 or 4 T1 G.703 PDH interface. These options have four RJ-45 interface connectors, identified as CH 1 to CH 4 (G703 indicates that the PDH interfaces comply with ITU-T Rec. G.703). Each port connector has a pair of status built-in indicators.

Another option is to install a 8 E1 or 8 T1 G.703 PDH interface. These options have one 44-pin D-type female connector, identified as 8CH-G703, for all the 8 ports. Each port has a dual-color status indicator.

The third PDH option is an E3 or T3 PDH interface. These options have two mini-BNC connectors, identified as RX and TX, and a status indicator.

3. Auxiliary connectors area: includes the ALARM and CONTROL connectors.

Table 3-1 explains the functions of all the indicators located on the FCD-155 front panel.

Note   *Some of the indicators appearing in* Table 3-1 *support functions that are ordering options, therefore ignore those not included in your FCD-155 version.*

Table 3-1. FCD-155 Front Panel Components

Group	Item	Function
System Indicators	**PWR** Indicator (green)	Lights when the FCD-155 is powered and operating normally Flashes during the power-up self-test
	TST Indicator (yellow)	Lights when a test is activated on the FCD-155
	ALM MAJ Indicator (red)	Lights when major alarm condition is present
	ALM MIN Indicator (red)	Lights when minor alarm condition is present
	SYNC LOSS LOC Indicator (red)	Lights when the local FCD-155 loses frame synchronization to the incoming link signal
	SYNC LOSS REM Indicator (red)	Lights when the remote equipment sends a Far End Receive Fail indication (RDI)
MNG, ETH and GbE Port Indicators	**LINK** Indicator (green)	Lights when the link integrity signal is detected by the corresponding port (normal operating condition)
	ACT Indicator (yellow)	Flashes in accordance with the transmit and/or receive activity on the corresponding port
LINK Port Indicators	**LOS** Indicator (red)	Lights when no optical receive is detected by the corresponding link
	ON LINE Indicator (green)	Lights when the corresponding network port is active, that is, carries the traffic (when the FCD-155 network interface has two links, at any time only one of the two ports is active). For FCD-155 with two links, flashes for the redundant (standby) port
PDH 4 E1 or 4 T1 Port Indicators	**LOS** Indicator (red)	Lights when the receive signal of the corresponding PDH port is missing
	AIS Indicator (red)	Lights when the corresponding PDH port detects an alarm indication signal (AIS)
PDH 8 E1 or 8 T1 Port Indicators	**LOS/AIS** Indicator (red/yellow)	Lights in red in case of local loss of signal. Lights in yellow when the port receives an AIS signal

Group	Item	Function
PDH E3 or T3 Port Indicators	**LOS** Indicator (red)	Lights when the receive signal of the E3 or T3 port is missing

Note   *The indicator functions listed in Table 3-1 are the default functions. When the alarm masking functions are used (see Chapter 5 for details), the meaning of the various indications may change.*

FCD-155 Rear Panels

Figure 3-3 shows typical rear panels of FCD-155 units.

The rear panels include only the AC or DC power connector (in accordance with order), for connecting of the FCD-155 supply voltage and protective ground. The AC connector has a built-in fuse.

A. FCD-155 with AC Power Connector

B. FCD-155 with DC Power Connector
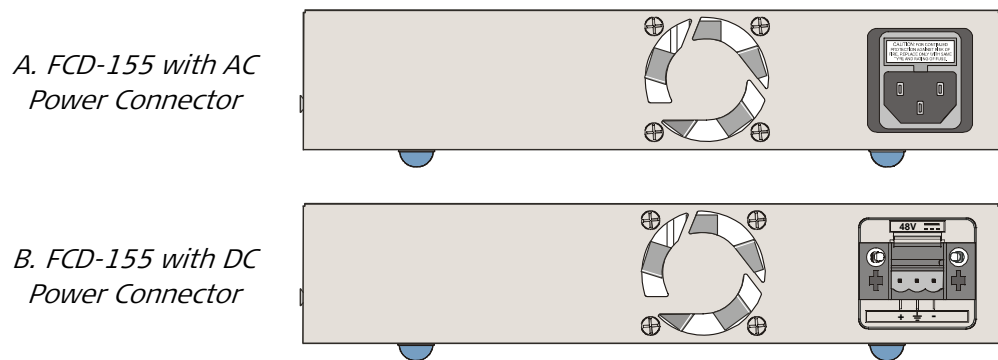
Figure 3-3. Typical FCD-155 Rear Panels

3.7   Installing FCD-155

Caution   Before installing an FCD-155 unit, review the safety precautions given in *Section 3.2.*

Installing the FCD-155 Unit

FCD-155 units are intended for installation on desktops, shelves, or 19 in. racks. Single units may also be installed on walls.

Appropriate rack and wall mount kits are available from RAD. Refer to the installation leaflet of the mount kit for detailed instructions.

Do not connect power to the enclosure before it is installed in the designated position.

Connecting the Cables

Before starting, refer to the site installation plan and identify the cables intended for connection to this FCD-155 unit. For general information regarding the required connections, refer to *Section 3.3.*

General Optical Cable Handling Instructions

When connecting optical cables, make sure to prevent cable twisting and avoid sharp bends (unless otherwise specified by the optical cable manufacturer, the minimum fiber bending radius is 35 mm). Always leave some slack, to prevent stress.

Caution

Make sure all the optical connectors are closed at all times by the appropriate protective caps, or by the mating cable connector.

Do not remove the protective cap until an optical fiber is connected to the corresponding connector, and immediately install a protective cap after a cable is disconnected.

Before installing optical cables, it is recommended to clean thoroughly their connectors using an approved cleaning kit.

Connecting FCD-155 to Ground and Power

Any interruption of the protective (grounding) conductor (inside or outside the device) or disconnecting the protective earth terminal can make the device dangerous. Intentional interruption is prohibited.

⚠️
Grounding

Before switching this FCD-155 unit on and before connecting any other cable, FCD-155 protective ground terminals must be connected to protective ground. This connection is made through the DC or AC power cable. The power cord plug should only be inserted in an outlet provided with a protective ground (earth) contact. The protective action must not be negated by using of an extension cord (power cable) without a protective conductor (grounding).

Ground may also be provided by installing the FCD-155 in a properly grounded rack, provided electrical continuity from its case to the rack structure is ensured.

⚠️
Warning

Dangerous voltages may be present on the cables connected to the FCD-155:

- **Never connect cables to an FCD-155 unit if it is not properly installed and grounded. This means that its power cable must be inserted in an outlet provided with a protective ground (earth) contact before connecting any user or network (network) cable to the FCD-155.**

- **Disconnect all the cables connected to the connectors of the FCD-155 before disconnecting the FCD-155 power cable.**

Caution   FCD-155 does not have a power on/off switch, and therefore it will start operating as soon as power is applied. It is recommended to use an external power on/off switch to control the connection of power to the FCD-155. For example, the circuit breaker used to protect the supply line to the FCD-155 may also serve as the on/off switch.

Power should be connected only after completing cable connections.

Power should be supplied to FCD-155 through a power cable terminated in an appropriate plug, in accordance with the required power source.

➤ **To connect FCD-155 power and ground:**

1. Check that the external circuit breaker controlling the power to the FCD-155 is set to OFF.

2. Connect one end of the power cable to the FCD-155 power connector.

3. When ready to apply power, insert the plug at other end of the power cable into a socket (outlet) with a protective ground contact. If power is connected, the PWR indicator of the FCD-155 must light.

Connecting FCD-155 Links to Network Ports

Each link interface has two connectors, marked TX and RX.

The network connections are made to the optical connectors in the LINK 1 and LINK 2 areas (LINK 2 is an ordering option, which may not be installed on your FCD-155). These ports are equipped with SFP plug-in transceivers. If necessary, install SFPs using the following procedure.

Warning   **Third-party SFP optical transceivers must be agency-approved, complying with the local laser safety regulations for Class A laser equipment.**

Caution   During the installation of an SFP, make sure that all optical connectors are closed by protective caps.

Do not remove the covers until an optical fiber is connected to the corresponding connector. Be aware that when installing on a working unit, the SFP transmitter may start transmitting as soon as it is inserted.

Note   *For FCD-155 units with a single network interface, always install the SFP in the LINK 1 position.*

➤ **To install the SFP:**

• Lock the latch wire of the SFP module by lifting it up until it clicks into place, as illustrated in *Figure 3-4*.

Note   *Some SFP models have a plastic door instead of a latch wire.*
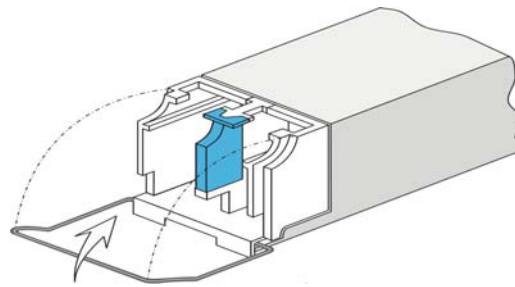
Figure 3-4. Locking the SFP Latch Wire

1. Carefully remove the dust covers from the corresponding FCD-155 socket, and from the SFP electrical connector.

2. Insert the rear end of SFP into the socket, and push slowly backwards to mate the connectors until the SFP clicks into place. If you feel resistance before the connectors are fully mated, retract the SFP using the latch wire as a pulling handle, and then repeat the procedure.

➤ **To connect optical cables to the FCD-155 network interface:**

1. For each optical interface (LINK 1 or LINK 2), refer to the site installation plan and identify the corresponding pair of cables intended for connection to the corresponding TX and RX connectors.

2. Connect the prescribed transmit fiber (connected to the receive input of the remote equipment) to the TX connector. Leave enough slack to prevent strain.

3. Connect the prescribed receive fiber (connected to the transmit output of the remote equipment) to the RX connector of the same interface. Leave enough slack to prevent strain.

Connecting FCD-155 to PDH Ports

The connection depend on the options installed on the FCD-155.

Cable Connections to 4 E1 or 4 T1 PDH Option

➤ **To connect cables to the 4 E1 or 4 T1 PDH ports:**

The connections to the E1 or T1 PDH ports are made to the RJ-45 connectors marked G.703 CH 1, 2, 3 and 4.

When connecting a PDH E1 port to equipment having an unbalanced interface, it is necessary to use an adapter cable terminated in two BNC connectors. RAD offers a suitable adapter cable, CBL-RJ45/2BNC/E1X, with one RJ-45 plug at one end and two BNC female connectors at the other end.

Make sure to connect the proper cable to each connector, in accordance with the site installation plan.

Cable Connections to 8 E1 or 8 T1 PDH Option

➤ **To connect the cable for the balanced E1 or T1 interface:**

1. Connect the 44-pin male connector of the CBL-G703-8/RJ45 cable to the FCD-155 front panel connector.

2. Connect the RJ-45 plug of each port (the plugs are marked CH-1 to CH-8) to the prescribed user's equipment or patch panel connector. Insulate unused connectors, to prevent accidental short-circuiting of their exposed contacts to metallic surfaces.

➤ **To connect the cable for the unbalanced interface:**

1. Connect the 44-pin male connector of the CBL-G703-8/COAX cable to the FCD-155 front panel connector.

2. Connect the BNC plugs of each port (the plugs are marked with the number of the port) to the prescribed user's equipment or patch panel connectors. Pay attention to correct connection:

   - TX connector is the transmit output of the port

   - RX connector is the receive input of the port.

➤ **To connect an "open" cable:**

When you are using the CBL-G703-8/OPEN/2M or CBL-G703-8/OPEN/8M cable, first connect its free ends in accordance with the prescribed termination method.

When done, connect the 44-pin male connector of the cable to the FCD-155 front panel connector.

Cable Connections to E3 or T3 PDH Option

➤ **To connect cables to the FCD-155 E3 or T3 PDH port:**

Connect cables to the E3/T3 mini-BNC connectors, paying attention to correct connection:

- Transmit cable – to the TX connector

- Receive cable – to the RX connector.

Make sure to connect the proper cable to each connector, in accordance with the site installation plan.

Connecting LAN Ports

Cable Connections to ETH Ports

➤ **To connect cables to the FCD-155 ETH ports 1 and 2:**

The connection to the FCD-155 LAN ports 1 and 2 is made to the RJ-45 connectors designated ETH LINK 1 and 2.

You can use any standard cable (straight or crossed) to connect to any type of Ethernet port (hub or station).

➤ **To connect cables to the FCD-155 transparent LAN ports 3 to 6:**

The connection to the FCD-155 LAN ports is made to the RJ-45 connectors designated ETH LINK 3 to 6. You can use any standard cable (straight or crossed) to connect to any type of Ethernet port (hub or station). However, if the FCD-155 MDI/MDIX automatic cross-over function is disabled, use the following cables.

- Use a standard (station) cable wired point-to-point for connection to an Ethernet station port

- Use a crossed cable for connection to another hub port.

Cable Connections to GbE Copper Port

The connection to the FCD-155 GbE ports is made to the RJ-45 connector designated GbE 3.

You can use any standard cable (straight or crossed) to connect to any type of Ethernet port (hub or station).

Cable Connections to GbE Optical Port

Caution   Do not install/remove the SFP while the FCD-155 unit is powered.

You can install an SFP plug-in module for the GbE interface by plugging it in the socket provided to the left of the GbE RJ-45 connector. Use the procedure given on page *3-16*. If necessary, refer to the SFP manufacturer's data sheet for details on installation and fiber connections. Pay attention to the general fiber handling precautions on page *3-15*.

Connecting Management

➤ **To connect to the FCD-155 supervisory port:**

The connections to the CONTROL connector are made as follows:

- Connection to a supervision terminal with 9-pin connector: by means of a straight cable (a cable wired point-to-point), e.g., CBL-DB9F-DB9M-STR.

- Connection to modem with 9-pin connector (for communication with remote supervision terminal): by means of a crossed cable.

Additional connection options are presented in *Appendix A*.

➤ **To connect to a management station, Telnet host or Web browser:**

The link to network management stations using SNMP, to Telnet hosts and/or Web browsers can be provided in two ways, provided the FCD-155 is appropriately configured:

- Through the dedicated Ethernet management connector, MNG, or through an ETH 1 or ETH 2 connector (depending on your FCD-155 version), provided IP connectivity to the management station or Telnet host is available through the LAN this port is connected to (for example, when the management station, Telnet host or Web browsers is attached to the same LAN, or connected to the same WAN).

- Inband, through the network, via a VCG. This connection automatically becomes available when the network cables are connected, provided IP connectivity to the management station, Telnet host or Web browser is available through a network port.

- Inband, through the network, via a DCC. This connection automatically becomes available when the network cables are connected, provided the IP connectivity to the management station, Telnet host or Web browser is available through the network port.

Connecting the FCD-155 ALARMS Connector

➤ **To connect to the FCD-155 ALARMS connector:**

The connection to the ALARMS connector is made by means of a cable provided by the customer, in accordance with the specific requirements of each site. Refer to *Appendix A* for connector pin functions.

Caution

To prevent damage to the internal alarm relay contacts, it is necessary to limit, by external means, the maximum current that may flow through the contacts (maximum allowed current through closed contacts is 1A). The maximum voltage across the open contacts must not exceed 60 VDC.

Section II FCD-155E Installation

3.8   FCD-155E Enclosures

This section presents a physical description of the various FCD-155E versions.

FCD-155E Front Panel

The front panel of the FCD-155E is shown in *Figure 3-5*. The functions of the front panel indicators are explained in *Table 3-2*.
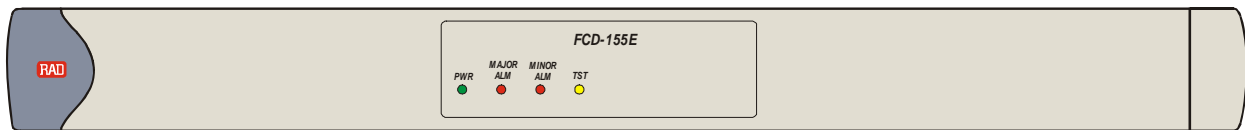
Figure 3-5. FCD-155E Front Panel

Table 3-2. FCD-155E Front Panel Indicators

Item	Function
PWR Indicator (green)	Lights when the FCD-155E is powered and operating normally.
	Flashes during the power-up self-test and software decompression
TST Indicator (yellow)	Lights when a test is activated on the FCD-155E
ALM MAJ Indicator (red)	Lights when a major alarm condition is present in the FCD-155E
ALM MIN Indicator (red)	Lights when a minor alarm condition is present in the FCD-155E

Note

The indicator functions listed in Table 3-2 are the default functions. When the alarm masking functions are used (see Chapter 5 for details), the meaning of the various indications may change.

The indicators listed above are duplicated on the rear panel.

FCD-155E Rear Panels

Figure 3-6 shows typical rear panels for FCD-155E. These panels illustrate typical configurations, and together cover all the port types.
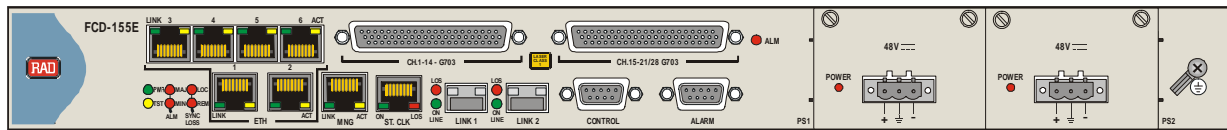
A. Version with 6 Ethernet LAN ports, 21 E1/28 T1 PDH ports, dual network interfaces
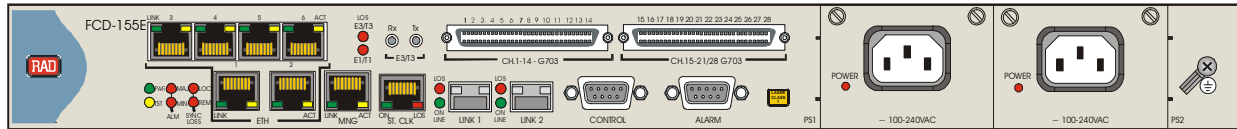
B. Version with 6 Ethernet LAN ports, 21 E1/28 T1, E3/T3 PDH ports, dual network interfaces
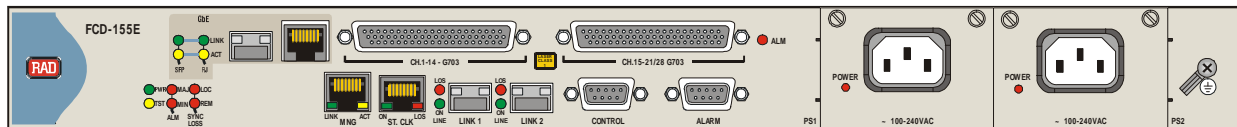
C. Version with GbE LAN port, 21 E1/28 T1 PDH ports, dual network interfaces
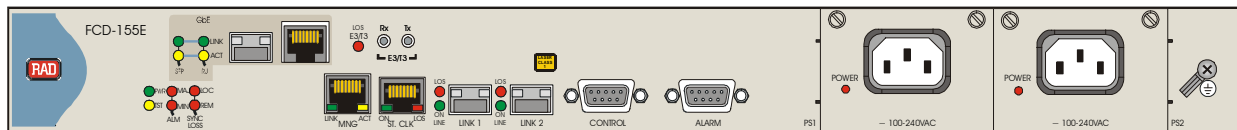
D. Version with GbE LAN port, E3/T3 PDH ports, dual network interfaces
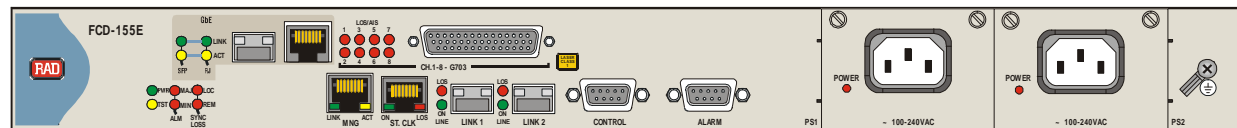
E. Version with GbE LAN port, 8 E1/T1 PDH ports, dual network interfaces

Figure 3-6. Typical FCD-155E Rear Panels

FCD-155E Rear Panel Components

The components located on the FCD-155E rear panel are arranged in several functional groups:

1. System status indicators: the group of indicators located in the lower left-hand corner of the panel display the system status. The four leftmost indicators duplicate the corresponding front panel indicators.

2. Middle area – lower section:

    ▪ LAN 1 and 2 ports area (at the left-hand side) includes two 10/100BASE-TX Ethernet interfaces terminated in the ETH 1 and ETH 2 connectors. Each connector has a pair of built-in indicators. These interfaces are ordering options.

    ▪ Management Ethernet port, has a 10/100BASE-TX Ethernet interface terminated in the MNG connector. The connector has a pair of built-in indicators.

▪ Station clock port (installed only on FCD-155E). This port has ITU-T Rec. G.703 interfaces terminated in an RJ-45 connector. The connector has a pair of built-in indicators.

▪ The aggregate interfaces area (at the right side) includes optical interfaces. The optical interfaces are located on SFPs inserted in the two sockets identified as LINK 1 and LINK 2. The maximum range depends on the characteristics of the SFP installed and the fiber type, and can reach many kilometers.

3. Middle area – upper section. The upper section is intended for additional optional user interfaces (two positions, one at the left and the other at the right):

▪ The left-hand options area may include additional Ethernet ports. Two options are offered: four 10/100BASE-TX Ethernet ports, designated ETH 3 to ETH 6, each with its pair of built-in indicators, or one GbE interface, designated GbE.

The GbE interface has an RJ-45 connector for the internal copper interface (10/100/1000BASE-T), and a position for installing an optical SFP plug-in module. The GbE area has two sets of indicators, one for the copper interface and the other for the optical interface.

With an SFP installed, the connection to the GbE port is made over optical fiber (the copper port is automatically disabled). The maximum range depends on the characteristics of the SFP installed and the fiber type, and can reach many kilometers.

▪ The right-hand options area may include additional PDH ports as follows:

▫ 8 E1 or 8 T1 G.703 PDH interface. These options have one 44-pin D-type female connector, identified as 8CH-G703, for all the 8 ports. Each port has a dual-color status indicator.

▫ 21 E1 or 28 T1 G.703 PDH interface. These options have two 44-pin D-type female connectors, identified as CH.1-14 G703 and CH.15-21/28 G.703, for the corresponding ports. A status indicator indicates whether a fault is present in one of these interfaces.

▫ E3 or T3 PDH interface. These options have two mini-BNC connectors, identified as RX and TX, and a status indicator.

▫ Hybrid E3 or T3 and 21 E1 or 28 T1 G.703 PDH interface. These options have two mini-BNC connectors for E3/T3, identified as RX and TX, and two 44-pin D-type female connectors for E1/T1, identified as CH.1-14 G703 and CH.15-21/28 G.703, for the corresponding ports. Status indicators indicate whether a fault is present in one of these interfaces.

4. Auxiliary connectors area: includes the ALARM and CONTROL connectors.

5. Power supply modules area: includes two PS modules. Each module has a POWER indicator.

6. Grounding terminal, located to the right of the power supply modules.

Table 3-3 explains the functions of all the indicators located on the FCD-155E rear panels.

Note   *Some of the indicators appearing in* Table 3-3 *support functions that are ordering options, therefore ignore those not included in your FCD-155E version.*

Note also that the alarm masking function may also effect the indications provided for masked alarms.

Table 3-3. FCD-155E Rear Panel Components

Indicators	Item	Function
System	PWR Indicator (green)	Lights when the FCD-155E is powered and operating normally Flashes during the power-up self-test
	TST Indicator (yellow)	Lights when a test is activated on the FCD-155E
	ALM MAJ Indicator (red)	Lights when a major alarm condition is present
	ALM MIN Indicator (red)	Lights when a minor alarm condition is present
	SYNC LOSS LOC Indicator (red)	Lights when the local FCD-155E loses frame synchronization to the incoming link signal
	SYNC LOSS REM Indicator (red)	Lights when the remote equipment sends a Far End Receive Fail indication (RDI)
MNG, ETH and GbE Port	LINK Indicator (green)	Lights when the link integrity signal is detected by the corresponding LAN port (normal operating condition)
	ACT Indicator (yellow)	Flashes in accordance with the transmit and/or receive activity on the corresponding LAN port
LINK Port	LOS Indicator (red)	Lights when no optical receive signal is detected by the corresponding link
	ON LINE Indicator (green)	Lights when the corresponding network port is active, that is, carries the traffic. For FCD-155E with two links using one of the protection options, flashes for the redundant (standby) port
PDH 4 E1 or 4 T1 Port	LOS Indicator (red)	Lights in case of local loss of signal (red alarm) at the corresponding port
	AIS Indicator (red)	Lights when the corresponding PDH port detects an alarm indication signal (AIS)
PDH 8 E1 or 8 T1 Port	LOS/AIS Indicator (red/yellow)	Lights in red in case of local loss of signal (red alarm) at the corresponding port. Lights in yellow when the port receives an AIS signal
PDH 21 E1 or 28 T1 Port	ALM Indicator (red)	Lights in case a problem (AIS or LOS (red alarm)) is detected in one or more interfaces of this group
PDH E3 or T3 Port	LOS Indicator (red)	Lights when the receive signal of the E3 or T3 port is missing
Hybrid Port E1/T1/E3/T3	LOS Indicator (red)	Lights when the receive signal of the E1/E3 or T1/T3 port is missing

Indicators	Item	Function
Station Clock Port	**ON** Indicator (green)	Lights steadily when the station clock port is configured as *connected*
	LOS Indicator (red)	Lights steadily to indicate a loss-of-signal condition at the station clock port, when configured as *connected*
PS Module	**POWER** Indicator (red)	Lights when the PS module is connected to power

3.9   Preparing FCD-155E for Installation

Internal Settings

Caution

Before performing the procedures described below, review the safety precautions given in *Section 3.2.*

If your FCD-155E does not include PS modules, or you want to replace a PS module, use the following procedures.

⚠

Warning High Voltage

Dangerous voltages are present inside the PS module when it is connected to power. Do not connect the PS module to power before it is properly installed within the FCD-155E enclosure. Always disconnect the input power from the PS module before removing it from the enclosure. A qualified person who is aware of the hazards involved shall prepare the module and do the installation.

➤ **To install a PS module:**

1. Insert the PS module in the appropriate PS slot, and fasten it with the two screws.

2. If an additional redundant module is used, install it in the second PS slot.

Note

You can install a redundant module in an operating enclosure without turning the FCD-155E power off. In this case:
*   *First insert the module in its slot*
*   *Connect its power cable*
*   *Apply power to the module.*

➤ **To remove a PS module:**

1. Disconnect the power to the PS module.

2. Disconnect power cable connected to the module.

3. Release the two module screws.

4. Pull the PS module out.

3.10   Installing FCD-155E

Caution   Before installing an FCD-155E unit, review the safety precautions given in *Section 3.2.*

Installing the FCD-155E Unit

FCD-155E units are intended for installation on desktops, shelves or in 19in. racks.

For rack installation, a rack mount kit is available from RAD. Refer to the installation leaflet of the rack mount kit for detailed instructions.

Do not connect power to the enclosure before it is installed in the designated position.

Connecting FCD-155E to Ground and Power

Any interruption of the protective (grounding) conductor (inside or outside the device) or disconnecting the protective earth terminal can make the device dangerous. Intentional interruption is prohibited.

⚠
Grounding

Before switching this FCD-155E unit on and before connecting any other cable, FCD-155E protective ground terminal must be connected to protective ground. This connection is made through the DC or AC power cable. The power cord plug should only be inserted in an outlet provided with a protective ground (earth) contact. The protective action must not be negated by using of an extension cord (power cable) without a protective conductor (grounding).

Ground may also be provided by installing the FCD-155E in a properly grounded rack, provided electrical continuity from its case to the rack structure is ensured.

⚠
Warning

Dangerous voltages may be present on the cables connected to the FCD-155E:

- **Never connect cables to an FCD-155E unit if it is not properly installed and grounded. This means that its power cable must be inserted in an outlet provided with a protective ground (earth) contact before connecting any user or network (network) cable to the FCD-155E.**

- **Disconnect all the cables connected to the connectors of the FCD-155E before disconnecting the FCD-155E power cable.**

Caution   FCD-155E does not have a power on/off switch, and therefore it will start operating as soon as power is applied. It is recommended to use an external power on/off switch to control the connection of power to the FCD-155E. For example, the circuit breaker used to protect the supply line to the FCD-155E may also serve as the on/off switch.

Power should be connected only after completing cable connections.

Power should be supplied to FCD-155E through a power cable terminated in an appropriate plug, in accordance with the required power source.

➤ **To connect FCD-155E power and ground:**

1. Connect a short, thick copper braid between the FCD-155E grounding screw and a nearby grounding point.

2. Check that the external circuit breaker controlling the power to the FCD-155E is set to OFF.

3. Connect one end of the power cable to the FCD-155E power connector.

4. When ready to apply power, insert the plug at other end of the power cable into a socket (outlet) with a protective ground contact. If power is connected, the POWER indicator on the FCD-155E front panel and on the PS module must light.

Connecting FCD-155E Links to Network Ports

Use the procedure described for FCD-155 units in the *Connecting FCD-155 Links to Network Ports* section (page *3-16*).

Connecting FCD-155E to Station Clock Port

The connections to the station clock port are made to the RJ-45 connector designated ST. CLK.

- To connect the ST. CLK port to equipment with balanced interface, use a standard RJ-45/RJ-45 cable

- To connect to equipment with an unbalanced interface, it is necessary to use an adapter cable terminated in two BNC connectors. RAD offers a suitable adapter cable, CBL-RJ45/2BNC/E1/X, with one RJ-45 plug at one end and two BNC female connectors at the other end. Pay attention to correct connection:

  ▪ The green BNC connector serves the station clock input, for locking the FCD-155E timing to an external source

  ▪ The red BNC connector serves as the station clock output, which provides the clock signal to other equipment.

Connecting FCD-155E to PDH Ports

The connections depend on the options installed on the FCD-155E.

Cable Connections to 8 E1 or 8 T1 PDH Option

Use the procedure described for FCD-155 units in the *Cable Connections to 8 E1 or 8 T1 PDH Option* (page *3-18*).

Direct Cable Connections to 21 E1 or 28 T1 PDH Option

➤ **To connect cables to the balanced E1 or T1 interface:**

1. Connect the 44-pin male connector of each CBL-G703-14/RJ45 cable to the appropriate FCD-155E front panel connector, CH.1-14 G.703 or CH.15-21/28.

2. Connect the RJ-45 plug of each port (the plugs are marked CH-1 to CH-8) to the prescribed user's equipment or patch panel connector. Insulate unused connectors, to prevent accidental short-circuiting of their exposed contacts to metallic surfaces.

➤ **To connect cables to the unbalanced interface:**

1. Connect the 44-pin male connector of each CBL-G703-14/COAX cable to the appropriate FCD-155E front panel connector, CH.1-14 G.703 or CH.15-21/28.

2. Connect the BNC plugs of each port (the plugs are marked with the number of the port) to the prescribed user's equipment or patch panel connectors. Pay attention to correct connection:

   ▪ TX connector is the transmit output of the port

   ▪ RX connector is the receive input of the port.

➤ **To connect an "open" cable:**

When you are using the CBL-G703-14/OPEN/2M or CBL-G703-14/OPEN/8M cables, first connect its free ends in accordance with the prescribed termination method.

When done, connect the 44-pin male connector of each cable to the appropriate FCD-155E front panel connector.

Using Patch Panel (OP-A/ADAPTOR/28RJ or OP-A/ADAPTOR/21BNC/1551) for Connecting to the 21E1 or 28T1 PDH Option

➤ **To install the patch panel:**

1. Before starting, determine the position of the patch panel in the equipment rack.

2. Attach the panel to the rack rails in the prescribed position using the appropriate screws.

3. Connect a wide copper strap between the patch panel grounding screw and the rack grounding port.

➤ **To connect cables to the patch panel:**

1. Before starting, refer to the site installation plan to determine the cables intended for connection to this FCD-155E.

2. Connect the adapter cables as follows:

   ▪ Connect the 62-pin connector of each CBL-G.703-14/PATCH cable to the FCD-155E CH.1-14 G.703 or CH.15-21/28 connectors, respectively.

   ▪ Route the cables through the cable guides provided in the rack, to the patch panel serving the FCD-155E.

   ▪ Connect the I/O 1 and I/O 2 connectors of the cable to the patch panel I/O 1 and I/O 2 connectors, respectively.

   ▪ Connect the grounding lugs of the I/O 1 and I/O 2 cable connectors to the corresponding patch panels grounding screws.

Cable Connections to E3 or T3 PDH Option

Use the procedure described for FCD-155 units in the *Cable Connections to E3 or T3 PDH Option* (page *3-18*).

Connecting LAN Ports

Use the procedure described for FCD-155 units in the *Connecting LAN Ports* (page *3-18*).

Connecting Management

Use the procedure described for FCD-155 units in the *Connecting Management* (page *3-19*).

Connecting FCD-155E to ALARMS Connector

Use the procedure described for FCD-155 units in the *Connecting the FCD-155 ALARMS Connector* (page *3-20*).

Chapter 4

Operation and Preliminary Configuration

This chapter provides general operating instructions and preliminary configuration instructions for FCD-155 and FCD-155E units.

The information presented in this chapter is organized as follows:

* Operating instructions: turn-on procedure, monitoring power-up sequence, normal indications, and turn-off: *Section 4.1*

* Configuration options for FCD-155: *Section 4.2*

* Preliminary configuration instructions: *Section 4.3*

* Configuring via supervision terminal: *Section 4.4* and *4.5*

* Configuring via Telnet: *Section 4.6*

* Configuring via Web browser: *Section 4.7*

* Configuring via SNMP: *Section 4.8*.

4.1 Operating FCD-155

Preparing for Monitoring the Power-Up Sequence

➤ **To prepare the FCD-155 for first-time turn-on:**

* Before first-time turn-on, check that the installation and the required cable connections have been correctly performed in accordance with *Chapter 3*.

   To enable monitoring the FCD-155 during preliminary configuration procedures, it is recommended to connect a terminal to the CONTROL connector of the FCD-155, using a straight (point-to-point) cable.

   Any standard ASCII terminal (dumb terminal or personal computer emulating an ASCII terminal) equipped with an RS-232 communication interface can be used to control the FCD-155 operation.

   Make sure to use VT-100 terminal emulation: using a different terminal type will cause display problems, for example, the cursor will not be located at the proper location, text may appear jumbled, etc.

   To monitor the FCD-155, configure the terminal for **115.2 kbps, one start bit, eight data bits, no parity,** and **one stop bit**. Select the **full-duplex** mode, **echo off**, and **disable any type of flow control**.

Turning FCD-155 On

➤   To turn the FCD-155 on:

Caution   FCD-155 does not have a power on/off switch, and therefore it will start operating as soon as power is applied.

1. Connect the FCD-155 to power (see detailed instructions in *Chapter 3*).

2. The FCD-155 PWR indicator turns on for a few seconds, and then starts flashing. The other indicators remain off while PWR flashes.

3. Wait for the completion of the power-up initialization. This takes about one minute.

4. After the power-up initialization ends, the PWR indicator must light steadily, and the other indicators display the FCD-155 status.

Normal Indications

Note   For a description of FCD-155 front panel indicator functions, refer to *Chapter 3*.

As long as the FCD-155 is powered, its PWR indicator lights steadily.

The TST indicator must be off, unless a test has been activated on the FCD-155.

The ALM MAJ and/or MIN must be off, however they may light as long as one or more of the FCD-155 ports is not connected to operational equipment.

Network Interface Status Indications

If the connection to the network has not yet been established:

*   The LOS indicators in the LINK area light

*   The SYNC LOSS LOC indicator in the system area lights.

If the equipment at the other end of the links is operational and the links are physically connected:

*   The LOS indicators in the LINK area must turn off, and at least one of the ON LINE indicators must light. The state of the other ON LINE indicator depends on the network link configuration:

    ▪   If only one link is used, the ON LINE indicator of the other link is OFF

    ▪   If a link protection mode is enabled, the ON LINE indicator of the standby link flashes

    ▪   If both links are active (FCD-155E only), both ON LINE indicators must light steadily

*   The SYNC LOSS LOC and REM indicators in the system area must be off.

Station Clock Interface Status Indications (FCD-155E only)

When the station clock is enabled, the green ON indicator of the ST. CLK connector must light.

If the equipment providing the station clock is operational and connected to the ST. CLK connector, the red LOS indicator must be off.

LAN Interface Status Indications

If an FCD-155 MNG, ETH, or GbE port is not yet connected to an active LAN, the corresponding LINK and ACT indicators are off.

After connecting an ETH or GbE port to an active LAN, the corresponding LINK indicator must be on. The ACT indicator of the port will flash, or appear to light steadily, in accordance with the traffic.

Note

For the GbE port, only one of the two interfaces is active at any time:

- *When the SFP module is not installed, only the RJ LINK and ACT indicators reflect the actual state of the GbE port. The SFP indicators are always off.*

- *When the SFP module is installed, it has priority: the FCD-155 will first attempt to use the optical interface. It will use the copper interface only if a valid signal is connected while no signal is detected by the optical interface.*

PDH Interface Status Indications

If an FCD-155 PDH port is not yet connected to operational equipment: the corresponding LOS indicator lights (for the 8 E1 or 8 T1 ports option, the LOS/AIS indicator lights in red).

If the equipment at the other end of the links is operational and the links are physically connected, the LOS and AIS indicators must turn off.

Note

For the 21 E1/28 T1 PDH option of the FCD-155E, a single ALM indicator is used: it should be OFF when all the ports are operational. If a problem (AIS or LOS (red alarm) is present at one or more ports, the red ALM indicator lights. Use the alarm log to find the port(s) causing the alarm.

Turning FCD-155 Off

➤ **To turn the FCD-155 off:**

Disconnect its power.

4.2   Configuration Options

The FCD-155 configuration activities can be performed by means of the following:

- Supervision terminal

- Telnet

- Web browser, using the ConfiguRAD utility

- SNMP-based network management system, e.g., the RADview network management system (refer to the *RADview User's Manual* for instructions).

The user can select whether to enable management by means of Telnet, Web browsers and/or network management systems: only the supervision terminal is always able to configure the FCD-155.

The capabilities of the four options listed above are similar, except that before using Telnet, Web browsers and/or network management systems, it is necessary to perform a preliminary configuration, using the supervision terminal.

The FCD-155 supports simultaneous management sessions: it is user's responsibility to prevent access conflicts and other errors that may occur when multiple users simultaneously access the same equipment.

4.3   Preliminary Configuration

This section covers the preliminary configuration activities needed to prepare a new FCD-155 for service.

Requirements

The preliminary activities are performed by means of an ASCII terminal (or a PC running a terminal emulation program) directly connected to the CONTROL port on the FCD-155 front panel.

Terminal Characteristics

Any standard ASCII terminal (dumb terminal or personal computer emulating an ASCII terminal) equipped with an RS-232 communication interface can be used to control the FCD-155 operation.

Software

The software necessary to run the FCD-155 supervision utility is contained in the FCD-155. Moreover, the FCD-155 stores all the configuration information generated or altered during the communication with the terminal: no information is stored in the terminal.

Note   *For proper display of screens on terminals, you must:*

1. *Select a fixed-pitch system font for the display. Use your operating system documentation to find how to select a proper font.*

2. *Configure the terminal utility to use VT-100 terminal emulation.*

Preparing for Preliminary Configuration

1. Connect a terminal to the CONTROL port on the FCD-155 front panel, as described in *Section 4.1 – Preparing for Monitoring the Power-Up Sequence*.

2. Turn the FCD-155 on as described in *Section 4.1 – Turning FCD-155 .*

Log-in for Supervision and Configuration

FCD-155 supports several access levels, which determine the functions the users can perform using supervisory terminals, Telnet hosts and Web browsers. The access level is determined by the user name, and the protection against unauthorized access is conferred by passwords.

The access levels supported by FCD-155 are described in *Table 4-1.* In addition to the menus listed in the table, each user can also change his/her own password, irrespective of the access level. However, only the administrator can specify and read the passwords assigned to each user.

Table 4-1. FCD-155 Access Levels

Access Level	User Name	Menus Accessible at this Level
Administrator	**su**	All the menus
Operator	**oper**	**Inventory, Monitoring, Diagnostics, File Utilities**
Technician	**tech**	**Inventory, Monitoring, Diagnostics**
Monitor	**user**	**Inventory, Monitoring**

The default passwords for all the levels are identical, **1234**. The passwords can be changed at the administrator level, using **Configuration>System>Control Ports> Terminal>Change Password**.

Notes
- *The user name and the password are not case-sensitive.*
- *If the administrator password has been changed and is not known, contact your nearest authorized RAD business partner for help. The usual procedure for recovering from such condition is to reload the software into the FCD-155 from the boot menu (Appendix B): this reloads the factory defaults, but the current configuration database will be lost.*

➤ **To log in:**

1. Wait for the initialization process to complete. *Figure 4-1* shows a typical sequence of messages displayed during power-up.

2. If the terminal is configured as explained in the *Preparing for Monitoring the Power-Up Sequence* section above, after the power-up initialization ends it

will display the cursor (a blinking underscore) at the home position of the
screen (top left-hand corner).

```
Loading ...
Decompressing to RAM.

Processing archive: FLASH
Extracting FCD155.BIN
...........................................................
.................................................................... CRC OK
Running ...
******************************************************************
* In order to start working - press the ENTER button for few times*
******************************************************************
```

Figure 4-1. Typical Sequence of Power-up Messages

3. Establish communication with the FCD-155 by pressing ‹**Enter**› once. You will
    see the log-in screen. A typical screen is shown below.

```
                        FCD-155E/2U/21E1/APS


  USER NAME:
  PASSWORD:


ESC - clear; & - exit                                                 0M/1C
-------------------------------------------------------------------------------
```

Note

*If the terminal is configured to different communication parameters (for example,
to another rate), you may see only random strings of characters, or there will be
no response after you press ‹Enter›.*

*Contact your nearest authorized RAD business partner for instructions on
reloading the default communication port parameters and terminal type using an
internal switch.*

4. If the FCD-155 default user name and password have not yet been changed,
    log in as follows:

    ▪ Type the default user name, for example **su**, and then press ‹**Enter**›.

    ▪ Type the default password, **1234**, and then press ‹**Enter**›.

5. If your password is accepted, you will see the FCD-155 main menu. A typical
    main menu screen for the administrator level is shown below. For other
    levels, see *Table 4-1*.

    If your log-in is not accepted, after pressing ‹**Enter**› the user name and
    password fields are cleared. In this case, try entering the user name and
    password again.

```
                         FCD-155E/2U/21E1/APS


Main Menu

 1. Inventory       []>
 2. Configuration  >
 3. Monitoring      >
 4. Diagnostics     >
 5. File Utilities >

>

Please select item <1 to 5>

ESC-prev.menu; !-main menu; &-exit; @-output                              1M/1C
-------------------------------------------------------------------------------
```

Figure 4-2. FCD-155 Main Menu (Administrator Level)

Preliminary Configuration Session

The purpose of the preliminary configuration session is to prepare the minimal set of parameters needed to manage the FCD-155.

In particular, by preliminary configuration you enable management access by Telnet hosts and management stations, for example, RADview. Management access is possible when the Telnet host or management station is attached to the same LAN the Ethernet management port(s) of the FCD-155 are attached; they can also be at a remote location, provided IP communication to the Ethernet management port(s) is possible.

After completing the preliminary configuration session, you may also use Web and MIB browsers to manage the FCD-155.

Note

To enable management access to the FCD-155 from any location, it is necessary to fully configure the FCD-155: only full configuration can permit management traffic to reach the FCD-155 via inband paths, and in particular - DCC.

The steps usually included in the preliminary configuration are described in *Table 4-2*. For detailed operating instructions, refer to the *Chapter 5* section describing each activity.

Note

Before starting the preliminary configuration, it is recommended to reload the factory defaults.

Table 4-2. General FCD-155 Preliminary Configuration Procedure

Step	Action	Using
1	Perform quick setup	**Configuration ›Quick Setup**
2	Configure the out-of-band management ports:	
	• Configure CONTROL port communication parameters and supervisory terminal options	**Configuration ›System ›Control Ports** *or* **Configuration ›System ›Control Ports ›Serial Port** **Configuration ›System ›Control Ports ›Terminal**
	• For FCD-155E: configure the Ethernet MNG port, when supported	**Configuration ›System ›Control Ports ›ETH**
3	Configure management authorizations for FCD-155 (optional)	**Configuration ›System ›Control Ports ›Terminal › Change Password**
4	Configure FCD-155 management agent (optional)	**Configuration ›System ›Management ›Host IP**
5	Configure FCD-155 management access (optional)	**Configuration ›System ›Management ›Management Access**
6	Configure specific management stations (optional)	**Configuration ›System ›Management ›Manager List**
7	Set FCD-155 real-time clock (optional)	**Configuration ›System ›Date & Time Update**
8	Define FCD-155 logistics information (optional)	**Configuration ›System ›Management ›Device Info**

➤ **Reload the factory-default parameters:**

1. Select item 5 – Factory-Default on the Configuration ›System menu.

2. You will see **Are you sure you want to initialize to default configuration?:**

   ▪ To abort, type **n**.

   ▪ To confirm, type **y.**

3. If you confirm, you must save the new configuration before it is actually activated:

   ▪ If you change your mind, undo by typing **%**.

   ▪ To activate the default configuration, type **#** (the **Save** command). In this case, you will see **Are you sure you want to update configuration?** and therefore you must confirm again:

      ▫ To abort, type **n**.

      ▫ To confirm, type **y.**

4. At this stage, the FCD-155 switches to the default parameters.

Note   *Usually, you must press <Enter> once to see again the main menu.*

However, if the FCD-155 did not use the default supervisory port communication parameters, then before you can establish again communication with the FCD-155 you must change the supervisory terminal communication parameters to the default values: 115.2 kbps, one start bit, eight data bits, no parity, one stop bit, and VT-100 terminal emulation.

Note   *The network interface standard, SDH or SONET, is selected by means of an internal jumper. Contact your nearest authorized RAD business partner for instructions on changing the network interface standard.*

➤ **Perform quick setup:**

1. Open Quick Setup on the Configuration›System menu.

2. Select the following parameters:

   ▪ Management host parameters (see description in **Host IP** configuration below)

   ▪ The number of external (traffic) LAN ports to be opened. For the GbE option, the GbE port is enabled by default.

   ▪ The number of PDH (E1 or T1) physical ports to be enabled; for E3/T3 ports, the corresponding port is enabled by default.

   ▪ The number of virtual ports (virtually concatenated groups – VCGs) to be enabled, and their structure (the number of VCs/VTs per VCG)

   ▪ The default encapsulation for virtually concatenated groups: **GFP** or **LAPS**

   ▪ For FCD-155E only – the **Path Protection** mode.

Note   *With the **Quick Setup** function you can define the number of active virtual ports only at the VC-11/VC-12 or VT-1.5 level.*
The configured ports are automatically mapped by FCD-155 in the first positions of the network port 1 (LINK 1).

*When **Path Protection** is set to **Manual**, protection ports for the configured ports must also be mapped, using the **Mapping** screen. In general, they would be mapped on network port 2, in the same positions as for network port 1, however you can also select different mappings.*

➤ **Configure the serial port parameters:**

1. Open **Control Ports** on the **Configuration›System** menu. For FCD-155E, select **Serial Port.**

```
                              FCD-155
Configuration>System>Control Ports


 1. Set Baud Rate  (bps) >    (115200Bps)
 2. Data Bits            >    (8)
 3. Parity               >    (None)
 4. Stop Bits            >    (1)
 5. CTS                  >    (equal RTS)
 6. DSR                  >    (On)
 7. Terminal             >




>


ESC-prev.menu; !-main menu; &-exit; @-output                            1M/1C
--------------------------------------------------------------------------------
```

*Figure 4-3. Typical **Control Ports** Screen (FCD-155)*

2. Select the desired value for **Speed** (recommended value: 115200).

3. Select the desired word format parameters: **Data Bits**, **Parity**, and **Stop Bit**. The recommended values are 8 data bits, no parity and 1 stop bit.

   The defaults for **CTS** and **DSR** are suitable for most applications.

➤ **Configure the FCD-155 management agent parameters:**

1. Open Host IP on the Configuration › System › Management menu.

```
                              FCD-155
Configuration>System>Management>Host IP

 1. DHCP Client          >    (No)
 2. IP address           ... (172.17.171.234)
 3. Subnet Mask          ... (255.255.255.0)
 4. Default Gateway      ... (172.17.171.1)
 5. Read Community       ... ()
 6. Write Community      ... ()
 7. Trap Community       ... ()
 8. Host Encapsulation >

>


Please select item <1 to 8>
# - Db Update; % - Db Undo; $ - Show sanity
ESC-prev.menu; !-main menu; &-exit; @-debug                             1M/1C
--------------------------------------------------------------------------------
```

*Figure 4-4. Typical **Host IP** Screen – Manual IP Address Configuration (DHCP Client Disabled)*

2. Enable DHCP, or select the prescribed IP communication parameters:

   ▪ **IP Address**. Enter the IP address of the FCD-155 management agent, using the dotted-quad format (four groups of digits in the range of 0 through 255, separated by periods).

- **IP Mask**. Enter the IP subnet mask of the FCD-155 management agent. Make sure to select a subnet mask compatible with the selected IP address, and whose binary representation consists of consecutive "ones", followed by the desired number of consecutive "zeroes".

- **Default Gateway**. Specify the IP address (usually an IP router port) to which the FCD-155 management agent will send packets when the destination IP address is not within the subnet specified in the **Mask** field. Type the desired IP address, using the dotted-quad format. Make sure the IP address is within the subnet of the host IP address. The default value, 0.0.0.0, means that no default gateway is defined.

3. Configure the SNMP access authorizations (communities):

Note   *The community names are case-sensitive.*

- **Read –** a station using this community cannot modify the FCD-155 configuration, nor initiate diagnostic activities

- **Write** – use this community for stations that must be able to perform all the activities

- **Trap –** enter the community to be specified by the FCD-155 management agent in the traps sent to SNMP-based management stations.

4. To use a management VLAN, select **Host Encapsulation,** enable **Host Tagging**, and configure the management VLAN ID and VLAN priority tag.

Note   *VLANs can be used only when the FCD-155 internal Ethernet switch is configured as **VLAN aware**. When a management VLAN ID is specified in the **Host VLAN ID** field, make sure to configure a forwarding rule for the VLAN ID using **Applications>Bridge>VLAN Membership**.*

➤ **To configure the Ethernet MNG port (FCD-155E only):**

1. Open **ETH** on the **Configuration>System>Control Ports** menu (*Figure 4-3*).

```
                           FCD-155E
Configuration>System>Control Ports>ETH


 1. IP address        ... (0.0.0.0)
 2. Subnet Mask       ... (0.0.0.0)
 3. Routing Protocol >   (Rip version2)
 4. Encapsulation     >

>


ESC-prev.menu; !-main menu; &-exit; @-debug                         1M/1C
-----------------------------------------------------------------------------
```

Figure 4-5. Typical FCD-155E Ethernet Management Port (MNG) Screen

2. Select parameters in accordance with the following guidelines:

- **IP Address**: used to enter a specific IP address for the MNG port. You always need a separate IP address when the RADview station connects through this FCD-155E to other managed units.

  Enter the IP address of the FCD-155E management agent, using the dotted-quad format (four groups of digits in the range of 0 through 255, separated by periods).

  If you do not enter a specific address, the FCD-155E host management IP address is used.

- **IP Mask**. used to enter the IP subnet mask for this port; needed only you selected a specific IP address for the MNG port.

  Make sure to select a subnet mask compatible with the selected IP address, and whose binary representation consists of consecutive "ones", followed by the desired number of consecutive "zeroes".

- **Routing Protocol:** used to select the routing protocol for management traffic carried through the MNG port:

  - **NONE** – Dynamic routing of management traffic is not supported. In this case, static routing is used, and you must specify the information needed for routing the management traffic.

  - **PROPRIETARY RIP** – The management traffic is routed using the RAD RIP proprietary routing protocol.

  - **RIP 2 –** The management traffic is routed using the RAD RIP proprietary routing protocol. In addition, RIP2 routing tables are also transmitted.

- **Host Tagging, Host VLAN ID,** and **Host VLAN Priority Tag** – see considerations and selection guidelines in the **Host IP** – **Host Encapsulation** section above.

Note

For the FCD-155, the MNG port is automatically configured with autonegotiation enabled (100 Mbps full duplex maximum advertised capacity) and with the same IP communication parameters as the FCD-155 management agent (host). Therefore, it is not necessary to configure physical port parameters.

➤ **Configure management access options:**

1. Open Management Access on the Configuration>System>Management menu.

2. Select **ON** or **OFF**, as prescribed, for **Telnet** and **Web** access. Make sure to select ON for **SNMP** access.

```
                              FCD-155
Configuration>System>Management>Management Access

  1.  SNMP                            >    (On)
  2.  Telnet                          >    (On)
  3.  WEB                             >    (On)


>


Management Access options


ESC-prev.menu; !-main menu; &-exit; @-output                          1M/1C
-----------------------------------------------------------------------------
```

*Figure 4-6. Typical **Management Access** Screen*

➤   **Configure specific management stations:**

     1.   Open Manager List on the Configuration ›System ›Management menu.

     2.   Move the selection block to the desired row, type **1 – Change Cell**, and then press ‹**Enter**›. Now you can enter the desired IP address, in the dotted-quad format. Press ‹**Enter**› to end.

     3.   Repeat the process until all the desired management stations have been defined.

```
                              FCD-155
Configuration>System>Management>Manager List


     Managers ID        IP Address
           1               0.0.0.0
           2               0.0.0.0
|          3               0.0.0.0
v          4               0.0.0.0
           5               0.0.0.0

  1. Change cell                      ... (0.0.0.0)


>


10 managers may be defined


ESC-prev.menu; !-main menu; &-exit; @-output; ?-help                  1M/1C
-----------------------------------------------------------------------------
```

*Figure 4-7. Typical **Manager List** Screen (First Page)*

     4.   Repeat the process until all the desired management stations have been defined.

➤ **Configure the logistics parameters:**

1. Open Device Info on the Configuration ›System ›Management menu.

```
                              FCD-155
Configuration>System>Management>Device Info


    Object Id                  ... (radFcd155E/APS)
    Hardware version           ... (1.0)
    Software version           ... (4.00e3)
    System Up Time             ... (0 day 01:16:51)
    sysDescr                   ... (                              ....)
 1. Contact Person             ... (FCD-155E/APS)
 2. Contact Person             ... (Name of contact person)
 3. Location                   ... (The location of this device)



>


Standard device information

ESC-prev.menu; !-main menu; &-exit; @-output                       1M/1C
--------------------------------------------------------------------------
```

*Figure 4-8. Typical **Device Info** Screen*

2. Enter the prescribed description for each item as explained below. You can enter up to 32 alphanumeric characters for each entry:

   ▪ **Sys Contact:** specify contact information for the person/organization in charge of this unit

   ▪ **Sys Name:** assign a logical name to this unit

   ▪ **Sys Location:** provide information on the location of this unit

   ▪ **Sys Description:** provide a supplementary description for this unit, for example, its function in the network.

➤ **Set the FCD-155 real-time clock:**

1. Open Date & Time Update on the Configuration ›System menu.

2. Open **Set Date Format** screen, and select the desired date format.

Note   *dd stands for day, **mm** for month and **yyyy** for year.*

3. When done, type **#** to save and then confirm the action.

4. Now set each component of the time of day and date. To change, select the desired item and then type the desired value. Confirm each change by pressing ‹**Enter**›.

Notes   ● *Time must be entered in the 24-hour format.*

   ● *It is recommended to set the time about one minute beyond the desired time, and then press ‹**Enter**› at the correct instant.*

5. When done, type **#** to save and then confirm the action.

➤ **Save the changes to the database:**

- Type **# (**the **Save** command) to save and activate the new configuration.

4.4   Configuring FCD-155 via Supervision Terminal

Organization of Terminal Screens

The FCD-155 is managed via a simple, menu-driven utility that uses a basic terminal user interface. A typical screen is shown in *Figure 4-9*.

```
                        FCD-155E/2U/21E1/APS


Configuration>Quick Setup

 1. Set Host IP address         ... (172.62.58.29)
 2. Set Subnet Mask             ... (255.255.255.0)
 3. Set Default Gateway         ... (172.62.58.1)
 4. Number of External LAN Ports [1 - 6]... (6)
 5. Number of External PDH Ports [1 - 4]... (4)
 6. Number Of Virtual Groups    [1 - 8]... (8)
 7. Number Of VC12's per Group  [0 - 63]... (7)
 8. Encapsulation               >   (GFP)
 9. Path Protection             >   (Auto)

>


# - Save; % - Undo
ESC-prev.menu; !-main menu; &-exit; @-output                        1M/1C
------------------------------------------------------------------------
ALM  86:        RESET OCCURRED       EVENT      ON   01-01-2003 02:26:32
ALM  14:LINK1   SIGNAL LOSS          ALARM      ON   01-01-2003 02:26:33
```

Figure 4-9. Typical FCD-155 Supervision Utility Screen (FCD-155E SDH Version)

Each screen includes the following main (refer to *Figure 4-9* for typical appearance):

- **Header:** identifies the device being configured for example, FCD-155E, and the user interfaces installed on the unit. The user interfaces are identified by two sets of indicators that follow the unit identification:

  ▪ The first indicator specifies the packet interface option:

    ▫ **2U** – 2 10/100BASE-TX ports (2 Ethernet LAN ports with Ethernet switch)

    ▫ **6U** – 6 10/100BASE-TX ports (2 Ethernet LAN ports with Ethernet switch and 4-port transparent Ethernet board option)

    ▫ **6USW** – 6 10/100BASE-TX ports (2 Ethernet LAN ports with Ethernet switch and 4-port Ethernet switch option)

    ▫ **GE** – 10/100/1000BASE-T port (GbE LAN board option, includes an Ethernet switch).

> If the packet interface indicator is missing, the unit has only one management Ethernet port.

- ▪ The second and third indicator specifies the TDM interface option:

  - ▫ **4E1** – 4 E1 G.703 ports option (FCD-155 only)

  - ▫ **4T1** – 4 T1 G.703 ports option (FCD-155 only)

  - ▫ **8E1** – 8 E1 G.703 ports option

  - ▫ **8T1** – 8 T1 G.703 ports option

  - ▫ **21E1** – 8 E1 G.703 ports option (FCD-155E only)

  - ▫ **28T1** – 8 T1 G.703 ports option (FCD-155E only)

  - ▫ **E3** – E3 G.703 port option

  - ▫ **T3** – T3 G.703 port option

  For example, **FCD-155/6U/4E1** means that the FCD-155 unit is equipped with a total of 6 Ethernet LAN ports (that is, it includes 2 Ethernet ports with Ethernet switch, and a 4-port transparent Ethernet board), and 4 E1 G.703 PDH ports, whereas **FCD-155E/GbE/21E1** means that the FCD-155E unit is equipped a single GbE LAN port, 8 E1 G.703 PDH ports.

- • The fourth indicator specifies the **APS** option (FCD-155E only).

- • **Status indicator:** the status indicator appears in the top right-hand corner.

  - ▪ **TEST** – displayed when a test is activated on the local FCD-155

  - ▪ **ALRM** – indicates that alarm conditions are present

  - ▪ **ERROR** – displayed after the user action is rejected, for example, because of an invalid selection or out-of-range value. The indicator disappears after a valid action is performed.

- • **Work area:** includes a description of the screen, followed by the items available for the current screen. Each selectable item has its own number.

  The screen description identifies the screen (in this example: `Quick Setup`), and also displays navigation data, that is, the path through the FCD-155 menu structure that has been traversed to reach this screen (`Configuration>Quick Setup`). If the full path string is too long, its beginning is truncated, in which case an ellipsis **...** appears.

  In addition, the work area includes the terminal prompt, **>**. The item number you type appears to the right of the prompt.

  The lower part of the work area is also used to display a concise explanation of the available options and prompts regarding the actions available to you. It may also display messages that request you to confirm operations such as configuration changes, resetting, etc. or alerts that errors have been detected during the evaluation of the parameters selected by you.

- • **Save/Undo:** after you make a configuration change, you must either save (activate) it or undo (cancel). Changes are indicated by the appearance of # **Save** and **% Undo** just above the bottom line:

  - ▪ To save all the pending changes, type **#**. You will be requested to confirm.

  - ▪ To undo (cancel) all the as-yet unsaved changes, type **%**.

In either case, the # **Save** and **% Undo** indicators disappear.

- **Bottom line:** displays the keys used for navigation, and additional keys that perform specific actions on the current screen.

  - **ESC** returns to the previous screen (not relevant for main menu)

  - **!**   returns directly to the main menu (not relevant for main menu)

  - **&**   ends the utility and displays the log-in screen again.

  - **@**   increases the area dedicated to the display of alarms.

  - **?**   displays additional help specific to the current screen.

  - **a**   add a new entry (relevant to screens that use the tabular format).

  - **d**   delete a selected table entry.

  - **b**   back to the previous port (when configuring a multiple-port option).

  - **f** forward to the next port (when configuring a multiple-port option).

  The bottom line also displays management status information:

  - For the FCD-155E, the number of management connections (C) and the number managers (M) currently connected to the FCD-155 is shown at the lower right-hand corner (*Figure 4-9,* this is 1 manager via one management connection). The managers' number indicates the total number of management sessions active at the instant the screen was displayed, irrespective of type (terminal, Telnet, SNMP or Web browser).

  - For the FCD-155, the number of users currently connected to the FCD-155 is shown at the right-hand corner (for example, `1 user(s)`). This number indicates the total number of active management sessions active at the instant the screen was displayed, irrespective of type (terminal, Telnet, SNMP or Web browser).

- The last two rows display the last two alarms. The alarms appear only when **Pop Alarm** is enabled using the **Configuration›System›Control Ports› Terminal›Security Timeout**.

Note

*If **Pop Alarm** is enabled, it is normal to see at least the **RESET OCCURRED** event after power up.*

If the FCD-155 is not yet connected to operating equipment, you will also see alarms reporting loss of the STM-1/OC-3 link signal, LAN not connected, etc.

General Terminal Operating Procedures

➤ **How to use the terminal to perform a desired activity:**

- To select a menu item, type the corresponding line number and then press **‹Enter›**. This will either …

  - … display a submenu or a parameter selection screen …

    or …

  - … let you type the (free text) parameter value in the same row

    or …

▪ ... toggle the current value of the corresponding parameter (relevant to **ENABLE/DISABLE** or **ON/OFF** selections).

• The type of response to be expected after selecting a menu item is indicated as follows:

> **›**   Selecting that item will display a submenu or a parameter selection screen (see for example item **6** in *Figure 4-9*).

> **...**   Selecting that item will let you type the desired value in the same line (see for example item **1** in *Figure 4-9*).

> **Nothing**   When neither symbol is displayed, selecting that item will toggle the current selection, now shown in brackets (for example, this will change **ENABLE** to **DISABLE** or vice versa).

• When a menu does not fit on one screen (because it includes many lines), it is displayed on consecutive pages. In this case, you will see **...(N)** after the last line on the first page and **...(P)** after the last line on the next page:

▪ While on the first page, press **N** to display the next page

▪ While on the second page, press **P** to return to the previous page.

• When a configuration screen is organized as a table, a special set of keys is used for navigation within the table (such screens always have a **?** (help) option that displays these keys). The following keys are used for navigation within tables:

• **^L** – scroll to the left   • **^R** – scroll to the left

• **^D** – scroll down   • **^U** – scroll up

• **Left Arrow** (←) – move to the left   • **Right Arrow** (→) – move to the right

• **Down Arrow** (↓) –move down   • **Up Arrow** (↑) – move up

In addition, the following shortcuts are also available:

▪ **Tab** – select the next cell that may be changed

▪ **M** – switch to the menu mode

▪ **G** followed by **‹row number›,‹col number›** – select a specific cell. For example, type **G2,5** to select the fifth cell in the second row.

• The current value of a parameter is listed within parentheses **( )**. To change a parameter value on a parameter selection screen:

▪ Type the line number corresponding to the desired value, and then press **‹Enter›**

▪ To enter a value which requires free text entry, type in the desired string and then press **‹Enter›**. Use backspace to erase the current string.

Note that whenever applicable, the allowed range of values of a parameter is listed within square brackets **[ ]**.

• The entry is checked after pressing **‹Enter›**, and is accepted only if it is valid:

- ▪ If you make an error, for example, if you press a key not active on the current screen or select an invalid parameter value, an ERROR indicator appears in the right-hand corner. This indicator disappears as soon as you make a correct operation.

- ▪ If you select a parameter value incompatible with the current operating state or other parameters, you will see a message that explains the error.

  For screens that may report multiple errors, you will see instead a message that offers to display the list of errors detected: if you accept, you will see a screen similar to that displayed when **Monitoring>System>Display Sanity** is selected. See *Chapter 7* for a description of the errors and alarms.

  After reporting the error, the FCD-155 is ready to accept your next entry.

- • When done with the current screen, press ESC to return to the previous screen, or type ! to return directly to the main menu.

On-Line versus Off-Line Configuration

FCD-155 operation is controlled by the parameters contained in its database. The database is stored in flash memory, and therefore the latest configuration parameters are always available upon power-up.

Any changes to the FCD-155 configuration are made to a backup copy of the configuration database, stored separately: therefore, you can make configuration changes and cancel them as required without affecting the traffic flow through the FCD-155. Any changes take effect (are activated) only when they are saved: in this case, the contents of the backup database are copied to the on-line database. The FCD-155 then starts using the new parameters.

For your convenience, FCD-155 offers two configuration display modes (selected by **Configuration>System>Select Configuration**):

- • **On Line:** in this mode, the various configuration screens display the parameter values contained in the on-line database.

  The result is that you can see configuration changes made on the current screen, but cannot see new parameter values selected on previous screens during the current configuration session until the new values are saved (activated), because only then are the new parameter values transferred to the on-line database.

- • **Off Line**: normal configuration display mode. In this mode, the parameter values displayed on the various configuration screens reflect the last selected values, even if they have not yet been saved. When the new parameter values are ready for activation, save them to the on-line database.

During configuration sessions, it is recommended to use the **Off Line** mode, which enables you to see parameter values that have been changed but not yet saved. Whenever you want to see the current (on-line) parameter values, switch to the **On Line** mode, and then return to the **Off Line** mode to continue the configuration activities.

Saving Changes to Configuration Database

As explained above, the # **Save** and **% Undo** indicators appear when changes have been made but not yet activated.

- To save all the pending changes, type **#**. You will be requested to confirm.

Note

After saving, press ‹Enter› once to establish communication with the FCD-155.

- To undo (cancel) all the as-yet unsaved changes, type **%**.

Any unsaved changes are lost when the FCD-155 is powered down.

Ending a Terminal Configuration Session

➤ **To end the current terminal session:**

Type **&** and then press **‹Enter›**.

In addition, FCD-155 will automatically terminate the current session after no activity is detected for a user-selected time-out interval (default – 3 minutes, can be increased to 10 minutes). The automatic session termination can however be disabled. The time-out option is selected using **Configuration › System › Control Ports › Terminal › Security Timeout**.

Note

For Telnet, Web, and SNMP sessions, the automatic session termination cannot be disabled: it is always 3 minutes.

After a session is ended, it is necessary to enter again a valid user name and password to start a new session.

4.5   Menu Structure of Supervision Utility

Main Menu Structure

Figure 4-10 shows the structure of the main menu.
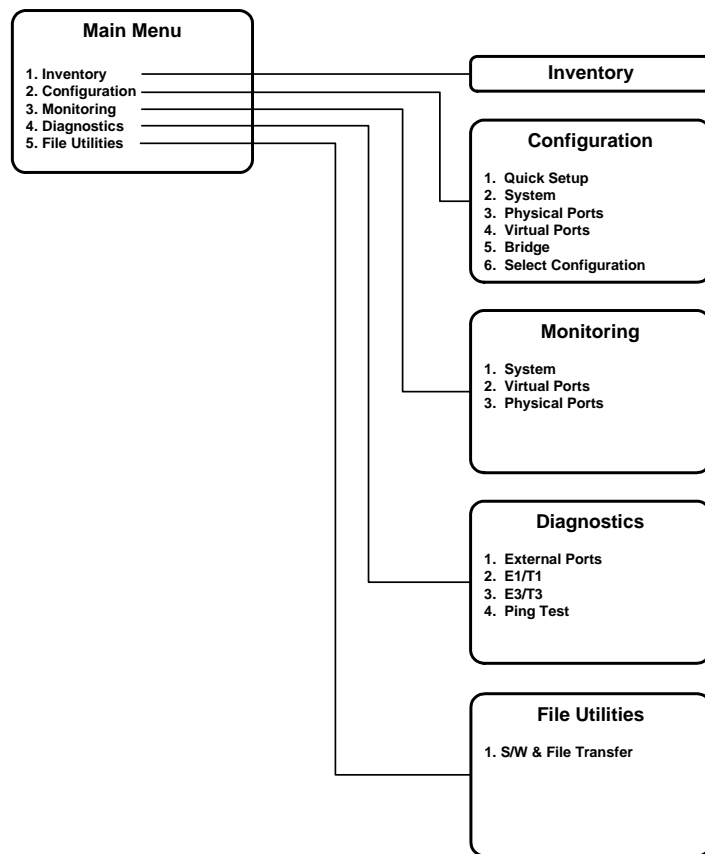
Figure 4-10. Main Menu Structure

The functions of the various main menu items are as follows:

Inventory   Displays logistic information on the FCD-155 software and hardware versions, and its subsystems. See *Chapter 5* for details.

Configuration   Configure all the FCD-155 operational parameters. Includes submenus for configuring the general system parameters, and the parameters of the physical ports, virtual ports and Ethernet switch. See *Chapter 5* for details.

Monitoring   Display system information (alarms, events, configuration errors, and the remote agents learned by the FCD-155), and the performance monitoring statistics collected for the physical and virtual ports. See *Chapter 7* for details.

Diagnostics   Used to initiate test loopbacks on the various external ports, and check IP connectivity. See *Chapter 7* for details.

File Utilities   Control the use of TFTP to download software, and upload/download configuration files. See *Chapter 5* for details.

Navigation Maps for Supervision Utility

Figure 4-11 to *Figure 4-14* show typical menu trees for typical FCD-155E and FCD-155 units operating in the SDH and SONET modes, respectively. You may use these figures as navigation maps to find the screen used for any desired activity.

The actual menus available on any specific unit depend on its type (FCD-155E or FCD-155), and the set of interfaces and options installed on that unit. Therefore, additional navigation maps are presented in the Chapter covering each menu (see list on previous page); in these Chapters you will also find detailed views and a description of the functions and parameters available on each menu and screen.

Figure 4-11. Typical FCD-155E Menu Tree (SDH Mode)

Figure 4-12. Typical FCD-155E Menu Tree (SONET)

Main Menu

- **Inventory**
- **Configuration**
- **Monitoring**
- **Diagnostics**
- **File Utilities**

Diagnostics
- **External Ports**
  - **No Test**
  - **Local Loopback**
  - **Remote Loopback**
- **PDH Ports**
- **Ping Test**

File Utilities
- **S/W & File Transfer**

(4E1, 4T1 only)
- **Port 1 - 4** or
  - **Test Type**
    - **Test**
    - **Timeout**

(8E1, 8T1)
- **Port 1 - 8** or
  - **Test Type**
    - **Test**
    - **Timeout**
  - **BERT Results**

(E3, T3 only)
- **Port 1**
  - **Test Type**
    - **Test**
    - **Timeout**
    - **Bert Pattern**
    - **Inject Error Rate**
  - **BERT Results**

Configuration
- **Quick Setup**

Monitoring
- **System**
  - **Active Alarms**
  - **Event Log**
  - **Clear Event Log**
  - **Display Sanity**
  - **Remote Agents**

Physical Ports
- **STM-1 Port**
  - **Port Status**
  - **Port Statistics**
    - **Current Interval**
    - **Select Interval**
    - **Total**
- **LAN**
  - **Port 1 - 2**
  - **GbE (Transparent only)**
  - **Port 1 - 6**
    - **Port Status**
    - **LAN Counters**
- **PDH**
  - **Port 1** ... to maximum supported
- **DCC Statistics**

Virtual Ports
- **VC-4**
- **VC-3**
- **VC-12**
  - **Port Status**
  - **Port Statistics**
    - **Current Interval**
    - **Select Interval**
    - **Total**
- **VCAT**
  - **VCG 1 - 8**
    - **LAN Counters**
    - **WAN Intervals**
    - **LCAS Path Info**

System
- **Mapping**
- **Management**
  - **Device Info**
  - **Host IP**
  - **Manager List**
  - **Management Access**
- **Inband Management (DCC)**
  - **Encapsulation**
  - **Routing Protocol**
  - **Management DCC**
  - **Gateway Ring Subnet Address**
  - **Gateway Ring Subnet Mask**
  - **Proprietary**
- **Control Ports**
  - **Set Baud Rate (bps)**
  - **Data Bits**
  - **Parity**
  - **Stop Bits**
  - **CTS**
  - **DSR**
  - **Terminal**
- **Date & Time Update**
  - **Set Time**
  - **Set Date**
  - **Set Date Format**
- **Factory Default**
- **Reset Device**

Physical Ports
- **STM-1**
  - **AIS on Fail**
  - **RDI on Fail**
  - **SD Threshold**
  - **EED Threshold**
  - **Protection Mode**
  - **Wait to Restore**
  - **Master Timing Source**
  - **Master Rx Clock**
  - **Fallback Timing Source**
  - **Fallback Rx Clock**
  - **Port Name**
- **LAN**
  - **Port 1 - 2**
  - **GbE**
    or
  - **Port 1 - 6** (Transparent only)
- **PDH**
  - **Port 1** ... to maximum supported
  - **All Ports**

Virtual Ports
- **STM-1**
  - **SDH Configuration**
    - **VC-4**
- **VCAT**
  - **VCG 1 - 8**
  - **All VCGs**
  - **GFP Mux**

Applications
- **Bridge**

VLAN Mode - Unaware	VLAN Mode - Aware
Aging Time (Seconds)	Aging Time (Seconds)
Scheduling Mode	Scheduling Mode
Bridge Port	Bridge Port
Port Membership	VLAN Membership
MAC Table	MAC Table
Spanning Tree Protocol	Spanning Tree Protocol

- **QoS**
- **Link Aggregation**

Select Configuration

Figure 4-13. Typical FCD-155 Menu Tree (SDH Mode)

Main Menu

- Inventory
- Configuration
- Monitoring
- Diagnostics
- File Utilities

Diagnostics
- External Ports
  - No Test
  - Local Loopback
  - Remote Loopback
- PDH Ports
- Ping Test

File Utilities
- S/W & File Transfer

Configuration
- Quick Setup

Monitoring
- System
  - Active Alarms
  - Event Log
  - Clear Event Log
  - Display Sanity
  - Remote Agents

(4T1 only) Port 1 - 4 or (8T1) Port 1 - 8 or (T3 only) Port 1

Test Type
- Test
- Timeout

Test Type
- Test
- Timeout
- BERT Results

Test Type
- Test
- Timeout
- Bert Pattern
- Inject Error Rate
- BERT Results

Physical Ports
- OC-3 Port
  - Port Status
    - Current Interval
    - Select Interval
    - Total
  - Port Statistics
- LAN
  - Port 1 - 2
  - GbE
  - Port 1 - 6 (Transparent only)
    - Port Status
    - LAN Counters
- PDH
  - Port 1 ... to maximum supported
- DCC Statistics

Virtual Ports
- STS3-1 to STS3-3
- VT-1.5
  - Port Status
    - Current Interval
    - Select Interval
    - Total
  - Port Statistics
- VCAT
  - VCG 1 - 8
    - LAN Counters
    - WAN Intervals
    - LCAS Path Info

System
- Mapping
- Management
  - Device Info
  - Host IP
  - Manager List
  - Management Access
- Inband Management (DCC)
  - Encapsulation
  - Routing Protocol
  - Management DCC
  - Gateway Ring Subnet Address
  - Gateway Ring Subnet Mask
  - Proprietary
- Control Ports
  - Set Baud Rate (bps)
  - Data Bits
  - Parity
  - Stop Bits
  - CTS
  - DSR
  - Terminal
- Date & Time Update
  - Set Time
  - Set Date
  - Set Date Format
- Factory Default
- Reset Device

Physical Ports
- OC-3
  - AIS on Fail
  - RDI on Fail
  - SD Threshold
  - EED Threshold
  - Protection Mode
  - Wait to Restore
  - Master Timing Source
  - Master Rx Clock
  - Fallback Timing Source
  - Fallback Rx Clock
  - Port Name
- LAN
  - Port 1 - 2
  - GbE
  - or
  - Port 1 - 6 (Transparent only)
- PDH
  - Port 1 ... to maximum supported
  - All Ports

Virtual Ports
- STS-3
  - SONET Configuration
    - STS3-1 to STS3-3
    - Common Parameters
  - VCAT
    - VCG 1 - 8
    - All VCGs
    - GFP Mux

Applications
- Bridge
  - VLAN Mode - Unaware
    - Aging Time (Seconds)
    - Scheduling Mode
    - Bridge Port
    - Port Membership
    - MAC Table
    - Spanning Tree Protocol
  - VLAN Mode - Aware
    - Aging Time (Seconds)
    - Scheduling Mode
    - Bridge Port
    - VLAN Membership
    - MAC Table
    - Spanning Tree Protocol
- QoS
- Link Aggregation

Select Configuration

Figure 4-14. Typical FCD-155 Menu Tree (SONET)

4.6   Configuring FCD-155 via Telnet

Telnet (IP) Host Characteristics

Typically, the Telnet host is a PC or a UNIX station with the appropriate suite of TCP/IP protocols. To enable a Telnet host to communicate with the FCD-155, it is necessary to configure the IP address of the FCD-155 management subsystem. After this preliminary configuration, you can use a Telnet host directly connected to the MNG port, or to a basic LAN port (ETH port 1 or ETH 2) of the managed FCD-155 to perform additional configuration tasks.

However, after configuring the communication parameters of the FCD-155 management subsystem, you may also use a Telnet host located at a remote site, the only requirement being that IP communication be established between the LAN at the remote that site and the LAN connected to the FCD-155 MNG port, or to ETH port 1 or 2.

General Telnet Operating Procedures

Telnet uses the terminal utility screens for configuration. See *General Terminal Operating Procedures* on page *4-17*.

The only difference is that Telnet management access is possible only after performing a preliminary configuration of the FCD-155 (see *Table 4-2*).

➤ **To prepare for using Telnet:**

1.   Configure the FCD-155 host IP address.

Note

When the Telnet host is not on a LAN connected to FCD-155 port ETH 1 or 2, it is necessary to configure all the IP communication parameters appearing on the **Configuration ›System ›Management ›Host IP** *screen.*

2.   Enable Telnet access using **Configuration ›System ›Management › Management Access**.

4.7   Configuring FCD-155 via Web Browsers

Web Browser Requirements

You may use any Web browser, for example, the Internet Explorer offered with the Microsoft, Inc. Windows™ operating system or equivalent, to access the FCD-155 supervision utility from any location that enables access to the FCD-155 using Internet protocols. However, before using Web access, it is necessary to perform a preliminary configuration of the FCD-155 (see *Table 4-2*).

Guidelines for Using Web Browsers

When using a Web browser, pay attention to the following points:

- Enable scripts

- Configure the firewall that is probably installed on your PC to allow access to the destination IP address (that is, the FCD-155 management address)

- Disable pop-up blocking software (such as the Google Popup Blocker); you may also have to configure your spyware/adware protection program to accept traffic from/to the destination IP address

- Browsers store the last viewed pages in a special cache. To prevent configuration errors, it is absolutely necessary to flush the browser's cache whenever you return to the same screen.

Preparations for Using Web Browsers

➤ **To prepare for using Web access:**

1. Configure the FCD-155 host IP address and all the other IP communication parameters (use the **Configuration>System>Management>Host IP** screen).

2. Enable Web browser access using **Configuration>System>Management> Management Access**.

General Web Browsers Operating Procedures

Before starting, make sure you know the management IP address of the FCD-155.

1. Open the Web browser.

2. Enter the IP address of the FCD-155 in the address field of the browser in the following format: **http://'IP address'** (**'IP address'** stands for the actual FCD-155 IP address).

3. After entering the address, press **‹Enter›** to command the browser to connect.

4. After the opening window (see *Figure 4-16*) is displayed, click **LOGIN**.

5. Perform log-in as described in *Section 4.1 – Log-in*.

6. You will see the main menu (*Figure 4-17*).

7. Use standard browser operating procedures to perform the desired activities.
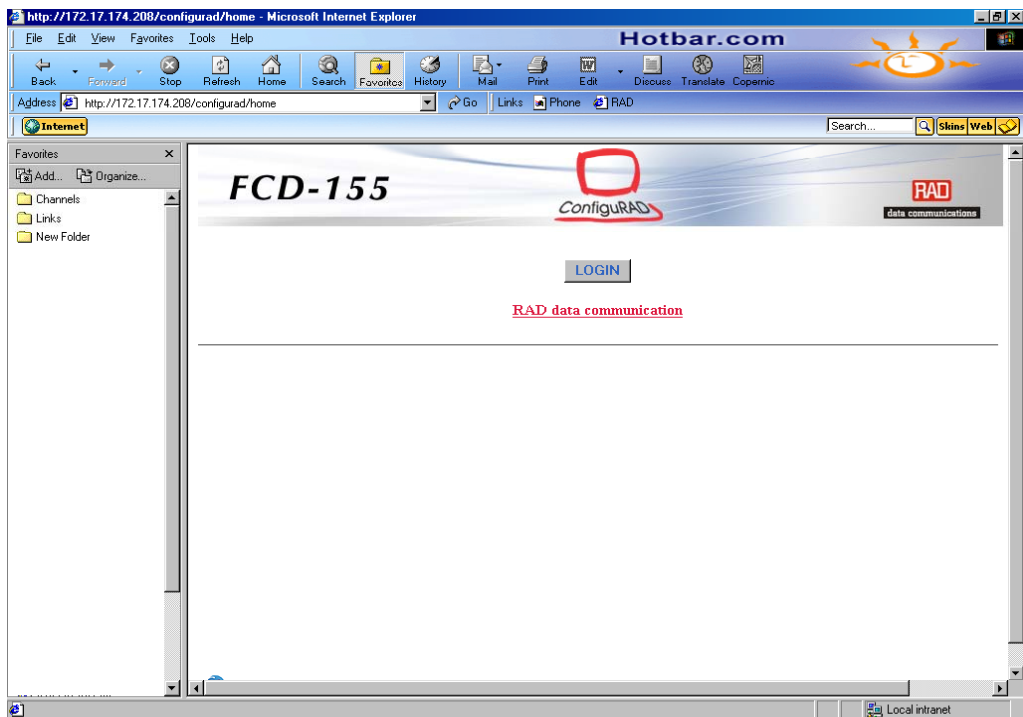
Figure 4-15. Web Browser Access, Typical Opening Window
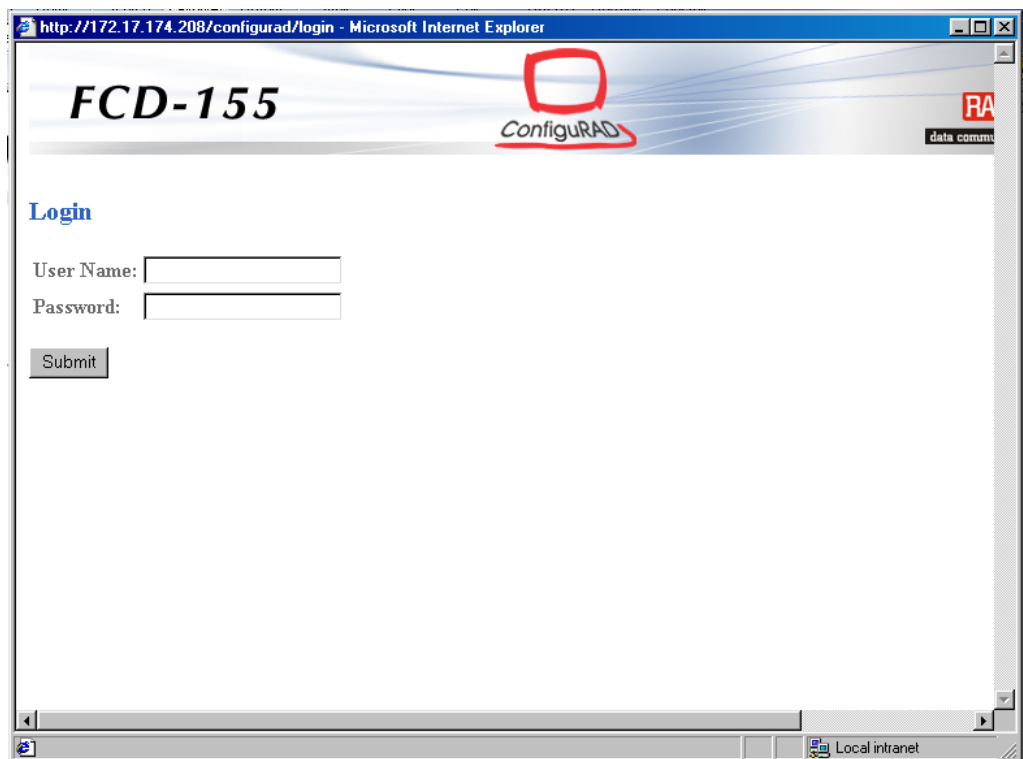
Figure 4-16. Web Browser Access, Typical Log-in Window
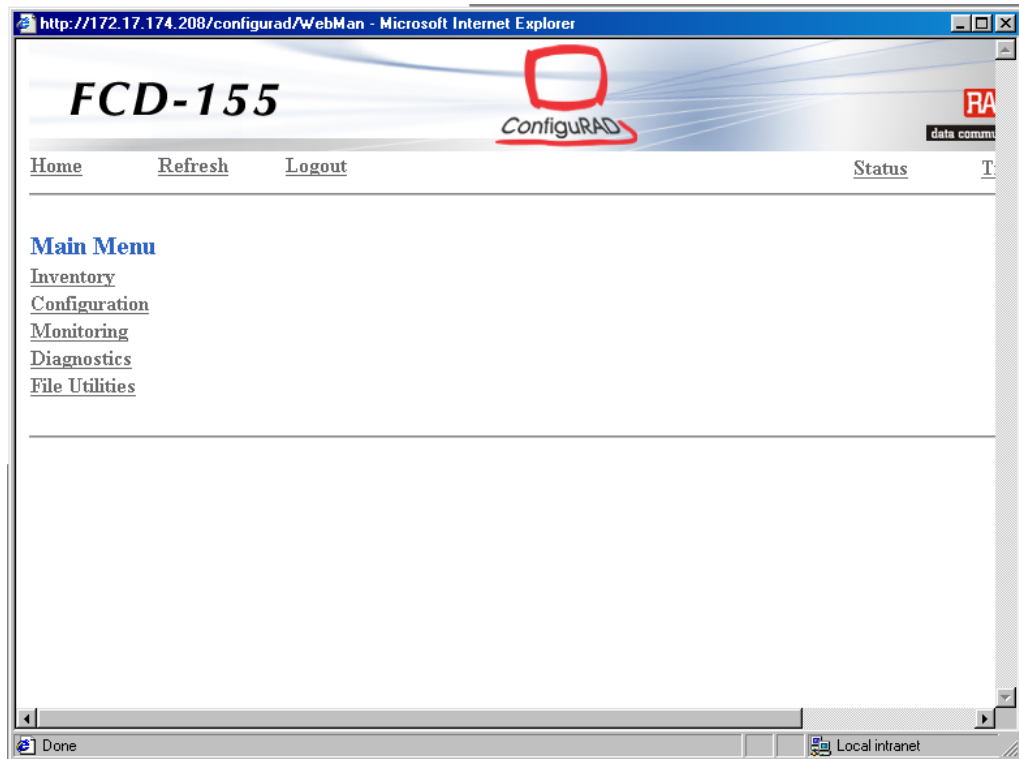
Figure 4-17. Web Browser Access, Typical Main Menu Window

4.8   Configuring FCD-155 via SNMP

FCD-155 can be configured by any SNMP-based network management station, for example, RADview, provided IP communication is possible with the management station.

For SNMP management instructions, refer to the User's Guide of the desired SNMP station.

The sequence of operations needed to configure for SNMP management access is as follows (see preliminary configuration in *Section 4.3* for details):

1. Configure management access via the desired ports:

    ▪ From an external Ethernet port: the dedicated MNG port, or a traffic port (either a basic Ethernet port, ETH 1 or ETH 2, or a GbE port, in accordance with installed option).

Note

The external management port can be used in two typical ways:

- *To enable the management station to access the local FCD-155 only*

- *To enable the management station to use the FCD-155 as a management gateway to other FCD-155 units. In this case, a separate IP address should be used for the management port, and for DCC ports, when used for management.*

    ▪ From the network side: via a virtually concatenated group, or via DCC. In this case, use the **Configuration > Physical Ports > STM-1 > Link 1** or **Link**

          2>DCC Configuration screen to select the overhead bytes that carry the DCC (regenerator section, or multiplex section bytes), the IP communication parameters, and the routing protocol.

2. Configure the SNMP management parameters.

3. Configure specific management stations.

4. Enable SNMP access.

Chapter 5

Configuring FCD-155

5.1 Overview

This chapter provides detailed configuration instructions for FCD-155 units. Separate sections are provided for each type of configuration activity: to help you navigate, each section starts with maps presenting the associated menu structure.

Note

Appendix C describes the FCD-155 operating environment and provides technical background information on the various FCD-155 configuration parameters.

The configuration activities presented in this chapter assume that the FCD-155 is configured using a standard ASCII terminal, as explained in *Chapter 4*. The information appearing in this chapter assumes that you are familiar with the general operating instructions for the supervisory terminal, as described in *Chapter 4*. If necessary, review *Section 4.2* and *Section 4.4*.

However, after preliminary configuration of the terminal and the FCD-155 as described in *Chapter 4*, the same configuration activities can also be performed by Telnet hosts, Web browsers, or SNMP network management stations.

Note

Unless otherwise specified, all the parameter values appearing in the following screens are given for illustration purposes only. They do not reflect recommended values. The options appearing on the screens depend on the equipment version being configured, and therefore ignore items not supported by your unit.

To simplify the identification of the various equipment versions, this manual uses the following conventions:

- **FCD-155/FCD-155E with single Ethernet port**: FCD-155 with one Ethernet port (management only, no LAN switch). Can include any PDH option.

- **Basic FCD-155/FCD-155E**: FCD-155 with two 10/100 Mbps Ethernet LAN ports (2U option), has internal Ethernet switch. Can include any PDH option.

- **FCD-155/FCD-155E with GbE port**: FCD-155 with GbE port (GbE option), can include any PDH option. Includes 10/100/1000 Mbps Ethernet switch. Note that an FCD-155 with GbE port has only one Ethernet traffic port.

- **FCD-155/FCD-155E with transparent LAN ports**: FCD-155 with a total of six LAN ports (6U option), that is, four transparent LAN ports (no LAN switch) added to the two ports of the 2U option.

- **FCD-155E with 6U switched LAN ports**: FCD-155 with a total of six switched LAN ports (6U option), that is, four switched LAN ports added to the two ports of the 2U option.

  May be equipped with any of the PDH options.

5.2   Configuration Sequence

Table 5-1 lists the steps needed to configure a new FCD-155.

The steps cover the configuration of all the FCD-155 versions, and therefore, skip steps not relevant to your equipment version. For example, it is not necessary to select a specific network link when your equipment has only one link, nor is it necessary to configure virtually concatenated groups when your equipment has only a management Ethernet port. Menu items for irrelevant steps do not appear on the supervision utility menus displayed by your equipment.

Note   *You may use the **Index of Main Activities** at the end of this manual to find the page location for any desired activity.*

Table 5-1. FCD-155 Configuration Sequence

Step	Action	Using
1	Reload the factory-default parameters.	Configuration>System>Factory Default
2	Use quick setup to define FCD-155 main characteristics. Skip configuration of parameters that you intend to configure manually, e.g., the number of ports to be enabled. If DHCP is used for management IP address assignment, use Step 4	Configuration>Quick Setup
3	Configure the out-of-band management ports:	
	• Configure CONTROL port communication parameters and supervisory terminal options	Configuration>System>Control Ports *or* Configuration>System>Control Ports>Serial Port Configuration>System>Control Ports>Terminal
	• For FCD-155E: configure the Ethernet MNG port, when supported	Configuration>System>Control Ports>ETH
4	Configure the additional FCD-155 management agent parameters	Configuration>System>Management>Host IP
5	Configure FCD-155 management access	Configuration>System>Management>Management Access
6	Configure specific management stations	Configuration>System>Management>Manager List
7	Set FCD-155 real-time clock	Configuration>System>Date & Time Update
8	Define FCD-155 logistics information	Configuration>System>Management>Device Info
9	Configure FCD-155E station clock port, when in use	Configuration>Physical Ports>Station Clock

Table 5-1. FCD-155 Configuration Sequence (Cont.)

Step	Action	Using
10	Configure FCD-155 STM-1 or OC-3 physical ports:	
	• Configure STM-1 or OC-3 physical port parameters	**Configuration**›**Physical Ports**›**STM-1** or **OC-3**
	• For FCD-155 with two network links, configure the physical layer protection parameters	**Configuration**›**Physical Ports**›**STM-1** or **OC-3**› **Protection Mode, Wait to Restore**
	• Configure the master timing source for the SDH/SONET subsystem	**Configuration**›**Physical Ports**›**STM-1** or **OC-3**› **Master Timing Source, Master RX Clock**
	• Configure the fallback timing source for the SDH/SONET subsystem	**Configuration**›**Physical Ports**›**STM-1** or **OC-3**› **Fallback Timing Source, Fallback RX Clock**
	• Configure the DCC parameters, to enable inband management via DCC.	**Configuration**›**Physical Ports**›**STM-1** or **OC-3**›**DCC Configuration**
	or	
	Configure FCD-155E STM-1 or OC-3 physical ports:	
	• Configure separate physical port parameters for each link	**Configuration**›**Physical Ports**›**STM-1** or **OC-3**›**Link 1** and/or **Link 2**
	• Configure the DCC parameters for each link	**Configuration**›**Physical Ports**›**STM-1** or **OC-3**›**Link 1** and/or **Link 2**›**DCC Configuration**
	• Configure the timing mode for the SDH/SONET subsystem	**Configuration**›**Physical Ports**›**STM-1** or **OC-3**›**Clock Parameters**
	For FCD-155E only:	
	Configure the protection type,	**Configuration**›**Physical Ports**›**STM-1** or **OC-3** ›**APS**›**Protection**
	and the protection parameters	**Configuration**›**Physical Ports**›**STM-1** or **OC-3**›**APS**
11	Configure FCD-155 physical LAN ports	**Configuration**›**Physical Ports**›**LAN** *or* **Configuration**›**Physical Ports**›**Ethernet**
12	Configure FCD-155 physical PDH ports:	
	• Configure the common parameters	**Configuration**›**Physical Ports**›**PDH**›**Common Parameters** **Configuration**›**Physical Ports**›**PDH**›**Port Parameters**
	• Configure the individual port parameters (at this stage, you can also enable/disable ports configured by means of the **Quick Setup** screen)	
	Configure FCD-155E physical PDH ports:	**Configuration**›**Physical Ports**›**E1/T1** or **E3/T3**› **Common Parameters**
	• Configure the common parameters	**Configuration**›**Physical Ports**›**E1/T1** or **E3/T3**›**Port Parameters**
	• Configure the individual port parameters (at this stage, you can also enable/disable ports configured by means of the **Quick Setup** screen)	

Table 5-1. FCD-155 Configuration Sequence (Cont.)

Step	Action	Using
13	When using PDH ports as timing reference, configure FCD-155 system timing (not supported by FCD-155E):	Not relevant to FCD-155E
	• Main (master) timing source	**Configuration**›**Physical Ports**›**STM-1** or **OC-3**›**Master Timing Source** and **Master Rx Clock**
	• Fallback timing source	**Configuration**›**Physical Ports**›**STM-1** or **OC-3**›**Fallback Timing Source** and **Fallback Rx Clock**
14	Configure FCD-155 virtual STM-1 or STS-3 port	**Configuration**›**Virtual Ports**›**STM-1** or **STS-3**
15	Configure FCD-155 virtual concatenation groups	**Configuration**›**Virtual Ports**›**VCAT**›**VCG 1** to **VCG 8**, or **All VCG**
16	Configure FCD-155 GFP multiplexing (when function is used)	**Configuration**›**Virtual Ports**›**VCAT**›**GFP Mux** (type **a** to add a new GFP mux)
17	Perform mapping:	
	• For FCD-155E: first select the link for mapping	**Configuration**›**System**›**Mapping**›**Link 1** or **Link 2**
	• Map the VCGs not processed by any GFP mux	**Configuration**›**System**›**Mapping**›**Link x** (select defined **VCG** entities) *or* **Configuration**›**System**›**Mapping**› (select defined **VCG** entities)
	• Map the primary group of the defined GFP mux	**Configuration**›**System**›**Mapping**›**Link x** (select **VCG** defined as primary group of the defined GFP mux) *or* **Configuration**›**System**›**Mapping** (select **VCG** defined as primary group of the defined GFP mux)
	• Map active PDH ports (option), and disconnect unused VCs/VTs	**Configuration**›**System**›**Mapping**›**Link x** (select **None** for each unused VC/VT) *or* **Configuration**›**System**›**Mapping** (select **None** for each unused VC/VT)
	• For FCD-155E: map protection ports for the active virtually concatenated groups and PDH ports	**Configuration**›**System**›**Mapping**›**Link x** (select **None** for each unused VC/VT)
	• For FCD-155E: map the cross-connections (bypass) between the two links	**Configuration**›**System**›**Mapping**›**Link x** (select **None** for each unused VC/VT)
18	Configure general bridge characteristics	**Configuration**›**Applications**›**Bridge**
19	Configure general bridge STP parameters, when STP or RSTP is enabledused	**Configuration**›**Applications**›**Bridge**›**Spanning Tree Protocol**
20	Configure bridge port characteristics and associated STP parameters	**Configuration**›**Applications**›**Bridge**›**Bridge Port**
21	Configure port-based VLANs in accordance with system requirements (only when the FCD-155 does not include the GbE option)	**Configuration**›**Applications**›**Bridge**›**Port Membership**›
22	Configure general QoS parameters	**Configuration**›**Applications**›**QoS**
23	Configure per-port QoS parameters	**Configuration**›**Applications**›**QoS**›**Port Mapping**
24	Configure layer 2 QoS (priority) parameters	**Configuration**›**Applications**›**QoS**›**Layer 2 Mapping**

Table 5-1. FCD-155 Configuration Sequence (Cont.)

Step	Action	Using
25	Configure layer 3 QoS (DSCP/ToS) parameters	**Configuration>Applications>QoS>Layer 3 Mapping**
26	Configure link aggregation in accordance with system requirements:	
	• Select a link aggregation (trunk) ID	**Configuration>Applications>Link Aggregation,** and press **F** or **B** to scroll to the desired ID
	• Configure the LAN ports, or VCG ports, included in this trunk	**Configuration>Applications>Link Aggregation>LAN Ports** or **VCG Ports**
27	Save the updated database	Type **#** and confirm. If errors are reported, use the **Monitoring>Display Sanity Errors and Warnings** screen to collect the error information, and then refer to *Chapter 7* for explanations and corrective measures

5.3   Configuration Menu Structure

Figure 5-1 to Figure 5-4 show the structure of the **Configuration** menu for the main FCD-155E and FCD-155 versions.

Ignore menu options not relevant to your particular equipment version.

Configuration

1. Quick Setup
2. System
3. Physical Ports
4. Virtual Ports
5. Applications
6. Select Configuration

E3 or T3

Quick Setup

1. Set Host IP address
2. Set Subnet Mask
3. Set Default Gateway
4. Number of External LAN Ports
5. Number of External PDH Ports
6. Number of Virtual Groups
7. Number of VC-12's per VCG
8. Encapsulation
9. Path Protection

or

Quick Setup

1. Set Host IP address
2. Set Subnet Mask
3. Set Default Gateway
4. Number of External LAN Ports
5. Number of Virtual Groups
6. Number of VC-12's per VCG
7. Encapsulation
8. Path Protection

System

1. Mapping
2. Management
3. Control Ports
4. Date & Time Update
5. Factory Default
6. Reset Device
7. Fault Propagation

Physical Ports

1. STM-1
2. Ethernet
3. E1/T1 *or* E3/T3
4. Station Clock

Virtual Ports

1. STM-1
2. VCAT

Applications

1. Bridge
2. Qos
3. Link Aggregation

**Structure depends
on LAN option**

Select Configuration

1. Off Line
2. On Line

Figure 5-1. **Configuration** *Menu Structure (FCD-155E SDH Versions with PDH Ports)*

Configuration

1. Quick Setup
2. System
3. Physical Ports
4. Virtual Ports
5. Applications
6. Select Configuration

Quick Setup

1. Set Host IP address
2. Set Subnet Mask
3. Set Default Gateway
4. Number of External LAN Ports
5. Number of External PDH Ports
6. Number of Virtual Groups
7. Number of VT1.5's per Group
8. Encapsulation
9. Path Protection

or

Quick Setup

1. Set Host IP address
2. Set Subnet Mask
3. Set Default Gateway
4. Number of External LAN Ports
5. Number of Virtual Groups
6. Number of VT1.5's per Group
7. Encapsulation
8. Path Protection

T3 only

System

1. Mapping
2. Management
3. Control Ports
4. Date & Time Update
5. Factory Default
6. Reset Device
7. Fault Propagation

Physical Ports

1. OC-3
2. Ethernet
3. E1/T1 *or* E3/T3
4. Station Clock

Virtual Ports

1. STS-3
2. VCAT

Applications

1. Bridge
2. Qos
3. Link Aggregation

**Structure depends
on LAN option**

Select Configuration

1. Off Line
2. On Line

*Figure 5-2. **Configuration** Menu Structure (FCD-155E SONET Versions)*

Configuration

1. Quick Setup
2. System
3. Physical Ports
4. Virtual Ports
5. Applications
6. Select Configuration

Quick Setup

1. Set Host IP address
2. Set Subnet Mask
3. Set Default Gateway
4. Number of External LAN Ports
5. Number of External PDH Ports
6. Number of Virtual Groups
7. Number of VC-12's per VCG
8. Encapsulation

or

E3 or T3

Quick Setup

1. Set Host IP address
2. Set Subnet Mask
3. Set Default Gateway
4. Number of External LAN Ports
5. Number of Virtual Groups
6. Number of VC-12's per VCG
7. Encapsulation

System

1. Mapping
2. Management
3. Control Ports
4. Date & Time Update
5. Factory Default
6. Reset Device
7. Fault Propagation

Physical Ports

1. STM-1
2. LAN
3. PDH

Virtual Ports

1. STM-1
2. VCAT

Applications

1. Bridge
2. Qos
3. Link Aggregation

Structure depends on LAN option

Select Configuration

1. Off Line
2. On Line

*Figure 5-3. **Configuration** Menu Structure (FCD-155 SDH Versions with PDH Ports)*

Configuration

1. Quick Setup
2. System
3. Physical Ports
4. Virtual Ports
5. Applications
6. Select Configuration

Quick Setup

1. Set Host IP address
2. Set Subnet Mask
3. Set Default Gateway
4. Number of External LAN Ports
5. Number of External PDH Ports
6. Number of Virtual Groups
7. Number of VT1.5's per Group
8. Encapsulation

or

Quick Setup

1. Set Host IP address
2. Set Subnet Mask
3. Set Default Gateway
4. Number of External LAN Ports
5. Number of Virtual Groups
6. Number of VT1.5's per Group
7. Encapsulation

T3 only

System

1. Mapping
2. Management
3. Control Ports
4. Date & Time Update
5. Factory Default
6. Reset Device
7. Fault Propagation

Physical Ports

1. OC-3
2. LAN
3. PDH

Virtual Ports

1. STS-3
2. VCAT

Applications

1. Bridge
2. Qos
3. Link Aggregation

**Structure depends
on LAN option**

Select Configuration

1. Off Line
2. On Line

*Figure 5-4. **Configuration** Menu Structure (FCD-155 SONET Versions)*

5.4   Configuring System Parameters

Quick Setup

Purpose

Configure the basic FCD-155 parameters:

- FCD-155 management IP address and IP subnet (mandatory), and optionally an IP gateway.

- Number of active ports of each type (mandatory)

- Number of virtually concatenated groups using low-order VCs/VTs (optional)

- The default encapsulation mode (optional).

- For FCD-155E versions: the path protection option.

Note   *Quick Setup provides a single point of access to the main system parameters (normally reached from several different menus). Its purpose is to help you prepare an initial system configuration, to serve as a starting point for more detailed configuration procedures.*

The Quick Setup screen is not intended to replace the specific configuration procedures, some of which modify the parameters initially selected on the Quick Setup screen. Therefore, it is recommended to use the Quick Setup screen only once, when you start configuring an FCD-155 unit from the factory defaults.

Reached from

Configuration

Several typical **Quick Setup** screens are shown below:

- *Figure 5-5* shows the screen for an FCD-155E with SDH network interface. Note that the **Number of External PDH Ports** is displayed only when the FCD-155 is equipped with E1 or T1 PDH interfaces.

```
                          FCD-155E
Configuration>Quick Setup

 1. Set Host IP address          ... (1.2.3.4)
 2. Set Subnet Mask              ... (255.0.0.0)
 3. Set Default Gateway          ... (1.2.3.1)
 4. Number of External LAN Ports [1 - 6]... (6)
 5. Number of External PDH Ports [1 - 4]... (4)
 6. Number Of Virtual Groups     [1 - 8]... (8)
 7. Number Of VC12's per VCG     [0 - 63]... (3)
 8. Encapsulation                >    (GFP)
 9. Path protection              >    (None)
>


ESC-prev.menu; !-main menu; &-exit; @-output                        1M/1C
------------------------------------------------------------------------
```

Figure 5-5. Typical SDH Quick Setup Screen (FCD-155E)

- *Figure 5-6* shows the **Quick Setup** screen for an FCD-155E with SONET network interface. Note that item **7** is **Number of VT1.5s per VCG**, and the allowed range is up to 64.

```
                              FCD-155E
Configuration>Quick Setup

 1. Set Host IP address          ... (1.2.3.4)
 2. Set Subnet Mask              ... (255.0.0.0)
 3. Set Default Gateway          ... (1.2.3.1)
 4. Number of External LAN Ports [1 - 6]... (6)
 5. Number of External PDH Ports [1 - 4]... (4)
 6. Number Of Virtual Groups     [1 - 8]... (6)
 7. Number Of VT1.5's per VCG    [0 - 64]... (7)
 8. Encapsulation                >   (LAPS)
 9. Path protection              >   (None)

>


ESC-prev.menu; !-main menu; &-exit; @-output                          1M/1C
------------------------------------------------------------------------------
```

*Figure 5-6. Typical SONET **Quick Setup** Screen (FCD-155E)*

Note   *Path Protection appears only for FCD-155E.*

- *Figure 5-7* shows the **Quick Setup** screen for an FCD-155 with single Ethernet port.

```
                              FCD-155
Configuration>Quick Setup

 1. Set Host IP address          ... (1.2.3.4)
 2. Set Subnet Mask              ... (255.0.0.0)
 3. Set Default Gateway          ... (1.2.3.1)
 4. Number of External PDH Ports [0 - 4]... (4)
 5. Path Protection              ... (None)

>


ESC-prev.menu; !-main menu; &-exit; @-output                          1M/1C
------------------------------------------------------------------------------
```

*Figure 5-7. Typical **Quick Setup** Screen for FCD-155 with Single Ethernet Port*

To configure a parameter on the **Quick Setup** screen, select the corresponding item by typing its number and then pressing **‹Enter›**. You can then type the desired value in the same line.

To confirm your entry, press **‹Enter›.**

➤ **To configure the FCD-155 management IP address:**

1. Select item 1: Set Host IP address.

2. Enter the prescribed IP address of the FCD-155 management agent, in the dotted quad format, and then press **‹Enter›**.

3. Select item **2: Set Subnet Mask**.

4. Enter the IP subnet mask to be used by of the FCD-155 management agent, in the dotted quad format, and then press **‹Enter›**.

   Make sure that the subnet mask is compatible with the specified IP address, and that it consists of consecutive 1s, followed by consecutive 0s.

5. You may also specify a default gateway, which will be used by the FCD-155 management agent to send packets with destinations not located on a local LAN to a specific router. For this purpose, type **3: Set Default Gateway**, and then press **‹Enter›:** now enter the IP address of the desired router port in the dotted-quad format, and then press **‹Enter›**.

   The default gateway IP address must be within the same IP subnet as the management IP address. The default value, 0.0.0.0, means that no default gateway is defined.

   To use the default gateway option, enter the IP address of the desired router port in the dotted-quad format.

➤ **To configure the active FCD-155 ports:**

For each parameter, select a value within the range indicated in the square brackets:

Number of External LAN Ports	To enable a single Ethernet port (this will always be port ETH 1), select 1.
	To enable more Ethernet ports, up to the maximum supported by your FCD-155 version, select the desired number, 2 to 6. This will enable the corresponding number of LAN ports, starting with port ETH 1.
	This item is not relevant for an FCD-155 with single Ethernet port.
Number of External PDH Ports (optional item)	This field appears only for FCD-155 with E1 or T1 PDH interfaces.
	Select the desired number of PDH ports, up to the maximum supported by your FCD-155 version, which may be 4 (FCD-155 only), 8, 21 (FCD-155E only) or 28 (0 will disable all the PDH ports). Selecting a smaller number of ports will enable the corresponding number of PDH ports, starting with port 1.

➤ **To configure a set of virtually concatenated groups:**

Note   *Skip this step for the FCD-155 with single Ethernet port.*

For each parameter, select a value within the range indicated in the square brackets, or select from the list displayed when the corresponding item is

selected. See *Configuration Considerations for Virtually Concatenated Groups* section below for configuration considerations and guidelines.

Number of Virtual Groups

Select the number of virtually concatenated groups to be automatically generated and mapped. The supported range, which depends on your FCD-155 version, is indicated on the screen: it is 1 to 4 for FCD-155 with two LAN ports, and 1 to 8 for FCD-155 and FCD-155E units with GbE port or transparent LAN ports.

Number of VC12s per VCG
              or
Number of VT1.5s per VCG

Select the number of VCs (when using SDH) or VTs (for SONET) in each virtually concatenated group. The display shows either VCs or VTs, in accordance with the FCD-155 network interface type.

The allowed range is 1 to 63 for SDH, and 1 to 64 for SONET.

Encapsulation

Select the desired encapsulation mode for the virtually concatenated groups defined above:

- **LAPS:** Link Access Procedure for SONET/SDH protocols per ITU-T Rec. X.85/X.86 draft.

- **GFP:** Generic Framing Procedure in accordance with ITU-T Rec. G.7041, framed mode, including support for GFP multiplexing.

Path Protection

Controls the use of path (trail) protection for the selected port. This parameter is supported only by equipment with the APS option. Trail protection should be enabled only when the APS protection mode is OFF.

The available selections are as follows:

- **NONE** – Path protection for the selected port is disabled. The trail may still be protected, together with all the other trails, if the APS protection is enabled.

- **AUTO** – Path protection is enabled. Protection ports for each of the ports created on link 1 are automatically created on link 2, in the same positions (the mapping of each port on link 1 is automatically copied to the same TU on link 2). **AUTO** cannot be selected when APS protection is on, or when the channel is already mapped (the mapping must be performed only after the **Path Protection** mode is selected).

- **MANUAL** – Path protection is enabled. You must map the protection ports manually in different TUs of the same link, or on different links.

Note

*Each time you press ‹Enter›, FCD-155 checks your selection. If it is not correct, it is rejected (the previous value remains unchanged), and you see the **ERROR** indicator in the top right-hand corner.*

➤ **To save and activate the new configuration:**

Type **#** and then type **y** to confirm the action.

Configuration Considerations for Virtually Concatenated Groups

The options available in the **Quick Setup** screen enable building the number of virtually concatenated groups selected by you (the groups are then automatically mapped). To avoid configuration errors, use the following step-by-step sequence:

1. When using an FCD-155 with E1 or T1 PDH interfaces, always start by defining the number of active (enabled) PDH E1 or T1 interfaces.

2. Refer to *Table 5-2* and determine the number of VCs/VTs to be reserved for PDH traffic.

Table 5-2. Bandwidth to be Reserved for PDH Traffic

Network Interface	Interface Type	Number of VCs/VTs	Total Bandwidth to be Reserved
SDH	4 E1	1 VC-12 per interface	4 VC-12
	8 E1	1 VC-12 per interface	8 VC-12
	21 E1	1 VC-12 per interface	21 VC-12 (all in one TUG-3)
	4 T1	1 VC-11 per interface	3 VC-12/4 VC-11 in one TUG-2 (occupy only one TUG-2 in the TUG-3)
	8 T1	1 VC-11 per interface	6 VC-12/8 VC-11 in two TUG-2 (occupy only two TUG-2 in the TUG-3)
	28 T1	1 VC-11 per interface	21 VC-12/28 VC-11 (all in one TUG-3)
	E3	1 VC-3 (21 VC-12)	One TUG-3 (21 VC-12)
	T3	28 VC-11	21 VC-12 (whole TUG-3 carrying VC-11s)
SONET	4 T1	1 VT-1.5 per interface	4 VT-1.5
	8 T1	1 VT-1.5 per interface	8 VT-1.5
	28 T1	1 VT-1.5 per interface	28 VT-1.5 (all in one STS-1)
	T3	28 VT-1.5	28 VT-1.5 (all in one STS-1)

3. Decide whether management traffic must be carried over the SDH/SONET link. If the answer is *no* or you will use the DCC for this purpose, skip to *Step 4* below. If the answer is **yes**, check whether it is necessary to reserve a dedicated management VC-12 or VT-1.5:

   ▪ If management traffic will be encapsulated using LAPS, reserve one dedicated VC-12 or VT-1.5 (the type depends on the network standard)

   ▪ If management traffic will be encapsulated using GFP, you may use GFP multiplexing to combine management traffic with payload traffic in a manually-configured virtually concatenated group:

      □ If GFP multiplexing is **not used**, reserve one dedicated VC-12 or VT-1.5

      □ If GFP multiplexing is **used**, do not reserve dedicated bandwidth.

4. Select the number of virtually concatenated groups to be defined. The range is 1 to 4, or 1 to 8, depending on the number of LAN ports on your FCD-155 unit. Decrease the number as needed when dedicated bandwidth must be reserved on the SDH/SONET link for management (see *Step 3* above), and/or for future growth.

5. Select the number of VC-12s or VT-1.5s in each group.

   If you want to use more than a few VC-12s or VT-1.5s per group, you must check how many can be assigned to the virtually concatenated groups you are defining now. Calculate the maximum allowed number as follows:

   ▪ If you want to manually configure additional groups (using **Configuration>Virtual Ports>VCAT>VCG**) or just want to reserve some link bandwidth for future growth, determine how many VC-12s or VT1.5s to set aside (if using high-order containers, this translates to 21 VC-12s or VT-1.5s per VC-3).

   ▪ Now calculate the maximum number of VC-12s or VT-1.5s that remain available:

      ▫ For an FCD-155 with PDH E1 interfaces, this is 63 less the number selected in *Step 2* and *Step 3* above, and the number reserved above.

         Example 1: If 8 PDH E1 interfaces are active and one VC-12 is dedicated to management, the available number is **63 – 8 – 1 = 54**.

         Example 2: If 4 PDH E1 interfaces are active, no VC-12 is dedicated to management, but you want to add one more group over one VC-3, the available number is **63 – 4 – 0 – 21 = 38**.

      ▫ For an FCD-155 with PDH T1 or T3 interfaces, the number is 84 less the number selected in *Step 2* and *Step 3* above, and the number reserved above.

      ▫ For an FCD-155 without PDH interfaces, the number is 63 when using SDH and 84 when using SONET. Subtract 1 if management uses a dedicated VC-12 or VT-1.5. Also subtract any bandwidth to be set aside for future growth.

   ▪ Divide the number calculated above by the number of virtually concatenated groups, and select only the integer part of the result. For example, if you define now four groups and the available number of VC-12s or VT-1.5s is 62, the maximum number per group is 15.

Note   *You can select any number that does not exceed the result obtained in the last step.*

The VC-12s or VT-1.5s assigned in this way are consecutively mapped on link 1 starting with the first one, until all are mapped.

For example, the screen shown in *Figure 5-8* (displayed using the FCD-155 **Configuration>System>Mapping)** shows the result of the automatic mapping when you configure 8 virtually concatenated groups, each using 7 VC-12s.

As seen in *Figure 5-8*, the automatic mapping completely fills the first two TUG-3, and some of the third TUG-3 remains free. Thus, you may increase the bandwidth assigned to one or more virtually concatenated groups.

```
                                    FCD-155
Configuration>System>Mapping


               TUG3 1                    TUG3 2                    TUG3 3
          TU1   TU2   TU3          TU1   TU2   TU3          TU1   TU2   TU3
 TUG2-1  VCG1  VCG1  VCG1         VCG4  VCG4  VCG4         VCG7  VCG7  VCG7
 TUG2-2  VCG1  VCG1  VCG1         VCG4  VCG4  VCG4         VCG7  VCG7  VCG7
 TUG2-3  VCG1  VCG2  VCG2         VCG4  VCG5  VCG5         VCG7  VCG8  VCG8
 TUG2-4  VCG2  VCG2  VCG2         VCG5  VCG5  VCG5         VCG8  VCG8  VCG8
 TUG2-5  VCG2  VCG2  VCG3         VCG5  VCG5  VCG6         VCG8  VCG8  Ex1
 TUG2-6  VCG3  VCG3  VCG3         VCG6  VCG6  VCG6         Ex2   Ex3   Ex4
 TUG2-7  VCG3  VCG3  VCG3         VCG6  VCG6  VCG6         None  None  None


 1. VCG1 3. VCG3 5. VCG5 7. VCG7 9. Ex1 11. Ex3 13. None
 2. VCG2 4. VCG4 6. VCG6 8. VCG810. Ex2 12. Ex4

>


ESC-prev.menu; !-main menu; &-exit; @-Output; ?-help                      1M/1C
-----------------------------------------------------------------------------
```

*Figure 5-8. Typical **Mapping** Screen after Quick Setup (FCD-155)*

For the FCD-155E, the available bandwidth is 2 × STM-1/OC-3. Therefore, the payload can be distributed in different ways:

- One STM-1/OC-3 can be used for the virtually concatenated groups that carry Ethernet traffic

- The other STM-1/OC-3 can be used for PDH traffic, where the required bandwidth can be calculated using *Table 5-2*, for example, one VC-3/STS-1 can carry E3 or T3 traffic, or 21 E1/28 T1. The remaining bandwidth can be used to add path protection of critical virtually concatenated groups, and/or for bypassing traffic between the link 1 and link 2, when applicable.

Figure 5-9 and *Figure 5-10* show an example of mapping for the FCD-155E. In this example, the number of enabled PDH E1 ports is 10, and the number of virtually concatenated groups is 8, each assigned 3 VC-12s. Path protection is enabled (**Manual** mode) for VCG5 and for PDH ports 1, 2, 4, 5.

Note the following:

- In the **Link 1** map: the port selection line under the link map includes entries for the protection VCGs identified as **PVCG1**, **PVCG2**, ..., **PVCG8**; in addition, typing **N** will also show the protection entries **PEx1**, **PEx2**, ..., **PEx10**. The same entries also appear on the map of link 2. This permits placing the protection in the same link with the protected link, or in the other link (the most often used way), at user's discretion.

- In the **Link 2** map: the protection entries are shown mapped in the same positions they have been mapped on link 1.

```
                                    FCD-155E
Configuration>System>Mapping>Link 1


                TUG3  1                  TUG3  2                  TUG3  3
         TU1    TU2    TU3       TU1    TU2    TU3       TU1    TU2    TU3
 TUG2-1 VCG1   VCG1   VCG1       VCG8   VCG8   VCG8      None   None   None
 TUG2-2 VCG2   VCG2   VCG2       Ex1    Ex2    Ex3       None   None   None
 TUG2-3 VCG3   VCG3   VCG3       Ex4    Ex5    Ex6       None   None   None
 TUG2-4 VCG4   VCG4   VCG4       Ex7    Ex8    Ex9       None   None   None
 TUG2-5 VCG5   VCG5   VCG5       Ex10   None   None      None   None   None
 TUG2-6 VCG6   VCG6   VCG6       None   None   None      None   None   None
 TUG2-7 VCG7   VCG7   VCG7       None   None   None      None   None   None


... (P)
9. VCG8  10. PVCG1 11. PVCG2 12. PVCG3 13. PVCG4 14. PVCG5 15. PVCG6 16.PVCG7
... (N)
>


Link 1  1:1:1
# - Save; % - Undo
ESC-prev.menu; !-main menu; &-exit; @-debug; ?-help                 1 M/ 1 C
-------------------------------------------------------------------------------
```

*Figure 5-9. Typical **Mapping** Screen after Quick Setup – Link 1 of FCD-155E*

```
                                    FCD-155E
Configuration>System>Mapping>Link 2


                TUG3  1                  TUG3  2                  TUG3  3
         TU1    TU2    TU3       TU1    TU2    TU3       TU1    TU2    TU3
 TUG2-1 PVCG1  PVCG1  PVCG1      PVCG8  PVCG8  PVCG8     None   None   None
 TUG2-2 PVCG2  PVCG2  PVCG2      PEx1   PEx2   PEx3      None   None   None
 TUG2-3 PVCG3  PVCG3  PVCG3      PEx4   PEx5   PEx6      None   None   None
 TUG2-4 PVCG4  PVCG4  PVCG4      PEx7   PEx8   PEx9      None   None   None
 TUG2-5 PVCG5  PVCG5  PVCG5      PEx10  None   None      None   None   None
 TUG2-6 PVCG6  PVCG6  PVCG6      None   None   None      None   None   None
 TUG2-7 PVCG7  PVCG7  PVCG7      None   None   None      None   None   None



1. None   2. VCG1   3. VCG2   4. VCG3   5. VCG4   6. VCG5   7. VCG6   8. VCG7
... (N)
>


Link 2  1:1:1
# - Save; % - Undo
ESC-prev.menu; !-main menu; &-exit; @-debug; ?-help                 1 M/ 1 C
-------------------------------------------------------------------------------
```

*Figure 5-10. Typical **Mapping** Screen after Quick Setup – Link 2 of FCD-155E*

System Configuration Submenu Structure

Figure 5-11 to *Figure 5-14* show the structure of the **System** submenu for the main FCD-155E and FCD-155 versions. Ignore menu options not relevant to your particular FCD-155 version.

System

1. Mapping
2. Management
3. Control Ports
4. Date & Time Update
5. Factory Default
6. Reset Device
7. Fault Propagation

Mapping

1. Link 1
2. Link 2
3. Link 3

Typical Screen (SDH)

Mapping

	TUG3 1			TUG3 2			TUG3 3		
	TU1	TU2	TU3	TU1	TU2	TU3	TU1	TU2	TU3
TUG2-1	None	None	None	None	None	None	None	None	None
TUG2-2	None	None	None	None	None	None	None	None	None
TUG2-3	None	None	None	None	None	None	None	None	None
TUG2-4	None	None	None	None	None	None	None	None	None
TUG2-5	None	None	None	None	None	None	None	None	None
TUG2-6	None	None	None	None	None	None	None	None	None
TUG2-7	None	None	None	None	None	None	None	None	None

Management

1. Device Info
2. Host IP
3. Manager List
4. Management Access

Device Info

Object Id
Hardware version
Software version
System Up Time
sysDescr
1. Device Name
2. Contact Person
3. Location

Host IP

1. DHCP Client
2. Set Host IP Address
3. Set Subnet Mask
4. Set Default Gateway
5. Read
6. Write
7. Trap
8. Host Encapsulation

Manager List

Managers ID	IP Address
1	24.89.216.0
2	0.0.0.0
3	0.0.0.0
4	0.0.0.0
5	0.0.0.0

1. Change Cell

Management Access

1. SNMP
2. Telnet
3. WEB

Host Encapsulation

1. Host Tagging
2. Host VLAN ID
3. Host VLAN Priority Tag

Control Ports

1. Serial Port
2. ETH

Set Baud Rate (bps)

Data Bits

Parity

Serial Port

1. Set Baud Rate (bps)
2. Data Bits
3. Parity
4. Stop Bits
5. CTS
6. DSR
7. Terminal

Stop Bits

CTS

DSR

ETH

1. IP address
2. Subnet Mask
3. Routing Protocol
4. Encapsulation

Terminal

1. Change Password
2. Pop Alarm
3. Security Timeout

Date & Time Update

1. Set Time (hh:mm:ss)
2. Set Date (dd/mm/yyyy)
3. Set Date Format

Set Date Format

1. dd/mm/yyyy
2. mm/dd/yyyy
3. yyyy/mm/dd

Figure 5-11. **Configuration>System** *Submenu Structure (FCD-155E SDH Version)*

System

1. Mapping
2. Management
3. Control Ports
4. Date & Time Update
5. Factory Default
6. Reset Device
7. Fault Propagation

Typical Screen (SONET)

Mapping

	STS1 1				STS1 2				STS1 3			
	TU1	TU2	TU3	TU4	TU1	TU2	TU3	TU4	TU1	TU2	TU3	TU4
TUG2-1	VCG1	VCG1	VCG1	VCG1	VCG3	VCG3	VCG4	VCG4	VCG6	VCG6	VCG6	VCG6
TUG2-2	VCG1	VCG1	VCG1	VCG1	VCG4	VCG4	VCG4	VCG4	Ex1	Ex2	Ex3	Ex4
TUG2-3	VCG1	VCG1	VCG1	VCG1	VCG4	VCG4	VCG4	VCG4	None	None	None	None
TUG2-4	VCG2	VCG2	VCG2	VCG2	VCG5	VCG5	VCG5	VCG5	None	None	None	None
TUG2-5	VCG2	VCG2	VCG2	VCG2	VCG5	VCG5	VCG5	VCG5	None	None	None	None
TUG2-6	VCG3	VCG3	VCG3	VCG3	VCG6	VCG6	VCG6	VCG6	None	None	None	None
TUG2-7	VCG3	VCG3	VCG3	VCG3	VCG6	VCG6	VCG6	VCG6	None	None	None	None

Mapping

1. Link 1
2. Link 2

Management

1. Device Info
2. Host IP
3. Manager List
4. Management Access

Device Info

Object Id
Hardware version
Software version
System Up Time
sysDescr
1. Device Name
2. Contact Person
3. Location

Host IP

1. DHCP Client
2. Set Host IP Address
3. Set Subnet Mask
4. Set Default Gateway
5. Read
6. Write
7. Trap
8. Host Encapsulation

Manager List

Managers ID	IP Address
1	24.89.216.0
2	0.0.0.0
3	0.0.0.0
4	0.0.0.0
5	0.0.0.0

1. Change Cell

Management Access

1. SNMP
2. Telnet
3. WEB

Host Encapsulation

1. Host Tagging
2. Host VLAN ID
3. Host VLAN Priority Tag

Control Ports

1. Serial Port
2. ETH

Set Baud Rate (bps)

Data Bits

Serial Port

1. Set Baud Rate (bps)
2. Data Bits
3. Parity
4. Stop Bits
5. CTS
6. DSR
7. Terminal

Parity

Stop Bits

CTS

DSR

ETH

1. IP address
2. Subnet Mask
3. Routing Protocol
4. Encapsulation

Terminal

1. Change Password
2. Pop Alarm
3. Security Timeout

Date & Time Update

1. Set Time (hh:mm:ss)
2. Set Date (dd/mm/yyyy)
3. Set Date Format

Set Date Format

1. dd/mm/yyyy
2. mm/dd/yyyy
3. yyyy/mm/dd

Figure 5-12. **Configuration>System** *Submenu Structure (FCD-155E SONET Version)*

System

1. Mapping
2. Management
3. Control Ports
4. Date & Time Update
5. Factory Default
6. Reset Device
7. Fault Propagation

Typical Screen (SDH)

Mapping

	TUG3 1			TUG3 2			TUG3 3		
	TU1	TU2	TU3	TU1	TU2	TU3	TU1	TU2	TU3
TUG2-1	None	None	None	None	None	None	None	None	None
TUG2-2	None	None	None	None	None	None	None	None	None
TUG2-3	None	None	None	None	None	None	None	None	None
TUG2-4	None	None	None	None	None	None	None	None	None
TUG2-5	None	None	None	None	None	None	None	None	None
TUG2-6	None	None	None	None	None	None	None	None	None
TUG2-7	None	None	None	None	None	None	None	None	None

Management

1. Device Info
2. Host IP
3. Manager List
4. Management Access

Device Info

Object Id
Hardware version
Software version
System Up Time
sysDescr
1. Device Name
2. Contact Person
3. Location

Host IP

1. DHCP Client
2. Set Host IP Address
3. Set Subnet Mask
4. Set Default Gateway
5. Read
6. Write
7. Trap
8. Host Encapsulation

Manager List

Managers ID	IP Address
1	24.89.216.0
2	0.0.0.0
3	0.0.0.0
4	0.0.0.0
5	0.0.0.0

1. Change Cell

Management Access

1. SNMP
2. Telnet
3. WEB

Host Encapsulation

1. Host Tagging
2. Host VLAN ID
3. Host VLAN Priority Tag

Set Baud Rate (bps)

Data Bits

Parity

Control Ports

1. Set Baud Rate (bps)
2. Data Bits
3. Parity
4. Stop Bits
5. CTS
6. DSR
7. Terminal

Stop Bits

CTS

DSR

Terminal

1. Change Password
2. Pop Alarm
3. Security Timeout

Date & Time Update

1. Set Time (hh:mm:ss)
2. Set Date (dd/mm/yyyy)
3. Set Date Format

Set Date Format

1. dd/mm/yyyy
2. mm/dd/yyyy
3. yyyy/mm/dd

Figure 5-13. **Configuration>System** *Submenu Structure (FCD-155 SDH Version)*

System

1. Mapping
2. Management
3. Control Ports
4. Date & Time Update
5. Factory Default
6. Reset Device
7. Fault Propagation

Typical Screen (SONET)

Mapping

	STS1 1				STS1 2				STS1 3			
	TU1	TU2	TU3	TU4	TU1	TU2	TU3	TU4	TU1	TU2	TU3	TU4
TUG2-1	VCG1	VCG1	VCG1	VCG1	VCG3	VCG4	VCG4	VCG4	VCG6	VCG6	VCG6	VCG6
TUG2-2	VCG1	VCG1	VCG1	VCG1	VCG4	VCG4	VCG4	VCG4	Ex1	Ex2	Ex3	Ex4
TUG2-3	VCG1	VCG1	VCG1	VCG1	VCG4	VCG4	VCG4	VCG4	None	None	None	None
TUG2-4	VCG2	VCG2	VCG2	VCG2	VCG5	VCG5	VCG5	VCG5	None	None	None	None
TUG2-5	VCG2	VCG2	VCG2	VCG2	VCG5	VCG5	VCG5	VCG5	None	None	None	None
TUG2-6	VCG3	VCG3	VCG3	VCG3	VCG6	VCG6	VCG6	VCG6	None	None	None	None
TUG2-7	VCG3	VCG3	VCG3	VCG3	VCG6	VCG6	VCG6	VCG6	None	None	None	None

Management

1. Device Info
2. Host IP
3. Manager List
4. Management Access

Device Info

Object Id
Hardware version
Software version
System Up Time
sysDescr
1. Device Name
2. Contact Person
3. Location

Host IP

1. DHCP Client
2. Set Host IP Address
3. Set Subnet Mask
4. Set Default Gateway
5. Read
6. Write
7. Trap
8. Host Encapsulation

Manager List

Managers ID	IP Address
1	24.89.216.0
2	0.0.0.0
3	0.0.0.0
4	0.0.0.0
5	0.0.0.0

1. Change Cell

Management Access

1. SNMP
2. Telnet
3. WEB

Host Encapsulation

1. Host Tagging
2. Host VLAN ID
3. Host VLAN Priority Tag

Set Baud Rate (bps)

Data Bits

Control Ports

1. Set Baud Rate (bps)
2. Data Bits
3. Parity
4. Stop Bits
5. CTS
6. DSR
7. Terminal

Parity

Stop Bits

CTS

DSR

Terminal

1. Change Password
2. Pop Alarm
3. Security Timeout

Date & Time Update

1. Set Time (hh:mm:ss)
2. Set Date (dd/mm/yyyy)
3. Set Date Format

Set Date Format

1. dd/mm/yyyy
2. mm/dd/yyyy
3. yyyy/mm/dd

Figure 5-14. **Configuration>System** *Submenu Structure (FCD-155 SONET Version)*

Mapping Procedures

Purpose

Map the payload from the various FCD-155 interfaces to specific TUs or SPEs in the network link, for transmission through the SDH/SONET network.

- For FCD-155 units, even when equipped with dual links, only one link is active at any time, and therefore only one mapping display is required.

  A description of typical FCD-155 mapping screens appears below. A description of the FCD-155 mapping procedures appears on page *5-25*.

- For FCD-155E versions, which have a cross-connect matrix, separate mappings to each link are also possible. Mapping between the links is also possible (such cross-connections are required to continue the payload at add-drop locations).

  A description of FCD-155E mapping screens and associated mapping procedures starts on page *5-25*.

Reached from

Configuration›System

Typical Mapping Screens – FCD-155 Units

Figure 5-15 to *Figure 5-17* show typical SONET and SDH mapping screens.

Note   *No groups (**VCG**) appear on the mapping screens of the FCD-155 with single Ethernet port.*

```
                          FCD-155/6U/4T1
Configuration>System>Mapping
              STS-1 1                  STS-1 2                  STS-1 3
         TU1  TU2  TU3  TU4                               TU1   TU2   TU3   TU4
 TUG2-1 VCG1 VCG1 VCG1 VCG2      --- ---- ---- ---        None None None None
 TUG2-2 VCG2 VCG2 None None       |                |      None None None None
 TUG2-3 None None None None       |                |      None None None None
 TUG2-4 None None None None       |      VCG3      |      None None None None
 TUG2-5 None None None None       |                |      None None None None
 TUG2-6 None None None None       |                |      None None None None
 TUG2-7 None None None None       --- ---- ---- ---        None None None None


 1. VCG1 3. VCG3 5. VCG5 7. VCG7  9. Ex1 11. Ex3 13. None
 2. VCG2 4. VCG4 6. VCG6 8. VCG8 10. Ex2 12. Ex4
>
ESC-prev.menu; !-main menu; &-exit; @-output; ?-help                     1M/1C
--------------------------------------------------------------------------------
```

*Figure 5-15. Typical SONET **Mapping** Screen (FCD-155 with Quad T1 PDH Ports and 6 LAN Ports)*

```
                               FCD-155/6U/4T1
Configuration>System>Mapping


              TUG3 1                      TUG3 2                     TUG3 3
        TU1   TU2   TU3   TU4       TU1   TU2   TU3   TU4      TU1   TU2   TU3   TU4
 TUG2-1 VCG1  VCG1  VCG1  N/A       VCG8  VCG8  VCG8  N/A      None  None  None  None
 TUG2-2 VCG2  VCG2  VCG2  N/A       Ex1   Ex2   Ex3   Ex4      None  None  None  None
 TUG2-3 VCG3  VCG3  VCG3  N/A       None  None  None  None     None  None  None  None
 TUG2-4 VCG4  VCG4  VCG4  N/A       None  None  None  None     None  None  None  None
 TUG2-5 VCG5  VCG5  VCG5  N/A       None  None  None  None     None  None  None  None
 TUG2-6 VCG6  VCG6  VCG6  N/A       None  None  None  None     None  None  None  None
 TUG2-7 VCG7  VCG7  VCG7  N/A       None  None  None  None     None  None  None  None


 1. VCG1 3. VCG3 5. VCG5 7. VCG7  9. Ex1 11. Ex3 13. None
 2. VCG2 4. VCG4 6. VCG6 8. VCG8 10. Ex2 12. Ex4
>
ESC-prev.menu; !-main menu; &-exit; @-output; ?-help                      1M/1C
-------------------------------------------------------------------------------
```

*Figure 5-16. Typical SDH **Mapping** Screen (FCD-155 with Quad T1 PDH Ports and 6 LAN Ports)*

```
                               FCD-155/6U/E3
Configuration>System>Mapping


              TUG3 1                    TUG3 2                TUG3 3
        TU1    TU2    TU3                                TU1    TU2    TU3
 TUG2-1 VCG1   VCG1   VCG2       ---  ----  ---          None   None   None
 TUG2-2 None   None   None       |              |        None   None   None
 TUG2-3 VCG2   VCG2   None       |              |        None   None   None
 TUG2-4 VCG3   VCG3   VCG8       |    Ex1       |        VCG4   VCG4   None
 TUG2-5 VCG8   VCG8   VCG8       |              |        None   None   None
 TUG2-6 None   None   None       |              |        None   None   None
 TUG2-7 None   None   None       ---  ----  ---          None   None   None


 1. VCG1 3. VCG3 5. VCG5 7. VCG7  9. Ex1
 2. VCG2 4. VCG4 6. VCG6 8. VCG8 10. None

>

ESC-prev.menu; !-main menu; &-exit; @-output; ?-help                      1M/1C
-------------------------------------------------------------------------------
```

*Figure 5-17. Typical SDH **Mapping** Screen (FCD-155 with E3 PDH Port and 6 LAN Ports)*

Each mapping screen has two main parts:

- **Map section**: displays the current utilization of the link. The map is organized as a table that initially shows all the VC-12s/VC-11s or VT-1.5s in the STM-1 or STS-3 frame; after assigning (mapping) bandwidth to the external ports or virtually concatenated groups, the map changes to show the mapped entities.

  The map is organized as follows:

  ▪ The table includes three main sections, one for each TUG-3 (for FCD-155 with SDH network interface) or STS-1 (for FCD-155 with SONET network interface).

- When an external port or a group uses a whole VC-3 or STS-1 SPE, it is represented as a single block under the corresponding TUG-3/STS-1. See for example *Figure 5-15*, where STS-1 No. 2 is assigned to **VCG2**, or *Figure 5-17,* where TUG-3 No. 2 is assigned to **Ex1**).

- For other mappings, these sections are subdivided as follows:

  □ SONET: each STS-1 section has four columns, TU1 to TU4, one for each VT-1.5 in each TUG-2. See *Figure 5-15* for an example.

  □ SDH with T1 interfaces: each TUG-3 section has four columns, TU1 to TU4. The columns represent either VC-12s or VC-11s in each TUG-2. When representing VC-12s, the fourth column is always **N/A** and cannot be changed (for an example, see TUG-3 No. 1 in *Figure 5-16*); when representing VC-11s, the fourth column is either **None** or is assigned to an external port (for an example, see TUG-3 No. 2 in *Figure 5-16*).

Note   *A TUG-2 can be used either to carry 3 VC-12 or 4 VC-11. Therefore, after making any selection in a TUG-2, the FCD-155 automatically determines the associated VC type and immediately adjust the allowed selections accordingly.*

*For example, if the TUG-2 is originally empty (**None** in all positions), after mapping a group the fourth column automatically changes to **N/A**. However, if you first map an external T1 port, the group options disappear (groups require VC-12s).*

  □ SDH with E1 interfaces: each TUG-3 section has three columns, one for each VC-12 in each TUG-2 (see *Figure 5-17* for an example).

Note   *When virtually concatenated groups have been configured by means of the **Quick Setup** screen, they are automatically mapped according to the factory-defaults, and appear on the map in the automatically assigned positions.*

- **List of payload types to be mapped**. Each item in the list is assigned a number. The payload types are identified as follows:

  - **Ex** – external PDH port. The supported range depends on the number of active (enabled) PDH ports. For FCD-155, the maximum range is **Ex1** to **Ex8**, in accordance with the installed PDH option. By default, all the external ports are disabled; you can select the initial number of ports to be enabled on the **Quick Setup** screen (see *Section 5.4*), or enable the required number using the appropriate **Physical Ports** configuration screens.

  - **VCG** – virtually concatenated group. The supported range depends on the number of currently defined virtually concatenated groups; the maximum range is **VCG1** to **VCG8** for an FCD-155 with GbE port, or transparent LAN ports.

  In addition, there is a **None** selection, used to disconnect a TU.

Note   *To see the navigation keys available for the mapping screen, type* **?** *(help). The help screen is automatically updated in accordance with the current position of the cursor: for example, when the cursor is at the leftmost position, the keys for moving the cursor to the left are not displayed.*

➤ **To map a payload unit on the FCD-155:**

1. Move the selection block to an unassigned cell (i.e., a cell that shows **None**). The selected cell in all the screens shown above (*Figure 5-15* to *Figure 5-17*) is that corresponding to the first TU in the STM-1/STS-3 frame.

Note   *If the desired cell is currently assigned, before continuing to* Step 2 *type the number corresponding to* **None** *and then press* **‹Enter›**.

2. When the selection block is in the desired cell, type the number of the desired group or port and then press **‹Enter›**. The corresponding designation appears in the selected cell.

➤ **To save the new mapping configuration:**

1. Type **#** to save and then confirm the action. The FCD-155 checks your configuration and saves it only if no errors are detected.

2. If errors are detected in your mapping, the new mapping cannot be saved. In this case, the FCD-155 will display **Error in configuration. Do you want to see errors?**:

   ▪ To ignore, type **n**. Now you can return to the mapping screen and correct the errors.

   ▪ To see the errors, type **y**. You will see the **Sanity** screen (normally reached from **Monitoring›System›Display Sanity**). Now select **1 – Errors and Warnings** to display the list of sanity errors. Refer to *Chapter 7* for an explanation of the error messages that may be displayed.

Typical Mapping Screens – FCD-155E

The FCD-155E includes a cross-connect matrix that permits mapping to each of the two network links, **Link 1** and **Link 2**.

Note   *The mapping between links need not be symmetrical: the cross-connected entities can be located in different positions, that is, you can remap traffic as it passes through the FCD-155E.*

The first operation after selecting **Mapping** is the selection of a target link. A typical link selection screen is shown in *Figure 5-18*.

```
                                      FCD-155E
Configuration>System>Mapping


 1. Link 1 []>
 2. Link 2 []>

>


ESC-prev.menu; !-main menu; &-exit; @-debug                                1M/1C
-------------------------------------------------------------------------------
```

*Figure 5-18. Typical **Mapping** Link Selection Screen*

After selecting a link, the corresponding mapping screen is displayed. The screen includes the regular mapping display, and the list of payload selections. In most cases, the list is rather long (for FCD-155E, the maximum number of external PDH ports is 28); therefore, it is necessary to use the scrolling keys. For FCD-155E, the list always ends with the mapping options to the other link.

A typical screen for link 1, showing the last section with the mapping options to link 2, is shown in *Figure 5-19*. The screen labels depend on the network interface version, SDH or SONET, the same as for the FCD-155 versions.

```
                                      FCD-155E
Configuration>System>Mapping>Link 1


              TUG3  1                TUG3  2                 TUG3  3
         TU1    TU2    TU3      TU1    TU2    TU3       TU1    TU2    TU3
 TUG2-1 VCG1   VCG1   VCG1     VCG8   VCG8   VCG8      None   None   None
 TUG2-2 VCG2   VCG2   VCG2     Ex1    Ex2    Ex3       None   None   None
 TUG2-3 VCG3   VCG3   VCG3     Ex4    Ex5    Ex6       None   None   None
 TUG2-4 VCG4   VCG4   VCG4     Ex7    Ex8    Ex9       None   None   None
 TUG2-5 VCG5   VCG5   VCG5     Ex10   None   None      None   None   None
 TUG2-6 VCG6   VCG6   VCG6     None   None   None      None   None   None
 TUG2-7 VCG7   VCG7   VCG7     None   None   None      None   None   None

... (P)
17. Ex8    18. Ex9   19. Ex10  20. L2    21. L2VC3 22. L2VC4

>

Link 1  1:1:1

ESC-prev.menu; !-main menu; &-exit; @-debug; ?-help                        1M/1C
-------------------------------------------------------------------------------
```

*Figure 5-19. Typical **Mapping** Screen for Source Link (SDH FCD-155E Version)*

➤ To map payload to an FCD-155E link:

Use the procedure given above for the FCD-155 versions.

➤ **To map payload between FCD-155E links:**

Note

> *The following instructions are given for SDH links; for SONET links, the labels differ as illustrated above for the FCD-155 versions, but the procedure is identical.*

1. For any level of bypassing except VC-4, move the selection block to the desired position on the map of the source link. The position of the selection block appears at the bottom of the screen, in the format **Link x A:B:C,** where **x** stands for the number of the source link (for example, **Link 1** in *Figure 5-19*), **A** stands for the TUG-3/STS-1 number, **B** stands for the TUG-2, and **C** stands for the TU-12/TU11/VT-1.5.

   For the VC-4 level, there is no need to move the selection block: any position will do.

2. Type the number of the payload to be mapped (you may have to scroll using the **N** and **P** keys); to deselect (cancel) a mapping, select **None**. The following types of destination-link identifiers are used:

   ▪ **Ly**, where **y** stands for the number of the destination link (for example, **L2** in *Figure 5-19*): used to map an individual VC-12/VC-11

   ▪ **LyVC3**: used to bypass a whole VC-3

   ▪ **LyVC4**: used to map the whole VC-4 (full bypass between the two links).

Note

> *It is not possible to bypass an already mapped entity (for VC-3 and VC-4 cross-connections, no mappings are permitted within the entity): any existing mapping must be cancelled before a bypass selection may be made.*
>
> *If mappings are present, your selection is rejected and you see the **ERROR** indicator at the top right-hand corner.*

3. To confirm the selection, press ‹**Enter**›: the map of the destination link is automatically displayed, as shown in *Figure 5-20* (the selection for this display was **21: L2VC3**).

4. Move the selection block to desired position on the destination link map. The position of the selection block appears at the bottom of the screen, in the format **Bypass from Link x A1:B1:C1 to Link y**, A2:B2:C2:

   ▪ For VC-3 and VC-4, the lower levels are not displayed

   ▪ For VC-4, there is no need to move the selection block.

5. When the correct position is marked, type 1 to **SET** and then press ‹**Enter**› to confirm.

```
                                    FCD-155E
Configuration>System>Mapping>Link 2


               TUG3  1                TUG3  2                TUG3  3
        TU1    TU2    TU3      TU1    TU2    TU3      TU1    TU2    TU3
 TUG2-1 None   None   None     None   None   None     None   None   None
 TUG2-2 None   None   None     None   None   None     None   None   None
 TUG2-3 None   None   None     None   None   None     None   None   None
 TUG2-4 None   None   None     None   None   None     None   None   None
 TUG2-5 None   None   None     None   None   None     None   None   None
 TUG2-6 None   None   None     None   None   None     None   None   None
 TUG2-7 None   None   None     None   None   None     None   None   None


 1. SET


>


Bypass From Link 1  TUG3-1 to Link 2  TUG3-1


ESC-prev.menu; !-main menu; &-exit; @-debug; ?-help                     1M/1C
-------------------------------------------------------------------------------
```

*Figure 5-20. Typical **Mapping** Screen for Destination Link (SDH FCD-155E Version)*

6. The destination map display closes, and the new selection appears in the source map, in the format **Ly**. See example in *Figure 5-21*.

```
                                    FCD-155E
Configuration>System>Mapping>Link 1


                TUG3   1                TUG3  2                TUG3  3
                                 TU1    TU2    TU3      TU1    TU2    TU3
 TUG2-1   ---   ----   ---       VCG8   VCG8   VCG8     None   None   None
 TUG2-2   |             |        Ex1    Ex2    Ex3      None   None   None
 TUG2-3   |             |        Ex4    Ex5    Ex6      None   None   None
 TUG2-4   |     L2      |        Ex7    Ex8    Ex9      None   None   None
 TUG2-5   |             |        Ex10   None   None     None   None   None
 TUG2-6   |             |        None   None   None     None   None   None
 TUG2-7   ---   ----   ---       None   None   None     None   None   None

>

Link 1  TUG3-1 -> Link 2  TUG3-1
# - Save; % - Undo
ESC-prev.menu; !-main menu; &-exit; @-debug; ?-help                     1M/1C
-------------------------------------------------------------------------------
```

*Figure 5-21. Typical **Mapping** Screen for Source Link after Cross-Connect is Confirmed (SDH FCD-155E Version)*

7. Repeat the procedure as required, until all the necessary entities are mapped, and then use the **#** command to save and update database.

Configuring Device Info Parameters

Purpose

Display basic information on the FCD-155 unit, and define logistics information.

The information entered by you on this screen can also be displayed by management stations.

Reached from

Configuration >System >Management

A typical **Device Information** screen for a FCD-155E is shown in *Figure 5-22*.

```
                              FCD-155E
Configuration>System>Management>Device Info

     Object Id              ... (radFcd155E/APS)
     Hardware version       ... (1.0)
     Software version       ... (1.00B3)
     System Up Time         ... (0 day 02:37:12)
     sysDescr               ... (   FCD-155E HW Version:1.0 SW version:1.00B3)
  1. Device Name            ... (   FCD-155E)
  2. Contact Person         ... (Name of contact person)
  3. Location               ... (The location of this device)

>

Standard device information

ESC-prev.menu; !-main menu; &-exit; @-output                           1M/1C
-----------------------------------------------------------------------------
```

Figure 5-22. Typical **Device Information** *Screen (FCD-155E)*

The **Device Info** screen includes two sections:

- Read-only device information:

  Object ID   Displays the formal FCD-155 object identifier (its MIB root).

  Hardware Version   Displays the hardware version of the FCD-155 main board.

  Software Version   Displays the software version currently used by the FCD-155.

  System Up Time   Displays the time elapsed since the FCD-155 has been powered up.

  sysDescr   Displays the formal FCD-155 system descriptor (as defined in its MIB).

- Logistics data, which can be defined by the user:

    Device Name   Used to assign an arbitrary name to the FCD-155 unit (up to 40 characters).

    Contact Person   Used to enter the name of the person to be contacted in matters pertaining to this equipment unit (up to 40 characters).

    Location   Used to enter a description of the physical location of this equipment unit.

➤ **To define or modify logistics data:**

1. Type the number of the desired type of data and then press ‹**Enter**›.

2. Type the desired string. If you exceed the maximum allowed length of the string for the selected field, the excess characters are ignored.

3. After checking your entry, press ‹**Enter**› to confirm.

4. Repeat the steps listed above to define all the required fields.

5. Type **#** to save and then confirm the action.

Configuring Host IP Parameters

Purpose

Define the FCD-155 management agent parameters. The following types of parameters must be configured:

- IP address configuration mode – manual or DHCP

- When using the manual IP address configuration mode: IP communication parameters

- SNMP communities.

When VLANs are used for management traffic, you can also configure the management VLAN parameters.

Note   *FCD-155 with single Ethernet port does not support management VLAN tagging. Therefore, the items related to this options do not appear on **Host IP** screens of FCD-155 with single Ethernet port.*

Reached from

Configuration ›System ›Management

Typical **Host IP** screens are shown in *Figure 5-23* and *Figure 5-24*.

The parameters that can be configured by means of the **Host IP** screen are explained in *Table 5-3.*

Note   *The community names are case-sensitive. See also Appendix C.*

```
                                FCD-155
Configuration>System>Management>Host Ip

 1. DHCP Client                 >    (No)
 2. IP address                  ... (172.17.171.234)
 3. Subnet Mask                 ... (255.255.255.0)
 4. Default Gateway             ... (172.17.171.1)
 5. Read Community              ... ()
 6. Write Community             ... ()
 7. Trap Community              ... ()
 8. Host Encapsulation          >
 9. NSAP Address                >
10. Static Forwarding Table     []>

>


Please select item <1 to 8>
# - Db Update; % - Db Undo; $ - Show sanity
ESC-prev.menu; !-main menu; &-exit; @-debug                            1M/1C
------------------------------------------------------------------------------
```

Figure 5-23. Typical **Host IP** *Screen – Manual IP Address Configuration (DHCP Client Disabled)*

```
                                FCD-155
Configuration>System>Management>Host IP

 1. DHCP Client                     (Yes)
 2. Read                        ... (public)
 3. Write                       ... (private)
 4. Trap                        ... (public)
 5. Host Encapsulation >

>

Management interfaces available on the system

ESC-prev.menu; !-main menu; &-exit; @-output                          1M/1C
------------------------------------------------------------------------------
```

Figure 5-24. Typical **Host IP** *Screen – Automatic IP Address Configuration (DHCP Client Enabled)*

➤ **To manually define the Host IP parameters:**

1. Select **NO** for **DHCP Client** (the selection is toggled each time you select item **1**).

2. Select the number of the desired parameter and then press **‹Enter›**:

   ▪ For the **Host Encapsulation** item, you will see a separate parameters selection screen. The parameters are also explained in *Table 5-3*

   ▪ For the other items, you can then enter the desired value in the same line.

➤ **To enable automatic IP address configuration using DHCP:**

1. Select **YES** for DHCP client. After saving this selection, a new item appears, **DHCP Status**.

2. Configure the SNMP communities.

3. To monitor the DHCP protocol status, type **5**. A typical **DHCP Status** screen is shown in *Figure 5-25*.

```
                                FCD-155
Configuration>System>Management>Host IP>DHCP_Status


    Current Status        >    (Trying to locate available server)

>


ESC-prev.menu; !-main menu; &-exit; @-output                              1M/1C
-----------------------------------------------------------------------------

```

*Figure 5-25. Typical **DHCP Status** Screen*

Table 5-3. Host IP Parameters

Parameter	Function	Values	
DHCP Client	Controls the method used to assign an IP address to the FCD-155 management agent	**NO**	The IP address is manually configured using the **Host IP** field.
		YES	The FCD-155 management agent operates as a DHCP client, and therefore its IP address must be assigned using the DHCP protocol.
		Default: NO	
Host IP Address	When **DHCP Client** is **NO:** used to enter the IP address of the FCD-155 management agent. When **DHCP Client** is **YES**: this field appears only after an IP address has been assigned by the DHCP server. The address displayed in this field cannot be changed	When **DHCP Client** is **NO:** type the desired IP address, using the dotted-quad format (four groups of digits in the range of 0 through 255, separated by periods). **Default: 0.0.0.0**	
Subnet Mask	When **DHCP Client** is **NO:** used to enter the IP subnet mask of the FCD-155 management agent. When **DHCP Client** is **YES**: this field appears only after an IP subnet mask has been configured by the DHCP server. The address displayed in this field cannot be changed	When **DHCP Client** is **NO:** type the desired IP subnet mask, using the dotted-quad format. Make sure to select a subnet mask compatible with the selected IP address, and whose binary representation consists of consecutive "ones", followed by the desired number of consecutive "zeroes". **Default: 0.0.0.0**	

Table 5-3. Host IP Parameters (Cont.)

Parameter	Function	Values
Default Gateway	When **DHCP Client** is **NO:** used to specify the IP address (usually an IP router port) to which the FCD-155 management agent will send packets when the destination IP address is not within the subnet specified in the **Mask** field. The default value, 0.0.0.0, means that no default gateway is defined. When **DHCP Client** is **YES:** this field appears only after a default gateway IP address has been configured by the DHCP server. The address displayed in this field cannot be changed	When **DHCP Client** is **NO:** type the desired IP address, using the dotted-quad format. Make sure the IP address address is within the subnet of the host IP address. **Default: 0.0.0.0**
Read	Enter here the read-only SNMP community name to be accepted by the FCD-155 management agent. SNMP-based management stations using this community will not be able to modify the FCD-155 configuration, nor initiate diagnostic activities	Enter the desired alphanumeric string (pay attention to case). **Default: public**
Write	Enter here the read-and-write SNMP community name to be accepted by the FCD-155 management agent. Use this community for SNMP-based management stations that must be able to perform all the activities	Enter the desired alphanumeric string (pay attention to case). **Default: private**
Trap	Enter here the SNMP community name that will be specified by the FCD-155 management agent in the traps sent to SNMP-based management stations	Enter the desired alphanumeric string (pay attention to case). **Default: public**
DHCP Status	Field displayed only when **DHCP Client** is **YES:** displays DHCP status information (see typical screen in *Figure 5-25*)	See *Table 5-4*

Table 5-4. DHCP Status Parameters

Parameter	Meaning
Server ID	Displays the IP address of the DHCP server that provides the IP address, IP subnet and default gateway parameters.
	This field appears only after a DHCP server has been discovered
Lease Expiration Time	Displays the date and time at which the current set of parameters provided by the DHCP server will expire.
	This field appears only after the DHCP server has provided the required parameters
Current Status	Displays the status of the DHCP protocol exchange:
	Trying to locate available server: the FCD-155 DHCP client is trying to find a DHCP server (DHCP discovery state)
	Waiting for confirmation of lease: the FCD-155 DHCP client is trying to obtain the required parameters from the DHCP server that has been identified (its IP address appears in the **Server ID** field)
	Holding lease: the FCD-155 has received the required parameters and they are valid. The assigned host IP address, IP subnet and default gateway are displayed in the corresponding fields of the **Host IP** screen (see *Table 5-3*). The expiry time is displayed in the **Server ID** field
	T1 expired: Asking for extension of lease: the lease over the original parameters has expired, and the FCD-155 DHCP client is sending a **Renewing** request in accordance with the DHCP protocol
	T2 expired: Asking for extension of lease: the lease over the original parameters has expired, and the FCD-155 DHCP client is in the **Rebinding** state of the DHCP protocol
	Restarting the process: the FCD-155 DHCP client restarts the whole process (sending a DHCP discovery request again)

➤ **To enable Host Encapsulation:**

1. Select **Host Encapsulation** for the Host IP menu. A typical **Host Encapsulation** screen is shown in *Figure 5-26*

2. Configure the Host Tagging, Host VLAN ID, and Host VLAN Priority Tag.

```
                              FCD-155
Configuration>System>Management>Host IP> Host Encapsulation


 1. Host Tagging                    (No)
 2. Host VLAN ID[1 - 4094]      ... (0)
 3. Host VLAN Priority Tag[0 - 7]... (0)


ESC-prev.menu; !-main menu; &-exit; @-output                          1M/1C
----------------------------------------------------------------------------
```

Figure 5-26. Typical **Host Encapsulation** Screen

Table 5-5. **Host Encapsulation** Parameters

Parameter	Function	Values

Host Tagging	Controls the use of VLAN tagging for the FCD-155 management traffic.	**YES**	Management VLAN tagging is enabled. In this case, make sure to configure a forwarding rule for the VLAN ID specified in the **Host VLAN ID** field.
	For an FCD-155 whose bridge is configured as **VLAN-unaware**, the only relevant selection is **No**. You can however select **YES** and configure the relevant parameters, but the VLAN information is ignored until the bridge is configured as **VLAN aware**.	**NO**	Management VLAN tagging is disabled.
			Default: NO
	This parameter is not displayed for an FCD-155 with single Ethernet port		
Host VLAN ID	When management VLAN tagging is enabled, specifies the VLAN ID number used by the management traffic sent through this port.		The allowed range is 1 to 4094. **0** means that no VLAN ID has been specified.
	When management VLAN tagging is disabled or the bridge is **VLAN-unaware**, this parameter is ignored.		**Default: 0**
	This parameter is not displayed for an FCD-155 with single Ethernet port		
Host VLAN Priority	When management VLAN tagging is enabled, specifies the priority assigned to the management VLAN traffic sent through this port.		The allowed range is 7 (highest priority) to 0 (lowest priority).
	When management VLAN tagging is disabled or the bridge is **VLAN-unaware**, this parameter is ignored.		**Default: 0**
	This parameter is not displayed for an FCD-155 with single Ethernet port		

➤ **To configure the NSAP address:**

1. Select **NSAP address** from the Host IP menu. The NSAP address screen appears (*Figure 5-27*).

2. Configure the area ID and system ID.

```
                        FCD-155
Configuration>System>Management>Host IP> NSAP Address

 1. Area ID              ... ()
 2. System ID            ... ()
    NSAP Address         ... ()


ESC-prev.menu; !-main menu; &-exit; @-output                           1M/1C
-----------------------------------------------------------------------------
```

*Figure 5-27. Typical **NSAP Address** Screen*

*Table 5-5. **NSAP Address** Parameters*

Parameter	Function	Values

Area ID	Sets the area ID	Area ID of the device
System ID	Sets the system ID	System ID of the device
NSAP Address	Displays the NSAP address	(Read only)

➤ **To configure the Static Forwarding Table:**

The static forwarding table contains the IP addresses, IP masks, and NSAP destinations of up to 20 referring static IP interfaces.

1. Select **Static Forwarding Table** from the Host IP menu. The Static Forwarding Table screen appears (*Figure 5-28)*.

2. To change a table entry, select **Change Cell** and configure the destination IP address, destination mask, and area ID of the destination system.

```
                             FCD-155
Configuration>System>Management>Host IP>Static Forwarding Table

 Index    Dest IP Address    Dest Mask           Area ID
   1       0.0.0.0.           0.0.0.0.


 1. Change cell                  ... (0.0.0.0)
>

ESC-prev.menu; !-main menu; &-exit
------------------------------------------------------------------------------
```

Figure 5-28. **Static Forwarding Table** *Screen*

Table 5-6. Static Forwarding Parameters

Parameter	Function	Values
Dest IP Address	IP address of the destination system	xxx.xx.xxx.xxx
Dest Mask	IP mask of the destination system	xxx.xx.xxx.xxx
Area ID	Area ID of the remote ES (end system)	20 bytes long
System ID	System ID of the remote ES (end system)	

Configuring Manager List Parameters

Purpose

Define the IP addresses of network management stations that may manage the FCD-155.

The maximum number of network management stations is 10.

Reached from

Configuration ›System ›Management

The first page of a typical **Manager List** screen, which includes the first 5 management stations, is shown in *Figure 5-29*. To continue to the next page, type **D** until the 6th line is reached.

Note   *To see the navigation keys available for this screen, type ? (help).*

```
                              FCD-155
Configuration>System>Management>Manager List


    Managers ID       IP Address
          1              0.0.0.0
          2              0.0.0.0
|         3              0.0.0.0
v         4              0.0.0.0
          5              0.0.0.0

 1. Change cell                    ... (0.0.0.0)



>


10 managers may be defined

ESC-prev.menu; !-main menu; &-exit; @-output; ?-help                    1M/1C
-------------------------------------------------------------------------------
```

*Figure 5-29. Typical **Manager List** Screen (First Page)*

The screen includes two columns:

Managers ID   Index number of management station, 1 to 10.

IP Address   The IP address of the management station.

➤   **To define a management station:**

1. Move the selection block to the desired row.

2. Type **1 – Change Cell**, and then press ‹**Enter**›. Now you can enter the desired IP address, in the dotted-quad format. Press ‹**Enter**› to end.

3. Repeat the process until all the desired management stations have been defined.

4. When done, type **#** to save and then confirm the action.

Configuring Management Access Parameters

Purpose

Define the additional management access options: SNMP, Telnet, and/or Web browser.

The supervisory terminal is always available, and therefore does not appear on this screen.

Reached from

Configuration >System >Management

A typical **Management Access** screen is shown in *Figure 5-30*.

```
                              FCD-155
Configuration>System>Management>Management Access

 1. SNMP                              >    (On)
 2. Telnet                            >    (On)
 3. WEB                               >    (On)

>


Management Access options

ESC-prev.menu; !-main menu; &-exit; @-output                        1M/1C
-------------------------------------------------------------------------
```

Figure 5-30. Typical **Management Access** *Screen*

➤ **To change the access rights:**

1. Type the number corresponding to the management means to be modified, and then press **‹Enter›** to display the selection screen.

2. On the selection screen, type the number of the desired option and then press **‹Enter›**. The selection screen closes.

3. Repeat the process until all the desired management access means have been defined.

4. When done, type **#** to save and then confirm the action.

Configuring Control Ports Parameters – FCD-155

Purpose

Define the FCD-155 CONTROL port parameters. Two types of parameters can be defined:

- Serial port communication parameters. These parameters are configured directly on the **Control Ports** screen.

- Operational and security parameters. These parameters are configured on the **Terminal** screen, reached from the **Control Ports** screen.

Reached from

Configuration >System

Changing the Serial Port Parameters

A typical **Control Ports** screen is shown in *Figure 5-31*. Note that the screen displays the current values of each parameter.

```
                                FCD-155
Configuration>System>Control Ports

 1. Set Baud Rate  (bps) >    (115200Bps)
 2. Data Bits            >    (8)
 3. Parity               >    (None)
 4. Stop Bits            >    (1)
 5. CTS                  >    (equal RTS)
 6. DSR                  >    (On)
 7. Terminal             >

>


ESC-prev.menu; !-main menu; &-exit; @-output                        1M/1C
--------------------------------------------------------------------------
```

*Figure 5-31. Typical FCD-155 **Control Ports** Screen*

➤ **To change the CONTROL serial port communication parameters:**

1. Type the number corresponding to the desired parameter, and then press ‹**Enter**› to display the selection screen.

2. On the selection screen, type the number of the desired option and then press ‹**Enter**›. The selection screen closes.

3. Repeat the process until all the desired communication parameters (items **1** to **6**) have been defined.

4. To continue to the operational and security parameters screen, type **7** and then press ‹**Enter**›.

5. When done, type **#** to save and then confirm the action.

Note   *After changing the CONTROL port communication parameters, you must reconfigure the communication parameters of the supervisory terminal before it is possible to establish again communication with the FCD-155.*

The same is true when you change the terminal emulation mode.

The serial port communication parameters that can be configured by means of the **Control Ports** screen are described in *Table 5-7*.

*Table 5-7. **Configuration>Control Ports** Serial Port Communication Parameters*

Parameter	Function	Values
Baud Rate	Selects the supervisory port data rate	The supported rates are **300, 1200, 2400, 4800, 9600, 19200, 38400, 57600,** and **115200** bps. **Default: 115200bps**
Data Bits	Selects the number of data bits in the word format	The available selections are **7** or **8** data bits. **Default: 8**
Parity	Controls the use of parity	**ODD** — Odd parity. **EVEN** — Even parity. **NONE** — Parity disabled. **Default: NONE**
Stop Bits	Selects the number of stop bits in the word format	The available selections are **1** or **2** stop bits. **Default: 1**
CTS	Controls the state of the CTS line in the CONTROL port	**ON** — The CTS line is always ON (active). **=RTS** — The CTS line tracks the RTS line. **Default: ON**
DSR	Controls the state of the DSR line in the CONTROL port	**ON** — The DSR line is always ON (active). **=DTR** — The DSR line tracks the DTR line. **Default: ON**
Terminal	Opens the **Terminal** screen	

Change Terminal Parameters

➤ **To change the operational parameters:**

1. Type **7** on the **Control Ports** screen (*Figure 5-31*) and then press **‹Enter›**.

2. You will see the **Terminal** screen. A typical **Terminal** screen is shown in *Figure 5-32*. Note that the screen shows the current values for the various parameters (except the password).

```
                          FCD-155
Configuration>System>Control Ports>Terminal

 1. Change Password>
 2. Pop Alarm           (OFF)
 3. Security Timeout>   (Timeout 3 min)

>


ESC-prev.menu; !-main menu; &-exit; @-output                          1M/1C
-------------------------------------------------------------------------
```

*Figure 5-32. Typical **Terminal** Screen*

3. Type the number corresponding to the desired parameter, **2** or **3** and then press **‹Enter›** to display the corresponding selection screen.

   The parameters that can be configured by means of the **Terminal** screen are described in *Table 5-8*.

Note   *See separate procedure for changing the password.*

4. On the selection screen, type the number of the desired option and then press **‹Enter›**. The selection screen closes.

5. When done, type **#** to save and then confirm the action.

*Table 5-8. **Configuration›Terminal** Operational Parameters*

Parameter	Function	Values	
Pop Alarm	Enable/disable the automatic display of alarms on the terminal	YES	The terminal automatically displays any event or new alarm, or change in the state of an alarm.
		NO	The automatic display feature is disabled.
		Default: NO	
Security Timeout	Controls the idle disconnect time of the CONTROL port	None	Automatic session disconnection disabled. To disconnect the session, use the **&** (exit) command. For other types of sessions (Telnet, Web), the automatic disconnection is always set to 3 minutes.
		3 min	Automatic disconnection after ten minutes if no input data is received by the CONTROL port.
		10 min	Automatic disconnection after ten minutes if no input data is received by the **CONTROL** port.
		Default: 3 min	

Changing the Security Parameters

The FCD-155 supports four access levels, as explained in *Chapter 4*. The unit is delivered with four factory-default user names, one for each access level, and with default passwords.

You can manage the users list (add/delete users) and assign passwords to the various users by means of the item **3 – Change Password** on the **Terminal** screen.

➤ **To access the users security functions:**

1. Type **3** on the **Terminal** screen to display the **Change Password** submenu (*Figure 5-33*)

2. Type the number corresponding to the desired task:

   ▪ To change the current password assigned to a user, select **1**

▪   To add/delete users, select **2**.

Note   *It is not possible to change the access level of an existing user. You must delete the user, and then define another user with the desired attributes.*

```
                                FCD-155
...>System>Control Ports>Terminal>Change Password

 1. Change User details    >
 2. Show all users        []>

>

Please select item <1 to 2>

ESC-prev.menu; !-main menu; &-exit; @-output                        1M/1C
----------------------------------------------------------------------
```

Figure 5-33. Typical **Change Password** *Screen*

➤   **To change the current password of a user:**

1.   After typing **1** on the **Change Password** screen and pressing **‹Enter›**, you will see the **Change User Details** screen.

2.   On the **Change User Details** screen, type **1** and then press **‹Enter›**. You can now type the desired user name. When done, press **‹Enter›** to continue.

3.   On the **Change User Details** screen, select **1.** Now enter the current password, to verify your authorization, and then press **‹Enter›**.

Note   *Password characters are not displayed on the screen (only an asterisk ***** appears for each character you type). The string changes to 8 asterisks after pressing **‹Enter›**, irrespective of the number of characters typed.*

4.   If your password is accepted, select **2**: the screen changes to the password entry screen.

5.   On the password entry screen, select **1** and then type the new password (4 to 8 characters). Pay attention to case.

6.   After pressing **‹Enter›**, the screen is updated.

7.   A typical **Change User Details** screen, as seen after Step 6, is shown in *Figure 5-34*. Select again **1** and then type the new password a second time for confirmation. Press **‹Enter›** when done.

```
                              FCD-155
...>Control Ports>Terminal>Change Password>Change User details


    Enter UserName (to change)    ... (su)
    New Password                  ... (********)
 1. Confirm Password              ... ()

>


ESC-prev.menu; !-main menu; &-exit; @-output                              1M/1C
------------------------------------------------------------------------------
```

*Figure 5-34. Typical **Change User Details** Screen*

8. To activate the new password, type **#** to save and then confirm the action.

➤ **To manage the users list:**

1. Type **2** on the **Change Password** screen and then press **‹Enter›** to display the current list of users. *Figure 5-35* shows a typical screen with factory-defaults.

```
                              FCD-155
...>Control Ports>Terminal>Change Password>Show all users

 User ID       UserName           Access Level
 1             su                 Administrator
 2             oper               Operator
 3             tech               Technician
 4             user               Monitor

>


ESC-prev.menu; !-main menu; &-exit; @-output; ?-help                      1M/1C
------------------------------------------------------------------------------
```

*Figure 5-35. Typical **Show All Users** Screen*

Note   *To see the options available for this screen, display the help screen by typing ?.*

2. To delete an existing user, move the cursor to the appropriate row and then type **R**. You will be required to confirm.

3. To add a new user, type **A**. You will see the **Add New User** screen. A typical screen is shown in *Figure 5-36*.

```
                                FCD-155
...>Control Ports>Terminal>Change Password>Show all users


    User ID                      (5)
 1. UserName                 ... ()
 2. Access Level             >   (Monitor)
 3. Save All

>


ESC-prev.menu; !-main menu; &-exit; @-output                            1M/1C
--------------------------------------------------------------------------
```

*Figure 5-36. Typical **Add New User** Screen*

4. Select **1** and type the desired user name (up to 8 characters).

5. If necessary, change the access level, which by default is **Monitor** (see *Chapter 4* for details on the capabilities of each access level).

   ▪ To change the access level, type **2** and then press **‹Enter›**.

   ▪ You will see a selection screen with the four access levels (*Figure 5-37*).

```
                                FCD-155
...>Terminal>Change Password>Show all users        >Access Level (Monitor)

 1. Monitor
 2. Technician
 3. Operator
 4. Administrator

>


ESC-prev.menu; !-main menu; &-exit; @-output                            1M/1C
--------------------------------------------------------------------------
```

*Figure 5-37. Typical **Access Level** Selection Screen*

   ▪ Type the number corresponding to the desired level and then press **‹Enter›**. You will see again the **Show All Users** screen, updated with the new user name and access level.

6. To confirm the changes and add the new user, select item **3** – **Save All**.

Note   *The new user is assigned the factory-default password, 1234. To change it, use the procedure described on page 5-42.*

7. To add or delete all the required users, repeat the process described above as required.

Configuring Control Ports Parameters – FCD-155E

Purpose

Define the FCD-155E control ports parameters. Three types of parameters can be defined:

- Serial port communication parameters. These parameters are configured on the **Serial Port** screen, reached from the **Control Ports** submenu.

- Operational and security parameters. These parameters are configured on the **Terminal** screen, reached from the **Serial Port** screen.

- Ethernet management port (MNG) parameters. These parameters are configured on the **ETH** screen, reached from the **Control Ports** submenu.

Reached from

Configuration>System

Use – Selecting the Control Port to be Configured

A typical **Control Ports** submenu is shown in *Figure 5-38*.

```
                         FCD-155E
Configuration>System>Control Ports

 1. Serial Port >
 2. ETH         >

>

ESC-prev.menu; !-main menu; &-exit; @-debug                        1 M/ 1 C
----------------------------------------------------------------------------
```

*Figure 5-38. Typical **Control Ports** Submenu*

➤ **To select the FCD-155E control port to be configured:**

Type the number of the desired port and then press **‹Enter›**.

Changing the Serial Port Parameters

A typical **Serial Port** screen is shown in *Figure 5-39*. Note that the screen displays the current values of each parameter.

Use the procedure described for FCD-155 in the *Changing the Serial Port Parameters* section on page *5-38*.

```
                              FCD-155E
Configuration>System>Control Ports>Serial Port

 1. Set Baud Rate  (bps) >    (115200Bps)
 2. Data Bits            >    (8)
 3. Parity              >    (None)
 4. Stop Bits           >    (1)
 5. CTS                 >    (equal RTS)
 6. DSR                 >    (On)
 7. Terminal            >

>


ESC-prev.menu; !-main menu; &-exit; @-output                          1M/1C
--------------------------------------------------------------------------
```

*Figure 5-39. Typical **Serial Port** Screen for FCD-155E*

Configuring Ethernet Management Port

For the FCD-155E, you can configure separate parameters for the Ethernet management port, MNG.

The MNG port can be assigned its own parameters, including a separate IP address. However, if you do not assign IP addresses to the MNG port, it will automatically use the management IP address of the FCD-155E, configured by means of the **Host IP** screen.

The port uses auto-negotiation, and advertises its maximum capability as 100 Mbps, full duplex. Therefore, it is not necessary to configure the physical layer parameters.

➤ **To configure the Ethernet management port parameters:**

1. Type **2: ETH** on the **Control Ports** screen (*Figure 5-31*) and then press ‹Enter›.

2. You will see the **ETH** screen. A typical screen is shown in *Figure 5-59.*

```
                              FCD-155E
Configuration>System>Control Ports>ETH

 1. IP address        ... (0.0.0.0)
 2. Subnet Mask       ... (0.0.0.0)
 3. Routing Protocol >   (Rip version2)
 4. Encapsulation    >

>


ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
--------------------------------------------------------------------------
```

*Figure 5-40. Typical **ETH** Management Port Screen*

3. Select the number of the desired parameter and then press ‹Enter›:

- ▪ For the **Encapsulation** and **Routing Protocol** items, you will see separate parameters selection screens.

- ▪ For the other items, you can enter the desired value in the same line.

4. When done, type **#** to save and then confirm the action.

   All the parameters are explained in *Table 5-9*.

*Table 5-9. **MNG** Port Configuration Parameters*

Parameter	Function	Values
IP Address	Used to enter a specific IP address for the MNG port. If you do not enter a specific address, the FCD-155E host management IP address is used	Type the desired IP address, using the dotted-quad format (four groups of digits in the range of 0 through 255, separated by periods). **Default: 0.0.0.0** (means that this port will use the management IP address of the FCD-155E)
Mask	Used to enter the IP subnet mask for this port	Type the desired IP subnet mask, using the dotted-quad format. Make sure to select a subnet mask compatible with the selected IP address, and whose binary representation consists of consecutive "ones", followed by the desired number of consecutive "zeroes". **Default: 0.0.0.0**
Routing Protocol	Selects the routing protocol for management traffic carried through the MNG port	**NONE** – Dynamic routing of management traffic is not supported. In this case, static routing is used, and you must specify the information needed for routing the management traffic. **PROPRIETARY RIP** – The management traffic is routed using the RAD RIP proprietary routing protocol. **RIP 2 –** The management traffic is routed using the RAD RIP proprietary routing protocol. In addition, RIP2 routing tables are also transmitted. **Default: NONE**
Host Tagging	Controls the use of VLAN tagging for the management traffic transmitted through the MNG port. Appears on the **Encapsulation** screen	**YES** Management VLAN tagging is enabled. **NO** Management VLAN tagging is disabled. **Default: NO**
Host VLAN ID	When VLAN tagging is enabled, specifies the VLAN ID number used by the traffic transmitted through the MNG port. When VLAN tagging is disabled, this parameter is ignored. Appears on the **Encapsulation** screen	The allowed range is 1 to 4094. **0** means that no VLAN ID has been specified. **Default: 0**

*Table 5-9. **MNG** Port Configuration Parameters (Cont.)*

Parameter	Function	Values
Host VLAN Priority Tag	When VLAN tagging is enabled, specifies the priority assigned to the VLAN traffic transmitted through the MNG port. When VLAN tagging is disabled, this parameter is ignored. Appears on the **Encapsulation** screen	The allowed range is 7 (highest priority) to 0 (lowest priority). **Default: 0**

Configuring Date & Time Update

Purpose

Update the time of day and date of the FCD-155 internal real-time clock, and select the date format displayed on the FCD-155 screens.

Reached from

Configuration>System

A typical **Date & Time Update** screen is shown in *Figure 5-41*.

```
                              FCD-155
Configuration>System>Date & Time Update

 1. Set Time (hh:mm:ss)...   (10:38:25)
 2. Set Date (dd/mm/yyyy)... (1/7/2003)
 3. Set Date Format    >     (dd/mm/yyyy)

>

ESC-prev.menu; !-main menu; &-exit; @-output                        1M/1C
-----------------------------------------------------------------------------

```

*Figure 5-41. Typical **Date & Time Update** Screen*

➤ **To change the time:**

1. Type **1**, and then press ‹**Enter**›.

2. Type the desired time in the 24-hour format. Make sure to type any leading zeroes, for example, for 9 hours type **09** (no need to type the separators :). It is recommended to set the time about one minute beyond the desired time, and then press ‹**Enter**› at the correct instant.

➤ **To change the date:**

1. Type **2**, and then press ‹**Enter**›.

2. Type the desired date in the format appearing in the line of item 3 (**dd** stands for day, **mm** for month and **yyyy** for year). Make sure to type any leading zeroes, for example, for September type 09.

3. When done, press **‹Enter›**.

➤ **To change the date format:**

1. Type **3**, and then press **‹Enter›** to display the **Set Date Format** screen.

2. On the **Set Date Format** screen, type the number corresponding to the desired date format and then press **‹Enter›**.

3. When done, type **#** to save and then confirm the action.

Reloading the Factory-Default Parameters

Purpose

Reload the factory-default configuration, instead of the user's configuration.

This action can be used to create a clean, known starting point or delete the existing configuration before starting configuring the FCD-155 for operation in a new application.

Reached from

Configuration›System

➤ **To reload the factory-default parameters:**

1. Select item **5 – Factory-Default** on the **System** menu.

2. You will see **Are you sure you want to initialize to default configuration?:**

   ▪ To abort, type **n**.

   ▪ To confirm, type **y.**

3. If you confirmed, you must save the new configuration before it is actually activated:

   ▪ If you change your mind, undo by typing **%**.

   ▪ To activate the default configuration, type **#** (the **Save** command). In this case, You will see **Are you sure you want to update configuration?** and therefore you must confirm again:

      ▫ To abort, type **n**.

      ▫ To confirm, type **y.**

4. At this stage, the FCD-155 switches to the default parameters.

Note   *Usually, you must press ‹Enter› before you see again the menu.*

However, if the FCD-155 did not use the default supervisory port communication parameters, then before you can establish again communication with the FCD-155 you must change the supervisory terminal communication parameters to the default values: 115.2 kbps, one start bit, eight data bits, no parity, one stop bit and VT-100 terminal emulation.

Resetting the Device

Purpose

Reset the FCD-155.

Resetting does not erase the configuration data changed by the user, even it has not yet saved.

Reached from

Configuration>System

➤ **To reset the FCD-155:**

1. Select item **6 – Reset Device** on the **System** menu.

2. You will see **Are you sure you want to reset device?:**

   ▪ To abort, type **n**.

   ▪ To confirm, type **y.**

3. At this stage, the FCD-155 is reset.

Fault Propagation

Purpose

Controls the transfer of an indication to the far end when a fault is detected at the local end of this port.

Reached from

Configuration>System>Fault Propagation

➤ **To assign fault propagation:**

1. With **Failed Port** highlighted, select the item number of the Ethernet port or VCG.

2. To toggle between the Failed Port and Affected Port, press the right- or left-arrows.

3. With **Affected Port** highlighted, select the item number of the Ethernet port or VCG.

4. To add another Failed/Affected port for fault propagation, type **a** and repeat the previous steps.

5.5   Configuration>Physical Port Menu Structure

Figure 5-42 to *Figure 5-47* show typical **Physical Ports** menus for FCD-155E and FCD-155 versions. Ignore menu options not relevant to your particular unit.

Physical Ports

1. STM-1
2. Ethernet
3. E1/T1 *or* E3/T3
4. Station Clock

STM-1

1. LINK 1
2. LINK 2
3. Clock Parameters
4. APS

LINK 1

1. DCC Configuration
2. Admin Status
3. RDI on Fail
4. SD Threshold
5. EED Threshold
6. ALS
7. Port Name

DCC Configuration

1. Inband Management
2. Routing Protocol
3. Management DCC
4. Proprietary
5. Same as Host
6. IP address
7. Subnet Mask

Station Clock

1. Admin Status
2. Transmit Timing Source
3. Clock Rate
4. Interface Type
5. Mode
6. Rx Gain Limit
7. Quality

Transmit Timing Source

1. Nodal
2. Station RCLK
3. Station RCLK after JA

Clock Parameters

1. TX Clock based on SSM
2. SDH Tx Clock
3. Master Port
4. Fallback Port

1544 KBPS only

AMI
B8ZS

APS

Current Working Port
1. Protection
2. Flip Upon SD
3. Revertive
4. Working Port
5. Protection Port
6. WTR (seconds)

PRC
SSU-T
SSU-L
SEC
Unknown

Clock Rate

1. 2048 KBPS
2. 1544 KBPS
3. 2048 KHZ

Protection

1. No
2. Yes

Port 1, 2

LAN Rate
1. Admin Status
2. Auto Negotiation
3. Max Capability Advertised
4. Flow Control/Back Pressure
5. MDIX Auto Cross Over
6. Polarity
7. Port Name

Max Capability Advertised

1. 10 Mbps Half Duplex
2. 10 Mbps Full Duplex
3. 100 Mbps Half Duplex
4. 100 Mbps Full Duplex

Ethernet

1. Port 1
2. Port 2
3. Port 3
4. Port 4
5. Port 5
6. Port 6

or

Ethernet

1. GbE

Port 3-6

LAN Rate
Associated VCG
1. Admin Status
2. Auto Negotiation
3. Max Capability Advertised
4. Flow Control/Back Pressure
5. Port Name

or

Max Capability Advertised

1. 10 Mbps Half Duplex
2. 10 Mbps Full Duplex
3. 100 Mbps Half Duplex
4. 100 Mbps Full Duplex
5. 1000 Mbps Half Duplex
6. 1000 Mbps Full Duplex

GbE port only

E3 or T3

E3/T3

1. Port 1

Port 1

LIU Usage (E3/T3)
1. Admin Status
2. Rx Clock Selection
3. Port Name
4. VC Configuration

VC Configuration

1. AIS & RDI on Payload Label
2. AIS & RDI on Path Trace
3. J2 Rx Path Trace
4. J2 Path Trace
5. EED Threshold
6. SD Threshold
7. Payload Label
8. Padding
9. Path Protection

or

E1 Ports

E1/T1

1. Common Parameters
2. Port Parameters

8E1, 21E1

VC Configuration

1. AIS & RDI on Payload Label
2. AIS & RDI on Path Trace

Common Parameters

1. VC Configuration
2. Interface Parameters

Interface Parameters

1. Interface Type

Interface Type

1. Balance
2. Unbalance

Port Parameters

1. Port 1   13. Port 13
2. Port 2   14. Port 14
3. Port 3   15. Port 15
4. Port 4   16. Port 16
5. Port 5   17. Port 17
6. Port 6   18. Port 18
7. Port 7   19. Port 19
8. Port 8   20. Port 20
9. Port 9   21. Port 21
10. Port 10   22. All Ports
11. Port 11
12. Port 12

Port 1

LIU Usage (E1/T1)
1. Admin Status
2. Rx Clock Selection — 8E1 only
3. Rx Gain
4. Port Name
5. VC Configuration

VC Configuration

1. J2 Rx Path Trace
2. J2 Path Trace
3. EED Threshold
4. SD Threshold
5. Payload Label
6. Padding
7. Path Protection

Figure 5-42. **Configuration>Physical Ports** *Submenu for FCD-155E (SDH with E1, T1, E3, T3 Ports)*

*Figure 5-43. T1 Ports **Configuration>Physical Ports** Submenu for FCD-155E (SDH Versions)*

Physical Ports

1. OC-3
2. Ethernet
3. E1/T1 *or* E3/T3
4. Station Clock

Transmit Timing Source

1. Nodal
2. Station RCLK
3. Station RCLK after JA

Station Clock

1. Admin Status
2. Transmit Timing Source
3. Clock Rate
4. Line Termination
5. Mode
6. Rx Gain Limit
7. Quality

1544 KBPS only
AMI
B8ZS

Clock Rate

1. 2048 KBPS
2. 1544 KBPS
3. 2048 KHZ

DCC Configuration

1. Inband Management
2. Routing Protocol
3. Management DCC
4. Proprietary
5. Same as Host
6. IP address
7. Subnet Mask

ST1
ST2
ST3
SMC
Unknown

LINK 1

1. DCC Configuration
2. Admin Status
3. RDI on Fail
4. SD Threshold
5. EED Threshold
6. ALS
7. Port Name

Clock Parameters

1. TX Clock based on SSM
2. SONET Tx Clock
3. Master Port
4. Fallback Port

OC-3

1. LINK 1
2. LINK 2
3. Clock Parameters
4. APS

APS

Current Working Port
1. Protection
2. Flip on SD
3. Revertive
4. Working Port
5. Protection Port
6. WTR (seconds)

Protection

1. No
2. Yes

Ethernet

1. Port 1
2. Port 2
3. Port 3
4. Port 4
5. Port 5
6. Port 6

or

Ethernet

1. GbE

Port 1, 2

LAN Rate
1. Admin Status
2. Auto Negotiation
3. Max Capability Advertised
4. Flow Control/Back Pressure
5. MDIX Auto Cross Over
6. Polarity
7. Port Name

Max Capability Advertised

1. 10 Mbps Half Duplex
2. 10 Mbps Full Duplex
3. 100 Mbps Half Duplex
4. 100 Mbps Full Duplex

or

Port 3-6

LAN Rate
Associated VCG
1. Admin Status
2. Auto Negotiation
3. Max Capability Advertised
4. Flow Control/Back Pressure
5. Port Name

Max Capability Advertised

1. 10 Mbps Half Duplex
2. 10 Mbps Full Duplex
3. 100 Mbps Half Duplex
4. 100 Mbps Full Duplex
5. 1000 Mbps Half Duplex
6. 1000 Mbps Full Duplex

GbE port only

E3/T3

1. Port1

T3 only

or

Port 1

LIU Usage(E3/T3)
1. Admin Status
2. Rx Clock Selection
3. Port Name

Rx Clock Selection

1. RX STS
2. SONET

E1/T1

1. Common Parameters
2. Port Parameters

8T1, 28T1

Common Parameters

1. VT Configuration

VT Configuration

1. AIS & RDI on Payload Label
2. AIS & RDI on Path Trace

Port Parameters

1. Port 1
2. Port 2
3. Port 3
4. Port 4
5. Port 5
    :
    :
9. All Ports

Port 1

LIU Usage (E1/T1)
1. Admin Status
2. Rx Clock Selection—— *8T1 only*
3. Rx Gain
4. Interface
5. Tx Gain
6. Line Loopback Code Detector
7. Port Name
8. VT Configuration

VT Configuration

1. J2 Rx Path Trace
2. J2 Path Trace
3. EED Threshold
4. SD Threshold
5. Payload Label
6. Padding
7. Path Protection

Figure 5-44. ***Configuration***›***Physical Ports*** *Submenu for FCD-155E (SONET Versions)*

Physical Ports

1. STM-1
2. LAN
3. PDH

DCC Configuration

1. Inband Management
2. Routing Protocol
3. Management DCC
4. Proprietary
5. Same as Host
6. IP address
7. Subnet Mask

STM-1

1. DCC Configuration
2. RDI on Fail
3. SD Threshold
4. EED Threshold
5. Protection Mode
6. Wait to Restore
7. Master Timing Source
8. Master Rx Clock
9. Fallback Timing Source
10. Fallback Rx Clock
11. Port Name

Port 1, 2

LAN Rate
1. Admin Status
2. Auto Negotiation
3. Max Capability Advertised
4. Flow Control/Back Pressure
7. MDIX Auto Cross Over
8. Polarity
9. Port Name

Max Capability Advertised

1. 10 Mbps Half Duplex
2. 10 Mbps Full Duplex
3. 100 Mbps Half Duplex
4. 100 Mbps Full Duplex

or

LAN

1. Port 1
2. Port 2
3. Port 3
4. Port 4
5. Port 5
6. Port 6

or

LAN

1. GbE

Port 3-6

LAN Rate
Associated VCG
1. Admin Status
2. Auto Negotiation
3. Max Capability Advertised
4. Flow Control/Back Pressure
5. Port Name

Max Capability Advertised

1. 10 Mbps Half Duplex
2. 10 Mbps Full Duplex
3. 100 Mbps Half Duplex
4. 100 Mbps Full Duplex
5. 1000 Mbps Half Duplex
6. 1000 Mbps Full Duplex

GbE port only

E3 or T3

PDH

1. Port 1

Port 1

LIU Usage (E3/T3)
1. Admin Status
2. Rx Clock Selection
3. Port Name
4. VC Configuration

VC Configuration

1. AIS & RDI on Payload Label
2. AIS & RDI on Path Trace
3. J2 Rx Path Trace
4. J2 Path Trace
5. EED Threshold
6. SD Threshold
7. Payload Label
8. Padding
9. Path Protection

or

E1 Ports

PDH

1. Common Parameters
2. Port Parameters

4E1, 8E1

VC Configuration

1. AIS & RDI on Payload Label
2. AIS & RDI on Path Trace

Common Parameters

1. VC Configuration
2. Interface Parameters

Interface Parameters

1. Interface Type

Interface Type

1. Balance
2. Unbalance

Port Parameters

1. Port 1
2. Port 2
3. Port 3
4. Port 4
5. Port 5
:
:
9. All Ports

Port 1

LIU Usage (E1/T1)
1. Admin Status
2. Rx Clock Selection
3. Rx Gain
4. Port Name
5. VC Configuration

VC Configuration

1. J2 Rx Path Trace
2. J2 Path Trace
3. EED Threshold
4. SD Threshold
5. Payload Label
6. Padding

Figure 5-45. Configuration>Physical Ports Submenu for FCD-155 (SDH with E1 Ports)

Figure 5-46. T1 Ports **Configuration>Physical Ports** *Submenu for FCD-155 (SDH Versions)*

Physical Ports

1. OC-3
2. LAN
3. PDH

DCC Configuration

1. Inband Management
2. Routing Protocol
3. Management DCC
4. Proprietary
5. Same as Host
6. IP address
7. Subnet Mask

OC-3

1. DCC Configuration
2. RDI on Fail
3. SD Threshold
4. EED Threshold
5. Protection Mode
6. Wait to Restore
7. Master Timing Source
8. Master Rx Clock
9. Fallback Timing Source
10. Fallback Rx Clock
11. Port Name

LAN

1. Port 1
2. Port 2
3. Port 3
4. Port 4
5. Port 5
6. Port 6

or

LAN

1. GbE

Port 1, 2

LAN Rate
1. Admin Status
2. Auto Negotiation
3. Max Capability Advertised
4. Flow Control/Back Pressure
5. MDIX Auto Cross Over
6. Polarity
7. Port Name

Max Capability Advertised

1. 10 Mbps Half Duplex
2. 10 Mbps Full Duplex
3. 100 Mbps Half Duplex
4. 100 Mbps Full Duplex

or

Max Capability Advertised

1. 10 Mbps Half Duplex
2. 10 Mbps Full Duplex
3. 100 Mbps Half Duplex
4. 100 Mbps Full Duplex
5. 1000 Mbps Half Duplex
6. 1000 Mbps Full Duplex

GbE port only

Port 3-6

LAN Rate
Associated VCG
1. Admin Status
2. Auto Negotiation
3. Max Capability Advertised
4. Flow Control/Back Pressure
5. Port Name

PDH

1. Port1

T3 only

or

PDH

1. Common Parameters
2. Port Parameters

4T1, 8T1

Port 1

LIU Usage(E3/T3)
1. Admin Status
2. Rx Clock Selection
3. Port Name

Rx Clock Selection

1. RX STS
2. SONET

Common Parameters

1. VT Configuration

VT Configuration

1. AIS & RDI on Payload Label
2. AIS & RDI on Path Trace

Port Parameters

1. Port 1
2. Port 2
3. Port 3
4. Port 4
5. Port 5
   :
   :
9. All Ports

Port 1

LIU Usage (E1/T1)
1. Admin Status
2. Rx Clock Selection
3. Rx Gain
4. Interface
5. Tx Gain
6. Line Loopback Code Detector
7. Port Name
8. VT Configuration

VT Configuration

1. J2 Rx Path Trace
2. J2 Path Trace
3. EED Threshold
4. SD Threshold
5. Payload Label
6. Padding

*Figure 5-47. **Configuration>Physical Ports** Submenu for FCD-155 (SONET Versions)*

Selecting the Type of Physical Ports to Configure

Purpose

Select the type of physical ports to be configured. This is the first step in the configuration procedure of any physical port.

Reached from

Configuration>Physical Ports

Use – FCD-155

The items appearing on the **Physical Ports** selection screen depend on the specific FCD-155 version. A typical screen for an FCD-155 with SDH network interface, payload LAN ports, and E1/T1 ports is shown in *Figure 5-48*.

The differences between this typical screen and other screens are as follows:

- Item **1 – STM-1** is replaced by item **1 – OC-3** For FCD-155 with SONET interface.

- Item **2 – LAN** is not included for FCD-155 units with single Ethernet port.

- Item **3 – PDH** is included only for FCD-155 units equipped with PDH interfaces.

```
                              FCD-155
Configuration>Physical Ports

 1. STM-1             >
 2. LAN               >
 3. PDH               >

>


ESC-prev.menu; !-main menu; &-exit; @-Output                          1M/1C
----------------------------------------------------------------------------
```

*Figure 5-48. Typical **Physical Ports** Type Selection Screen (FCD-155)*

➤ **To select the type of physical ports to be configured:**

Type the corresponding item number and then press **<Enter>**.

Use – FCD-155E

The items appearing on the **Physical Ports** selection screen depend on the specific FCD-155E version. A typical screen for an FCD-155E with SDH network interface, payload Ethernet ports, and E1/T1 ports is shown in *Figure 5-49*.

The differences between this typical screen and other screens are as follows:

- Item **1 – STM-1** is replaced by item **1 – OC-3** For FCD-155E with SONET interface.

- Item **2 – Ethernet** is not included for FCD-155E units with single Ethernet port.

- Item **3 – E1/T1**, in accordance with the installed interface type, is included only for FCD-155E units equipped with PDH interfaces.

- Item **4 – E3/T3**, in accordance with the installed interface type, is included only for FCD-155E units equipped with PDH interfaces.

- Item **5 – Station Clock** is included.

```
                          FCD-155E
Configuration>Physical Ports

 1. STM-1             >
 2. Ethernet          >
 3. E1/T1             >
 4. E3/T3
 5. Station Clock     >

>


ESC-prev.menu; !-main menu; &-exit; @-Output                       1M/1C
--------------------------------------------------------------------------
```

*Figure 5-49. Typical **Physical Ports** Type Selection Screen (FCD-155E)*

➤ **To select the type of physical ports to be configured:**

Type the corresponding item number and then press ‹**Enter**›.

Configuring STM-1 Physical Port Parameters for FCD-155E

Purpose

Configure the network-side physical port parameters of FCD-155E.

Reached from

Configuration›**Physical Ports**

Selecting the Configuration Task

The first step is to select the STM-1 configuration task:

- Link physical port parameters (including its DCC management parameters)

- Link timing (clock) parameters

- Automatic protection switching (APS) mode.

A typical task selection screen is shown in *Figure 5-50.*

```
                              FCD-155E
Configuration>Physical Ports>STM-1


 1. LINK 1              >
 2. LINK 2              >
 3. Clock Parameters >
 4. APS                 >

>


# - Save; % - Undo
ESC-prev.menu; !-main menu; &-exit; @-debug                                 1M/1C
-------------------------------------------------------------------------------
```

*Figure 5-50. Typical **STM-1** Task Selection Screen (FCD-155E)*

➤ To select the STM-1 configuration task

Type the corresponding item number, and then press ‹Enter›.

Configuring an STM-1 Link

A typical **STM-1** link screen for an FCD-155 unit with SDH interfaces is shown in *Figure 5-51*. For SONET interfaces, **STM-1** is replaced by **OC-3**.

```
                              FCD-155E
Configuration>Physical Ports>STM-1>LINK 1

 1. DCC Configuration >
 2. Admin Status          (Enable)
 3. RDI on Fail           (Enable)
 4. SD Threshold       >  (1E-6)
 5. EED Threshold      >  (1E-3)
 6. ALS                   (Disable)
 7. Port Name        ... ()

>


# - Save; % - Undo
ESC-prev.menu; !-main menu; &-exit; @-debug                                 1M/1C
-------------------------------------------------------------------------------
```

*Figure 5-51. Typical **STM-1** Link Physical Port Configuration Screen (FCD-155E)*

The parameters that can be configured by means of the **STM-1** screen are described in *Table 5-10*.

➤ To configure the link physical port parameters:

1. Type the number corresponding to the desired parameter (all references are made to *Figure 5-51*), and then press ‹Enter›:

   ▪ For items **2**, **3** and **6**, the selection is toggled as soon as you press ‹Enter›

   ▪ For items **4**, **5** and **7**, you can type the desired value in the same line. When done, press ‹Enter›.

▪ For item **1**, you will see the corresponding selection screen.

2. When done, type **#** to save and then confirm the action.

Table 5-10. **Configuration › Physical Ports › STM-1 › Link** *Parameters*

Parameter	Function	Values	
DCC Configuration	See *Table 5-11*		
Admin Status	Used to enable/disable the flow of traffic through the selected link	**DISABLE**	The flow of traffic is disabled. This state should be selected as long as the configuration of the link has not yet been completed, or when it is necessary to stop traffic flow through the link.
		ENABLE	The flow of traffic is enabled.
		Default:	**ENABLE**
RDI on Fail	Controls the sending of RDI (remote defect indication) in case of failure	**ENABLE**	RDI sending is enabled.
		DISABLE	RDI sending is disabled.
		Default: ENABLE	
SD Threshold	Selects the BER value, which if exceeded results in the generation of the signal-degraded alarm	The available selections are 10E-6 (BER threshold of 10^{-6}), 10E-7 (10^{-7}), 10E-8 (10^{-8}) or 10E-9 (10^{-9}). **Default: 10E-6** (BER of 10^{-6})	
EED Threshold	Selects the BER value, which if exceeded results in the generation of the error rate degradation alarm	The available selections are 10E-3 (BER threshold of 10^{-3}), 10E-4 (10^{-4}) or 10E-5 (10^{-5}). **Default: 10E-3** (BER of 10^{-3})	
ALS	Enables/disables the automatic laser shutdown (ALS) function. The ALS function automatically switches off the transmitter of a regenerator section in case of cable break	**ENABLE**	ALS function is enabled.
		DISABLE	ALS function is disabled.
		Default: DISABLE	
Port Name	Used to enter a logical name for the STM-1 port	Up to 8 characters. **Default: Empty string**	

DCC Configuration Screen

The **DCC Configuration** screen controls the use of inband management for the selected link and defines the inband management parameters for that link.

A typical **DCC Configuration** screen is shown in *Figure 5-52*.

```
                                FCD-155E
Configuration>Physical Ports>STM-1>LINK 1>DCC Configuration

 1. Inband Management          >    (HDLC)
 2. Routing Protocol           >    (None)
 3. Management DCC             >    (D1-D3)
 4. Proprietary               >    (No)
 5. Same as Host                   (No)
 6. IP address                ... (0.0.0.0)
 7. Subnet Mask               ... (0.0.0.0)
 8. LAPD Role                  >    (Network)
 9. LAPD Reliable              >    (No)

>


ESC-prev.menu; !-main menu; &-exit; @-debug                             1M/1C
-----------------------------------------------------------------------------
```

*Figure 5-52. Typical **DCC Configuration** Screen*

This screen shows all the parameters that may be configured: as explained in
Table 5-11, the parameters actually displayed on the screen depend on the
encapsulation and routing protocol values selected by you. Therefore, it is
recommended to configure the parameters in the order they are displayed on the
screen.

Note   *Some of the required parameter values depend on the equipment used together
with the FCD-155 in the same network. Contact your nearest authorized RAD
business partner for specific recommendations that take into consideration your
special application requirements.*

➤   **To configure the DCC parameters:**

1. Type the number corresponding to the parameter to be modified, and then
    press ‹**Enter**› to display the selection screen.

2. On the selection screen, type the number of the desired option and then
    press ‹**Enter**›. The selection screen closes.

3. Repeat the process until all the parameters have been defined.

4. When done, type **#** to save and then confirm the action.

The parameters that can be configured by means of the **DCC Configuration** screen
are described in *Table 5-11*.

Table 5-11. **DCC Configuration** *Parameters*

Parameter	Function	Values
Inband Management	Selects the encapsulation protocol used for inband management traffic carried over the DCC	**OFF –** No encapsulation protocol selected; inband management is not possible.
		HDLC – HDLC encapsulation. This protocol is compatible with all the RAD equipment, and in particular with Optimux-1551 and Optimux-1553.
		PPP OVER HDLC – PPP over HDLC encapsulation. This protocol is compatible with RAD OptiMux-1550, and equipment from other vendors.
		IP Tunneling – IP tunneling over OSI enapsulation. ES-IS protocol compatible with G.7712.
		Default: OFF
Routing Protocol	When the transfer of inband management traffic is enabled, selects the routing protocol for management traffic carried through this main link. This field is not displayed when **Inband Management** is **OFF**	**NONE** – Dynamic routing of management traffic is not supported. In this case, static routing is used, and you must specify the information needed for routing the management traffic.
		PROPRIETARY – The management traffic is routed using the RAD RIP proprietary routing protocol.
		RIP VERSION2 – The management traffic is routed using the RAD RIP proprietary routing protocol. In addition, RIP2 routing tables are also transmitted.
		Default: NONE
Management DCC	Selects the DCC bytes used to carry inband management traffic. This field is not displayed when **Inband Management** is **OFF**	**D1 – D3 –** The management traffic is carried by the regenerator section DCC bytes (D1, D2, D3).
		D4 – D12 – The management traffic is carried by the multiplex section DCC bytes (D4 to D12).
		Default: D1 – D3
Proprietary	Selects the PPP over HDLC flavor supported by the FCD-155. This field is displayed only when **Encapsulation** is **HDLC** or **PPP OVER HDLC**	**NO** – PPP over HDLC in accordance with RFC1661 and RFC1662.
		TYPE 1 – PPP over HDLC based on RFC1661 and RFC1662, but LCP (Link Control Protocol) packets do not include address and control fields in their overhead.
		Default: NO

Table 5-11. *DCC Configuration* Parameters (Cont.)

Parameter	Function	Values
Same as Host	Controls the IP address assigned to the inband management channel	**YES** – The DCC uses the management IP address and subnet mask of the FCD-155 host, configured by means of the Quick Setup or Host IP screen. **NO** – The DCC uses the IP address and subnet mask configured by the user. **Default: YES**
Host IP Address	When **Same as Host** is **NO:** used to enter the IP address for this DCC	Type the desired IP address, using the dotted-quad format (four groups of digits in the range of 0 through 255, separated by periods). **Default: 0.0.0.0**
Subnet Mask	When **Same as Host** is **NO:** used to enter the IP subnet mask for this DCC	Type the desired IP subnet mask, using the dotted-quad format. Make sure to select a subnet mask compatible with the selected IP address, and whose binary representation consists of consecutive "ones", followed by the desired number of consecutive "zeroes". **Default: 0.0.0.0**
LAPD Role	The device must be the opposite role of the connected device. Applicable for IP tunneling.	**NETWORK** – The connected device is defined as User **USER** – The connected device is defined as Network. **Default: USER**
LAPD Reliable	The device must have the same LAPD reliable status as the attached system. Applicable for IP tunneling.	**YES –** The device and system are defined LAPD Reliable. **NO–** The device and system are defined not LAPD Reliable. **Default: YES**

Configuring Network Interface Clock Parameters

The **Clock Parameters** screen is used to configure the timing source for link transmit path. The same clock source is used for both links. A typical screen is shown in *Figure 5-53*. This screen displays all the parameters that can be configured – see details in *Table 5-12*.

```
                              FCD-155E
Configuration>Physical Ports>STM-1>Clock Parameters

 1. TX Clock based on SSM      (No)
 2. SDH Tx Clock          >    (Rx Clock)
 3. Master Port           >    (Link 1)
 4. Fallback Port         >    (Internal)


>


ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
-----------------------------------------------------------------------
```

*Figure 5-53. Typical **Clock Parameters** Screen*

*Table 5-12. **Clock Parameters** (FCD-155E)*

Parameter	Function	Values
Tx Clock Based on SSM	Controls the selection mode of the link transmit clock reference	**YES –** The selection of the timing reference uses the SSM received in the S1 byte of the link overhead (also considering the station clock **Quality**, when the station clock **Admin Status** is **UP**).
		NO – The selection of the timing reference does not use the SSM.
		Default: **NO**
SDH Tx Clock or SONET Tx Clock	Selects the timing reference source of the network interface transmit clock.	**INTERNAL –** The transmit clock is derived from the FCD-155 internal oscillator.
	This parameter is displayed only when **Tx Clock Based on SSM** is **NO**	**RX CLOCK –** The transmit clock is locked to the clock recovered from the signal received by the STM-1 links.
		Default: **SYSTEM**
Master Port	Selects the master timing reference source.	The available selections are **LINK 1, LINK 2** and **STATION.**
	This parameter is displayed only when when network interface transmit clock is **RX CLOCK**	You can select **STATION** only when the station clock **Admin Status** is **UP**.
		Default: **LINK 1**
Fallback Port	Selects the fallback timing reference source.	The available selections are **INTERNAL**, **LINK 1, LINK 2** and **STATION**. Always select the link not selected as master port.
	This parameter is displayed only when when network interface transmit clock is **RX CLOCK**	You can select **STATION** only when the station clock **Admin Status** is **UP**.
		Default: **LINK 2**

Configuring APS

The APS function is used to select the protection mode for the network connection. A typical screen is shown in *Figure 5-54.*

```
                              FCD-155E
Configuration>Physical Ports>STM-1>APS

 1. Protection                >    (No)

>


ESC-prev.menu; !-main menu; &-exit; @-debug                        1 M/ 1 C
-------------------------------------------------------------------------
```

*Figure 5-54. APS **Protection Mode** Screen (FCD-155E)*

Currently, two options are supported:

- No protection. In this case, each link operates independently, and therefore the total capacity of the network connection is 2 STM-1/OC-3.

- 1+1 uni-directional protection with automatic switching (**Yes**). In this mode, one link serves as backup for the working link, and therefore the total capacity of the network connection is one STM-1/OC-3.

➤ **To configure the protection mode:**

1. Select the **Protection**: type 1 and then press **‹Enter›** to display the selection screen. A typical screen is shown in *Figure 5-55*.

```
                              FCD-155E
Configuration>Physical Ports>STM-1>APS>Protection (No)

 1. No
 2. Yes

>

# - Save; % - Undo
ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
-------------------------------------------------------------------------
```

*Figure 5-55. APS **Protection** Type Selection Screen (FCD-155E)*

2. To enable the protection, select **Yes,** and then press **‹Enter›.**

3. After returning to the **APS** screen, you will see the current working link, and additional fields appear on the screen (see *Figure 5-56*).

4. On the selection screen, type the number of the desired option and then press **‹Enter›**. The selection screen closes and the new value appears in the screen.

5. When done, type # to save and update the database.

```
                              FCD-155E
Configuration>Physical Ports>STM-1>APS

 1. Protection                >    (Yes)
 2. Flip Upon SD                   (Yes)
 3. Revertive                      (Yes)
 4. Working Port              >    (Link 1)
 5. Protection Port           >    (Link 2)
 6. WTR (Seconds)[1 - 720]  ... (60)

>

ESC-prev.menu; !-main menu; &-exit; @-debug                            1 M/ 1 C
--------------------------------------------------------------------------
```

*Figure 5-56. APS **Protection Mode** Screen – Protection Enabled (FCD-155E)*

The parameters that can be configured by means of the **APS** screen are described in *Table 5-13*.

*Table 5-13. **APS** Configuration Parameters (FCD-155E)*

Parameter	Function	Values
Current Working Port	Read-only field, displays the current working link	**Link 1** or **Link 2**
Protection	Controls the use of MSP 1+1 protection switching on the link to the network	**NO –** Protection switching is disabled. **YES** – MSP 1+1 unidirectional protection with automatic switching. **Default: NO**
Flip Upon SD	Controls switching to protection when a signal-degraded (SD) condition is detected	**NO –** Protection switching on SD condition is disabled. **YES** – Protection switching on SD condition is enabled. **Default: NO**
Revertive	Selects the protection mode	**NO** – Switching is non-revertive, that is, the FCD-155 will not flip back after the failed link returns to normal operation, but only when the currently used link fails. **YES** – Switching is revertive: the FCD-155 will return to the original link when it returns to normal operation. **Default: NO**
Working Port	Selects the working link	**AUTO –** Automatic selection of working port. **LINK 1** or **LINK 2 –** Manual selection of the current working link. The new selection automatically changes the **Protection Port** field to the other selection. **Default: LINK 1**

*Table 5-13. **APS** Configuration Parameters (FCD-155E) (Cont.)*

Parameter	Function	Values
Protection Port	Selects the protection link	**LINK 1** or **LINK 2.** The new selection automatically changes the **Working Port** field to the other selection. **Default: LINK 2**
WTR	When protection switching is enabled and a link interface becomes active, specifies the time during which all the alarms reported by the framer will be ignored. This field is displayed only when the protection mode is **Revertive=YES**	The supported range is **1** to **720** seconds. **Default: 60**

Configuring STM-1 Physical Port Parameters for FCD-155

Purpose

Configure the physical port parameters of the STM-1 network interface.

Reached from

Configuration › Physical Ports

A typical **STM-1** link screen for an FCD-155 unit with SDH interfaces is shown in *Figure 5-57*.

```
                          FCD-155
Configuration>Physical Ports>STM-1

 1. DCC Configuration      >
 2. RDI on Fail                (Enable)
 3. SD Threshold           >   (1E-6)
 4. EED Threshold          >   (1E-3)
 5. Protection Mode        >   (Automatic)
 6. Wait to restore        [1 - 255]... (1)
 7. Master Timing source   >   (Rx Clock)
 8. Master Rx clock        >   (SDH)
 9. Fallback Timing source>    (Rx Clock)
10. Fallback Rx clock      >   (SDH)
11. Port Name                 ... ()

>


ESC-prev.menu; !-main menu; &-exit; @-output                        1M/1C
--------------------------------------------------------------------------
```

*Figure 5-57. Typical **STM-1** Physical Port Configuration Screen (FCD-155 with PDH Interfaces)*

The parameters that can be configured by means of the **STM-1** screen are described in *Table 5-14*.

➤ **To change an STM-1 physical port parameter:**

1. Type the number corresponding to the desired parameter (all references are made to *Figure 5-57*), and then press **‹Enter›**:

   ▪ For items **2** and **5**, the selection is toggled as soon as you press **‹Enter›**

   ▪ For items **6** and **11**, you can type the desired value in the same line. When done press **‹Enter›**.

   ▪ For the other items, you will see the corresponding selection screen. In this case, the **Values** column in *Table 5-14* lists the options displayed on the selection screen.

     On the selection screen, type the number of the desired option and then press **‹Enter›**. The selection screen closes and the new value appears in the **STM-1** screen.

2. When done, type **#** to save and then confirm the action.

Table 5-14. Configuration›Physical Ports›STM-1 Parameters (FCD-155)

Parameter	Function	Values
DCC Configuration	See *Table 5-11*	
RDI on Fail	Controls the sending of RDI (remote defect indication) in case of failure	**ENABLE** RDI sending is enabled. **DISABLE** RDI sending is disabled. **Default: ENABLE**
SD Threshold	Selects the BER value, which if exceeded results in the generation of the signal-degraded alarm	The available selections are 10E-6 (BER threshold of 10^{-6}), 10E-7 (10^{-7}), 10E-8 (10^{-8}) or 10E-9 (10^{-9}). **Default: 10E-6** (BER of 10^{-6})
EED Threshold	Selects the BER value, which if exceeded results in the generation of the error rate degradation alarm	The available selections are 10E-3 (BER threshold of 10^{-3}), 10E-4 (10^{-4}) or 10E-5 (10^{-5}). **Default: 10E-3** (BER of 10^{-3})
Protection Mode	Controls the use of MSP 1+1 protection switching on the link to the SDH network	**AUTOMATIC –** Protection switching is enabled: the FCD-155 will switch to the other network link in case the currently active link fails. Switching is non-revertive, that is, the FCD-155 will not flip back after the failed link returns to normal operation, but only in case the currently used link fails. This option is available only on FCD-155 units with two network interfaces. **OFF –** Protection switching is disabled. **Default:** **AUTOMATIC** for FCD-155 with two network interfaces. **OFF** for FCD-155 with single network interface

Table 5-14. *Configuration>Physical Ports>STM-1* Parameters (FCD-155) (Cont.)

Parameter	Function	Values	
Wait to Restore (Seconds)	When protection switching is enabled and a link interface becomes active, specifies the time during which all the alarms reported by the framer will be ignored	The supported range is **1** to **255** seconds, and **N/A** when protection mode is **OFF**. **Default:** **1** when **Protection Mode** is **AUTOMATIC**. **N/A** when **Protection Mode** is **OFF**	
Master Timing Source	Selects the master timing reference source used by the FCD-155 for the SDH side. For details on FCD-155 timing subsystem, refer to *Chapter 2*	**Rx Clock**	The master timing reference is the signal selected by means of the **Master Rx Clock** parameter.
		Internal	The master timing reference is the internal FCD-155 oscillator.
		Default: Rx Clock	
Master Rx Clock	Selects the master receive clock to be used as timing reference source for the SDH side when **Master Timing Source** is **Rx Clock**	**SDH**	Use of clock signal recovered from the received SDH line signal.
		PDH Port 1 to **Port 8**	Use of clock signal recovered from the received line signal of the corresponding PDH port. This option is available only when the FCD-155 is equipped with PDH interfaces, and the maximum number of ports depends on the installed option: 1, 4 or 8 ports.
		Default: SDH	
Fallback Timing Source	Selects the fallback timing reference source used by the FCD-155 for the SDH side. Make sure to select a source different from that selected by the **Master Timing Source** field	**Rx Clock**	The fallback timing reference is the signal selected by means of the **Fallback Rx Clock** parameter.
		Internal	The fallback timing reference is the internal FCD-155 oscillator.
		Default: Rx Clock	
Fallback Rx Clock	Selects the fallback receive clock to be used as timing reference source for the SDH side when **Fallback Timing Source** is **Rx Clock.** Make sure to select a source different from that selected by the **Master Rx Clock** field	**SDH**	Use of clock signal recovered from the received SDH line signal.
		PDH Port 1 to **Port 8**	Use of clock signal recovered from the received line signal of the corresponding PDH port. This option is available only when the FCD-155 is equipped with PDH interfaces, and the maximum number of ports depends on the installed option: 1, 4 or 8 ports.
		Default: SDH	
Port Name	Used to enter a logical name for the STM-1 port	Up to 8 characters. **Default: Empty string**	

Configuring OC-3 (Physical Ports) Parameters for FCD-155

A typical **Configuration>OC-3** screen is shown in *Figure 5-58*.

This screen is similar to the STM-1 screen for FCD-155 with PDH interfaces, except that it is displayed when the FCD-155 network interface uses the SONET standard.

```
                              FCD-155
Configuration>Physical Ports>OC-3

 1. DCC Configuration      >
 2. RDI on Fail               (Enable)
 3. SD Threshold          >   (1E-6)
 4. EED Threshold         >   (1E-3)
 5. Protection Mode       >   (Automatic)
 6. Wait to restore       [1 - 255]... (1)
 7. Master Timing source  >   (Rx Clock)
 8. Master Rx clock        >   (SONET)
 9. Fallback Timing source>   (Rx Clock)
10. Fallback Rx clock     >   (SONET)
11. Port Name             ... ()

>


ESC-prev.menu; !-main menu; &-exit; @-output                        1M/1C
-------------------------------------------------------------------------------
```

*Figure 5-58. Typical **OC-3** Physical Port Configuration Screen (FCD-155)*

➤ To change an OC-3 physical port parameter:

Refer to *Configuring STM-1 Physical Port Parameters for FCD-155* section for instructions.

The only difference is that the **SDH** parameters have been replaced with **SONET**.

Configuring Ethernet LAN Physical Ports Parameters

Purpose

Configure the physical layer parameters of LAN ports.

Reached from

Configuration>Physical Ports>LAN

Selecting an Ethernet LAN Port for Configuration

The first step is to select the Ethernet LAN port to be configured.

A typical port selection screen for an FCD-155 equipped with the maximum number of ports (6) is shown in *Figure 5-59.* The number of ports on the screen depends on the FCD-155 version. For FCD-155E, **LAN** is replaced by **Ethernet**.

```
                                   FCD-155
Configuration>Physical Ports>LAN


 1. Port 1   >
 2. Port 2   >
 3. Port 3   >
 4. Port 4   >
 5. Port 5   >
 6. Port 6   >

>


ESC-prev.menu; !-main menu; &-exit; @-Output                          1M/1C
-------------------------------------------------------------------------------
```

Figure 5-59. Typical *LAN* Port Selection Screen (FCD-155)

Note   *This screen is not available for FCD-155 with single Ethernet port.*

➤   **To select the LAN port to be configured:**

Type the corresponding item number, and then press **‹Enter›**.

LAN Ports 1, 2

LAN ports 1 and 2 are ports connected through the internal Ethernet switch.

A typical **LAN** or **Ethernet** screen for port 1, with auto-negotiation enabled, is shown in *Figure 5-60*. The port is identified in the screen header (port 1 in *Figure 5-60*).

When the port is configured for auto-negotiation, the port identification is followed by a **LAN Rate** line that indicates the current operating rate and mode (for example, 100 Mbps full duplex in *Figure 5-60*).

```
                                   FCD-155
Configuration>Physical Ports>LAN>Port 1


    Lan Rate                    >    (100 Mbps Full Duplex)
 1. Admin Status                     (Enable)
 2. Auto Negotiation                 (Enable)
 3. Max capability advertised >      (100 Mbps Full Duplex)
 4. Flow Control/Back Pressure       (Yes)
 5. MDIX Auto Cross Over       >     (Enable)
 6. Port Name                  ...   ()

>


ESC-prev.menu; !-main menu; &-exit; @-output                          1M/1C
-------------------------------------------------------------------------------
```

A. Auto-Negotiation Enabled

```
                              FCD-155
Configuration>Physical Ports>LAN>Port 1

 1. Admin Status                   (Disable)
 2. Auto Negotiation               (Disable)
 3. Lan Rate                  >    (10 Mbps Full Duplex)
 4. Flow Control/Back Pressure     (No)
 5. MDIX Auto Cross Over      >    (Disable)
 6. Polarity                  >    (Normal)
 7. Port Name                 ... ()

>


ESC-prev.menu; !-main menu; &-exit; @-output                           1M/1C
----------------------------------------------------------------------------
```

B. Auto-Negotiation Disabled

*Figure 5-60. Typical **LAN** or **Ethernet** Physical Port Configuration Screens (Ports 1 and 2)*

The parameters that can be configured by means of the **LAN** screen are described in *Table 5-15*.

➤ **To configure a LAN physical port parameter:**

1. Type the number corresponding to the desired parameter, and then press ‹**Enter**›:

   ▪ For items **1, 2, 4, 6**, the selection is toggled as soon as you press ‹**Enter**›.

   ▪ For item **8**, you can type the desired value in the same line. When done, press ‹**Enter**›.

   ▪ For the other items, you will see the corresponding selection screen. In this case, the **Values** column in *Table 5-15* lists the options displayed on the selection screen.

   On the selection screen, type the number of the desired option and then press ‹**Enter**›. The selection screen closes and the new value appears in the **LAN** screen.

2. When done, type **#** to save and then confirm the action.

Table 5-15. *Configuration>Physical Ports>LAN* Parameters

Parameter	Function	Values	
Admin Status	Used to enable/disable the flow of traffic through the selected LAN port	DISABLE	The flow of traffic is disabled. This state should be selected as long as the configuration of the corresponding port has not yet been completed, or when it is necessary to stop traffic flow through the port.
		ENABLE	The flow of traffic is enabled.
		Default:	ENABLE for all the ports within the number specified in the **Number of External LAN Ports** line of the **Configuration>Quick Setup** screen. DISABLE for other ports.
Auto Negotiation	Controls the use of auto-negotiation for the corresponding port. Auto-negotiation is used to select automatically the mode providing the highest possible traffic handling capability	ENABLE DISABLE Default: ENABLE	Auto-negotiation is enabled. Auto-negotiation is disabled.
Max Capability Advertised	Specifies the highest traffic handling capability to be advertised during the auto-negotiation process. The operating mode selected as a result of auto-negotiation cannot exceed the advertised capability. This parameter is displayed only when auto-negotiation is enabled	The available selections are listed in ascending order of capabilities: **10Mbps half duplex** – Half-duplex operation at 10 Mbps. **10Mbps full duplex** – Full-duplex operation at 10 Mbps. **100Mbps half duplex** – Half-duplex operation at 100 Mbps. **100Mbps full duplex** – Full-duplex operation at 100 Mbps. **1000Mbps half duplex** – Half-duplex operation at 1000 Mbps. Supported only for GbE port. **1000Mbps full duplex** – Full-duplex operation at 1000 Mbps. Supported only for GbE port. Default: 100Mbps full duplex for ports 1, 2 1000Mbps full duplex for port 3	

Table 5-15. **Configuration>Physical Ports>LAN** *Parameters (Cont.)*

Parameter	Function	Values
LAN Rate	Specifies the LAN rate and operating mode. This parameter is displayed only when auto-negotiation is disabled	The available selections are as for the **Max Capability Advertised** parameter. **Default: 100Mbps full duplex for ports 1, 2** **1000Mbps full duplex for port 3**
Flow Control/ Back Pressure	Controls the use of flow control (when operating in the full duplex mode), or back pressure (when operating in the half-duplex mode)	**YES** Flow control or back pressure is enabled. **NO** Flow control and back pressure are disabled. **Default: No**
MDIX Auto Cross Over	Controls the MDI/MDIX automatic cross-over detection and correction function for the corresponding port	**DISABLE** MDI/MDIX automatic cross-over correction disabled. **ENABLE** MDI/MDIX automatic cross-over correction enabled. **Default: DISABLE**
Polarity	Enables inverting the pair polarity when **Auto Negotiation** is disabled. This permits correcting wiring errors. When **Auto Negotiation** is enabled, polarity is automatically corrected. This parameter is displayed only when **Auto Negotiation** is **DISABLE**	**NORMAL** Normal polarity. **INVERT** Inverted polarity (same effects as interchanging the +wire with the -wire within each pair. **Default: NORMAL**
Port Name	Used to enter a logical name for the LAN port	Up to 8 characters. **Default: Empty string**

LAN Ports 3 to 6 (Transparent Ports)

A typical **LAN** screen for port 4, with auto-negotiation enabled, is shown in *Figure 5-61*.

```
                                 FCD-155
Configuration>Physical Ports>LAN>Port 4


    Lan Rate                   >    (10 Mbps Half Duplex)
    Associated VCG             >    (VCG 5)
 1. Admin Status                    (Enable)
 2. Auto Negotiation                (Enable)
 3. Max capability advertised >     (100 Mbps Full Duplex)
 4. Flow Control/Back Pressure      (No)
 5. Port Name                  ...  ()

>


ESC-prev.menu; !-main menu; &-exit; @-output                           1M/1C
------------------------------------------------------------------------------
```

*Figure 5-61. Typical **LAN** Physical Port Configuration Screen (Ports 3 to 6)*

The screen shown in *Figure 5-61* is similar to that of *Figure 5-60*, except for the following:

- The screen includes an additional line, **Associated VCG**, which displays the number of the virtually concatenated group that is used to transport the port traffic over the SDH/SONET network.

- The **MDIX Auto Cross Over** and **Polarity** items are not supported.

LAN Port with GbE Option

The physical port parameters for a GbE port are similar to those for the LAN ports 1 and 2. The main difference is that this port supports the 1000 Mbps half-duplex and full-duplex modes.

Selecting E1 or T1 PDH Port Parameters (4/8/21 E1 and 4/8/28 T1 Options)

Purpose

Select the type of PDH port parameters to be configured:

- Common parameters used by all the PDH ports.

- Port parameters, that is, parameters that may be independently selected for each port.

Reached from

Configuration ›Physical Ports

A typical **PDH** port selection screen for an FCD-155 with 8 E1 or T1 G703 ports is shown in *Figure 5-62.* For FCD-155E PDH is replaced by E1/T1.

```
                               FCD-155
Configuration>Physical Ports>PDH


 1. Common Parameters>
 2. Port Parameters  >

>


ESC-prev.menu; !-main menu; &-exit; @-output                            1M/1C
--------------------------------------------------------------------------------
```

*Figure 5-62. Typical **PDH** or **E1/T1** Physical Port Parameters Selection Screen (FCD-155 with 8-Port E1 or T1 G703 Option)*

➤ **To select the type of PDH parameters to be configured:**

Type the corresponding item number, **1** or **2**, and then press ‹ **Enter** ›.

Configuring Common PDH Port Parameters (4/8/21 E1)

Purpose

Configure the common PDH port parameters:

• VC parameters

• Interface parameters.

Reached from

Configuration ›Physical Ports ›PDH

Selecting the Common Port Parameters Type

Figure 5-63 shows a typical type selection screen for the common PDH port parameters. For FCD-155E **PDH** is replaced by **E1/T1**.

```
                               FCD-155
Configuration>Physical Ports>PDH>Common Parameters


 1. VC configuration     >
 2. Interface Parameters >

>

ESC-prev.menu; !-main menu; &-exit; @-Output                            1M/1C
--------------------------------------------------------------------------------
```

*Figure 5-63. Typical PDH **Common Parameters** Type Selection Screen (FCD-155 with 8-Port E1 G703 Option)*

➤ **To select the type of E1 parameters to be configured:**

Type the corresponding item number, **1** or **2**, and then press ‹ **Enter** ›.

Selecting the VC Configuration Parameters

Figure 5-64 shows a typical **VC Configuration** screen, as displayed after selecting **1** on the **Common Parameters** screen.

The parameters that can be configured by means of the **VC Configuration** screen are described in *Table 5-16*.

➤ **To configure the VC parameters of the E1 ports:**

1. Type the number of the desired parameter and then press **‹Enter›.**

2. When done, type **#** to save and then confirm the action.

```
                          FCD-155
...>Physical Ports>PDH>Common Parameters>VC configuration

 1. AIS & RDI on payload label     (Disable)
 2. AIS & RDI on path trace        (Disable)

>

ESC-prev.menu; !-main menu; &-exit; @-output                        1M/1C
--------------------------------------------------------------------------
```

*Figure 5-64. Typical **VC Configuration** Screen for E1 PDH Physical Ports (FCD-155 with 8-Port E1 G703 Option)*

*Table 5-16. **VC Configuration** Parameters for E1 Ports Option*

Parameter	Function	Values	
AIS & RDI on Payload Label	Controls the sending of AIS and RDI indications by E1 ports, in case the received payload label is different from the expected payload label. The signal label is separately configured for each port	ENABLE	AIS and RDI are sent when a payload label mismatch is detected.
		DISABLE	AIS and RDI are not sent when payload label mismatch is detected. Nevertheless, AIS and RDI are still sent in case of LOP (loss of pointer) or *unequipped signal label* condition.
		Default: DISABLE	
AIS & RDI on Path Trace	Controls the sending of AIS and RDI indications by E1 ports, in case the received path trace label (carried in SDH overhead byte J2) is different from the expected path trace label	ENABLE	AIS and RDI are sent in case a path trace label mismatch is detected.
		DISABLE	AIS and RDI are not sent when a path trace label mismatch is detected. Nevertheless, AIS and RDI are still sent in case a LOP (loss of pointer) or *unequipped signal label* condition is detected.
		Default: DISABLE	

Selecting the Interface Parameters

Figure 5-65 shows a typical **Interface Parameters** screen, as displayed after selecting **2** on the **Common Parameters** screen.

The screen has one parameter:

- **Interface Type:** selects the line interface type:

    UnBalance   Unbalanced interface. Use the CBL-G703-8/COAX or CBL-G70314/COAX adapter cable to connect to the G703 interface connector.

    Balance   Balanced interface. Use the CBL-G703-8/RJ45 or CBL-G703-14/RJ45 adapter cable to connect to the G703 interface connector.

```
                              FCD-155E
Configuration>Physical Ports>E1/T1>Common Parameters>Interface Parameters

 1. Interface Type >   (Balance)

>

ESC-prev.menu; !-main menu; &-exit; @-debug                           1M/1C
-------------------------------------------------------------------------
```

Figure 5-65. Typical Interface Parameters Screen for E1 PDH Physical Ports (FCD-155 with 8-Port E1 G703 Option)

➤ **To change the interface parameters of the E1 G703 ports:**

1. Type the parameter number and then press **‹Enter›.**

2. You will see a selection screen with two options.

3. Type the desired item number, **1** or **2,** and then press **‹Enter›**.

4. Type **#** to save and then confirm the action. The new selection appears on the **Interface Parameters** screen.

Configuring Common PDH Port Parameters (4/8/28 T1)

Purpose

Configure the VT parameters, which are common to all the T1 PDH ports.

This option is available only when the FCD-155 operates with SONET interfaces and is equipped with the T1 G703 option.

Reached from

Configuration›Physical Ports›PDH

Figure 5-66 shows a typical selection screen for the common T1 PDH port parameters. For FCD-155E **PDH** is replaced by **E1/T1**.

```
                           FCD-155
Configuration>Physical Ports>PDH>Common Parameters


  1. VT configuration      >


>


ESC-prev.menu; !-main menu; &-exit; @-Output                          1M/1C
--------------------------------------------------------------------------
```

*Figure 5-66. Typical PDH **Common Parameters** Type Selection Screen (FCD-155 with 8-Port T1 G703 Option, SONET Mode)*

➤ **To select the type of T1 parameters to be configured:**

Type the corresponding item number, **1** or **2,** and then press **‹Enter›**. To continue type **1**.

Figure 5-67 shows a typical **VT Configuration** screen, as displayed after selecting **1** on the **Common Parameters** screen.

The parameters that can be configured by means of the **VT Configuration** screen are described in *Table 5-17*.

➤ **To configure the VT parameters of the T1 ports:**

1. Type the number of the desired parameter and then press **‹Enter›.**

2. When done, type **#** to save and then confirm the action.

```
                           FCD-155
...>Physical Ports>PDH>Common Parameters>VT configuration

 1. AIS & RDI on payload label    (Disable)
 2. AIS & RDI on path trace       (Disable)


>


ESC-prev.menu; !-main menu; &-exit; @-output                          1M/1C
--------------------------------------------------------------------------
```

*Figure 5-67. Typical **VT Configuration** Screen for T1 PDH Physical Ports (FCD-155 with 8-Port T1 G703 Option)*

Table 5-17. VT Configuration Parameters for T1 Ports Option

Parameter	Function	Values	
AIS & RDI on Payload Label	Controls the sending of AIS and RDI indications by T1 ports, in case the received payload label is different from the expected signal label. The payload label is separately configured for each port	ENABLE	AIS and RDI are sent when a payload label mismatch is detected.
		DISABLE	AIS and RDI are not sent when payload label mismatch is detected. Nevertheless, AIS and RDI are still sent in case of LOP (loss of pointer) or *unequipped signal label* condition.
		Default: DISABLE	
AIS & RDI on Path Trace	Controls the sending of AIS and RDI indications by T1 ports, in case the received path trace label (carried in SONET overhead byte J2) is different from the expected path trace label	ENABLE	AIS and RDI are sent in case a path trace label mismatch is detected.
		DISABLE	AIS and RDI are not sent when a path trace label mismatch is detected. Nevertheless, AIS and RDI are still sent in case a LOP (loss of pointer) or *unequipped signal label* condition is detected.
		Default: DISABLE	

Selecting E1 or T1 PDH Ports for Configuration

Purpose

Select the E1 or T1 PDH port to be configured. You may also configure all the eight ports with identical parameters.

Reached from

Configuration›Physical Ports›PDH›Port Parameters

A typical PDH port selection screen for an FCD-155 with 8 E1 or 8 T1 ports is shown in *Figure 5-68.* For FCD-155E **PDH** is replaced by **E1/T1**.

For the 21 E1 or 28 T1 options, you can scroll using the **N** and **P** to display the other options.

```
                                  FCD-155
Configuration>Physical Ports>PDH>Port Parameters


 1. Port 1            >
 2. Port 2            >
 3. Port 3            >
 4. Port 4            >
 5. Port 5            >
 6. Port 6            >
 7. Port 7            >
 8. Port 8            >
 9. All Ports         >

>


ESC-prev.menu; !-main menu; &-exit; @-Output                          1M/1C
-----------------------------------------------------------------------------
```

*Figure 5-68. Typical PDH **Port Parameters** Port Selection Screen (FCD-155 with 8-Port E1 or T1 G703 Option)*

➤ **To select the E1 or T1 PDH port to be configured:**

Type the corresponding item number, and then press **‹Enter›**.

➤ **To configure all the E1 or T1 PDH ports with similar parameters:**

Type the last number in the list, corresponding to **All Ports**, and then press **‹Enter›**.

Selecting an E3 or T3 PDH Port for Configuration

When the FCD-155 is equipped with an E3 or T3 interfaces, the port selection screen includes a single item, **Port 1**.

➤ **To select the PDH port to be configured:**

Type **1,** and then press **‹Enter›**.

Configuring PDH (Physical Ports) Parameters – E1 Ports

Purpose

Configure the physical layer parameters of the selected FCD-155 PDH port.

Reached from

Configuration ›Physical Ports ›PDH ›Port Parameters

A typical **PDH** screen for E1 ports is shown in *Figure 5-69*. The selected port is identified in the screen header. For FCD-155E **PDH** is replaced by **E1/T1**.

```
                                FCD-155
Configuration>Physical Ports>PDH>Port Parameters>Port 1


     LIU Usage(E1/T1)              >    (E1)
 1. Admin Status                   >    (Enable)
 2. Rx Clock Selection             >    (RX VC12)
 3. Rx Gain                        >    (Short Haul)
 4. Port Name                      ... ()
 5. VC configuration               >

>


ESC-prev.menu; !-main menu; &-exit; @-output                           1M/1C
------------------------------------------------------------------------------
```

*Figure 5-69. Typical **PDH** or **E1/T1** Physical Port Configuration Screen (E1 Ports)*

The parameters that can be configured by means of the **PDH** port configuration screen are described in *Table 5-18.*

➤ **To configure the physical port parameters of an E1 PDH port:**

1. Type the number corresponding to the desired parameter, and then press ‹Enter›:

   ▪ To change the **Admin Status**, type **1** and then press ‹Enter›.

   ▪ For item **4**, you can type the desired name in the same line. When done, press ‹Enter›.

   ▪ See separate procedure for item **5 – VC Configuration.**

   ▪ For the other items, you will see the corresponding selection screen. In this case, the **Values** column in *Table 5-18* lists the options displayed on the selection screen.

      On the selection screen, type the number of the desired option and then press ‹Enter›. The selection screen closes and the new value appears in the **PDH** screen.

2. When done, type **#** to save and then confirm the action.

Table 5-18. **Configuration>Physical Ports>PDH** *or* **E1/T1>Port Parameters** *for E1 Ports*

Parameter	Function	Values	
LIU Usage (E1/T1)	Used to display the operating mode of the line interface unit (LIU) of the corresponding port	Always displays **E1** and cannot be changed	
Admin Status	Used to enable/disable the flow of traffic through the selected PDH port	**DISABLE**	The flow of traffic is disabled. This state should be selected as long as the configuration of the corresponding port has not yet been completed, or when it is necessary to stop traffic flow through the port.
		ENABLE	The flow of traffic is enabled.
		Default: DISABLE	
Rx Clock Selection	Selects the timing reference source used by the FCD-155 for the PDH side. All the PDH ports must use the same timing reference. For details on FCD-155 timing subsystem, refer to *Chapter 2.* This item is not displayed by the 21 E1/28 T1 options of the FCD-155E	**Rx VC12**	PDH reference source locked to the receive clock recovered from the corresponding VC-12 timing. This mode locks the local timing of the PDH port to the timing of the PDH signal received by the remote equipment. This locks the local user's equipment timing reference to that of the remote PDH equipment.
		SDH	PDH reference source locked to the receive clock recovered from the line signal by the STM-1 interface. This locks the PDH timing reference to that of the SDH network.
		Default: Rx VC12	
Rx Gain	Determines the maximum attenuation of the receive signal that can be compensated for by the port receive path, to obtain the BER performance required by the standards	**SHORT HAUL –** Maximum attenuation of 12 dB, relative to the nominal transmit level (0 dB). **LONG HAUL –** Maximum attenuation of 36 dB, relative to the nominal transmit level (0 dB). The lower attenuation may actually improve the performance when operating over relatively short line sections, especially when operating over multi-pair cables. In such cables, significant interference is generated by the signals carried by other pairs, and therefore a weak desired signal may be masked by the interference. **Default: SHORT HAUL**	
Port Name	Used to enter a logical name for the PDH port	Up to 8 characters. **Default: Empty string**	
VC Configuration	Used to configure the parameters of the VC-12 used to transport the port payload	See procedure below	

➤ **To configure the VC-12 parameters of an E1 PDH port:**

1. Type **5** and then press **‹Enter›.** You will see the VC-12 configuration screen. A typical **VC Configuration** screen is shown in *Figure 5-70*. For FCD-155E **PDH** is replaced by **E1/T1**.

2. Type the desired item number and then press **‹Enter›**:

    ▪ For items **1, 2, 3**, the selection is toggled as soon as you press **‹Enter›**.

    ▪ For item **4**, you can type the desired value in the same line. When done press **‹Enter›**.

    ▪ For the other items, you will see the corresponding selection screen. In this case, the **Values** column in *Table 5-19* lists the options displayed on the selection screen.

    On the selection screen, type the number of the desired option and then press **‹Enter›**. The selection screen closes and the new value appears in the **VC Configuration** screen.

3. When done, type **#** to save and then confirm the action.

The parameters that can be configured by means of the **VC Configuration** screen are described in *Table 5-19*.

```
                              FCD-155E
Configuration>Physical Ports>E1/T1>Port Parameters>Port 1>VC configuration


 1. J2 Rx path trace              (Disable)
 2. J2 path trace             ... (fcd155)
 3. EED Threshold            >    (1E-3)
 4. SD Threshold             >    (1E-6)
 5. Payload Label[0 - 7]     ... (2)
 6. Padding                  >    (NULLs)
 7. Path Protection          >    (None)

>


# - Save; % - Undo
ESC-prev.menu; !-main menu; &-exit; @-debug                       1M/1C
-----------------------------------------------------------------------

```

*Figure 5-70. Typical **VC Configuration** Screen for 8/21 E1 PDH Physical Ports (FCD-155E)*

Table 5-19. **VC Configuration** *Parameters for E1 PDH Ports*

Parameter	Function	Values
J2 Rx Path Trace	Controls the checking of the received path trace label by the corresponding group	**ENABLE** – Path trace label is checked. **DISABLE** – Path trace label is not checked. Default: **DISABLE**
J2 Path Trace	Specifies the path trace label. This parameter is relevant only when **J2 Rx Path Trace** is **ENABLE**	Alphanumeric string of 15 characters. If not all of the 15 characters are needed for the prescribed label, make sure to specify the appropriate **Padding** method. Default: **fcd155**
EED Threshold	Selects the BER value, which if exceeded results in the generation of the error rate degradation alarm for the corresponding port	The available selections are 10E-3 (BER threshold of 10^{-3}), 10E-4 (10^{-4}), 10E-5 (10^{-5}). Default: **10E-3** (BER of 10^{-3})
SD Threshold	Selects the BER value, which if exceeded results in the generation of the signal-degraded alarm for the corresponding port	The available selections are 10E-6 (BER threshold of 10^{-6}), 10E-7 (10^{-7}), 10E-8 (10^{-8}) or 10E-9 (10^{-9}). Default: **10E-6** (BER of 10^{-6})
Payload Label	Specifies the expected signal label (one byte)	Number in the range of 0 to 7. Default: **2**
Padding	Specifies the type of characters used to pad the path trace label, when it is shorter than the required length of 15 characters	**NULLS** – NULL characters. **SPACES** – Space characters. Default: **NULLS**
Path Protection	Controls the use of path (trail) protection for the selected port. Trail protection should be enabled only when the APS protection mode is **OFF**. This parameter is supported only by the FCD-155E	**NONE** – Path protection for the selected port is disabled. The trail may still be protected, together with all the other trails, if the APS protection is enabled. **AUTO** – Path protection is enabled. The mapping of the selected port on link 1 is automatically copied to the same TU on link 2. **AUTO** cannot be selected when APS protection is on, or when the channel is already mapped (the mapping must be performed only after the **Path Protection** mode is selected). **MANUAL** – Path protection is enabled. The port is mapped manually in different TUs of the same link, or on different links. Default: **NONE**

Configuring PDH (Physical Ports) Parameters – T1 Ports

Purpose

Configure the physical layer parameters of a selected FCD-155 T1 PDH port.

Reached from

Configuration › Physical Ports › PDH › Port Parameters

Typical **PDH** screens for T1 ports are shown in *Figure 5-71* and *Figure 5-72*. The selected port is identified in the screen header. For FCD-155E **PDH** is replaced by **E1/T1**. The parameters displayed on the screen depend on the selected interface type: CSU or DSU, and on the network interface – SDH or SONET. The parameters that can be configured by means of the **PDH** or **E1/T1** port configuration screen, for both interface options, are described in *Table 5-20.*

```
                              FCD-155
Configuration>Physical Ports>PDH>Port Parameters>Port 1


    LIU Usage(E1/T1)            >    (T1)
 1. Admin Status                >    (Enable)
 2. Rx Clock Selection          >    (SONET)
 3. Rx Gain                     >    (Short Haul)
 4. Interface                   >    (CSU)
 5. Tx Gain                     >    (7.5 dB)
 6. Line Loopback code detector>    (Disable)
 7. Port Name                   ... ()
 8. VT configuration            >

>


ESC-prev.menu; !-main menu; &-exit; @-output                    1M/1C
--------------------------------------------------------------------------
```

*Figure 5-71. Typical **PDH** or **E1/T1** Physical Port Configuration Screen – T1 Ports with CSU Interface*

```
                              FCD-155
Configuration>Physical Ports>PDH>Port Parameters>Port 1


    LIU Usage(E1/T1)            >    (T1)
 1. Admin Status                >    (Enable)
 2. Rx Clock Selection          >    (SONET)
 3. Rx Gain                     >    (Short Haul)
 4. Interface                   >    (DSU)
 5. Tx Line Length              >    (0-133 FEET)
 6. Line Loopback code detector>    (Disable)
 7. Port Name                   ... ()
 8. VT configuration            >

>


ESC-prev.menu; !-main menu; &-exit; @-output                    1M/1C
--------------------------------------------------------------------------
```

*Figure 5-72. Typical **PDH** or **E1/T1** Physical Port Configuration Screen – T1 Ports with DSU Interface*

➤ **To configure the physical port parameters of a T1 PDH port:**

1. Type the number corresponding to the desired parameter, and then press **‹Enter›**:

   ▪ For item **1**, the selection is toggled as soon as you press **‹Enter›**.

   ▪ For item **7**, you can then type the desired name in the same line. When done, press **‹Enter›**.

   ▪ See separate procedure for item **8 – VC** or **VT Configuration.**

   ▪ For the other items, you will see the corresponding selection screen. In this case, the **Values** column in *Table 5-20* lists the options displayed on the selection screen. On the selection screen, type the number of the desired option and then press **‹Enter›**. The selection screen closes and the new value appears in the **PDH** screen.

2. When done, type **#** to save and then confirm the action.

Table 5-20. **Configuration ›Physical Ports ›PDH** *or* **E1/T1 ›Port Parameters** *for T1 Ports*

Parameter	Function	Values	
LIU Usage (E1/T1)	Displays the function of the line interface unit (LIU) of the corresponding port	Always displays **T1** and cannot be changed	
Admin Status	See *Table 5-18*		
Rx Clock Selection	See *Table 5-18*	The clock options depend on the network interface: • For SDH interface, the selections are **SDH**, and **RX VC-11** instead of **RX VC-12** • For SONET interface, the selections are **SONET** instead of **SDH**, and **RX VT-1.5** instead of **RX VC-12**	
Rx Gain	See *Table 5-18*		
Interface	Selects the port interface type	**CSU** **DSU** **Default: CSU**	CSU interface. DSU interface.

Table 5-20. **Configuration›Physical Ports›PDH** *or* **E1/T1›Port Parameters** *for T1 Ports (Cont.)*

Parameter	Function	Values
Tx Gain	Determines the attenuation of the T1 output signal, relative to the nominal transmit level (see *Note*).	**0 dB** — No attenuation.
		7.5 dB — Attenuation of 7.5 dB relative to the nominal transmit level.
	The T1 output transmit level must be adjusted to ensure reliable operation of the network, and for compliance with FCC Rules Part 68A.	**15 dB** — Attenuation of 15 dB relative to the nominal transmit level.
		22.5 dB — Attenuation of 22.5 dB relative to the nominal transmit level.
	This parameter is displayed only when **Interface** is **CSU**	**Default: 0 dB**

> **Note**
>
> The **Tx Gain** adjustment is used to minimize the interference caused by your transmit signal to other users that transmit their signals on other pairs of the same cable. The required setting depends mainly on the length of the cable that connects between the T1 port and the first repeater down the line.
>
> Repeaters are usually located every mile, and therefore, they are designed to optimally handle signals attenuated by one mile length of cable. If the T1 port were closer, the repeater would receive your signal at a higher level. This will not significantly improve the handling of your signal, but will certainly increase the interference coupled from your pair to repeaters that serve other pairs in the cable. To prevent this, you can select an attenuation value that will bring your signal level closer to the expected repeater signal level. This is achieved by connecting, as required, one, two, or three artificial line sections in series with your T1 transmit signal. Each line section introduces a nominal attenuation of 7.5 dB (equivalent to the attenuation of approximately 1000 feet of cable). Your system administrator or data carrier will tell you the proper setting for each port.

Parameter	Function	Values
Tx Line Length	Controls the T1 line transmit signal characteristics.	Select the value corresponding to the length of the cable (in feet) connected between the T1 port connector and the network access point:
	The transmit signal mask is selected in accordance with the transmit line length, to meet DSX-1 requirements, as specified by AT&T CB-119 and ANSI T1.102-1987.	• **000 to 133 FEET** • **134 to 266 FEET** • **267 to 399 FEET** • **400 to 533 FEET** • **534 to 655 FEET**
	This parameter is displayed only when **Interface** is **DSU**	**Default: 000 to 133 FEET**
Line Loopback Code Detector	Enables/disables the network line loopback (LLB) code detector	**ENABLE** – The LLB code detector is enabled. In this case, external equipment connected to the port can activate the LLB, for test purposes.
		DISABLE – The LLB code detector is disabled.
		Default: DISABLE

Table 5-20.　**Configuration ›Physical Ports ›PDH or E1/T1 ›Port Parameters** *for T1 Ports (Cont.)*

Parameter	Function	Values
Port Name	See *Table 5-18*	
VT or **VC Configuration**	Used to configure the parameters of the VC-11 (for SDH network interfaces) or VT-1.5 (for SONET network interfaces) used to transport the port payload	See procedure below

➤　**To configure the VC-11 or VT-1.5 parameters of a T1 PDH port:**

1. Type **7** on the **PDH Ports** screen, and then press **‹ Enter ›.** You will see the **VT Configuration** or **VC Configuration** screen. Typical **VC Configuration** screens for T1 ports are shown in *Figure 5-70*; the **VT Configuration** screen is similar, except for its header.

2. Type the desired item number and then press **‹ Enter ›.** You will see the corresponding selection screen. For a description of the parameters values, refer to the **Values** column in *Table 5-19*. On the selection screen, type the number of the desired option and then press **‹ Enter ›.** The selection screen closes and the new value appears in the **VT Configuration** screen.

3. When done, type **#** to save and then confirm the action.

Configuring PDH (Physical Ports) Parameters – E3 Ports

Purpose

Configure the physical layer parameters of the FCD-155 E3 PDH port.

Reached from

Configuration ›Physical Ports ›PDH or E3/T3 ›Port Parameters

A typical **PDH** screen for E3 ports is shown in *Figure 5-73*. The selected port is identified in the screen header. For FCD-155E, **PDH** is replaced by **E3/T3**.

```
                          FCD-155
Configuration>Physical Ports>PDH>Port Parameters>Port 1


    LIU Usage(E3/T3)            >    (E3)
 1. Admin Status                >    (Enable)
 2. Rx Clock Selection          >    (SDH)
 3. Port Name                   ... ()
 4. VC configuration            >

>


ESC-prev.menu; !-main menu; &-exit; @-output                        1M/1C
----------------------------------------------------------------------------
```

Figure 5-73. Typical **PDH** *or* **E3/T3** *Physical Port Configuration Screen (E3 Ports)*

The parameters that can be configured by means of the **PDH** port configuration screen are described in *Table 5-21.*

➤ **To configure the physical port parameters of the E3 PDH port:**

1. Type the number corresponding to the desired parameter, and then press ‹**Enter**›:

   ▪ To change the **Admin Status**, type **1** and then press ‹**Enter**›.

   ▪ For item **3**, you can type the desired name in the same line. When done, press ‹**Enter**›.

   ▪ See separate procedure for item **4 – VC Configuration.**

   ▪ For the other items, you will see the corresponding selection screen. In this case, the **Values** column in *Table 5-21* lists the options displayed on the selection screen.

     On the selection screen, type the number of the desired option and then press ‹**Enter**›. The selection screen closes and the new value appears in the **PDH** or **E3/T3** screen.

2. When done, type **#** to save and then confirm the action.

Table 5-21. Configuration>Physical Ports>PDH>Port Parameters for E3 Ports

Parameter	Function	Values	
LIU Usage (E3/T3)	Used to display the operating mode of the line interface unit (LIU) of the port	Always displays **E3** and cannot be changed	
Admin Status	See *Table 5-18*		
Rx Clock Selection	Selects the timing reference source used by the FCD-155 for the PDH side. For details on FCD-155 timing subsystem, refer to *Chapter 2*	Rx VC3	PDH reference source locked to the receive clock recovered from the corresponding VC-3 timing. This mode locks the local timing of the PDH port to the timing of the PDH signal received by the remote equipment. This locks the local user's equipment timing reference to that of the remote PDH equipment.
		SDH	PDH reference source locked to the receive clock recovered from the line signal by the STM-1 interface. This locks the PDH timing reference to that of the SDH network.
		Default: Rx VC3	
Port Name	Used to enter a logical name for the PDH port	Up to 8 characters. **Default: Empty string**	
VC Configuration	Used to configure the parameters of the VC-3 used to transport the port payload	See procedure below	

➤ **To configure the VC-3 parameters of the E3 PDH port:**

1. Type **4** and then press **‹Enter›.** You will see the VC-3 configuration screen. A typical **VC Configuration** screen is shown in *Figure 5-74*. For FCD-155E, **PDH** is replaced by **E3/T3**.

    The parameters that can be configured by means of the **VC Configuration** screen are described in *Table 5-19*.

2. Type the desired item number and then press **‹Enter›**:

    ▪   For items **1, 2, 3**, the selection is toggled as soon as you press **‹Enter›**.

    ▪   For item **4**, you can type the desired value in the same line. When done press **‹Enter›**.

    ▪   For the other items, you will see the corresponding selection screen. In this case, the **Values** column in *Table 5-19* lists the options displayed on the selection screen.

        On the selection screen, type the number of the desired option and then press **‹Enter›**. The selection screen closes and the new value appears in the **VC Configuration** screen.

3. When done, type **#** to save and then confirm the action.

    The parameters that can be configured by means of the **VC Configuration** screen are described in *Table 5-19*.

```
                          FCD-155
...>Physical Ports>PDH>Port Parameters>Port 1>VC configuration


 1. AIS & RDI on payload label    (Disable)
 2. AIS & RDI on path trace       (Disable)
 3. J1 Rx path trace              (Enable)
 4. J1 path trace            ... (fcd155)
 6. EED Threshold            >    (1E-3)
 7. SD Threshold             >    (1E-6)

>


ESC-prev.menu; !-main menu; &-exit; @-output                        1M/1C
-------------------------------------------------------------------------------
```

Figure 5-74. Typical VC Configuration Screen for E3 PDH Physical Ports

Configuring PDH (Physical Ports) Parameters – T3 Ports

Purpose

Configure the physical layer parameters of the FCD-155 T3 PDH port.

Reached from

Configuration›Physical Ports›PDH›Port Parameters

A typical **PDH** screen for the T3 port of an FCD-155 with SONET network interface is shown in *Figure 5-75*. For FCD-155E, **PDH** is replaced by **E3/T3**.

The screen for the T3 port of an FCD-155 with SDH network interface is similar. The selected port is identified in the screen header.

```
                          FCD-155
Configuration>Physical Ports>PDH>Port Parameters>Port 1


    LIU Usage(E3/T3)             >    (T3)
 1. Admin Status                 >    (Enable)
 2. Rx Clock Selection           >    (SONET)
 3. Port Name                    ... ()


>


ESC-prev.menu; !-main menu; &-exit; @-output                              1M/1C
-------------------------------------------------------------------------
```

*Figure 5-75. Typical **PDH** or **E3/T3** Physical Port Configuration Screen (T3 Ports)*

The parameters that can be configured by means of the **PDH** port configuration screen are described in *Table 5-22.*

➤ **To configure the physical port parameters of the T3 PDH port:**

1. Type the number corresponding to the desired parameter, and then press ‹Enter›:

   ▪ To change the **Admin Status**, type **1** and then press ‹Enter›.

   ▪ For item **2**, you will see a selection screen. In this case, the **Values** column in *Table 5-22* lists the options displayed on the selection screen.

      On the selection screen, type the number of the desired option and then press ‹Enter›. The selection screen closes and the new value appears in the **PDH** screen.

   ▪ For item **3**, you can type the desired name in the same line. When done, press ‹Enter›.

2. When done, type **#** to save and then confirm the action.

Table 5-22. Configuration >Physical Ports >PDH or E3/T3 >Port Parameters for T3 Ports

Parameter	Function	Values
LIU Usage (E3/T3)	Used to display the operating mode of the line interface unit (LIU) of the port	Always displays T3 and cannot be changed
Admin Status	See *Table 5-18*	
Rx Clock Selection	See *Table 5-18*	The clock options depend on the FCD-155 network interface: • For SDH interface, the selections are **SDH**, and **RX VC-3** instead of **RX VC-12** • For SONET interface, the selections are **SONET** instead of **SDH**, and **RX STS** instead of **RX VC-12**
Port Name	Used to enter a logical name for the PDH port	Up to 8 characters. **Default: Empty string**

Configuring Station Clock Parameters (FCD-155E)

Purpose

Configure the physical layer parameters of the FCD-155E station clock port.

Reached from

Configuration >Physical Ports >STM-1

Use

Figure 5-76 shows a typical **Station Clock** screen. The station clock port configuration parameters are explained in *Table 5-23*.

```
                            FCD-155E
Configuration>Physical Ports>Station Clock

 1. Admin Status              (Up)
 2. Transmit timing source >  (Nodal)
 3. Clock Rate            >   (2048 kbps)
 4. Interface Type        >   (Balance)
 5. Rx Gain Limit         >   (Short Haul)
 6. Quality               >   (Unknown)

>


ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
----------------------------------------------------------------------------
```

Figure 5-76. Configuration >Physical Ports > Station Clock Screen

➤ **To define the Station Clock port parameters:**

Select the number of the desired parameter, and then press **‹Enter›** to display the appropriate parameter selection screen, or toggle the current selection.

*Table 5-23. **Station Clock** Parameters*

Parameter	Function	Values
Admin Status	Used to enable/disable the station clock interface	**DOWN –** The station clock interface is disabled. This state should be selected as long as the port configuration has not yet been completed, or to stop using this port. **UP –** The station clock interface is enabled. **Default: DOWN**
Transmit Timing Source	Selects the source of the clock output signal provided in the station clock connector, for connection to other equipment	**NODAL** – the output (transmit) clock is derived from the FCD-155E nodal timing. **STATION RCLK** – the external clock signal applied to the station clock receive input is returned through the transmit output. **STATION RCLK AFTER JA** – the external clock signal applied to the station clock receive input is regenerated and filtered by a jitter attenuator, before being returned through the transmit output. **Default: NODAL**
Clock Rate	Selects the rate and type of signal accepted and transmitted via the station clock port	**2048 KBPS –** 2.048 Mbps signal per ITU-T Rec. G.703 Para. 6. **1544 KBPS –** 1.544 Mbps signal per ITU-T Rec. G.703 Para. 2. **2048 KHZ** – 2.048 MHz signal per ITU-T Rec. G.703 Para. 10. **Default: 2048 KBPS**
Interface Type	Selects the clock signal interface type	**BALANCE –** balanced interface (nominal impedance of 100 Ω for **1544 KBPS**, and 120 Ω for **2048 KBPS** and **2048 kHz**). **UNBALANCE –** 75 Ω unbalanced (coaxial) interface. This selection is available only for **2048 KBPS** and **2048 kHz**. **Default: BALANCE**
Line Code	Selects the line code. This parameter is not displayed for **2048 KHZ**	**AMI** – alternate mark inversion coding, relevant only for **1544 KBPS.** **HDB3** – high-density bipolar-3 coding, relevant only for **2048 KBPS.** **B8ZS (1544 KBPS)** – Binary-8 zero suppression coding, relevant only for **1544 KBPS.** **Default: AMI**

Table 5-23. **Station Clock** *Parameters (Cont.)*

Parameter	Function	Values
Rx Gain Limit	Determines the maximum attenuation of the receive signal that can be compensated for by the station port receive path. This parameter is not displayed for **2048 kHz** when **Interface Type** is **UNBALANCE**	**SHORT HAUL –** Maximum allowable attenuation of 10 dB, relative to the nominal transmit level (similar to DSU capabilities). **LONG HAUL –** Maximum allowable attenuation of 34 dB, relative to the nominal transmit level (similar to CSU or LTU capabilities). **Default: SHORT HAUL**
Quality	Specifies the timing quality value to be used by the FCD-155E timing circuits for the station clock. This parameter is relevant only when the S subsystem timing is configured to select a timing reference in accordance with the S1 byte of the STM-1 or OC-3 frame overhead (**Tx Clock Based on SSM=YES**)	The allowed selections for SDH operation (relevant for **2048 KBPS** and **2048 kHz**) are as follows: **PRC** – Primary source per ITU-T Rec. G.811 (associated SSM: 0001). **SSU-T –** transit (T-type) secondary synchronization source per ITU-T Rec. G.812 (associated SSM: 0100). **SSU-L** – Local (L-type) secondary synchronization source per ITU-T Rec. G.812 (associated SSM: 1000). **SEC** – SDH equipment clock per ITU-T Rec. G.813 (associated SSM: 1011). **Unknown** – unknown quality (associated SSM: 0000). The allowed selections for SONET operation per Telcordia GR-436-CORE (relevant for **1544 KBPS**) are as follows: **ST1** – Stratum 1 traceable reference source (associated SSM: 0001). **ST2** – Stratum 2 traceable reference source (associated SSM: 0111). **ST3** – Stratum 3 traceable reference source (associated SSM: 1010). **SMC** – SONET Minimum Clock, Traceable (sub Stratum 3 quality – associated SSM: 1100). **Unknown** – unknown quality (associated SSM: 0000). **Default: Unknown**

5.6   Configuration – Virtual Ports Menu

Figure 5-77 to *Figure 5-80* show typical **Virtual Ports** submenus. Ignore menu options not relevant to your particular FCD-155 version.

Figure 5-77. **Configuration›Virtual Ports** *Submenu Structure (SDH FCD-155E Version with PDH Ports)*

Virtual Ports

1. STS-3
2. VCAT

SONET Configuration

1. STS3-1-1 (To Link 1)
2. STS3-2-1 (To Link 1)
3. STS3-3-1 (To Link 1)
4. STS3-1-2 (To Link 2)
5. STS3-2-2 (To Link 2)
6. STS3-3-2 (To Link 2)
7. Common Parameters

STS3-1

1. J1 Path Trace
2. Payload Label
3. Padding

Common Parameters

1. RDI on Signal Label
2. RDI on Path Trace
3. J1 Rx Path Trace
4. EED Threshold
5. SD Threshold

STS-3

1. SONET Configuration

**GFP Encapsulation
(Typical)**

VCG-1

1. Admin Status
2. VC Type
3. LCAS
4. Number of VTs
5. Encapsulation
6. GFP Channel ID
7. Max Differential Delay
8. Group ID
9. Minimum Number of VCs
10. Virtual Concatenation
11. Group Name
- - - - - - - - - - - - - - - -
12. VT Configuration
13. GFP Configuration

VC Type

1. VT1.5/SPE
2. STS-1/SPE

Encapsulation

1. GFP
2. LAPS

**LAPS Encapsulation
(Typical)**

VCG 1

1. Admin Status
2. VC Type
3. LCAS
4. Number of VTs
5. Encapsulation
6. Max Differential Delay
7. Group ID
8. Virtual Concatenation
9. Group Name
10. VT Configuration
11. LAPS Configuration

VCAT

1. VCG 1
2. VCG 2
3. VCG 3
4. VCG 4
5. VCG 5
6. VCG 6
7. VCG 7
8. VCG 8
9. All VCGs
10. GFP Mux

**Same as for
SDH with PDH Ports**

GFP Configuration

1. FCS
2. PTI for Client Data
3. UPI for Client Data
4. Delta
5. Core Scrambling
6. Payload Scrambling

VT Configuration

1. RDI on Payload Label
2. RDI on Path Trace
3. J2 Rx Path Trace
4. J2 Path Trace
5. EED Threshold
6. SD Threshold
7. First Sequence Indicator
8. Extended Signal Label
9. Padding
10. Path Protection

LAPS Configuration

1. Address
2. Control
3. SAPI Value

Path Protection

1. None
2. Auto
3. Manual

VT Configuration

1. RDI on Payload Label
2. RDI on Path Trace
3. J2 Rx Path Trace
4. J2 Path Trace
5. EED Threshold
6. SD Threshold
7. Extended Signal Label
8. Padding
9. Path Protection

Figure 5-78. ***Configuration>Virtual Ports*** *Submenu Structure (SONET FCD-155E Version with PDH Ports)*

Virtual Ports

1. STM-1
2. VCAT

SDH Configuration

1. VC-4

VC-4-1

1. RDI on Payload Label
2. RDI on Path Trace
3. J1 Rx Path Trace
4. J1 Path Trace
5. Payload Label
6. EED Threshold
7. SD Threshold
8. Padding

STM-1

1. SDH Configuration

VC Type

1. VC-12
2. VC-3
3. VC-4

LAPS Encapsulation (Typical)

VCG 1

1. Admin Status
2. VC Type
3. LCAS
4. Number of VCs
5. Encapsulation
6. Max Differential Delay
7. Group ID
8. Virtual Concatenation
9. Group Name
10. VC Configuration
11. LAPS Configuration

Encapsulation

1. GFP
2. LAPS

GFP Encapsulation (Typical)

VCAT

1. VCG-1
2. VCG-2
3. VCG-3
4. VCG-4
5. VCG-5
6. VCG-6
7. VCG-7
8. VCG-8
9. All VCGs
10. GFP Mux

VCG-1

1. Admin Status
2. VC Type
3. LCAS
4. Number of VCs
5. Encapsulation
6. GFP Channel ID
7. Max Differential Delay
8. VCG ID
9. Minimum Number of VCs
10. Virtual Concatenation
11. VCG Name
- - - - - - - - - - - - - - - - - -
12. VC Configuration
13. GFP Configuration

VC Configuration

1. RDI on Payload Label
2. RDI on Path Trace
3. J2 Rx Path Trace
4. J2 Path Trace
5. EED Threshold
6. SD Threshold
7. Extended Signal Label

LAPS Configuration

1. Address
2. Control
3. SAPI Value

GFP Configuration

1. FCS
2. PTI for Client Data
3. UPI for Client Data
4. Delta
5. Core Scrambling
6. Payload Scrambling

VC Configuration

1. RDI on Payload Label
2. RDI on Path Trace
3. J2 Rx Path Trace
4. J2 Path Trace
5. EED Threshold
6. SD Threshold
7. Extended Signal Label

GFP Mux

Index VCG-1 VCG-2 VCG-3 VCG-4 VCG-5 VCG-6 VCG-7 VCG-8 Primary

Add

GFP Mux

Index (1)
1. GFP Mux Name
2. VCG 1
3. VCG 2
4. VCG 3
5. VCG 4
6. VCG 5
7. VCG 6
8. VCG 7
9. VCG 8
10. Primary

- Save

VCG 1 (0%)

1. 0%
2. 12.5%
3. 25%
4. 37.5%
5. 50%
6. 62.5%
7. 75%
8. 87.5%

· · · · ·

VCG 8 (0%)

1. 0%
2. 12.5%
3. 25%
4. 37.5%
5. 50%
6. 62.5%
7. 75%
8. 87.5%

Primary (VCG 1)

1. VCG 1
2. VCG 2
3. VCG 3
4. VCG 4
5. VCG 5
6. VCG 6
7. VCG 7
8. VCG 8

GFP Mux

Index (1)
1. GFP Mux Name
2. VCG 1
3. VCG 2
4. VCG 3
5. VCG 4
6. VCG 5
7. VCG 6
8. VCG 7
9. VCG 8
10. Primary

GFP Mux

Index (2)
1. GFP Mux Name
2. VCG 1
3. VCG 2
4. VCG 3
5. VCG 4
6. VCG 5
7. VCG 6
8. VCG 7
9. VCG 8
10. Primary

Modify

Add

GFP Mux

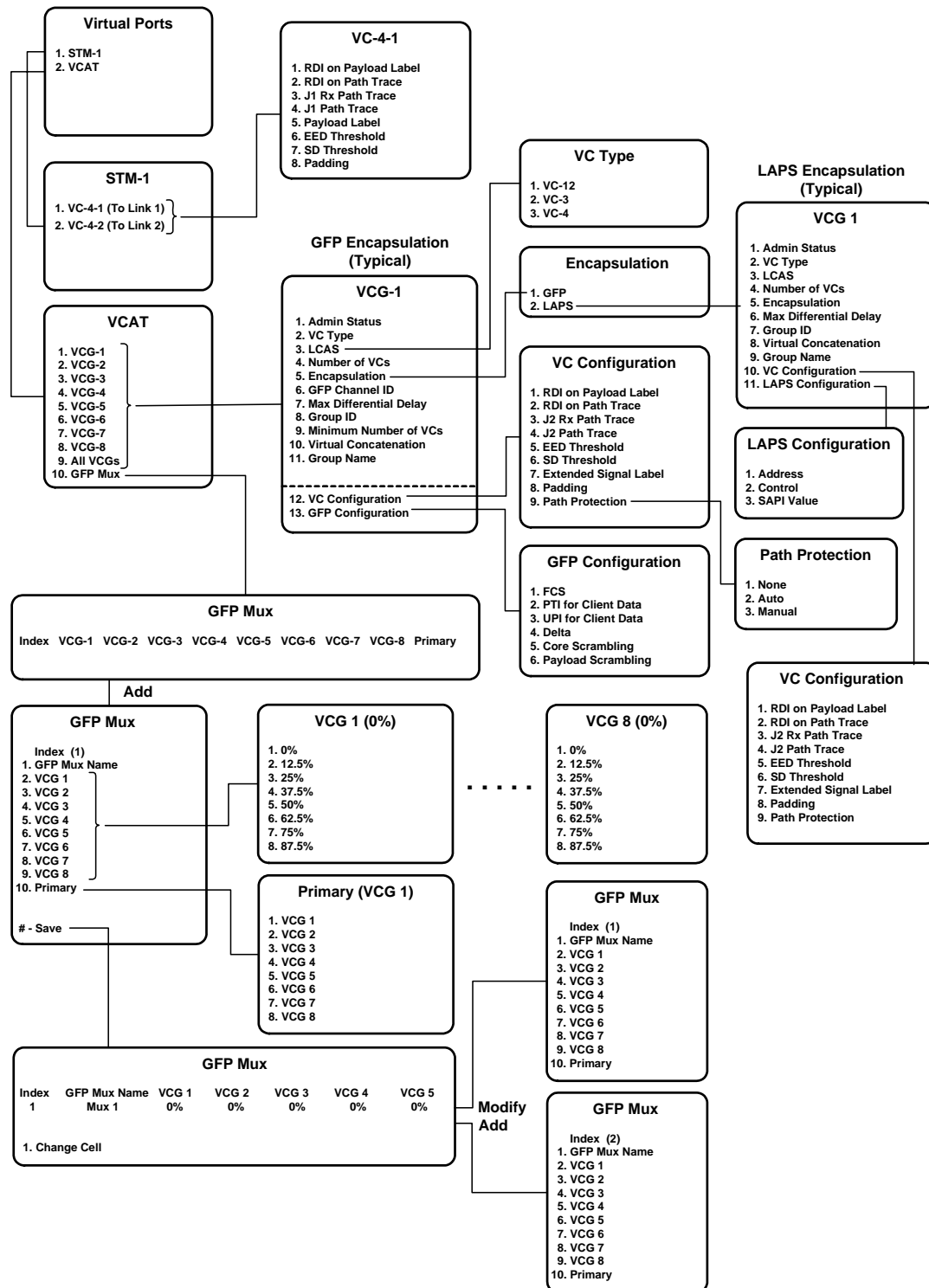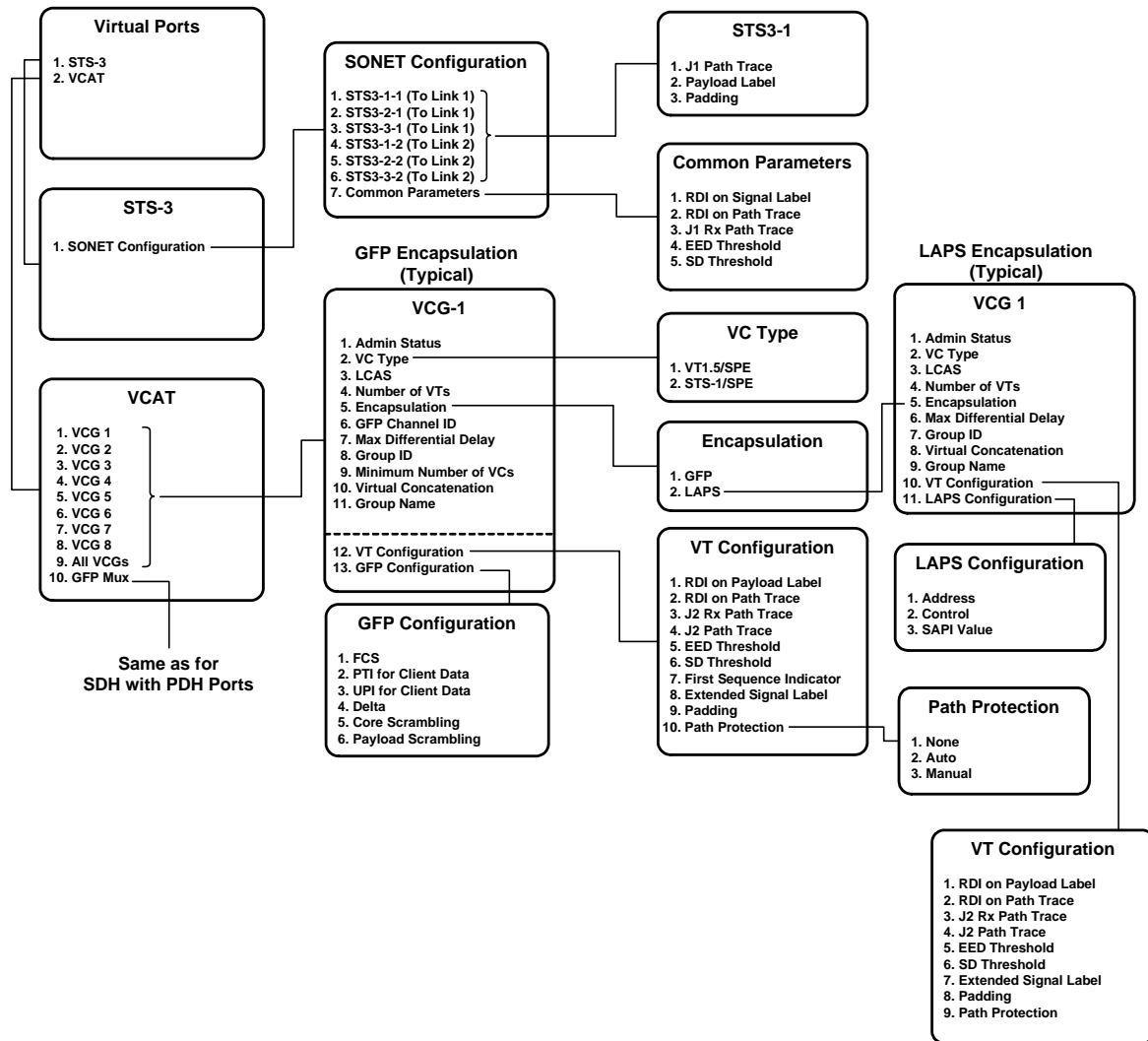| Index	GFP Mux Name	VCG 1	VCG 2	VCG 3	VCG 4	VCG 5
1	Mux 1	0%	0%	0%	0%	0%

1. Change Cell

*Figure 5-79. **Configuration>Virtual Ports** Submenu Structure (SDH FCD-155 Version with PDH Ports)*

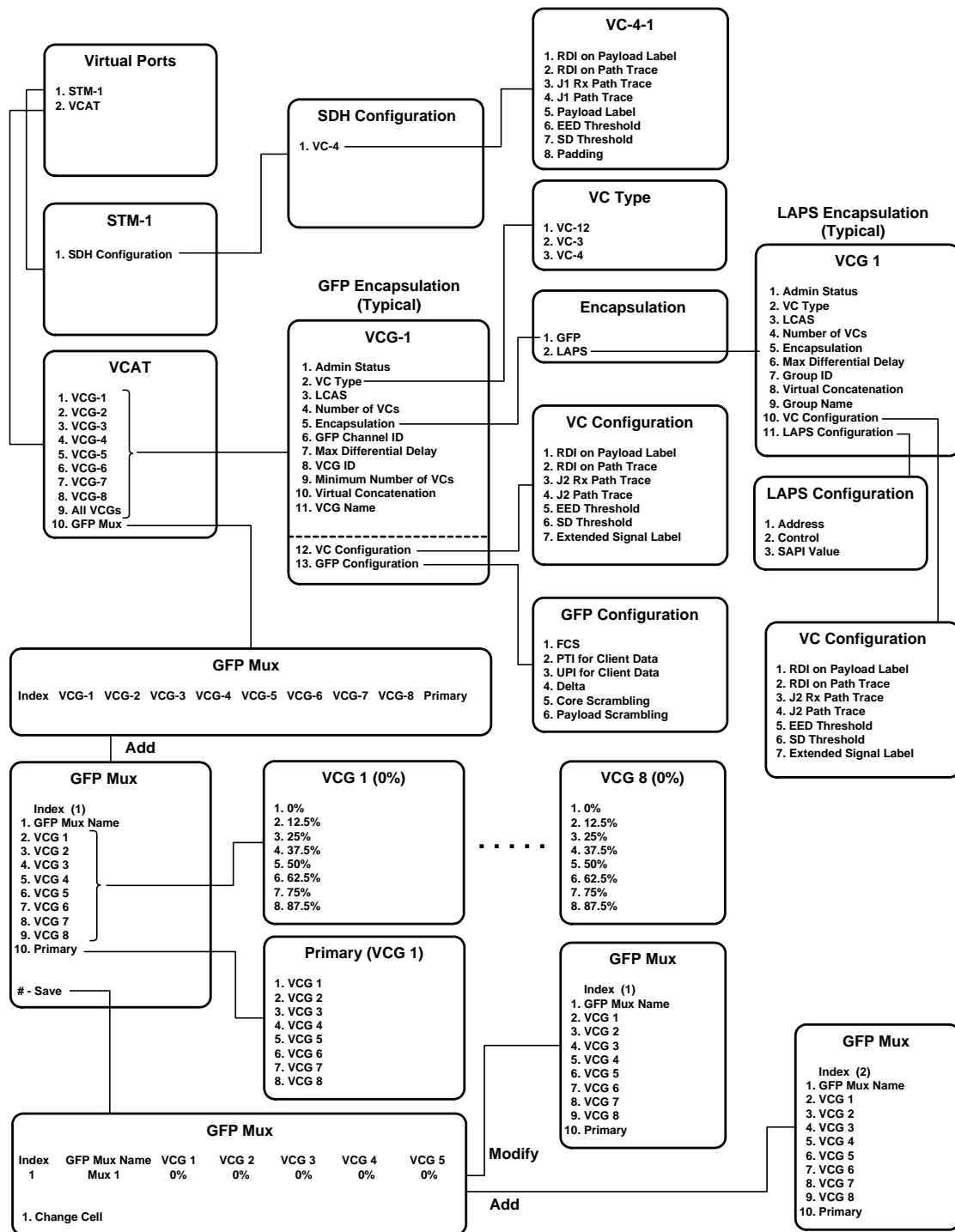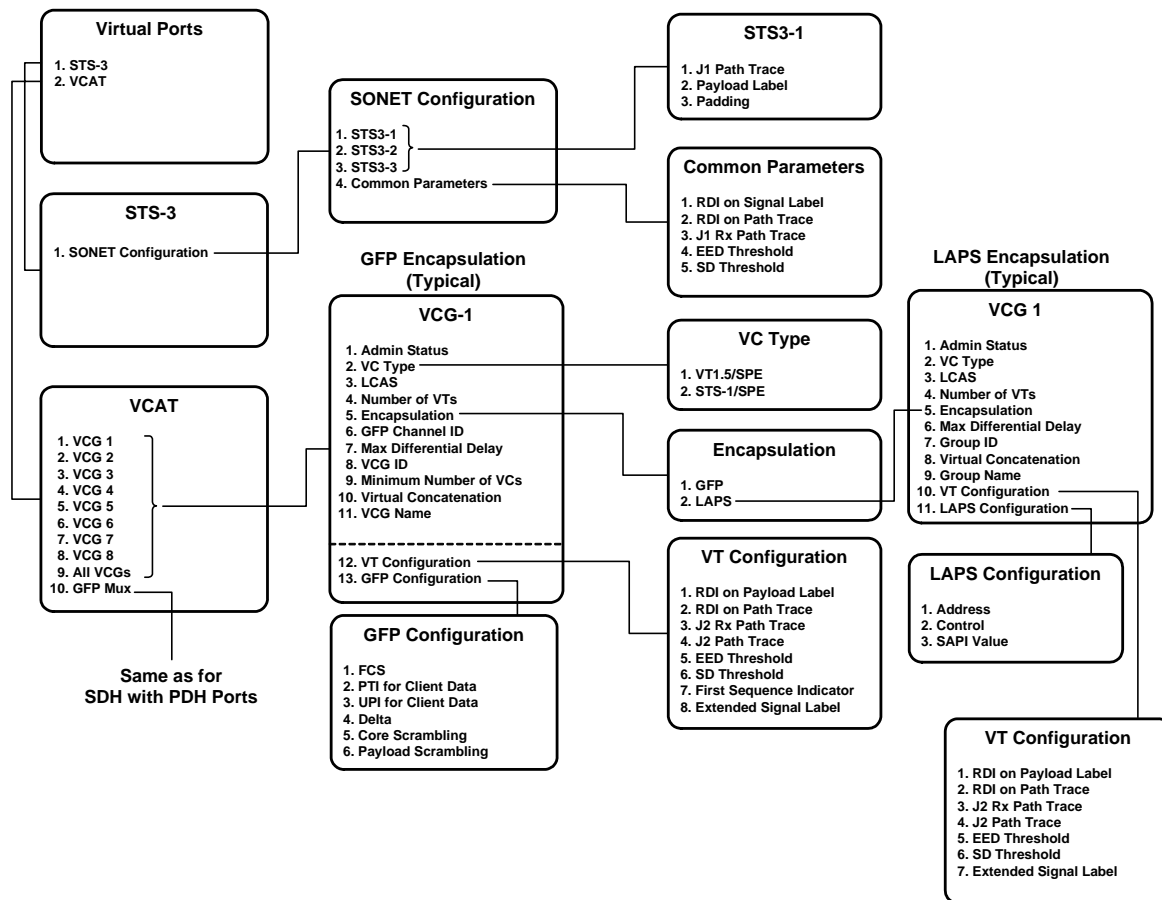*Figure 5-80. **Configuration>Virtual Ports** Submenu Structure (SONET FCD-155 Version with PDH Ports)*

5.7   Configuring Virtual Ports

Selecting the Type of Virtual Ports to be Configured

Purpose

Select the type of virtual ports to be configured.

Reached from

Configuration>Virtual Ports

A typical **Virtual Ports** screen for an FCD-155 with SDH network interface is shown in *Figure 5-81*.

Note   *For FCD-155 with single Ethernet port, item **2: VCAT** is not available.*

A typical screen for an FCD-155 with SONET network interface is shown in *Figure 5-82*.

```
                                      FCD-155
Configuration>Virtual Ports


 1. STM-1                    >
 2. VCAT>

>


ESC-prev.menu; !-main menu; &-exit; @-Output                              1M/1C
-------------------------------------------------------------------------------
```

*Figure 5-81. Typical **Virtual Ports** Selection Screen (SDH Network Interface)*

```
                                      FCD-155
Configuration>Virtual Ports


 1. STS-3                    >
 2. VCAT>

>


ESC-prev.menu; !-main menu; &-exit; @-Output                              1M/1C
-------------------------------------------------------------------------------
```

*Figure 5-82. Typical **Virtual Ports** Selection Screen (SONET Network Interface)*

➤ **To select the type of virtual ports to be configured:**

Type the corresponding item number and then press **‹Enter›**.

Configuring Virtual Ports Parameters for FCD-155E

Purpose

Select the scope of high order (VC-4 or STS-3) virtual port configuration.

Reached from

Configuration›Virtual Ports

Configuring VC-4 Virtual Ports

The first in the VC-4 configuration procedure is to select the target, by selecting **STM-1** on the **Virtual Ports** submenu.

A typical screen for an FCD-155E with SDH network interface is shown in *Figure 5-83*. This screen is used to select a specific VC-4.

```
                              FCD-155E
Configuration>Virtual Ports>STM-1


 1. SDH Configuration>

>

ESC-prev.menu; !-main menu; &-exit; @-Output                           1M/1C
-----------------------------------------------------------------------------
```

*Figure 5-83. Typical **STM-1 VC-4** Selection Screen (FCD-155E)*

➤ **To select the VC-4 virtual port configuration target:**

1. Type the corresponding number and then press ‹**Enter**›.

2. You will see the corresponding VC-4 configuration screen.

    A typical screen is shown in *Figure 5-84*. The selected link is identified in the header.

```
                              FCD-155E
Configuration>Virtual Ports>STM-1

 1. VC-4-1(To Link 1)   >
 2. VC-4-2(To Link 2)   >

>

ESC-prev.menu; !-main menu; &-exit; @-debug                            1M/1C
-----------------------------------------------------------------------------
```

*Figure 5-84. Typical **VC-4 Configuration** Screen (FCD-155E)*

➤ **To configure the VC-4 virtual port parameters for SDH network interfaces:**

1. Type the desired item number and then press ‹**Enter**›.

    ▪ For items **1, 2, 3,** the selection is toggled as soon as you press ‹**Enter**›.

    ▪ For items **4** and **5**, you can type the desired value in the same line. When done, press ‹**Enter**›.

    ▪ For the other items, after pressing ‹**Enter**› you will see the corresponding selection screen. In this case, the **Values** column in *Table 5-24* lists the options displayed on the selection screen.

       On the selection screen, type the number of the desired option and then press ‹**Enter**›. The selection screen closes and the new value appears in the **VC-4** screen.

2. When done, type **#** to save and then confirm the action.

    The parameters that can be configured by means of the **VC-4** screen are described in *Table 5-24*.

Table 5-24. **Configuration>VC-4** *Parameters (FCD-155E)*

Parameter	Function	Values	
RDI on Payload Label	Controls the sending of AIS and RDI indications by the port, in case the received payload label is different from the expected payload label	ENABLE	RDI is sent when a payload label mismatch is detected.
		DISABLE	RDI is not sent when payload label mismatch is detected. Nevertheless, RDI is still sent in case of LOP (loss of pointer) condition.
		Default: DISABLE	
RDI on Path Trace	Controls the sending of AIS and RDI indications by the port, in case the received path trace label (carried in SDH overhead byte J1) is different from the expected path trace label	ENABLE	RDI is sent in case a path trace label mismatch is detected.
		DISABLE	RDI is not sent when a path trace label mismatch is detected. Nevertheless, RDI is still sent in case a LOP (loss of pointer) condition is detected.
		Default: DISABLE	
J1 Rx Path Trace	Controls the checking of the received path trace label by the port	ENABLE	Path trace label is checked.
		DISABLE	Path trace label is not checked.
		Default: DISABLE	
J1 Path Trace	Specifies the path trace label. This parameter is relevant only when **J1 Rx Path Trace** is **ENABLE**	Alphanumeric string of up to 15 characters. If not all of the 15 characters are needed for the prescribed label, make sure to specify the appropriate **Padding** method. Default: Empty string	
Payload Label	Specifies the expected payload label (one byte)	Hexadecimal number in the range of 0 to FF (two digits). Default: 2	
EED Threshold	Selects the BER value, which if exceeded results in the generation of the error rate degradation alarm for the port	The available selections are 10E-3 (BER threshold of 10^{-3}), 10E-4 (10^{-4}), 10E-5 (10^{-5}). Default: 10E-3 (BER of 10^{-3})	
SD Threshold	Selects the BER value, which if exceeded results in the generation of the signal-degraded alarm for the port	The available selections are 10E-6 (BER threshold of 10^{-6}), 10E-7 (10^{-7}), 10E-8 (10^{-8}) or 10E-9 (10^{-9}). Default: 10E-6 (BER of 10^{-6})	
Padding	Specifies the type of characters used to pad the path trace label, when it is shorter than the required length of 15 characters	NULLS – NULL characters. SPACES – Space characters. Default: NULLS	

Configuring STS-3 Virtual Ports

Purpose

The configuration procedure for the high-order (STS-3) parameters for an FCD-155E with SONET network interface determines two types of parameters:

• Common configuration parameters, used by all the STS-1 SPE

• Payload label and J1 path trace assigned to each STS-1 SPE.

A typical task selection screen is shown in *Figure 5-85*.

```
                               FCD-155E
Configuration>Virtual Ports>STS-3

 1. STS3-1-1(To Link 1) >
 2. STS3-2-1(To Link 1) >
 3. STS3-3-1(To Link 1) >
 4. STS3-1-2(To Link 2) >
 5. STS3-2-2(To Link 2) >
 6. STS3-3-2(To Link 2) >
 7. Common Parameters    >

>

ESC-prev.menu; !-main menu; &-exit; @-debug                        1M/1C
-----------------------------------------------------------------------
```

*Figure 5-85. Typical **STS-3** Configuration Task Selection Screen (FCD-155E)*

➤ **To configure the J1 path trace and payload label assigned to a specific STS-1 SPE:**

1. Type the number of the desired STS-1 SPE (**1**, **2** or **3**) and then press **‹Enter›**.

2. You will see the corresponding **STS** screen (the selected STS-1 is identified in the header). A typical **STS** screen is shown in *Figure 5-86*.

```
                               FCD-155E
Configuration>Virtual Ports>STS-3>STS3-1-1(To Link 1)

 1. J1 path trace        ... ()
 2. Payload Label   [0 - ff]... (2)
 3. Padding              >   (NULLs)

>

ESC-prev.menu; !-main menu; &-exit; @-debug                        1M/1C
-----------------------------------------------------------------------
```

*Figure 5-86. Typical **STS** Virtual Port Configuration Screen (FCD-155E)*

3. Type **1**, and then press **‹Enter›.** Now type the desired J1 path trace string (a unique alphanumeric string that must include 15 characters) and then press **‹Enter›.**

4. If the prescribed J1 path trace string is shorter than 15 characters, it is necessary to select the type of characters automatically added to pad the string: select **Padding** to open the selection screen, and then select between **NULLS** and **SPACES** (see *Table 5-24* for details).

5. Type **2**, and then press **‹Enter›.** Now type the desired payload label (two hexadecimal digits in the range of 00 to FF). The default is **2**.

Note   *Make sure the **J1 Rx Path Trace** parameters on the **Common Parameters** screen are set to **ENABLE**.*

6. Repeat the process for all the other STS-1.

➤ **To define the common parameters of all the STS-1:**

1. Type **4** and then press **‹Enter›**.

2. You will see the **Common Parameters** screen. A typical **Common Parameters** screen is shown in *Figure 5-87*.

```
                          FCD-155E
Configuration>Virtual Ports>STS-3>Common Parameters

 1. RDI on payload label        (Disable)
 2. RDI on path trace           (Disable)
 3. J1 Rx path trace            (Enable)
 4. EED Threshold        >      (1E-3)
 5. SD Threshold         >      (1E-6)

>

ESC-prev.menu; !-main menu; &-exit; @-output                      1M/1C
------------------------------------------------------------------------
```

*Figure 5-87. Typical **STS-3 Common Parameters** Screen (FCD-155E)*

The parameters that can be configured by means of the **Common Parameters** screen are described in *Table 5-24*.

Configuring Virtual Ports Parameters for FCD-155

Purpose

Select the scope of high order (STM-1 or STS-3) virtual port configuration.

Reached from

Configuration ›Virtual Ports

A typical screen for an FCD-155 with SDH network interface is shown in *Figure 5-88*, and a screen for an FCD-155 with SONET network interface is shown in *Figure 5-89*.

```
                                 FCD-155
Configuration>Virtual Ports>STM-1


 1. SDH Configuration>

>

ESC-prev.menu; !-main menu; &-exit; @-Output                          1M/1C
--------------------------------------------------------------------------
```

*Figure 5-88. Typical **SDH Configuration** Screen (FCD-155)*

```
                                 FCD-155
Configuration>Virtual Ports>STS-3


 1. SONET Configuration>

>

ESC-prev.menu; !-main menu; &-exit; @-Output                          1M/1C
--------------------------------------------------------------------------
```

*Figure 5-89. Typical **STS-3 Configuration** Screen (FCD-155)*

➤ **To select the SDH or SONET virtual port configuration target:**

Type **1** and then press **‹Enter›** to display the configuration screen. Use the same procedures as described above for the FCD-155E.

Selecting a Virtual Concatenation (VCAT) Task

Note   *FCD-155 with single Ethernet port do not support virtually concatenated groups, and therefore the VCAT section is not available.*

Purpose

Select the desired configuration function related to virtual concatenation:

* Configure the parameters of a specific virtually concatenated group. After configuring a virtually concatenated group, make sure to map its VCs/VTs using **Configuration ›System ›Mapping**.

* Configure all the currently-defined virtually concatenated groups with similar parameters.

Note   *Virtually concatenated groups may also be defined by means of the **Quick Setup** screen. When you decide to edit the configuration of such groups, carefully plan ahead the process to avoid failing the sanity checks automatically performed whenever you attempt to save changes.*

Some changes may result in temporary configuration conflicts, and if the configuration fails the sanity check, it is rejected and you must repeat the configuration activities.

- Configure the GFP multiplexing functionality (when this option is used).

Note   *If the FCD-155 has only 2 LAN ports, the number of groups displayed on the screens is 4. All the following screens assume that the FCD-155 unit has a GbE port, or transparent LAN ports, and therefore show 8 groups.*

Reached from

Configuration›Virtual Ports

A full **VCAT** group selection screen is shown in *Figure 5-93.*

➤ **To select a specific virtually concatenated group to be configured:**

Type the corresponding item number, **1** to **8**, and then press **‹Enter›**.

➤ **To configure all the virtually concatenated groups with similar parameters:**

Type **9** and then press **‹Enter›**.

➤ **To configure a GFP multiplexer (relevant only when GFP encapsulation is used for at least one group):**

Type **10** and then press **‹Enter›**.

```
                                FCD-155
Configuration>Virtual Ports>VCAT


 1. VCG 1    >
 2. VCG 2    >
 3. VCG 3    >
 4. VCG 4    >
 5. VCG 5    >
 6. VCG 6    >
 7. VCG 7    >
 8. VCG 8    >
 9. All VCGs>
10. GFP Mux   []>

>


ESC-prev.menu; !-main menu; &-exit; @-output                       1M/1C
-----------------------------------------------------------------------------
```

Figure 5-90. Typical **VCAT** *Group Selection Screen (FCD-155 with 6 LAN Ports)*

Configuring VCG Parameters (SDH Network Interfaces)

Purpose

Configure the parameters of a specific virtually concatenated group, or all the virtually concatenated groups.

Note   *FCD-155 with single Ethernet port do not support virtually concatenated groups, and therefore this screen is not available.*

The group parameters depend on the encapsulation method used on the group (or groups) being configured: LCAS or GFP.

Note   *For configuration instructions regarding the encapsulation parameters, refer to Using LAPS Encapsulation section for LCAS and to Using GFP Encapsulation section for GFP.*

This section covers the configuration activities available when the FCD-155 or FCD-155E uses the SDH network interface. For FCD-155 or FCD-155E with SONET network interface, refer to *Configuring VCG Parameters (SONET Network Interfaces)* section.

Reached from

Configuration>Virtual Ports>VCAT

Using LAPS Encapsulation

A typical individual **VCG** screen for an FCD-155 with SDH network interface that uses LAPS encapsulation over VC-12 is shown in *Figure 5-91*. The selected group is identified in the screen header.

```
                                   FCD-155
Configuration>Virtual Ports>VCAT>VCG 1

 1. Admin Status              (Enable)
 2. VC type            >     (VC12)
 3. LCAS                      (Yes)
 4. Number of VCs       [1 - 63]... (1)
 5. Encapsulation       >     (LAPS)
 6. Max Differential Delay[10 - 64]... (64)
 7. VCG ID              >     (1)
 8. Minimum Number Of VCs [1 - 63]... (1)
 9. Virtual Concatenation     (Yes)
10. VCG Name             ... ()
11. VC Configuration     >
12. LAPS Configuration   >

>

ESC-prev.menu; !-main menu; &-exit; @-output                          1M/1C
------------------------------------------------------------------------------
```

*Figure 5-91. Typical **VCG** Configuration Screen for LAPS Encapsulation over VC-12, for Groups 1 to 4 (SDH Network Interface)*

The screen shown in *Figure 5-91* is for a group in the range of 1 to 4 and using VC-12. A typical screen for groups in the range of 5 to 8 (for FCD-155 with transparent LAN ports) is shown in *Figure 5-92*. In this case, the screen includes an additional header, **Associated Port,** which displays the number of the LAN port using the selected group:

- Group 5 is associated with LAN port 3

- Group 6 is associated with LAN port 4

- Group 7 is associated with LAN port 5

- Group 8 is associated with LAN port 6.

The screen shown in *Figure 5-92* includes all the available parameters, and therefore it extends on two pages: press **N** to go from the first page to the second, and press **P** to return from the second page to the first.

```
                              FCD-155
Configuration>Virtual Ports>VCAT>VCG 5

    Associated LAN Port   >   (Port 3)
 1. Admin Status              (Enable)
 2. VC type               >   (VC12)
 3. LCAS                      (Yes)
 4. Number of VCs [1 - 63]... (1)
 5. Encapsulation         >   (LAPS)
 6. Max Differential Delay[10 - 64]... (64)
 7. VCG ID                >   (1)
 8. Minimum Number Of VCs [1 - 63]... (1)
 9. Virtual Concatenation     (Yes)
10. VCG Name              ... ()
... (N)
>


ESC-prev.menu; !-main menu; &-exit; @-output                        1M/1C
--------------------------------------------------------------------------
```

A. First Page

```
                              FCD-155
Configuration>Virtual Ports>VCAT>VCG 5

... (P)
11. VC Configuration      >
12. LAPS Configuration    >

>

ESC-prev.menu; !-main menu; &-exit; @-output                        1M/1C
--------------------------------------------------------------------------
```

B. Second Page

*Figure 5-92. Typical **VCG** Configuration Screen for LAPS Encapsulation over VC-12, for Groups 5 to 8 Associated with Transparent LAN Ports (SDH Network Interface)*

Note   *Item **Virtual Concatenation** in* Figure 5-91 *and* Figure 5-92 *appears only when the value selected in the **Number of VCs** field is **1**.*

If you selected **All VCGs** on the **VCAT** screen, the header in *Figure 5-91* and *Figure 5-92* is **All VCGs**.

The parameters that can be configured by means of the **VCG** screen are described in *Table 5-25*. When a selection screen is used, the **Values** column in *Table 5-25* also lists the options displayed on the selection screen.

➤ **To change a virtually concatenated group parameter (for SDH network interfaces):**

1. Type the number corresponding to the desired parameter, and then press ‹**Enter**›.

2. See separate procedure for **VC Configuration**.

   On the selection screen, type the number of the desired option and then press ‹**Enter**›. The selection screen closes and the new value appears in the **VCG** screen.

3. When done, type **#** to save and then confirm the action.

*Table 5-25. **Configuration>Virtual Ports>VCG** Screen Parameters*

Parameter	Function	Values	
Admin Status	Used to enable/disable the flow of traffic through the selected virtually concatenated group	DISABLE	The flow of traffic is disabled. This state should be selected as long as the configuration of the corresponding group has not yet been completed, or when it is necessary to stop traffic flow through the group.
		ENABLE	The flow of traffic is enabled.
		Default: DISABLE	
VC Type	Selects the type of VC used to carry the corresponding virtually concatenated group.	The available selections are **VC-12**, **VC-3** and **VC-4**.	
	This parameter is one of the parameters that determine the bandwidth made available to the virtually concatenated group.	If no selection has yet been made for the corresponding group, this field displays **Error**.	
	See the *Configuration Considerations for Virtually Concatenated Groups* section on page *5-14* for considerations related to the allocation of main link bandwidth to virtually concatenated groups	Default: VC-12	
LCAS	Used to enable/disable use of the Link Capacity Adjustment Scheme (LCAS) on the corresponding group.	NO	The use of LCAS is disabled.
		YES	The use of LCAS is enabled.
	LCAS is relevant only when the group includes 2 or more VCs, and is not displayed when selecting **VC-4** for the **VC Type.**	Default: NO	
	This parameter is not displayed when selecting VC-4		

Table 5-25. **Configuration>Virtual Ports>VCG** *Screen Parameters (Cont.)*

Parameter	Function	Values
Number of VCs	Selects the number of VCs of the type selected by VC Type used to carry the corresponding virtually concatenated group. This is another parameter that determines the bandwidth made available to the virtually concatenated group. When you select the All VCGs option, take into consideration that the number selected by you is allocated to each active virtually concatenated group. Therefore, you should also review the *Configuration Considerations for Virtually Concatenated Groups* section on page *5-14* for considerations related to the allocation of main link bandwidth to virtually concatenated groups. This parameter is not displayed when selecting VC-4: in this case, the number is always 1	The available range for each type are as follows: • For VC-12: **1** to **63** • For VC-11: **1** to **64** • For VC-3: **1**, **2** or **3**. The number that can be selected also depends on the mapping of lower-order VCs assigned to other groups: any groups using lower-order VCs must be mapped in a way that leaves one or two whole VC-3s free. **Default: 1**
Encapsulation	Selects the encapsulation used by the virtually concatenated group. When using GFP multiplexing, make sure to configure GFP encapsulation for the primary group; the encapsulation mode of the other groups (referred to as secondary groups) will be automatically changed to GFP when the GFP multiplexer is configured	**LAPS** Link Access Procedure for SONET/SDH protocols per ITU-T Rec. X.85/X.86 draft. **GFP** Generic Framing Procedure in accordance with ITU-T Rec. G.7041, framed mode, including support for GFP multiplexing. **Default: LAPS**
GFP Channel ID	Selects the GFP channel identifier. This field is displayed only when using GFP encapsulation, and is not displayed for VC-4	The allowed range is **0** to **FF**. **Default: 0**
Max Differential Delay	Selects the maximum differential delay among the VCs carrying the selected group, that can be corrected. A larger value increases the latency, therefore always select the minimum value that can compensate for the expected delay variation	The allowed range is **10** to **64** msec. When the number of VCs in the virtually concatenated group is 1, always displays **N/A**. **Default: 64**
VCG ID	Selects the virtually concatenated group identifier	The allowed range is **0** to **7**. **Default: 1**

Table 5-25. **Configuration>Virtual Ports>VCG** *Screen Parameters (Cont.)*

Parameter	Function	Values
Virtual Concatenation	Used to enable/disable the use of the virtual concatenation format when the number of VCs in the group is 1. This parameter is displayed only when **1** is selected in the **Number of VCs** field. This parameter is not displayed when selecting VC-4	**NO** The use of the virtual concatenation format is disabled. **YES** The use of the virtual concatenation format is enabled. This selection is necessary only for compatibility with equipment from other vendors. **Default: NO**
Minimum Number of VCs	Selects the minimum allowed number of operational VCs that must remain in operation. If the number decreases below the selected value, an alarm is generated. This parameter is displayed only when LCAS is enabled	The allowed range is **1** to **63**. **Default: 1**
VCG Name	Used to enter a logical name for the selected group	Up to 15 characters. **Default: Empty string**
VC Configuration	Used to configure the parameters of the VC used to transport the group payload. This parameter is not displayed when selecting VC-4	See procedure below
LAPS Configuration	Used to configure the LAPS encapsulation parameters	See procedure in *Configuring LAPS Parameters* section

➤ **To configure the VC parameters of a virtually concatenated group (or groups):**

1. Select **VC Configuration** screen. A typical **VC Configuration** screen showing the default values for groups using VC-12 is shown in *Figure 5-93*; *Figure 5-94* shows the screen for groups using VC-3. The parameters that can be configured by means of the **VC Configuration** screen are described in the following tables:

   ▪ For groups using VC-12: *Table 5-26* (also applicable to units with E3 PDH interface, as well as to units with T1 or T3 PDH interfaces that use VC-12 for transport):

   ▪ For groups using VC-3: *Table 5-28*.

2. Type the desired item number and then press **‹Enter›**:

   ▪ For items **1**, **2**, **3**, **4**, the selection is toggled as soon as you press **‹Enter›**.

   ▪ For items **5** and **8**, you can type the desired value in the same line. When done, press **‹Enter›**.

   ▪ For the other items, you will see the corresponding selection screen. In this case, the **Values** column in *Table 5-26* lists the options displayed on the selection screen.

On the selection screen, type the number of the desired option and then press <**Enter**>. The selection screen closes and the new value appears in the **VC Configuration** screen.

3. When done, type **#** to save and then confirm the action.

```
                                FCD-155
Configuration>Virtual Ports>VCAT>VCG-1>VC Configuration

 1. RDI on payload label              (Disable)
 2. RDI on path trace                 (Disable)
 3. J2 Rx path trace                  (Enable)
 4. J2 path trace               ... (fcd155)
 5. EED Threshold              >    (1E-3)
 6. SD Threshold               >    (1E-6)
 7. First Sequence Indicator    ... (00000000)
 8. Extended Signal Label[0 - ff]... (D)
 9. Padding                    >    (NULLs)
10. Path Protection            >    (None)

>


ESC-prev.menu; !-main menu; &-exit; @-Output                         1M/1C
-----------------------------------------------------------------------------
```

Figure 5-93. Typical **VC Configuration** Screen for Virtually Concatenated Groups Using VC-12

```
                                FCD-155
...>Virtual Ports>VCAT>VCG-1>VC Configuration

 1. RDI on payload label              (Disable)
 2. RDI on path trace                 (Disable)
 3. J1 Rx path trace                  (Disable)
 4. J1 path trace               ... (fcd155)
 5. EED Threshold              >    (1E-3)
 6. SD Threshold               >    (1E-6)
 7. First Sequence Indicator ... (00000000)
 8. Payload label              [0 - ff]... (1B)
 9. Padding                    >    (NULLs)
10. Path Protection            >    (None)

>


ESC-prev.menu; !-main menu; &-exit; @-Output                         1M/1C
-----------------------------------------------------------------------------
```

Figure 5-94. Typical **VC Configuration** Screen for Virtually Concatenated Groups Using VC-3

Table 5-26. **Configuration›VCG›VC Configuration** *Parameters for* **VC Type – VC-12**

Parameter	Function	Values
RDI on Payload label	Controls the sending of AIS and RDI indications by the corresponding group, in case the received payload label is different from the expected payload label	**ENABLE** RDI is sent when a payload label mismatch is detected. **DISABLE** RDI is not sent when payload label mismatch is detected. Nevertheless, RDI is still sent in case of LOP (loss of pointer) condition. **Default: DISABLE**
RDI on Path Trace	Controls the sending of AIS and RDI indications by the corresponding group, in case the received path trace label (carried in SDH overhead byte J1) is different from the expected path trace label	**ENABLE** RDI is sent in case a path trace mismatch is detected. **DISABLE** RDI is not sent when a path trace mismatch is detected. Nevertheless, RDI is still sent in case a LOP (loss of pointer) condition is detected. **Default: DISABLE**
J2 Rx Path Trace	Controls the checking of the received path trace label by the corresponding group	**ENABLE** Path trace label is checked. **DISABLE** Path trace label is not checked. **Default: DISABLE**
J2 Path Trace	Specifies the path trace label. This parameter is relevant only when **J2 Rx Path Trace** is enabled	Alphanumeric string of 15 characters. If not all of the 15 characters are needed for the prescribed label, make sure to specify the appropriate **Padding** method. **Default: fcd155**
EED Threshold	Selects the BER value, which if exceeded results in the generation of the error rate degradation alarm for the corresponding group	The available selections are 10E-3 (BER threshold of 10^{-3}), 10E-4 (10^{-4}), 10E-5 (10^{-5}). **Default: 10E-3** (BER of 10^{-3})
SD Threshold	Selects the BER value, which if exceeded results in the generation of the signal-degraded alarm for the corresponding group	The available selections are 10E-6 (BER threshold of 10^{-6}), 10E-7 (10^{-7}), 10E-8 (10^{-8}) or 10E-9 (10^{-9}). **Default: 10E-6** (BER of 10^{-6})
Payload label	Specifies the expected payload label (one byte). This parameter is displayed only when the value selected in the **Number of VCs** field is **1**, and the **Virtual Concatenation** field is **NO**	Hexadecimal number in the range of 0 to FF (two digits). **Default: 5**
First Sequence Indicator	Specifies the label (indicator) assigned to the first VC in the virtually concatenated group. This parameter is displayed only when **LCAS** is **No**	String of 8 bits (one byte). **Default: 00000000**

Table 5-26. *Configuration>VCG>VC Configuration Parameters for **VC Type – VC-12** (Cont.)*

Parameter	Function	Values
Extended Signal Label	Selects the extended payload label, which is part of the SDH overhead when virtual concatenation is used. The default value, D, is the standard value used to indicate the use of virtual concatenation and therefore should not be changed unless specifically required. This parameter is displayed only when the value selected in the **Number of VCs** field is different from **1**; if the value is **1**, the parameter is displayed only when the **Virtual Concatenation** field is **YES**	Two hexadecimal digits, in the range of 00 to FF. **Default: D**
Padding	Specifies the type of characters used to pad the path trace label, when it is shorter than the required length of 15 characters	**NULLS** – NULL characters. **SPACES** – Space characters. **Default: NULLS**
Path Protection	Controls the use of path (trail) protection for the selected port. This parameter is supported only by the FCD-155E. Trail protection should be enabled only when the APS protection mode is OFF	**NONE** – Path protection for the selected port is disabled. The trail may still be protected, together with all the other trails, if the APS protection is enabled. **AUTO** – Path protection is enabled. The mapping of the selected port on link 1 is automatically copied to the same TU on link 2. **AUTO** cannot be selected when APS protection is on, or when the channel is already mapped (the mapping must be performed only after the **Path Protection** mode is selected). **MANUAL** – Path protection is enabled. The port is mapped manually in different TUs of the same link, or on different links. **Default: NONE**

Table 5-27. **Configuration>VCG>VC Configuration** *Parameters for* **VC Type – VC-3**

Parameter	Function	Values
RDI on Payload Label	Same as in *Table 5-26*	Same as in *Table 5-26*
RDI on Path Trace	Controls the sending of AIS and RDI indications by the corresponding group, in case the received path trace label (carried in SDH overhead byte J1) is different from the expected path trace label	**ENABLE** RDI is sent in case a path trace mismatch is detected. **DISABLE** RDI is not sent when a path trace mismatch is detected. Nevertheless, RDI is still sent in case a LOP (loss of pointer) condition is detected. **Default: DISABLE**
J1 Rx Path Trace	Controls the checking of the received path trace label by the corresponding group	**ENABLE** Path trace label is checked. **DISABLE** Path trace label is not checked. **Default: DISABLE**
J1 Path Trace	Specifies the path trace label	Alphanumeric string of 15 characters. If not all of the 15 characters are needed for the prescribed label, make sure to specify the appropriate **Padding** method. **Default: fcd155**
EED Threshold	Same as in *Table 5-26*	Same as in *Table 5-26*
SD Threshold	Same as in *Table 5-26*	Same as in *Table 5-26*
Payload label	Same as in *Table 5-26*	Default values are as follows: • For GFP encapsulation: 1B (hexa) • For LAPS encapsulation: 18 (hexa)
First Sequence Indicator	Same as in *Table 5-26*	Same as in *Table 5-26*
Extended Signal Label	Same as in *Table 5-26*	Same as in *Table 5-26*

Using GFP Encapsulation

A typical individual **VCG** screen for an FCD-155 with SDH network interface that uses GFP encapsulation is shown in *Figure 5-95*. This screen is for **LCAS** disabled (**No**).

The screen shown in *Figure 5-95* is for a group in the range of 1 to 4. For FCD-155 with transparent LAN ports, the screen for groups in the range of 5 to 8 includes an additional header, **Associated Port,** which displays the number of the LAN port using the selected group (see for example, *Figure 5-92* used with LAPS encapsulation).

The selected group is identified in the screen header. When you select **All VCGs**, the header is **All VCGs**.

The screen shown in *Figure 5-95* includes all the available parameters, and therefore it extends on two pages: press **N** to go from the first page to the second, and **P** to return from the second page to the first.

The parameters that can be configured by means of the **VCG** configuration screen are the same as described in *Table 5-25* for LAPS encapsulation, with two differences:

- A **GFP Channel ID** item has been added. This item, which consists of two hexadecimal digits (00 to FF), is used to identify the group and must be unique.

- The **LAPS Configuration** item is replaced by the **GFP Configuration** item, used to configure the GFP encapsulation parameters.

```
                              FCD-155
Configuration>Virtual Ports>VCAT>VCG 1

 1. Admin Status              (Enable)
 2. VC type              >    (VC12)
 3. LCAS                      (Yes)
 4. Number of VTs [1 - 63]... (1)
 5. Encapsulation        >    (GFP)
 6. GFP Channel ID[0 - ff]... (0)
 7. Max Differential Delay... (64)
 8. VCG ID               >    (1)
 9. Minimum Number Of VCs ... (1)
10. Virtual Concatenation     (Yes)
11. VCG Name             ... ()
... (N)

>


ESC-prev.menu; !-main menu; &-exit; @-output                      1M/1C
-------------------------------------------------------------------------------
```

A. First Page

```
                              FCD-155
VCG 2

... (P)
13. VC Configuration     >
14. GFP Configuration    >

>

ESC-prev.menu; !-main menu; &-exit; @-output                      1M/1C
-------------------------------------------------------------------------------
```

B. Second Page

*Figure 5-95. Typical **VCG** Configuration Screen for GFP Encapsulation, Groups 1 to 4 (SDH Network Interface)*

Configuring LAPS Parameters

Purpose

Configure the LAPS parameters. These parameters are relevant only when LAPS encapsulation is used for at least one virtually concatenated group.

Reached from

Reached from

Configuration›Virtual Ports›VCG

A typical **LAPS Configuration** screen is shown in *Figure 5-96*.

```
                              FCD-155
...>Virtual Ports>VCAT>VCG 1>LAPS Configuration

 1. Address              [0 - ff]... (4)
 2. Control              [0 - ff]... (3)
 3. SAPI value           [0 - ffff]... (FE01)

>

ESC-prev.menu; !-main menu; &-exit; @-output                      1M/1C
-----------------------------------------------------------------------------
```

*Figure 5-96. Typical **LAPS Configuration** Screen*

The parameters displayed on the **LAPS Configuration** screen are explained in *Table 5-28*. Any changes to the default values should be carefully considered, to ensure compatibility with other equipment.

*Table 5-28. **LAPS Configuration** Parameters*

Parameter	Function	Values
Address	Selects the HDLC address to be used by the LAPS protocol for handshaking.	Two hexadecimal digits, in the range of 00 to FF.
	The standardized HDLC address for Ethernet encapsulated with LAPS is 4	**Default: 4**
Control	Selects the HDLC control address to be used by the LAPS protocol for handshaking.	Two hexadecimal digits, in the range of 00 to FF.
	The standardized HDLC control value for Ethernet encapsulated with LAPS is 3	**Default: 3**
SAPI Value	Selects the service access point identifier (SAPI) for the LAPS protocol.	Four hexadecimal digits, in the range of 0000 to FFFF.
	The standardized SAPI for the Ethernet MAC is FE01	**Default: FE01**

Configuring GFP Parameters

Purpose

Configure the GFP multiplexing parameters. These parameters are relevant only when GFP encapsulation is used for at least one virtually concatenated group.

Reached from

Reached from

Configuration>Virtual Ports>VCG

A typical **GFP Configuration** screen is shown in *Figure 5-97*.

```
                           FCD-155
...>Virtual Ports>VCAT>VCG 1>GFP Configuration

 1. FCS                     (Yes)
 2. PTI For Client Data[0 - 8]... (0)
 3. UPI For Client Data[1 - 255]... (1)
 4. Delta              [1 - 7]... (1)
 5. Core Scrambling    >   (Both Side)
 6. Payload Scrambling >   (Both Side)

>


ESC-prev.menu; !-main menu; &-exit; @-output                      1M/1C
-----------------------------------------------------------------------
```

*Figure 5-97. Typical **GFP Configuration** Screen*

The parameters displayed on the **GFP Configuration** screen are explained in *Table 5-29*. Any changes to the default values should be carefully considered, to ensure compatibility with other equipment.

*Table 5-29. **GFP Configuration** Parameters*

Parameter	Function	Values	
FCS	Controls the use of error detection for the payload	**NO**	Payload error detection disabled.
		YES	Payload error detection enabled. In this case, a frame checksum is calculated, using the 32-bit polynomial recommended by ITU-T, and added to the GFP frame structure.
		Default: YES	
PTI For Client Data	Selects the payload type identifier (PTI) inserted in GFP frames	The allowed range is 0 to 8. **Default: 0 (user data)**	
UPI For Client Data	Selects the user payload identifier (PTI) inserted in GFP frames	The allowed range is 0 to 255. **Default: 1 (frame-mapped Ethernet)**	

Parameter	Function	Values
Delta	Selects the number of error-free frame headers that must be received before frame synchronization is declared	The allowed range is 1 to 7. Default: 1
Core Scrambling	Controls the use of frame core data scrambling	BOTH SIDES – Core scrambling enabled for both the transmit and receive directions. ONLY TRANSMIT – Core scrambling performed only on transmitted frames. No descrambling performed on the received core data. ONLY RECEIVE – Core descrambling performed on the received core data. No scrambling for the core data inserted in the transmitted frames. DISABLED – Core scrambling disabled for both the transmit and receive directions. Default: BOTH SIDES
Payload Scrambling	Controls the use of payload data scrambling, before insertion in frames	BOTH SIDES – Payload scrambling enabled for both the transmit and receive directions. ONLY TRANSMIT – Payload scrambling performed only on transmitted frames. No descrambling performed on the received payload. ONLY RECEIVE – Payload descrambling performed on the received core data. No scrambling for the payload inserted in the transmitted frames. DISABLED – Payload scrambling disabled for both the transmit and receive directions. Default: BOTH SIDES

Configuring VCG Parameters (SONET Network Interfaces)

Purpose

Configure the parameters of a specific virtually concatenated group.

Note   *FCD-155 with single Ethernet port do not support virtually concatenated groups, and therefore this screen is not available.*

The group parameters depend on the encapsulation method used on the group (or groups) being configured: LCAS or GFP.

Note   *For configuration instructions regarding the encapsulation parameters, refer to Using LAPS Encapsulation section for LCAS and to Using GFP Encapsulation section for GFP.*

This section covers the configuration activities available when the FCD-155 or FCD-155E uses the SONET network interface. For an FCD-155 or FCD-155E using the SDH network interface, refer to *Configuring VCG Parameters (SDH Network Interfaces)* section.

Reached from

Configuration›**Virtual Ports**›**VCAT**

A typical individual **VCG** screen for an FCD-155 with SONET network interface that uses GFP encapsulation over VT-1.5 SPEs is shown in *Figure 5-98.* The selected group is identified in the screen header.

The screen shown in *Figure 5-98* includes all the available parameters, and therefore it extends on two pages: press **N** to go from the first page to the second, and press **P** to return from the second page to the first.

Note *When LAPS encapsulation is used, the screen is slightly different. The differences are as follows:*

- *The **GFP Channel ID** item is removed.*
- *The **GFP Configuration** item is replaced by the **LAPS Configuration** item, used to configure the GFP encapsulation parameters.*
- *All the fields are displayed on one page, instead of two.*

➤ **To change a virtually concatenated group parameter (for SONET network interfaces):**

1. The **VCG** screens for an FCD-155 with SONET network interface are similar to those of an FCD-155 with SDH interfaces, except for the following differences:

   ▪ Item **2 – VC type** is replaced by **VT Type**, and the available selections are as follows:

     □ **STS1/SPE** – STS-1 SPE

     □ **VT1.5/SPE** – VT-1.5 virtual tributary. This is the default selection.

   ▪ Item **3 – Number of VCs:** the available selections are as follows:

     □ For STS-1 SPEs: 1, 2 or 3

     □ For VT-1.5: 1 to 64.

2. For operating instructions and configuration guidelines, see *Configuring VCG Parameters (SDH Network Interfaces)* section. This section also presents any differences between LAPS and GFP encapsulations.

```
                                    FCD-155
Configuration>Virtual Ports>VCAT>VCG 1


 1. Admin Status              (Enable)
 2. VC type             >     (VT1.5/SPE)
 3. LCAS                      (Yes)
 4. Number of VTs       [1 - 64]... (1)
 5. Encapsulation       >     (GFP)
 6. GFP Channel ID      [0 - ff]... (0)
 7. Max Differential Delay[10 - 64]... (64)
 8. VCG ID              >     (1)
 9. Minimum Number Of VCs [1 - 64]... (1)
10. Virtual Concatenation     (Yes)
11. VCG Name                  ... ()
... (N)
>


ESC-prev.menu; !-main menu; &-exit; @-output                         1M/1C
--------------------------------------------------------------------------------
```

A. First Page

```
                                    FCD-155
VCG 1

... (P)
13. VT Configuration     >
14. GFP Configuration    >

>

ESC-prev.menu; !-main menu; &-exit; @-output                         1M/1C
--------------------------------------------------------------------------------
```

B. Second Page

*Figure 5-98. Typical **VCG** Configuration Screen (SONET Network Interface)*

Configuring GFP Mux Parameters

Purpose

Configure GFP multiplexing parameters (for information on GFP multiplexing, refer to *Appendix C*).

Note   *The FCD-155 with single Ethernet port does not support virtually concatenated groups, and therefore this screen is not available.*

Considering the maximum number of virtually concatenated groups that can be defined on the FCD-155, the maximum number of GFP multiplexers depends on the number of virtually concatenated groups available on the FCD-155, which depends on its version:

- For FCD-155 units with 2 LAN ports, the maximum number is 2 (each handling two virtually concatenated groups).

- For FCD-155 units with GbE or transparent LAN ports, the maximum number is 4 (each handling two virtually concatenated groups).

It is not possible, nor meaningful, to define a GFP multiplexer with a single virtually concatenated group.

Reached from

Configuration >Virtual Ports >VCAT

A typical **GFP Mux** screen for an FCD-155 unit with 2 LAN ports, as seen before any GFP multiplexers are defined, is shown in *Figure 5-99*; a typical screen for an FCD-155 unit with GbE or transparent LAN ports is shown in *Figure 5-100*.

```
                              FCD-155
Configuration>Virtual Ports>VCAT>GFP Mux


    Index    GFP Mux Name     VCG 1   VCG 2   VCG 3   VCG 4   Primary
>


ESC-prev.menu; !-main menu; &-exit; @-output; ?-help                1M/1C
--------------------------------------------------------------------------

```

*Figure 5-99. Typical **GFP Mux** Screen – Default State (FCD-155 with 2 LAN Ports)*

```
                              FCD-155
Configuration>Virtual Ports>VCAT>GFP Mux

 Index  GFP Mux Name    VCG 1    VCG 2    VCG 3    VCG 4    VCG 5

>

ESC-prev.menu; !-main menu; &-exit; @-output; ?-help                1M/1C
--------------------------------------------------------------------------

```

*Figure 5-100. Typical **GFP Mux** Screen – Default State (FCD-155 with GbE or Transparent LAN Ports)*

The parameters displayed on the **GFP Mux** screen are as follows:

Index   The GFP multiplexer index number. This number is automatically assigned.

GFP Mux Name   Optional field, can be used to assign a logical name to the GFP multiplexer. The name may include up to 15 characters.

VCG 1 to VCG 4
or
VCG 1 to VCG 8

A number under a group designation indicates that the corresponding virtually concatenated group is processed by the GFP multiplexer (when more than 4 groups are displayed, press the right arrow to display the additional groups).

The number indicates the fraction of the total bandwidth guaranteed to the corresponding group (the bandwidth can be selected in steps of 12.5 %).

The total bandwidth available to the GFP multiplexer output is the bandwidth configured for the primary virtually concatenated group.

Primary

Displays the virtually concatenated group that serves as the transport group of the GFP multiplexer output. This is the rightmost field on the screen.

➤ **To display the keys available for the GFP Mux screen:**

1. Type **?** and then press **‹Enter›**.

2. You will see the help screen. When the **GFP Mux** screen is empty (for example, as shown in *Figure 5-99*), only one item is available: **a** – add a new GFP multiplexer definition.

   A full help screen, as seen after at least one GFP multiplexer is configured and the selection block is moved from its home position, is shown in *Figure 5-101*.

3. To return to the **GFP Mux** screen, press any key.

```
Table Hot Keys

Left Arrow - move left
^R - scroll right       Right Arrow - move right
A  - add row            R  - remove row
M  - represent entry as menu
TAB - select next changeable cell
G  <row number>,<col number> - go to cell


Press any key ...                                                       1M/1C
-----------------------------------------------------------------------------
```

*Figure 5-101. Full **Help** Screen for **GFP Mux** Screen*

➤ **To add a new GFP multiplexer:**

Note

*Before starting the configuration of a new GFP multiplexer, make sure to define all the virtually concatenated groups to be processed by the GFP, and to map the primary virtually concatenated group of each multiplexer. **Do not map the secondary virtually concatenated groups**.*

Remember that any virtually concatenated group can be included in only one GFP multiplexer.

1. Type **a** and then press **‹Enter›**.

2. You will see the **GFP Mux** configuration screen. A typical screen, as seen after making the various selections, is shown in *Figure 5-102*. The automatically assigned index number is displayed in the header.

Note   *Item 11 – Save All appears only after at least one parameter has been changed.*

3. Define the group logical name: select **1** and type the desired name (up to 15 characters – any characters beyond the first 15 are ignored). Press **‹Enter›** to end the string.

4. Define the virtually concatenated groups to be processed by the new GFP multiplexer and the guaranteed bandwidth by selecting the corresponding item, **2** to **9**. For each group to be processed:

    ▪   After pressing **‹Enter›**, you will see the group bandwidth assignment screen (see typical screen in *Figure 5-103*; the number of the selected group is displayed in the screen header).

    ▪   Type the number corresponding to the desired bandwidth fraction, and then press **‹Enter›**.

    ▪   The group bandwidth assignment screen closes, and the assigned fraction appears in the group column on the **GFP Mux** screen.

    ▪   Repeat the procedure for each group.

```
                          FCD-155
Configuration>Virtual Ports>VCAT>GFP Mux


    Index                       (1)
 1. GFP Mux Name          ... (New York 1)
 2. VCG 1                 >   (12.5%)
 3. VCG 2                 >   (25.0%)
 4. VCG 3                 >   (0%)
 5. VCG 4                 >   (37.5%)
 6. VCG 5                 >   (12.5%)
 7. VCG 6                 >   (0%)
 8. VCG 7                 >   (25.0%)
 9. VCG 8                 >   (12.5%)
10. Primary               >   (VCG 1)
11. Save All
>


# - Save; % - Undo
ESC-prev.menu; !-main menu; &-exit; @-Output                      1M/1C
-------------------------------------------------------------------------------
```

*Figure 5-102. Typical **GFP Mux** Configuration Screen*

```
                              FCD-155
...>Virtual Ports>VCAT>GFP Mux>VCG 1 (0%)


 1. 0%
 2. 12.5%
 3. 25%
 4. 37.5%
 5. 50%
 6. 62.5%
 7. 75%
 8. 87.5%


>


# - Save; % - Undo
ESC-prev.menu; !-main menu; &-exit; @-Output                          1M/1C
--------------------------------------------------------------------------------
```

Figure 5-103. *GFP Mux* *Configuration>Typical Group Bandwidth Assignment Screen*

5. Type **6** to select the primary virtually concatenated group, and then press ‹**Enter**›. You will see the primary group selection screen (see typical screen in *Figure 5-104*):

   ▪ Type the number corresponding to the desired group, and then press ‹**Enter**›.

   ▪ The primary group selection screen closes, and the assigned fraction appears in the group column on the **GFP Mux** screen.

```
                              FCD-155
...>Virtual Ports>VCAT>GFP Mux>Primary (VCG 1)


 1. VCG 1
 2. VCG 2
 3. VCG 3
 4. VCG 4
 5. VCG 5
 6. VCG 6
 7. VCG 7
 8. VCG 8


>


# - Save; % - Undo
ESC-prev.menu; !-main menu; &-exit; @-Output                          1M/1C
--------------------------------------------------------------------------------
```

Figure 5-104. *GFP Mux* *Configuration>Typical Primary Group Selection Screen*

6. At this stage, the configuration of the first GFP multiplexer is complete. *Figure 5-105* shows the left-hand section of a typical screen, with the selection block located on the home position. Use the arrows to move the selection block: when the block moves to the right, the end of the screen (including **Primary** as the last field) will be automatically displayed.

```
                              FCD-155
Configuration>Virtual Ports>VCAT>GFP Mux

 Index   GFP Mux Name      VCG 1    VCG 2    VCG 3    VCG 4    VCG 5
   1                        25%      25%      12.5%    37.5%    VCG 1

>


# - Save; % - Undo
ESC-prev.menu; !-main menu; &-exit; @-Output; ?-help                    1M/1C
-------------------------------------------------------------------------
```

*Figure 5-105. Typical **GFP Mux** Screen – After Configuring a GFP Multiplexer*

7. After the configuration of the first GFP multiplexer is complete, you may either save the new configuration, delete an existing GFP multiplexer or add another GFP multiplexer:

   ▪ To add a second GFP multiplexer:

      □ Type **a** and then press **‹Enter›**.

      □ You will see again the **GFP Mux** configuration screen (*Figure 5-102*): note that the automatically assigned index number displayed in the header has been incremented by 1.

      □ Continue as explained above.

➤ **To delete an existing GFP multiplexer:**

1. Move the selection block to the row to be deleted, type **t** and then press **‹Enter›**.

2. When you are ready to save the configuration, check again the information displayed on the screen after configuration (for example, *Figure 5-105*).

➤ **To modify the parameters of an existing GFP multiplexer:**

1. Move the selection block to the row to be corrected.

2. Type **m** and then press **‹Enter›**.

Note   *An alternative method for changing the bandwidth allocated to each group is to move the selection block to the group to be changed: the bandwidth assignment menu is then automatically displayed. Now type the corresponding number and press ‹Enter› to make the change.*

3. You will see the edit screen for the selected row. This screen is similar to the screen shown in *Figure 5-102*; the index number displayed in the header is the number of the selected row.

4. Continue as explained above for the configuration of a new GFP multiplexer.

➤ **To save the new GFP multiplexer configuration:**

1. Type **#** to save and then confirm the action. The FCD-155 checks your configuration and saves it only if no errors are detected.

2. If errors are detected in your configuration, the new configuration cannot be saved. In this case, the FCD-155 will display **Error in configuration. Do you want to see errors?**:

-   To ignore, type **n**. Now you can return to the GFP multiplexer screen and correct the errors.

-   To see the errors, type **y**. You will see the Sanity screen (normally reached from **Monitoring>System>Display Sanity**). Now select **1 – Errors and Warnings** to display the list of sanity errors. Refer to *Chapter 7* for an explanation of the error messages that may be displayed.

5.8   Configuration>Applications Submenu Structure

Figure 5-106 and *Figure 5-107* show the structure of the **Applications** submenu.

Note   *The **Applications** submenu is not available on FCD-155 with single Ethernet port.*
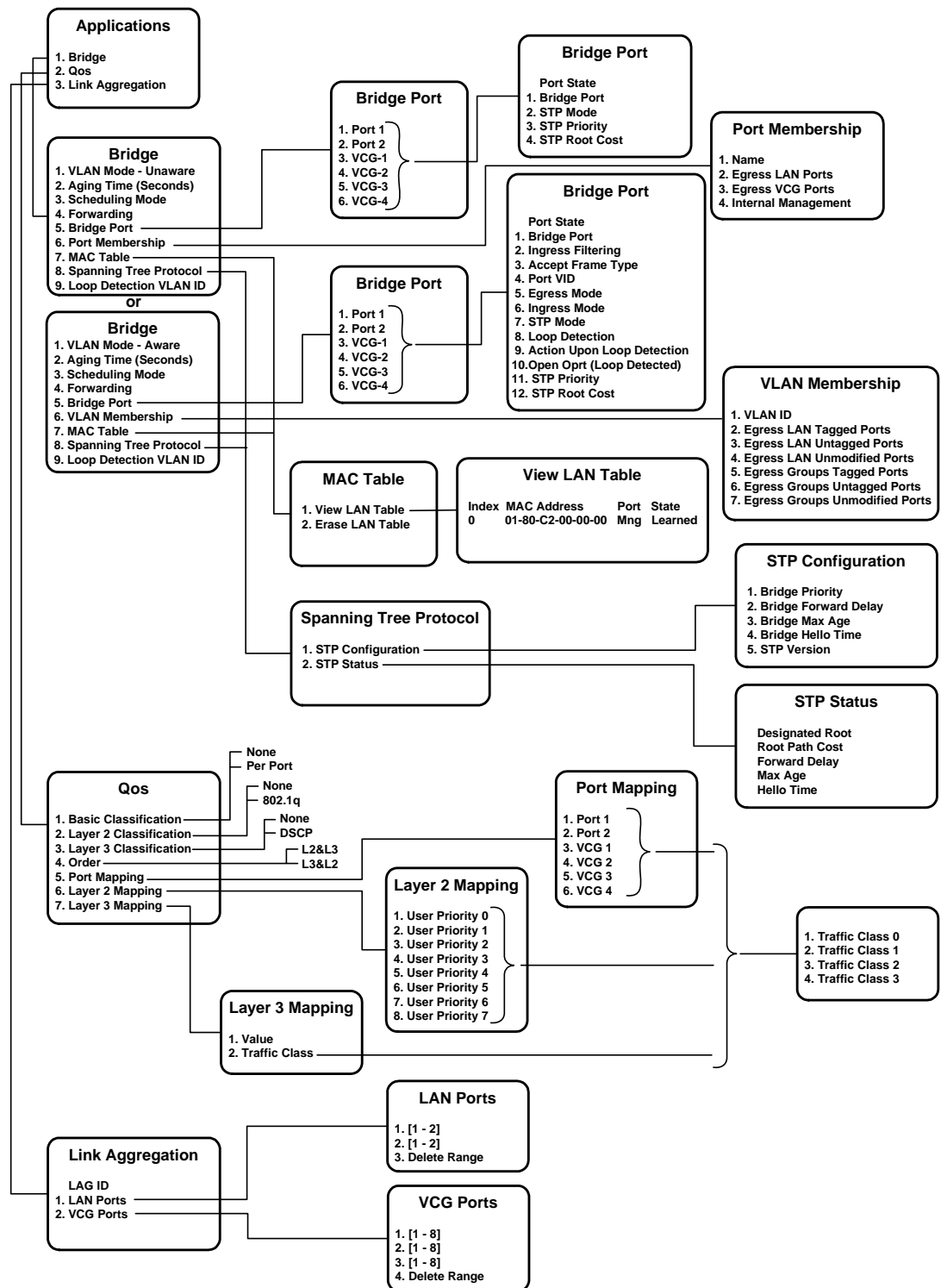
Applications

1. Bridge
2. Qos
3. Link Aggregation

Bridge Port

Port State
1. Bridge Port
2. STP Mode
3. STP Priority
4. STP Root Cost

Bridge Port

1. Port 1
2. Port 2
3. VCG-1
4. VCG-2
5. VCG-3
6. VCG-4

Port Membership

1. Name
2. Egress LAN Ports
3. Egress VCG Ports
4. Internal Management

Bridge

1. VLAN Mode - Unaware
2. Aging Time (Seconds)
3. Scheduling Mode
4. Forwarding
5. Bridge Port
6. Port Membership
7. MAC Table
8. Spanning Tree Protocol
9. Loop Detection VLAN ID

or

Bridge

1. VLAN Mode - Aware
2. Aging Time (Seconds)
3. Scheduling Mode
4. Forwarding
5. Bridge Port
6. VLAN Membership
7. MAC Table
8. Spanning Tree Protocol
9. Loop Detection VLAN ID

Bridge Port

Port State
1. Bridge Port
2. Ingress Filtering
3. Accept Frame Type
4. Port VID
5. Egress Mode
6. Ingress Mode
7. STP Mode
8. Loop Detection
9. Action Upon Loop Detection
10. Open Oprt (Loop Detected)
11. STP Priority
12. STP Root Cost

Bridge Port

1. Port 1
2. Port 2
3. VCG-1
4. VCG-2
5. VCG-3
6. VCG-4

VLAN Membership

1. VLAN ID
2. Egress LAN Tagged Ports
3. Egress LAN Untagged Ports
4. Egress LAN Unmodified Ports
5. Egress Groups Tagged Ports
6. Egress Groups Untagged Ports
7. Egress Groups Unmodified Ports

MAC Table

1. View LAN Table
2. Erase LAN Table

View LAN Table

Index   MAC Address   Port   State
0   01-80-C2-00-00-00 Mng   Learned

STP Configuration

1. Bridge Priority
2. Bridge Forward Delay
3. Bridge Max Age
4. Bridge Hello Time
5. STP Version

Spanning Tree Protocol

1. STP Configuration
2. STP Status

STP Status

Designated Root
Root Path Cost
Forward Delay
Max Age
Hello Time

Qos

1. Basic Classification
2. Layer 2 Classification
3. Layer 3 Classification
4. Order
5. Port Mapping
6. Layer 2 Mapping
7. Layer 3 Mapping

None
Per Port

None
802.1q

None
DSCP

L2&L3
L3&L2

Port Mapping

1. Port 1
2. Port 2
3. VCG 1
4. VCG 2
5. VCG 3
6. VCG 4

Layer 2 Mapping

1. User Priority 0
2. User Priority 1
3. User Priority 2
4. User Priority 3
5. User Priority 4
6. User Priority 5
7. User Priority 6
8. User Priority 7

1. Traffic Class 0
2. Traffic Class 1
3. Traffic Class 2
4. Traffic Class 3

Layer 3 Mapping

1. Value
2. Traffic Class

LAN Ports

1. [1 - 2]
2. [1 - 2]
3. Delete Range

Link Aggregation

LAG ID
1. LAN Ports
2. VCG Ports

VCG Ports

1. [1 - 8]
2. [1 - 8]
3. [1 - 8]
4. Delete Range

Figure 5-106. Configuration>Applications Submenu for FCD-155 without GbE Port

Applications

1. Bridge
2. Qos
3. Link Aggregation

Bridge Port

1. GbE
2. VCG-1
3. VCG-2
4. VCG-3
5. VCG-4
6. VCG-5
7. VCG-6
8. VCG-7
9. VCG-8

Bridge Port

Port State
1. Bridge Port
2. STP Mode

Bridge

1. VLAN Mode - Unaware
2. Aging Time (Seconds)
3. Scheduling Mode
4. Bridge Port
5. MAC Table
6. Spanning Tree Protocol
7. Loop Detection VLAN ID

or

Bridge

1. VLAN Mode - Aware
2. Aging Time (Seconds)
3. Scheduling Mode
4. Bridge Port
5. VLAN Membership
6. MAC Table
7. Spanning Tree Protocol
8. Loop Detection VLAN ID

Bridge Port

1. GbE
2. VCG-1
3. VCG-2
4. VCG-3
5. VCG-4
6. VCG-5
7. VCG-6
8. VCG-7
9. VCG-8

Bridge Port

Port State
1. Bridge Port
2. Ingress Filtering
3. Accept Frame Type
4. Port VID
5. Egress Mode
6. Ingress Mode
7. STP Mode
8. Loop Detection
9. Action Upon Loop Detection
10. Open Oprt (Loop Detected)
11. STP Priority
12. STP Root Cost

VLAN Membership

1. VLAN Name
2. VLAN ID
3. Egress VCGs Tagged Ports
4. Egress VCGs Untagged Ports
5. GbE
    — UnTagged
    — Tagged
    — Forbid

MAC Table

1. View LAN Table
2. Erase LAN Table

View LAN Table

Index	MAC Address	Port	State
0	01-80-C2-00-00-00	Mng	Learned

STP Configuration

1. Bridge Priority
2. Bridge Forward Delay
3. Bridge Max Age
4. Bridge Hello Time
5. STP Version

Spanning Tree Protocol

1. STP Configuration
2. STP Status

STP Status

Designated Root
Root Path Cost
Forward Delay
Max Age
Hello Time

Qos

1. Basic Classification
2. Layer 2 Classification
3. Layer 3 Classification
4. Order
5. Port Mapping
6. Layer 2 Mapping
7. Layer 3 Mapping

— None
— Per Port
— None
— 802.1q
— None
— DSCP
— L2&L3
— L3&L2

Port Mapping

1. VCG-1
2. VCG-2
3. VCG-3
4. VCG-4
5. VCG-5
6. VCG-6
7. VCG-7
8. VCG-8
9. GbE

Layer 2 Mapping

1. User Priority 0
2. User Priority 1
3. User Priority 2
4. User Priority 3
5. User Priority 4
6. User Priority 5
7. User Priority 6
8. User Priority 7

1. Traffic Class 0
2. Traffic Class 1

Layer 3 Mapping

1. Value
2. Traffic Class

VCG Ports

1. [1 - 8]
2. [1 - 8]
3. [1 - 8]
4. Delete Range

Link Aggregation

LAG ID
1. VCG Ports
2. GbE
    — No
    — Yes

Figure 5-107. **Configuration>Applications** *Submenu for FCD-155 with GbE Port*

5.9   Application Submenu, Overview

A typical **Applications** submenu is shown in *Figure 5-108*.

```
                             FCD-155
Configuration>Applications

 1. Bridge           >
 2. Qos              >
 3. Link Aggregation >

>


ESC-prev.menu; !-main menu; &-exit; @-output                        1M/1C
--------------------------------------------------------------------------

```

*Figure 5-108. Typical **Applications** Submenu*

The **Applications** submenu is used to configure the FCD-155 Ethernet switch to meet your specific application requirements. The configuration has three aspects:

- Configuration of the general bridge parameters

- Configuration of quality-of-service (QoS) parameters

- Configuration of trunks (link aggregation) for increasing the service bandwidth available to specific Ethernet clients.

The traffic handling capabilities of the Ethernet switches are as follows:

- Units with GbE port: the internal Ethernet switch has nine traffic ports:

  - One 10/100/1000 Mbps LAN port

  - Eight WAN ports, where each WAN port is connected to a virtually concatenated group. This provides support for up to eight virtually concatenated groups.

  The switch supports only tag-based VLANs, and the number of egress queues, which determines the number of traffic classes that may be defined, is 2.

- Units with transparent 10/100 Mbps LAN ports: the internal Ethernet switch supports up to eight traffic ports:

  - Two 10/100 Mbps LAN ports

  - Four WAN ports for the basic FCD-155, where each WAN port is connected to a virtually concatenated group. This provides support for up to four virtually concatenated groups.

  Note that installing transparent LAN ports does not increase the total number of virtually concatenated groups available to other Ethernet ports installed on the unit, which remains four (four WAN ports).

  The switch supports both port-based and tag-based VLANs, and the number of egress queues, which determines the number of traffic classes that may be defined, is 4.

- No Ethernet switch is installed on units with a single Ethernet port (this port is reserved for management), and therefore such units do not have any virtually concatenated groups.

Note that the optional transparent LAN ports are not processed by the FCD-155 Ethernet switch: they are directly connected to permanently associated virtually concatenated groups (groups 5 to 8).

All the FCD-155 units also support an internal management port, connected to the FCD-155 management agent, and another external management port (MNG). The internal management port is connected to the Ethernet switch, where present on the unit, via a separate port.

5.10   Configuring Bridge Parameters – FCD-155 Without GbE Port

Configuring the General Bridge Parameters

Purpose

Configure the parameters controlling the bridge operating mode: VLAN mode, aging time, and scheduling mode.

Reached from

Configuration>Applications>Bridge

A typical **Bridge** screen is shown in *Figure 5-109*.

```
                              FCD-155
Configuration>Applications>Bridge


 1. VLAN Mode                  >    (Unaware)
 2. Aging Time (Seconds)[16 - 4... (300)
 3. Scheduling Mode            >    (WFQ)
 4. Forwarding Mode            >    (Transparent)
 5. Bridge Port                >
 6. Port Membership            >
 7. MAC Table                  >
 8. Spanning Tree Protocol     >
 9. Loop Detection VLAN ID     >    (1-4091)


>


ESC-prev.menu; !-main menu; &-exit; @-output                       1M/1C
-----------------------------------------------------------------------------
```

*Figure 5-109. Typical **Bridge** Screen (FCD-155 without GbE Port)*

➤ **To configure the general parameters of the Ethernet switch (FCD-155 without GbE port):**

1. Type the number corresponding to the desired parameter, and then press ‹**Enter**›:

   ▪ For item **2**, you can type the desired value in the same line. When done, press ‹**Enter**›.

   ▪ For items **1** and **3**, you will see the corresponding selection screen. In this case, the **Values** column in *Table 5-30* lists the options displayed on the selection screen.

     On the selection screen, type the number of the desired option and then press ‹**Enter**›. The selection screen closes and the new value appears in the **Bridge** screen. In addition, items not supported in a specific **VLAN Mode** are automatically removed from the menu.

2. When done, type **#** to save and then confirm the action.

*Table 5-30. General **Bridge** Configuration Parameters (FCD-155 without GbE Port)*

Parameter	Function	Values
VLAN Mode	Selects the operating mode of the switch	**Aware** – The Ethernet switch uses the VLAN information to make forwarding decisions. When **Aware** is selected, the **Port Membership** item is removed from the **Bridge** submenu. However, existing port-based VLANs configuration data remains stored, and will take effect again after changing the **VLAN Mode** to **Unaware**. **Unaware** – The Ethernet switch ignores the VLAN information. When **Unaware** is selected, the **VLAN Membership** item is removed from the **Bridge** submenu. However, existing tag-based VLAN configuration data remains stored, and will take effect again after changing the **VLAN Mode** to **Aware.** **Default: Unaware**
Aging Time	Selects the maximum time learned MAC destination addresses are stored. If the information for a given destination is not refreshed before the selected interval expires, that information is deleted from the bridging table. Static MAC addresses, configured by means of the **View MAC Table** screen (see *Displaying View LAN Table*), are not subject to aging	The allowed range is 10 to 4080 sec, in 16-sec increments. If the entered value is not a multiple of 16, the nearest multiple of 16 not exceeding your entry, is actually used. **Default: 300 sec**

Table 5-30. General Bridge Configuration Parameters (FCD-155 without GbE Port) (Cont.)

Parameter	Function	Values
Scheduling Mode	Selects the frame eggress scheduling mode to be used when QoS support is enabled	**WFQ** (Weight Fair Queue) – 8, 4, 2, 1 weighting is applied to the four priority queues. This selection prevents the lower priority frames from being starved out, with only a slightly increased delay to the higher priority frames. **SP** (Strict Priority) – All top priority frames are egressed out a port until that priority's queue is empty, then the next lower priority queue's frames are egressed. Note that this selection may prevent lower-priority queues from transmitting any frames. **Default: WFQ**
Forwarding Mode	Selects the operating mode of the switch on the daughter board (This menu is shown only when the ^U switch is installed.)	**Transparent –** Functionality is the same as in transparent 6U. **Filter**– Packets can pass from the upper switch to the lower switch. **Default: Transparent**
Loop Detection VLAN ID	The VLAN ID sent in the packets is used for loop detection.	1-4091 **De3fault:4091**

Configuring the Individual Bridge Port Parameters

The **Bridge Port** item provides control over the use of the STP protocol for each port, and permits selecting separate STP parameters for each port.

The options available under the **Bridge Port** screen depend on the **VLAN Mode**.

Configuring Bridge Port – VLAN Unaware Mode

➤ **To configure a bridge port in VLAN Unaware Mode (FCD-155 without GbE port):**

1. Select **Bridge Port** on the **Bridge** submenu, and then press ‹**Enter**›. A typical screen for **Bridge Port 1**, as it appears after parameters are selected, is shown in *Figure 5-110*. The parameters are explained in *Table 5-31*.

```
                                 FCD-155
Configuration>Applications>Bridge>Bridge Port


    Port State                  >    (N/A)
 1. Bridge Port                 >    (Port 1)
 2. STP Mode                    >    (Enable)
 3. Loop Detection
 4. Action Upon Loop Detection
 5. Open Port (Loop Detected)
 6. STP Priority[0 - 255]       ... (128)
 7. STP Root Cost[0 - 65535]    ... (500)

>


# - Save; % - Undo
ESC-prev.menu; !-main menu; &-exit; @-debug                        1 M/ 1 C
-----------------------------------------------------------------------------
```

*Figure 5-110. Typical **Bridge Port** Configuration Screen (VLAN Unaware Mode)*

2. Select the port to be configured:

    ▪ Type **1** and then press ‹**Enter**› to display the port selection screen.

    ▪ On the port selection screen, type the number corresponding to the desired port, and then press ‹**Enter**›.

3. The new port number appears in the **Bridge Port** screen, together with its current state:

N/A	Not applicable – the port is not yet configured, or not connected and therefore its state is not relevant.
Disabled	The port does not allow any frames to enter (ingress), nor leave (egress), however it will accept management frames. The bridge does not learn through a disabled port.
Blocking	The port does not allow data frames to enter (ingress), nor leave (egress), but passes management frames and frames carrying bridge protocol data units (BPDUs) to the switch. The bridge does not learn through a disabled port.
Listening	The port listens to incoming frames, but does not allow data frames to pass in either the ingress or egress direction (only frames carrying BPDUs are allowed to enter; all the other frames are discarded). Learning through this port is disabled.
Learning	The port listens to incoming frames, but does not allow frames to pass in either the ingress or egress direction (only frames carrying BPDUs are allowed to enter). The bridge uses the information carried by the incoming frames accepted by the port for learning. Learning takes place on all good frames, even if not they do not carry BPDUs.

Forwarding   Normal operation: all the frames are allowed to enter (ingress) and leave (egress) the port. Learning takes place on all good frames.

4. Type the number corresponding to the desired parameter, and then press **‹Enter›**:

- For items **3**, **4**, you can type the desired value in the same line. When done, press **‹Enter›**.

- For the other items, you will see the corresponding selection screen. In this case, the **Values** column in *Table 5-31* lists the options displayed on the selection screen.

  On the selection screen, type the number of the desired option and then press **‹Enter›**. The selection screen closes and the new value appears in the **Bridge Port** screen.

5. When done, type **#** to save and then confirm the action.

*Table 5-31. **Bridge Port** Configuration Parameters (VLAN Unaware Mode)*

Parameter	Function	Values
Bridge Port	Displays the port being configured	The ports that can be configured are the external LAN ports (**Port 1**, **Port 2**) and the WAN ports (**VCG1** to **VCG4**). **Default: N/A**
STP Mode	Specifies the forwarding algorithm used for traffic passing for the corresponding port	**DISABLE** – Forwarding in accordance with the MAC bridge rules. **ENABLE** – The Spanning Tree Protocol (STP) is activated on this port. The STP type is selected by means of the **Spanning Tree Parameters** screen. **Default: DISABLE**
Loop Detection	Enables the sending of a loop detection packet. If received, a loop is indicated and service is shut down for a given amount of time.	**Disable** – Loop detection is disabled **Enable** – Loop detection is enabled **Default** – **Disable**
Action On Loop Detection	When a loop is detected the port is shut down. (This option is invisible if loop detection is disabled.)	**Port Down** – The port is shut down until manually opened. **Port Down 4 Minutes** – The port is shut down for 4 minutes then reopens. **Default** – **Port Down 4 Minutes**
Open Port (Loop Detected)	When a loop is detected the port can be opened. (This option is visible if loop detection is detected.)	Allows opening the port while a loop is detected.

STP Priority	Specifies the port priority, used by STP to generate the port ID.	The allowed range is 0 to 255.
	This parameter is displayed only when **STP Mode is ENABLE**	Default: 128
STP Root Cost	Specifies the cost added by the port to the total cost to the root bridge.	The allowed range is 0 to 65535.
	This parameter is displayed only when **STP Mode is ENABLE**	Default: 500

Configuring Bridge Port – VLAN Aware Mode

➤ **To configure a bridge port in VLAN Aware Mode (FCD-155 without GbE port):**

1. Select **Bridge Port** on the **Bridge** submenu, and then press **‹Enter›**. A typical screen for **Bridge Port 1**, as it appears after parameters are selected, is shown in *Figure 5-111*.

2. Use the procedure described for the **VLAN Unaware** mode to configure the ports. The parameters are explained in *Table 5-32*.

```
                              FCD-155
Configuration>Applications>Bridge>Bridge Port

    Port State                 >    (N/A)
 1. Bridge Port                >    (Port 1)
 2. Ingress Filtering          >    (Enable)
 3. Accept Frame Type          >    (Tag Only)
 4. Port VID[1 - 4094]         ... (1)
 5. Egress Mode                >    (Stacking)
 6. Ingress Mode               >    (Stripping)
 7. STP Mode                   >    (Enable)
 8. Loop Detection             >    (Enable)
 9. Action Upon Loop Detection>    (Port Down 4 Minutes)
10. Open Port Loop Detected    >    (Enable)
11. STP Priority[0 - 255]      ... (128)
12. STP Root Cost[0 - 65535]   ... (500)

>

# - Save; % - Undo
ESC-prev.menu; !-main menu; &-exit; @-debug                       1 M/ 1 C
-------------------------------------------------------------------------
```

Figure 5-111. Typical **Bridge Port** Configuration Screen (VLAN Aware Mode)

Table 5-32. Bridge Port Configuration Parameters (VLAN Aware Mode)

Parameter	Function	Values
Bridge Port	See *Table 5-31*	
Ingress Filtering	Controls the discarding of frames received through this port, if their IEEE 802.1Q tag does not match the port VLAN	**DISABLE** – Such frames are not discarded. **ENABLE** – Such frames are discarded. **Default: DISABLE**
Accept Frame Type	Controls the handling of untagged frames received through this port	**ALL** – Untagged frames are accepted, and tagged with the port VLAN ID. **TAG ONLY** – Untagged frames are discarded. **Default: DISABLE**
Port VID	Specifies the default VLAN ID (VID) associated with the corresponding port. This VID is used to process untagged frames received through this port, and is assigned to untagged frames that must be tagged before egress through this port	The allowed range is 1 to 4094. **Default: 1**
Egress Mode	Specifies the egress mode for the corresponding port of the Ethernet switch	**NONE** – Stacking is disabled. **STACKING** – A tag is always added to all the frames that egress the port. The added tag contains the VLAN ID defined for the frame ingress port. This mode should be selected only when the network supports a frame size of at least 1526 bytes. **Default: NONE**
Ingress Mode	Specifies the ingress mode for the corresponding port of the Ethernet switch	**NONE** – Stripping is disabled. **STRIPPING** – The first tag of the incoming frames is always removed by this port. Untagged frames are not modified. For this operation to be valid, the incoming frames must have at least 68 bytes. **Default: NONE**
STP Mode	See *Table 5-31*	
Loop Detection	See *Table 5-31*	
Action On Loop Detection	See *Table 5-31*	
Open Port Loop Detected	See *Table 5-31*	
STP Priority	See *Table 5-31*	
STP Root Cost	See *Table 5-31*	

Configuring Port-Based VLANs (Port Membership)

Port-based VLANs are in effect only when the **VLAN Mode** is **Unaware**.

The maximum number of port-based VLANs that can be defined and stored is 20. Each such VLAN can have its own logical name.

FCD-155 have two predefined port-based VLANs as part of the factory-default parameters:

- The port-based VLAN designated VLAN Port 1 includes the FCD-155 external LAN port ETH 1, the internal management port, and virtually concatenated groups 1 and 3

- The port-based VLAN designated VLAN Port 2, includes the FCD-155 external LAN port ETH 2, the internal management port, and groups 2 and 4.

For details on port-based VLAN applications, refer to the *Port-Based VLAN Configuration Guidelines* section.

Port-based VLANs are configured by means of the **Port Membership** item on the **Bridge** screen. A typical **Port Membership** screen is shown in *Figure 5-112*.

If the screen opens but nothing is displayed, it means that no port-based VLAN is currently defined. You may add a new port-based VLAN by typing **a** and then pressing ‹**Enter**› to display the configuration data form.

```
                              FCD-155
Configuration>Applications>Bridge >Port Membership


 1. Name                 ... (VlanPort1)
 2. Egress LAN Ports     >   (1)
 3. Egress VCG Ports     >   (1,3)
 4. Internal Management      (Yes)


>


# - Save; % - Undo; A - add; D - del; B - back; F - forw

ESC-prev.menu; !-main menu; &-exit; @-output                    1M/1C

--------------------------------------------------------------------------
```

*Figure 5-112. Typical **Port Membership** Screen*

When the screen is displayed, it automatically displays the first port-based VLAN in its database. The fields appearing on the **Port Membership** screen are as follows:

Name   Optional field, can be used to assign a unique logical name to each port-based VLAN.

                     The name may include up to 10 alphanumeric characters.

Egress LAN Ports   Displays the set of LAN ports that are allowed to serve as egress ports for this port-based VLAN. The maximum number is 2.

Egress VCG
Ports

Displays the set of virtually concatenated groups that are allowed to serve as egress ports for this port-based VLAN.

The maximum number is that supported by the FCD-155, 4 or 6.

Internal
Management

Indicates whether the internal management port is a member of this VLAN.

You can scroll forward or back to display the additional port-based VLANs in the database, using the **f** and **b** keys.

Pressing **d** deletes the currently displayed port-based VLAN.

➤ **To define a port-based VLAN (FCD-155 without GbE port):**

1. Select **Port Membership** on the **Bridge** screen.

2. Type **a** to add a new VLAN (you may also edit an existing but unused VLAN). You will see an empty data form similar to that shown in *Figure 5-112*.

   ▪ You can assign any desired name to the VLAN. To edit, type **1** and then press ‹**Enter**›: you can then type a new name or change the existing one.

   ▪ Select **2: Egress LAN Ports** to display the LAN port selection screen.

   ▪ Type **a** once or twice, to open new rows for selecting ports. A typical screen with blank rows is shown in *Figure 5-113*.

```
                             FCD-155
Configuration>Applications>Bridge >Port Membership>Egress LAN Ports (-)


 1. [1 - 2]... (-)
 2. [1 - 2]... (-)
 3. Save All

>


# - Save; % - Undo
ESC-prev.menu; !-main menu; &-exit; @-debug                    1 M/ 1 C
-------------------------------------------------------------------------

```

*Figure 5-113. Typical **Port Membership Add Ports** Screen*

   ▪ Select each blank row and type the desired LAN port number.

   ▪ When done, type **4: Save All** and then press ‹**Enter**›. The new definition appears on the **Port Membership** screen.

   ▪ Select **3: Egress VCG Ports** and repeat the procedure for the desired virtually concatenated groups.

   ▪ To include the internal management port in the new VLAN, select **4: Internal management,** select **YES,** and then press ‹**Enter**›. The new definition appears on the **Port Membership** screen.

Port-Based VLAN Configuration Guidelines

Figure 5-114 shows a network topology that illustrates the use of port-based VLANs to isolate traffic from different subnets.

The main consideration in the planning of the network is to prevent nodes on one subnet from learning nodes on the other subnets. This can be achieved by isolating the traffic flows from each external LAN port, where each FCD-155 LAN ports serves a single subnet.

When using port-based VLANs, the isolation is the result of the separation of the traffic flows from each external LAN port, obtained by directing them only to the appropriate virtually concatenated groups. Nodes attached to each subnet can then learn only nodes reached by the traffic flow, that is, only nodes within the same subnet.
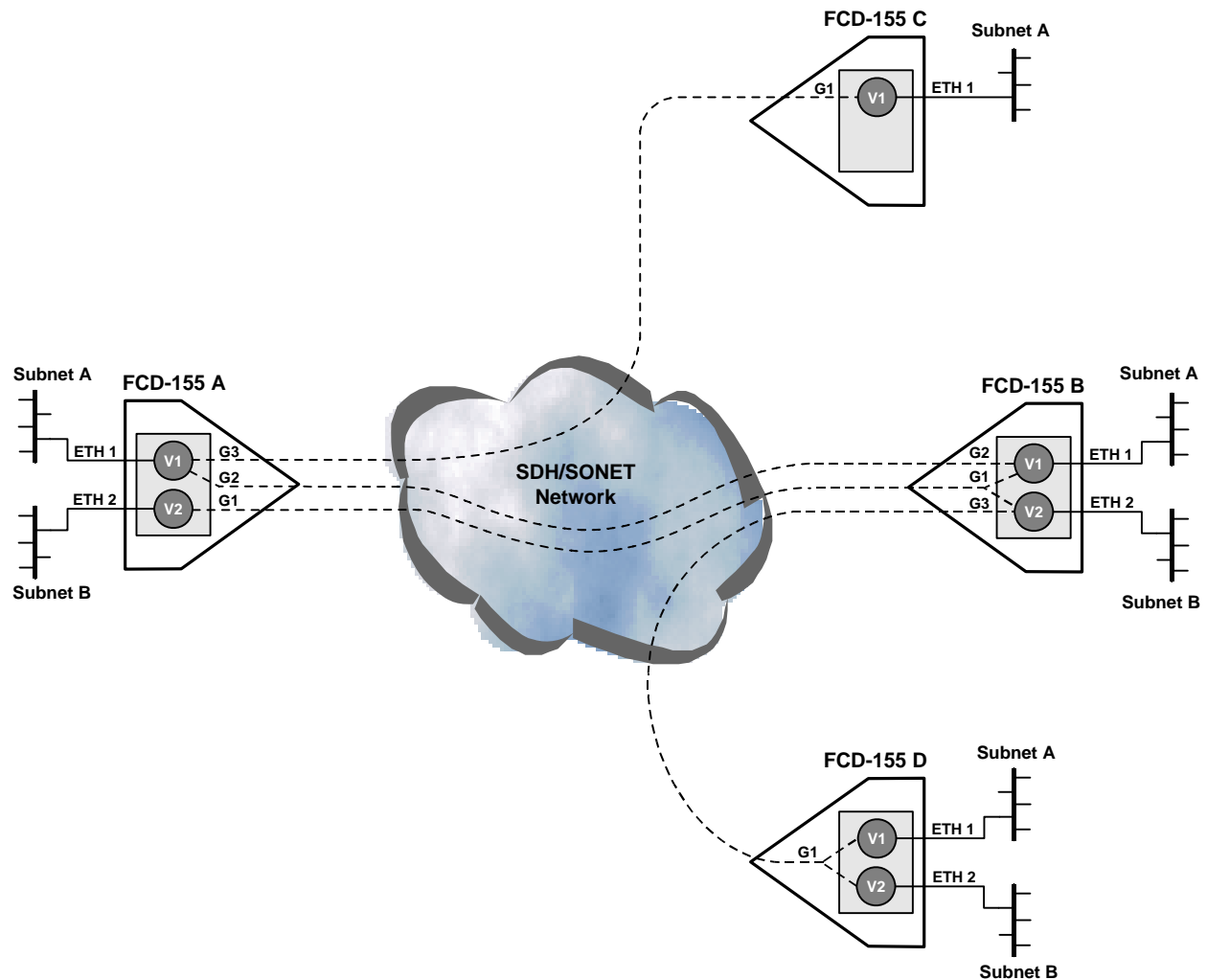
Figure 5-114. Port-Based VLAN Configuration Example

For your convenience, the following table identifies the port-based VLANs defined on each unit, as shown in *Figure 5-114*.

FCD-155 Unit	VLAN Name	External Port	Groups
FCD-155 A	VLANPORT1	ETH 1	2, 3
	VLANPORT2	ETH 2	1
FCD-155 B	VLANPORT1	ETH 1	2, 3

	VLANPORT2	ETH 2	1, 3
FCD-155 C	VLANPORT1	ETH 1	1
FCD-155 D	VLANPORT1	ETH 1	1
	VLANPORT2	ETH 2	1

Configuring Tag-Based VLANs (VLAN Membership)

Tag-based VLANs are in effect only when the **VLAN Mode** is **Aware**.

The maximum number of tag-based VLANs that can be defined and stored is 64. Each such VLAN can have its own logical name.

Each definition of a tag-based VLAN actually specifies a forwarding rule (procedure) for frames with the corresponding VLAN ID. For details on tag-based VLAN applications, refer to the *Tag-Based Switching Configuration Guidelines* section.

Tag-based VLANs are configured by means of the **VLAN Membership** item on the **Bridge** screen.

If the screen opens but nothing is displayed, it means that no tag-based VLAN is currently defined. You may add a new tag-based VLAN by typing **a** and then pressing **‹Enter›** to display the configuration data form. A typical **VLAN Membership** data form is shown in *Figure 5-115*.

```
                              FCD-155
Configuration>Applications>Bridge >VLAN Membership


 1. VLAN Name                       ... ()
 2. VLAN ID[1 - 4094]               ... (0)
 3. Egress Lan Tagged Ports         >   (-)
 4. Egress Lan UnTagged Ports       >   (-)
 5. Egress Lan Unmodified Ports     >   (-)
 6. Egress VCGs Tagged Ports        >   (-)
 7. Egress VCGs UnTagged Ports      >   (-)
 8. Egress VCGs Unmodified Ports    >   (-)

>


# - Save; % - Undo; A - add; D - del; B - back; F - forw
ESC-prev.menu; !-main menu; &-exit; @-debug                      1M/1C
------------------------------------------------------------------------------
```

*Figure 5-115. Typical **VLAN Membership** Screen*

The parameters that can be configured by means of the **VLAN Membership** screen are explained in *Table 5-33*.

Table 5-33. Tag-Based **VLAN Membership** *Configuration Parameters*

Parameter	Function	Values
VLAN Name	Used to assign a unique logical name to each forwarding rule. This entry is optional. The name may include up to 10 alphanumeric characters	**Default: Empty string**
VLAN ID	Specifies the VLAN ID (VID) handled in accordance with the forwarding rule defined	The allowed range is 1 to 4094. **Default: Empty string**
Egress Lan Tagged Ports	Specify the LAN ports that will egress all the frames as tagged frames. Therefore, tagged frames egress the port unmodified, whereas untagged frames are converted to tagged frames before egressing the port (this is performed by adding a tag with the VLAN ID defined for the corresponding ingress port in the **Bridge Port** screen, and recalculating the frame CRC)	Use the **add** procedure for LAN ports described in the *Configuring Tag-Based VLANs (VLAN Membership)* section, *Figure 5-113*
Egress Lan UnTagged Ports	Specify the LAN ports that will egress all the frames as untagged frames. Therefore, untagged frames egress the port unmodified, whereas tagged frames are converted to untagged frames before egressing the port (this is performed by removing their tag and recalculating the frame CRC)	Use the **add** procedure for LAN ports described in the *Configuring Tag-Based VLANs (VLAN Membership)* section, *Figure 5-113*
Egress Lan Unmodified Ports	Specify the LAN ports that will transfer the tags of the frames forwarded to it without change. Therefore, untagged frames egress the port as intagged frames, and tagged frames egress the port as tagged frames	Use the **add** procedure for LAN ports described in the *Configuring Tag-Based VLANs (VLAN Membership)* section, *Figure 5-113*
Egress VCGs Tagged Ports	Specify the VCG ports that will egress all the frames as tagged frames. Therefore, tagged frames egress the port unmodified, whereas untagged frames are converted to tagged frames before egressing the port (this is performed by adding a tag with the VLAN ID defined for the corresponding ingress port in the **Bridge Port** screen, and recalculating the frame CRC)	Use the **add** procedure for LAN ports described in the *Configuring Tag-Based VLANs (VLAN Membership)* section, *Figure 5-113*

*Table 5-33. Tag-Based **VLAN Membership** Configuration Parameters (Cont.)*

Parameter	Function	Values
Egress VCG UnTagged Ports	Specify the VCG ports that will egress all the frames as untagged frames. Therefore, untagged frames egress the port unmodified, whereas tagged frames are converted to untagged frames before egressing the port (this is performed by removing their tag and recalculating the frame CRC)	Use the **add** procedure for LAN ports described in the *Configuring Tag-Based VLANs (VLAN Membership)* section, *Figure 5-113*, except that it now refers to VCG ports
Egress VCG Unmodified Ports	Specify the VCG ports that will transfer the tags of the frames forwarded to it without change. Therefore, untagged frames egress the port as untagged frames, and tagged frames egress the port as tagged frames	Use the **add** procedure for LAN ports described in the *Configuring Tag-Based VLANs (VLAN Membership)* section, *Figure 5-113*, except that it now refers to VCG ports

Notes
- *Unlike the port-based VLAN configuration table (Figure 5-112), the tag-based table does not include the management port. When management (host) tagging is enabled, make sure to define an entry (forwarding rule) for the management VLAN.*
- *Make sure to configure a forwarding rule for each port configured (by means of the **Bridge Port** configuration screen) to use IEEE 802.1Q tags: if the switching table does not include a rule for each such port, all the traffic received through that port will be discarded.*

➤ **To add a new tag-based forwarding rule (FCD-155 without GbE port):**

1. Type **a** on the **VLAN Membership** screen, and then press ‹**Enter**›.

2. You will see the **VLAN Membership** configuration screen. A typical screen with default values is shown in *Figure 5-115*.

3. Define the logical name of the new tag-based VLAN forwarding rule: select **1** and then type the desired name (up to 10 characters – any characters beyond the first 10 are ignored). Press ‹**Enter**› to end the string.

4. Define the VLAN ID to be handled in accordance with the new forwarding rule: select **2** and then type the desired number, in the range of 1 to 4094. Press ‹**Enter**› to end.

5. Define the required egress ports for each handling mode:
   - Type the item number for the desired member, **3** to **8**.
   - After pressing ‹**Enter**›, you will see the port selection screen (similar to *Figure 5-113*). The selected egress mode is displayed in the screen header.

     Use the procedure described above for port-based VLANs to define the port.
   - Repeat the procedure for each egress mode.

6. At this stage, the configuration of the new tag-based forwarding rule is complete. Now you may either save the new configuration, delete an existing forwarding rule or add another one.

➤ **To save the new configuration (FCD-155 without GbE port):**

•   Type **#** to save and then confirm the action.

Alternatively, you may select item **9 – Save All** on the **Tag-Based** screen.

Tag-Based Switching Configuration Guidelines

Figure 5-116 shows a network topology that illustrates the use of VLAN tag-based switching.

In the application shown in *Figure 5-116*, the FCD-155 units A, B, C and D communicate with the units E and F (this is typical of branch office sites communicating with the headquarters, or sites connecting to the Internet through the ISP PoPs). The customers' IP-NTU units are controlled by the carrier (or the headquarters network manager), which can then assign the desired VLAN tags and configure the units to use them.
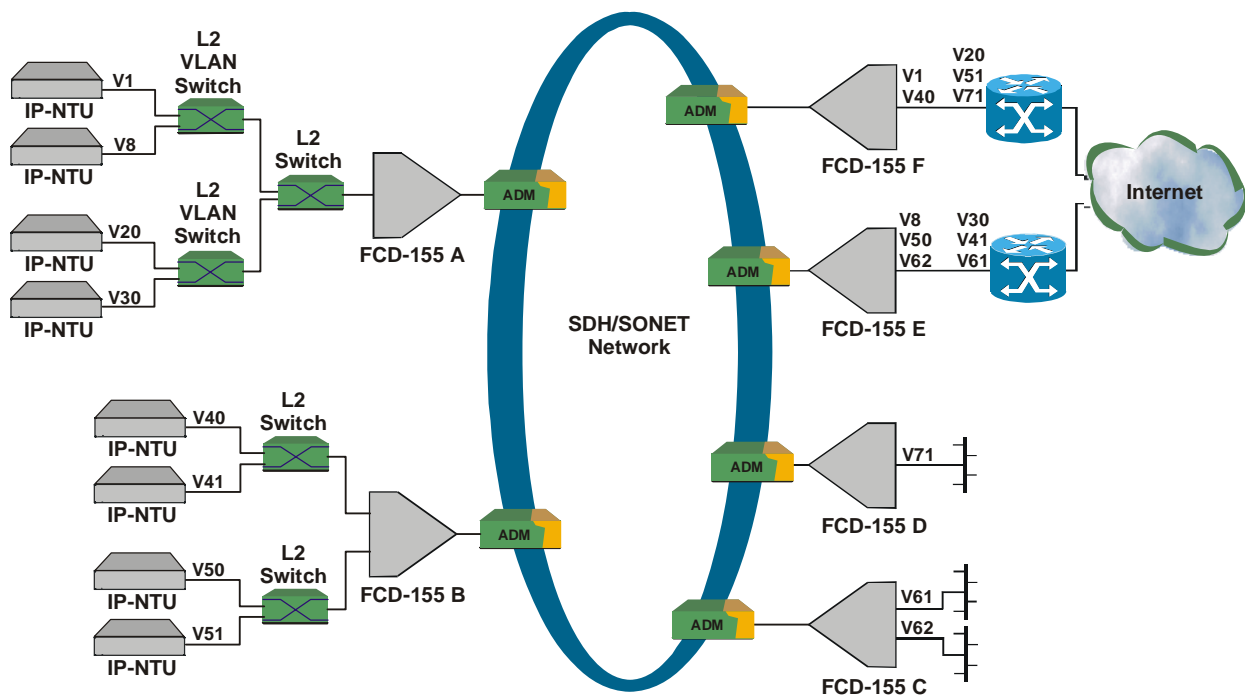
Figure 5-116. Typical Application Using VLAN Tag-Based Switching (FCD-155 without GbE Port)

The VLAN tag is then used throughout the network, and each node in the network shown must be configured to switch the traffic in accordance with IEEE 802.1Q. The assigned VLAN IDs are marked near the corresponding ports (the ID is preceded by a **V**).

The required configuration activities are listed below:

FCD-155	Role in Network	VLAN Switching Action
A	Connects Layer 2 switch concentrating traffic from customers' IP-NTUs	VLAN switching must enable using different virtually concatenated groups, to seggregate the served customers' traffic
B	Connects two Layer 2 switches concentrating traffic from customers' IP-NT	VLAN switching must enable using different virtually concatenated groups, to seggregate the served customers' traffic
C	LAN ports directly connected to customer's LANs	• Use port-based VLANs to separate among the different customer's networks • VLAN tags must be added to customer's traffic on egress toward the SDH/SONET network
D	LAN port directly connected to customer's LAN	• VLAN tag must be added to customer's traffic on egress toward the SDH/SONET network • VLAN tag must be removed on egress toward the customer's LAN

5.11   Configuring Bridge Parameters – FCD-155 with GbE Port

Configuring the General Bridge Parameters

Purpose

Configure the parameters controlling the bridge operating mode: VLAN mode, aging time, and scheduling mode.

Reached from

Configuration >Applications >Bridge

A typical **Bridge** screen is shown in *Figure 5-109*.

```
                              FCD-155
Configuration>Applications>Bridge

 1. VLAN Mode                    >    (Aware)
 2. Aging Time (Seconds)[16 - 4... (300)
 3. Scheduling Mode              >    (WFQ)
 4. Forwarding Mode              >    (Transparent)
 5. Bridge Port                  >
 6. Port Membership              >
 7. MAC Table                    >
 8. Spanning Tree Protocol       >
 9. Loop Detection VLAN ID[1 - 4094]... (4094)              >
>


ESC-prev.menu; !-main menu; &-exit; @-output                          1M/1C
-------------------------------------------------------------------------
Figure 5-117. Typical Bridge Screen (FCD-155 with GbE Port)
```

➤ **To configure the general parameters of the Ethernet switch (FCD-155 with GbE port):**

1. Type the number corresponding to the desired parameter, and then press ‹Enter›:

   ▪ For item **2**, you can type the desired value in the same line. When done, press ‹Enter›.

   ▪ For items **1** and **3**, you will see the corresponding selection screen. In this case, the **Values** column in *Table 5-34* lists the options displayed on the selection screen.

   On the selection screen, type the number of the desired option and then press ‹Enter›. The selection screen closes and the new value appears in the **Bridge** screen. In addition, items not supported in a specific **VLAN Mode** are automatically removed from the menu.

2. When done, type **#** to save and then confirm the action.

*Table 5-34. General **Bridge** Configuration Parameters (FCD-155 with GbE Port)*

Parameter	Function	Values
VLAN Mode	Selects the operating mode of the switch	**Aware** – The Ethernet switch uses the VLAN information to make forwarding decisions.
		When **Aware** is selected, the **VLAN Membership** item appears on the **Bridge** submenu.
		Unaware – The Ethernet switch ignores the VLAN information. As a result, all the ports are "open" that is, forward all the frames.
		When **Unaware** is selected, the **VLAN Membership** item is removed from the **Bridge** submenu. However, existing tag-based VLAN configuration data remains stored, and will take effect again after changing the **VLAN Mode** to **Aware.**
		Default: Unaware
Aging Time	Selects the maximum time learned MAC destination addresses are stored. If the information for a given destination is not refreshed before the selected interval expires, that information is deleted from the bridging table. Static MAC addresses, configured by means of the **View MAC Table** screen (see *Displaying View LAN Table*), are not subject to aging	The allowed range is 10 to 4080 sec, in 16-sec increments. If the entered value is not a multiple of 16, the nearest multiple of 16 not exceeding your entry, is actually used. **Default: 300 sec**
Scheduling Mode	Selects the frame eggress scheduling mode to be used when QoS support is enabled	**WFQ** (Weight Fair Queue) –2:1 weighting is applied to the two priority queues. This selection prevents the lower priority frames from being starved out, with only a slightly increased delay to the higher priority frames.
		SP (Strict Priority**)** – All top priority frames are egressed out a port until that priority's queue is empty, then the next lower priority queue's frames are egressed. Note that this selection may prevent lower-priority queues from transmitting any frames.
		Default: WFQ

Configuring the Individual Bridge Port Parameters

The **Bridge Port** item provides control over the use of the STP protocol for each port, and permits selecting separate STP parameters for each port.

The options available under the **Bridge Port** screen depend on the **VLAN Mode**.

Configuring Bridge Port – VLAN Unaware Mode

➤ **To configure a bridge port in VLAN Unaware Mode (FCD-155 with GbE port):**

1. Select **Bridge Port** on the **Bridge** submenu, and then press **‹ Enter ›**. A typical screen for **Bridge Port 1**, as it appears after parameters are selected, is shown in *Figure 5-110*. The parameters are explained in *Table 5-31*.

```
                               FCD-155
Configuration>Applications>Bridge>Bridge Port

    Port State                 >    (N/A)
 1. Bridge Port                >    (Port 1)
 2. STP Mode                   >    (Enable)
 3. Loop Detection             >    (Enable)
 4. Action Upon Loop Detection>    (Port Down 4 Minutes)
 5. Open Port Loop Detected    >    (Enable)
 6. STP Priority[0 - 255]      ... (128)
 7. STP Root Cost[0 - 65535]   ... (500)

>


# - Save; % - Undo
ESC-prev.menu; !-main menu; &-exit; @-debug                         1 M/ 1 C
-------------------------------------------------------------------------
```

*Figure 5-118. Typical **Bridge Port** Configuration Screen (VLAN Unaware Mode)*

2. Use the procedure given in the *Configuring the Individual Bridge Port Parameters* section on page *5-133*.

Configuring Bridge Port – VLAN Aware Mode

➤ **To configure a bridge port in VLAN Aware Mode (FCD-155 with GbE port):**

1. Select **Bridge Port** on the **Bridge** submenu, and then press **‹ Enter ›**. A typical screen for **Bridge Port 1**, as it appears after parameters are selected, is shown in *Figure 5-119*.

2. Use the procedure given in the *Configuring Bridge Port – VLAN Aware Mode* section on page *5-136* to configure the ports.

```
                              FCD-155
Configuration>Applications>Bridge>Bridge Port

     Port State                 >    (N/A)
 1. Bridge Port                 >    (Port 1)
 2. Ingress Filtering           >    (Enable)
 3. Accept Frame Type           >    (Tag Only)
 4. Port VID[1 - 4094]          ... (1)
 5. Egress Mode                 >    (Stacking)
 6. Ingress Mode                >    (Stripping)
 7. STP Mode                    >    (Enable)
 8. Loop Detection              >    (Enable)
 9. Action Upon Loop Detection>     (Port Down 4 Minutes)
10. Open Port Loop Detected     >    (Enable)
11. STP Priority[0 - 255]       ... (128)
12. STP Root Cost[0 - 65535]    ... (500)

>


# - Save; % - Undo
ESC-prev.menu; !-main menu; &-exit; @-debug                        1 M/ 1 C
---------------------------------------------------------------------------
```

*Figure 5-119. Typical **Bridge Port** Configuration Screen (VLAN Aware Mode)*

Configuring Tag-Based VLANs (VLAN Membership)

Tag-based VLANs are in effect only when the **VLAN Mode** is **Aware**.

The maximum number of tag-based VLANs that can be defined and stored is 64. Each such VLAN can have its own logical name.

Each definition of a tag-based VLAN actually specifies a forwarding rule (procedure) for frames with the corresponding VLAN ID.

Tag-based VLANs are configured by means of the **VLAN Membership** item on the **Bridge** screen.

If the screen opens but nothing is displayed, it means that no tag-based VLAN is currently defined. You may add a new tag-based VLAN by typing **a** and then pressing ‹**Enter**› to display the configuration data form. A typical **VLAN Membership** data form is shown in *Figure 5-120*.

```
                                    FCD-155
Configuration>Applications>Bridge >VLAN Membership


 1. VLAN Name                        ... ()
 2. VLAN ID[1 - 4094]                ... (0)
 3. Egress VCGs Tagged Ports       >   (-)
 4. Egress VCGs UnTagged Ports     >   (-)
 5. GbE                            >   (Forbid)

>


# - Save; % - Undo; A - add; D - del; B - back; F - forw
ESC-prev.menu; !-main menu; &-exit; @-debug                              1M/1C
------------------------------------------------------------------------------
```

*Figure 5-120. Typical **VLAN Membership** Screen*

The parameters that can be configured by means of the **VLAN Membership** screen are explained in *Table 5-35*.

*Table 5-35. Tag-Based **VLAN Membership** Configuration Parameters*

Parameter	Function	Values
VLAN Name	Used to assign a unique logical name to each forwarding rule. This entry is optional. The name may include up to 10 alphanumeric characters	**Default: Empty string**
VLAN ID	Specifies the VLAN ID (VID) handled in accordance with the forwarding rule defined	The allowed range is 1 to 4094. **Default: Empty string**
Egress VCGs Tagged Ports	Specify the VCG ports that will egress all the frames as tagged frames. Therefore, tagged frames egress the port unmodified, whereas untagged frames are converted to tagged frames before egressing the port (this is performed by adding a tag with the VLAN ID defined for the corresponding ingress port in the **Bridge Port** screen, and recalculating the frame CRC)	Use the **add** procedure for LAN ports described in the *Configuring Tag-Based VLANs (VLAN Membership)* section, *Figure 5-113*, except that it now refers to VCG ports section
Egress VCG UnTagged Ports	Specify the VCG ports that will egress all the frames as untagged frames. Therefore, untagged frames egress the port unmodified, whereas tagged frames are converted to untagged frames before egressing the port (this is performed by removing their tag and recalculating the frame CRC)	Use the **add** procedure for LAN ports described in the *Configuring Tag-Based VLANs (VLAN Membership)* section, *Figure 5-113*, except that it now refers to VCG ports section

*Table 5-35. Tag-Based **VLAN Membership** Configuration Parameters (Cont.)*

Parameter	Function	Values	
GbE	Specify the egress mode for the GbE port	**Forbid**	The port does not serve as egress port for the VLAN ID specified by the corresponding entry.
		Tagged	All the frames egress the port as tagged frames. Therefore, tagged frames egress the port unmodified, whereas untagged frames are converted to tagged frames before egressing the port (this is performed by adding a tag with the VLAN ID defined for the corresponding ingress port in the **Bridge Policy Configuration** screen, and recalculating the frame CRC).
		Untagged	All the frames egress the port as untagged frames. Therefore, untagged frames egress the port unmodified, whereas tagged frames are converted to untagged frames before egressing the port (this is performed by removing their tag and recalculating the frame CRC).
		Default: Forbid	

5.12   Managing the MAC Table

Selecting a MAC Table Task

Purpose

Select the task to be performed on the bridge MAC table.

Reached from

Configuration›Applications›Bridge

A typical **MAC Table** task selection screen is shown in *Figure 5-121*.

```
                              FCD-155
Configuration>Applications>Bridge>MAC table


 1. View LAN Table []>
 2. Erase LAN Table


>


ESC-prev.menu; !-main menu; &-exit; @-output                          1M/1C
-------------------------------------------------------------------------
```

*Figure 5-121. Typical **MAC Table** Task Selection Screen*

➤ **To display and/or edit the contents of the MAC table:**

Type **1** and then press ‹**Enter**›. See *Displaying View LAN Table* section for instructions.

➤ **To erase all the static entries in the MAC table:**

Type **2** and then press ‹**Enter**›. All the static entries are removed from the table.

Displaying View LAN Table

Purpose

Display the current contents of the bridge MAC table, and edit its contents to add/remove static entries.

Note

The supervision utility can display up to 255 entries. The MAC table supports several thousands entries.

Reached from

Configuration ›Applications ›Bridge ›MAC Table

A typical **View LAN Table** screen is shown in *Figure 5-122*.

```
                              FCD-155
Configuration>Applications>Bridge>MAC table>View LAN Table

 Index MAC Address        Port    State
   vvv 01-80-C2-00-00-00 Mng     Learned
 1     01-80-C2-00-00-07 Port 2  Static


>


ESC-prev.menu; !-main menu; &-exit; @-output; ?-help                  1M/1C
-------------------------------------------------------------------------
```

*Figure 5-122. Typical **View LAN Table** Screen*

Note   *You can see the navigation keys available for this screen by typing **?** followed by ‹Enter›.*

The parameters displayed on the **View LAN Table** screen are as follows:

Index   The index number of each entry (automatically assigned).

MAC Address   Displays the corresponding MAC address.

Port   Displays the port through which the corresponding MAC address can be reached:

- FCD-155 without GbE port: **Mng**, **Port 1**, **Port 2**, and **VCG 1** to **VCG 4** (management, external LAN ports and groups 1 to 4, respectively).

- FCD-155 with GbE port: **Mng**, **Port 1**, **Port 2**, **GbE** and **VCG 1** to **VCG 8** (management, external LAN ports and groups 1 to 8, respectively).

State   Displays the port state:

- **Learned** – dynamically learned address

- **Static** – static (user-configured) address.

➤ **To add a static entry:**

1. Type **a** and then press **‹Enter›**.

2. You will see the **View MAC Table** screen, used to add a new entry. The automatically assigned index number is displayed in the header.

3. Type **1** and then press **‹Enter›**.

4. Define the MAC address (12 hexadecimal digits) assigned to the new entry and then press **‹Enter›**.

5. Type **2** and then press **‹Enter›** to display the port selection screen. A typical screen is shown in *Figure 5-124*. The screen presents all the ports for which static entries can be configured.

```
                          FCD-155E
...>Applications>Bridge >MAC Table>View LAN Table >Port (Port 2)


 1. Port 1
 2. Port 2
 3. VCG-1
 4. VCG-2
 5. VCG-3
 6. VCG-4
 7. Mng


>
# - Save; % - Undo
ESC-prev.menu; !-main menu; &-exit; @-debug                        1 M/ 1 C
-----------------------------------------------------------------------------
```

*Figure 5-123. **View MAC Table** – **Add** Screen, Typical Port Selection Screen*

6. On the port selection menu, select the desired port or group, and then press ‹Enter›. A typical screen, as seen after pressing ‹Enter› all the values have been selected, is shown in *Figure 5-124*.

Note *A new item, 3 – Save All appears on the screen, in addition to the # Save and % Undo commands.*

7. At this stage, the configuration of the static entry is complete. Now you may either save the new configuration, or add another entry. Before adding a new entry, select item **3 – Save All** to save the configured entries.

```
                              FCD-155
Configuration>Applications>Bridge>MAC table>View LAN Table


    Index                    ... (1)
 1. MAC Address              ... (25-53-45-67-99-33)
 2. Port                     >   (Port 2)
    State                    >   (Static)
 3. Save All

>


# - Save; % - Undo
ESC-prev.menu; !-main menu; &-exit; @-output                         1M/1C
-------------------------------------------------------------------------------
```

*Figure 5-124. Typical **View MAC Table** – **Add** Screen*

➤ **To save the new configuration:**

- Type **#** to save and then confirm the action.

5.13   Configuring Spanning Tree Protocol Parameters

Selecting a Spanning Tree Protocol Task

Purpose

Select the Spanning Tree Protocol-related task to be performed.

Reached from

Configuration›Applications›Bridge

A typical **Spanning Tree Protocol** task selection screen is shown in *Figure 5-125*.

```
                              FCD-155
Configuration>Applications>Bridge>Spanning Tree Protocol


 1. STP configuration>
 2. STP Status        >

>


ESC-prev.menu; !-main menu; &-exit; @-output                              1M/1C
--------------------------------------------------------------------------------
```

*Figure 5-125. Typical **Spanning Tree Protocol** Screen*

➤ **To configure the STP parameters:**

Type **1** and then press **‹Enter›**. See *Configuring STP Configuration Parameters* section for instructions.

➤ **To display information on the current STP status:**

Type **2** and then press **‹Enter›**. See *Displaying STP Status* section for instructions.

Configuring STP Configuration Parameters

Purpose

Configure the Spanning Tree Protocol parameters in accordance with the specific requirements of customer's application.

Reached from

Configuration›Applications›Bridge›Spanning Tree Protocol

A typical **STP Configuration** screen is shown in *Figure 5-126*.

```
                              FCD-155
Configuration>Applications>Bridge>Spanning Tree Protocol>STP configuration

 1. Bridge Priority     [0 - 65535]... (32768)
 2. Bridge Forward Delay[4 - 30]... (15)
 3. Bridge Max Age      [6 - 40]... (20)
 4. Bridge Hello Time   [1 - 10]... (2)
 5. STP Version         >   (STP)

>


ESC-prev.menu; !-main menu; &-exit; @-output                              1M/1C
--------------------------------------------------------------------------------
```

*Figure 5-126. Typical **STP Configuration** Screen*

The parameters that can be configured by means of the **STP Configuration** screen are described in *Table 5-36*.

➤ **To configure the STP parameters:**

1. Type the number corresponding to the desired parameter, and then press
    ‹**Enter**›:

    ▪ For items **1** to **4**, you can then type the desired value in the same line.
       When done, press ‹**Enter**›.

    ▪ For item **5**, you will see the corresponding selection screen. In this case,
       the **Values** column in *Table 5-36* lists the options displayed on the
       selection screen.

       On the selection screen, type the number of the desired option and then
       press ‹**Enter**›. The selection screen closes and the new value appears in
       the **STP Configuration** screen.

2. When done, type **#** to save and then confirm the action.

Note   *Any changes to the values of parameters 2, 3, 4 must be carefully considered,
         because the effect these parameters have on the network performance and
         stability.*

Table 5-36. **STP Configuration** *Parameters*

Parameter	Function	Values
Bridge Priority	Specifies the bridge priority. This parameter is used, together with the bridge MAC address, to generate the Bridge ID. Since the selection of the root bridge of the STP tree is based on the bridge ID, a bridge can be forced to become root by assigning it a lower bridge priority.	The allowed range is 0 to 65535. **Default: 32768**
Bridge Forward Delay	Specifies the time spent in the listening and in the learning state while moving from the Blocking to the Forwarding state. The configured value is used only when the FCD-155 bridge is the root bridge	The allowed range is 4 to 30 sec. **Default: 15**
Bridge Max Age	Specifies the maximum age of received protocol information before it is discarded. The configured value is used only when the FCD-155 bridge is the root bridge	The allowed range is 6 to 40 sec. **Default: 20**
Bridge Hello Time	Specifies the time interval between consecutive transmissions of bridge protocol data units (BPDUs). The configured value is used only when the FCD-155 bridge is the root bridge	The allowed range is 1 to 10 sec. **Default: 2**
STP Version	Specifies the STP version used by the bridge	**STP** Standard STP. **RSTP** Rapid STP. **Default: STP**

Displaying STP Status

Purpose

Display information on the current status of the Spanning Tree Protocol.

Reached from

Configuration › Applications › Bridge › Spanning Tree Protocol

A typical **STP Status** screen is shown in *Figure 5-127*.

```
                            FCD-155
Configuration>Applications>Bridge>Spanning Tree Protocol>STP Status


    Designated Root[0 - 65535]... (32768)
    Root Path Cost[0 - 65535]... (0)
    Forward Delay [4 - 30]... (15)
    Max Age        [6 - 40]... (20)
    Hello Time     [1 - 10]... (2)


>


ESC-prev.menu; !-main menu; &-exit; @-output                          1M/1C
-----------------------------------------------------------------------------
```

*Figure 5-127. Typical **STP Status** Screen*

The parameters displayed by means of the **STP Status** screen are as follows:

Designated Root	The bridge currently selected as root bridge.
Root Path Cost	The cost of the path from this bridge to the root bridge.
Forward Delay	The forwarding delay of this bridge.
Max Age	The aging time of bridge protocol information at this bridge.
Hello Time	The interval between consecutive transmissions of bridge protocol information (BPDUs) by this bridge.

For each current parameter value, you can also see the allowed range of values.

5.14   Configuring the QoS

Quality of Service (QoS) Classification

Classifications Supported by FCD-155 without GbE Port

The **QoS** submenu is used to configure the ingress and egress handling characteristics of the FCD-155 Ethernet switch.

The ingress policy below determines the priority of each frame. The priority of a frame is determined, in the following priority order, by:

1. The IEEE 802.1p Layer 2 priority information, when enabled on the port.

   This option is enabled by the **Layer 2 Classification** item on the **QoS** screen, and is configured on a per-port basis by the **Layer 2 Mapping** item.

2. The IPv4 Type of Service (TOS) DiffServ field (Layer 3), when enabled on the port. IPv4 priority classification can be configured on a per port basis to have a higher priority than the IEEE tag.

   This option is enabled by the **Layer 3 Classification** item on the **QoS** screen, and is configured by the **Layer 3 Mapping** item.

3. The user-specified port default priority. This option is controlled by the **Port Mapping** item on the **QoS** screen.

Each priority classification can be enabled, giving the user any combination that is needed. For instance, if a "hot", higher priority port is desired for a switch design, priority classifications 1 and 2 above can be disabled. This setting leaves only the priority classification 3 (the port default priority), resulting in all ingressed frames being assigned the same priority on that port.

The additional user-configured QoS options are as follows:

- The priority classification can be disabled separately on a per port basis. These settings allow each port to be configured for different rules for priority classification. This option is controlled by the **Basic Classification** item on the **QoS** screen.

- Priority classification 2 (Layer 2 priority) and 3 (IP – Layer 3 priority) can be reversed on a per port basis as well. This allows the priority to be selected for frames that are both Tagged and IP. This option is controlled by the **Order** item on the **QoS** screen.

At each level, the priority is configured by specifying its traffic class: each traffic class is assigned to one of the egress queues of the Ethernet switch.

The number of egress queues depends on the installed LAN option: for FCD-155 without GbE port, the Ethernet switch has four egress queues, whose priorities are identified as 0 (low) to 3 (high priority), whereas the range of priorities supported by IEEE 802.1p tags is 0 to 7, and the range of DSCP/TOS values is 0 to 63.

Classifications Supported by FCD-155 with GbE Port

The QoS characteristics of FCD-155 with GbE port differ in the following points relative to those of FCD-155 without GbE port:

- FCD-155 with GbE port does not support Layer 2 classification, and the assignment of default port priorities. Therefore, these items are removed from the **QoS** screen.

- The Ethernet switch of an FCD-155 with GbE has two egress queues, whose priorities are identified as 0 (low) and 1 (high priority. Therefore, the number of selectable traffic classes is 2 (0 and 1).

QoS Configuration Screen

➤ **To configure QoS parameters:**

1. Select **QoS** on the **Applications** menu.

2. A typical screen is shown in *Figure 5-128*.

```
                          FCD-155/2U/4E1
Configuration>Applications>Qos

 1. Basic Classification   >    (Per Port)
 2. Layer 2 Classification >    (802.1p)
 3. Layer 3 Classification >    (DSCP)
 4. Order                  >    (L2&L3)
 5. Port Mapping           >
 6. Layer 2 Mapping        >
 7. Layer 3 Mapping        >

>


# - Save; % - Undo
ESC-prev.menu; !-main menu; &-exit; @-output                          1M/1C
----------------------------------------------------------------------------

```

Figure 5-128. QoS Screen

Configuring the General QoS Parameters

➤ **To configure the general QoS parameters of the Ethernet switch:**

1. Type the number corresponding to the desired parameter, and then press **‹Enter›**:

2. When done, type **#** to save and then confirm the action.

Table 5-37. General QoS Configuration Parameters

Parameter	Function	Values
Basic Classification	Enables/disables the per-port QoS classification option	**None** – All the ports have the same class rating
		Per Port – Each port can be separately configured.
		Default: Per Port
Layer 2 Classification	Enables/disables QoS classification in accordance with the IEEE 802.1p priority tag	**None** – Classification in accordance with the IEEE 802.1p priority tag is disabled.
		802.1p – Classification in accordance with the IEEE 802.1p priority tag is enabled.
		Default: None

*Table 5-37. General **QoS** Configuration Parameters (Cont.)*

Parameter	Function	Values
Layer 3 Classification	Enables/disables QoS classification in accordance with the IPv4 DSCP/TOS field defined in RFC FC2474	**None** – Classification in accordance with DSCP/TOS priority tag is disabled **DSCP** – Classification in accordance with DSCP/TOS priority tag is enabled **Default: None**
Order	Selects the relative priority of Layer 2 and Layer 3 classification	**L2&L3** – The priority is determined by Layer 2 first, that is, Layer 2 has priority over Layer 3 classification. **L3&L2** – The priority is determined by Layer 3 first, that is, Layer 3 has priority over Layer 2 classification. **Default: L2&L3**

Configuring Port Mapping

Port Mapping is used to assign each switch port a default traffic class, in accordance with user's preferences.

➤ **To configure port mapping:**

1. Select **Port Mapping** on the **QoS** screen.

    A typical screen is shown in *Figure 5-129*.

```
                              FCD-155
Configuration>Applications>Qos>Port Mapping


 1. Port 1 >    (Traffic Class 0)
 2. Port 2 >    (Traffic Class 0)
 3. VCG-1  >    (Traffic Class 0)
 4. VCG-2  >    (Traffic Class 0)
 5. VCG-3  >    (Traffic Class 0)
 6. VCG-4  >    (Traffic Class 0)

>


ESC-prev.menu; !-main menu; &-exit; @-output                      1M/1C
-----------------------------------------------------------------------------
```

*Figure 5-129. Typical **Port Mapping** Screen*

2. Select the desired port and then press **‹Enter›** to display the classification screen. *Figure 5-130* shows a typical screen for FCD-155 without GbE port; the screen for FCD-155 with GbE port includes only traffic classes 0 and 1.

3. Select the traffic class for this port and then press **‹Enter›**. The new selection appears on the **Port Mapping** screen.

4. Repeat the procedure for the other ports. When done, type **#** to save and update.

```
                            FCD-155
...>Applications>Qos>Port Mapping           >Port 1 (Traffic Class 0)


 1. Traffic Class 0
 2. Traffic Class 1
 3. Traffic Class 2
 4. Traffic Class 3

>


ESC-prev.menu; !-main menu; &-exit; @-output                            1M/1C
--------------------------------------------------------------------------
```

*Figure 5-130. Typical **Traffic Class** Selection Screen*

Configuring Layer 2 Mapping

Layer 2 Mapping is used to assign each IEEE 802.1p priority to a traffic class (a total of 2 classes for FCD-155 with GbE port, and 4 classes for FCD-155 without GbE port).

➤ **To configure layer 2 mapping:**

1. Select **Layer 2 Mapping** on the **QoS** screen. A typical screen is shown in *Figure 5-131*.

```
                            FCD-155
Configuration>Applications>Qos>Layer 2 Mapping

 1. User Priority 0>   (Traffic Class 0)
 2. User Priority 1>   (Traffic Class 0)
 3. User Priority 2>   (Traffic Class 0)
 4. User Priority 3>   (Traffic Class 0)
 5. User Priority 4>   (Traffic Class 1)
 6. User Priority 5>   (Traffic Class 1)
 7. User Priority 6>   (Traffic Class 1)
 8. User Priority 7>   (Traffic Class 1)

>

ESC-prev.menu; !-main menu; &-exit; @-output                            1M/1C
--------------------------------------------------------------------------
```

*Figure 5-131. Typical **Layer 2 Mapping** Screen*

2. Select the desired **User Priority** and then press ‹ **Enter** › to display the classification screen. A typical screen is shown in *Figure 5-130*.

3. Select the traffic class for this priority and then press ‹ **Enter** ›. The new selection appears on the **Layer 2 Mapping** screen.

4. Repeat the procedure for the other priorities. When done, type **#** to save and update.

Configuring Layer 3 Mapping

Layer 3 Mapping is used to assign each DSCP value to a traffic class (a total of 2 classes for FCD-155 with GbE port, and 4 classes for FCD-155 without GbE port).

➤ To configure layer 3 mapping:

1. Select Layer 3 Mapping on the QoS screen. A typical screen is shown in *Figure 5-132*.

```
                            FCD-155
Configuration>Applications>Qos>Layer 3 Mapping

 1. Value            [0 – 63]... (0)
 2. Traffic Class    >   (Traffic Class 0)

>

ESC-prev.menu; !-main menu; &-exit; @-output                          1M/1C
--------------------------------------------------------------------------
```

Figure 5-132. Typical Layer 3 Mapping Screen

2. Select the desired DSCP Value and then press <Enter> to display the classification screen. A typical screen is shown in *Figure 5-130*.

3. Select the traffic class for this Value and then press <Enter>. The new selection appears on the Layer 3 Mapping screen.

4. Repeat the procedure for the other Values. When done, type # to save and update.

5.15   Configuring the Link Aggregation

FCD-155 enables link aggregation (trunking), and specifies the link aggregate (trunk) in which the corresponding port participates. The link aggregate (LAG) is actually created when two or more ports are assigned the same LAG label.

Note

Link aggregation is supported only in the VLAN Unaware mode.

Each LAG is automatically assigned; the total number of LAGs that may be created is 8. However, any given port can participate in a single LAG.

➤ To configure the link aggregation

1. Select Link Aggregation on the Applications menu. A typical default screen is shown in *Figure 5-133*.

```
                          FCD-155/2U/4E1
Configuration>Applications>Link Aggregation


    LAG ID     ... (1)
 1. LAN Ports >   (-)
 2. VCG Ports >   (-)

>


# - Save; % - Undo; B - back; F - forw
ESC-prev.menu; !-main menu; &-exit; @-output                          1M/1C
--------------------------------------------------------------------------
```

Figure 5-133. Default **Link Aggregation** *Screen*

2. Note the **LAG ID** at the top of the screen: there are 8 identifiers, and the first one is selected. If necessary, change the number by pressing **f** or **b**.

3. After the correct **LAG ID** is displayed, select **1: LAN Ports** or **2: VCG Ports** to display the port selection screen.

4. Type **a** as required to add blank rows for the required number of ports that will be aggregated.

5. For each row, select the number of the corresponding port.

6. When done, type **4: Save All** and then press **‹Enter›.** The new definition appears on the **Link Aggregation** screen. A typical **Link Aggregation** screen is shown in *Figure 5-134*.

7. To delete an aggregate, type **3: Delete Range** and then press **‹Enter›.**

```
                          FCD-155/2U/4E1
Configuration>Applications>Link Aggregation


    LAG ID     ... (2)
 1. LAN Ports >   (-)
 2. VCG Ports >   (1,2,3)

>


# - Save; % - Undo; B - back; F - forw
ESC-prev.menu; !-main menu; &-exit; @-output                          1M/1C
--------------------------------------------------------------------------
```

Figure 5-134. Typical **Link Aggregation** *Screen*

5.16   Selecting Configuration Mode

Purpose

Select the FCD-155 configuration display mode.

Two configuration display modes are available:

- **On Line:** in this mode, the various configuration screens display the parameter values contained in the on-line database (the database that actually determines the FCD-155 operating mode).

  The result is that you can see configuration changes made on the current screen, but cannot see new parameter values selected on previous screens during the current configuration session, until the new values are activated using the **Save** command. The reason is that you can see such changes only after the **Save** command transfers the new parameter values to the on-line database.

- **Off Line**: normal configuration display mode. In this mode, the parameter values displayed on the various configuration screens reflect the last selected values, even if they have not yet been saved (such values are temporarily stored in an off-line database, whose contents are lost when the FCD-155 is reset or powered down). When the new parameter values are ready for activation, save them to the on-line database using the **Save** command.

Note   *To alert you that parameter values have been changed but not yet saved (activated), the **Save** command appears on each screen. To save, type **#** and then confirm the operation by typing **y** (typing **n** cancels the **Save** command).*

In either mode, you can also undo (delete) any unsaved changes using the **Undo** command (type **%** to undo).

During configuration sessions, it is recommended to use the **Off Line** mode, which enables you to see parameter values that have been changed but not yet saved. Whenever you want to see the actually used (on-line) parameter values, switch to the **On Line** mode, and then return to the **Off Line** mode to continue the configuration activities.

Reached from

Configuration › Select Configuration

A typical display is shown *Figure 5-135*. Note that the current mode is displayed in the screen header.

➤ **To change the configuration display mode:**

Type the number corresponding to the desired mode, and then press **‹Enter›**.

```
                         FCD-155
Configuration>Select configuration (Off Line)


 1. Off Line
 2. On Line

>


ESC-prev.menu; !-main menu; &-exit; @-Output                          1M/1C
----------------------------------------------------------------------------

```

*Figure 5-135. Typical **Select Configuration** Screen*

5.17   File Utilities

Overview

Figure 5-136 shows the structure of the **File Utilities** menu.
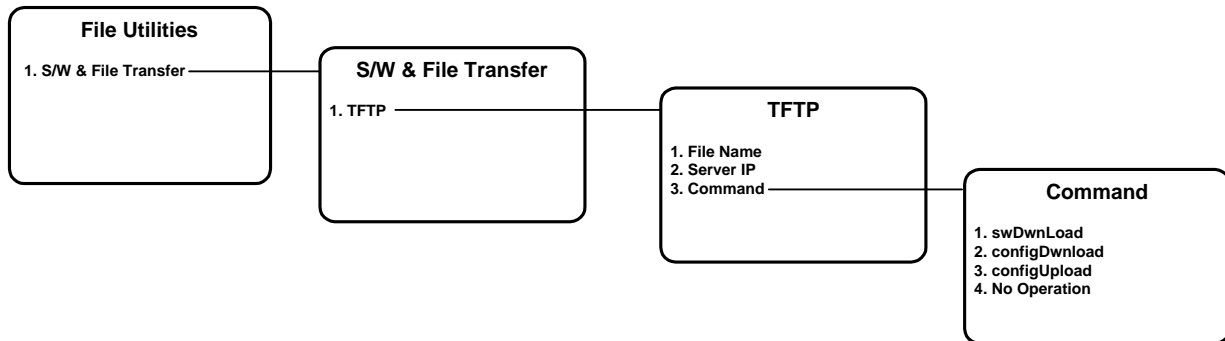
*Figure 5-136. **File Utilities** Menu Structure*

S/W & File Transfer Screen

Purpose

Use TFTP to perform the following operations:

• Download software to the FCD-155. This is usually performed by downloading from a host connected to the MNG, or to the ETH 1 or ETH 2 LAN port. You can also download from a remote location that provides an IP communication path to one of these FCD-155 LAN ports.

For detailed software downloading instructions, refer to *Appendix B*.

• Download a configuration parameters file to the FCD-155.

• Upload the configuration parameters file of the local FCD-155.

Reached from

File Utilities

A typical **S/W & File Transfer** screen is shown in *Figure 5-137*.

```
                             FCD-155
File Utilities>S/W & File Transfer

 1. TFTP                                >

>

File Transfer operations

ESC-prev.menu; !-main menu; &-exit; @-Output                            1M/1C
----------------------------------------------------------------------------

```

*Figure 5-137. Typical **S/W & File Transfer** Screen*

➤ **To start a TFTP transfer:**

1. Type **1** and then press **‹Enter›**.

2. You will see the **TFTP** screen. A typical **TFTP** screen is shown in *Figure 5-138*.

3. Define the parameters needed for the TFTP transfer:

   ▪ Type **1** and then press **‹Enter›**. Enter the name of the desired software distribution file (make sure to include the path, when necessary). When done, press **‹Enter›** to continue.

   ▪ Type **2** and then press **‹Enter›**. Enter the IP address of the server that will download the software distribution file (use the dotted quad format), and then **‹Enter›** to continue.

```
                              FCD-155
File Utilities>S/W & File Transfer>TFTP

 1. File Name                      ... ()
 2. Server IP                      ... (0.0.0.0)
 3. Command                        >

>

TFTP operations

ESC-prev.menu; !-main menu; &-exit; @-Output                      1M/1C
-------------------------------------------------------------------------
```

*Figure 5-138. Typical **TFTP** Screen*

4. When ready, type **3** and then press **‹Enter›**. You will see the **Command** screen. A typical **Command** screen is shown in *Figure 5-139*.

```
                              FCD-155
File Utilities>S/W & File Transfer>TFTP>Command

 1. swDwnLoad
 2. swDwnLoad W/O Reboot
 3. configDwnLoad
 4. configUpLoad
 5. No Operation

>

Please select item <1 to 4>

ESC-prev.menu; !-main menu; &-exit; @-output                      1M/1C
-------------------------------------------------------------------------
```

*Figure 5-139. Typical **Command** Screen*

5. Select the desired command by typing its number. The available selections are as follows:

swDwnLoad	Download a software distribution file from the specified TFTP server to the FCD-155. FCD-155 is automatically reset after software downloading is successfully completed, and therefore the new software is immediately activated.
swDwnLoad W/O Reboot	Download a software distribution file from the specified TFTP server to the FCD-155, but delay the activation of the new software, by disabling the automatic reboot after software downloading is successfully completed. In this case, the activation occurs when you reset the FCD-155, or when the FCD-155 is turned OFF and then back ON
configDwnLoad	Download a configuration parameters file from the specified TFTP server to the FCD-155.
configupLoad	Upload the current configuration parameters file of the FCD-155 to the specified TFTP server.
No Operation	No operation – only closes the **Command** screen.

6. When ready to start the transfer, press ‹**Enter**›.

7. If no errors are detected, the downloading process starts, and the screen displays its relative progress.

8. After the transfer is successfully completed, the FCD-155 is automatically reset (if you selected **2: swDwnLoad W/O Reboot**, you must manually reset, or turn the FCD-155OFF and back ON when you are ready.) After the resetting is successfully completed, you will see the FCD-155 log in screen again.

5.18   Displaying Inventory

Purpose

Displays information on the FCD-155 software and hardware versions, and logistics data on its subsystems.

The information displayed on the **Inventory** screen cannot be modified.

➤ **To display the Inventory screen:**

Type 1 on the main menu and then press ‹**Enter**›.

A typical **Inventory** screen is shown in *Figure 5-140*.

```
                          FCD-155E/2U/28T1/APS
Inventory


        Description                    Software Rev     Hardware Rev
     1 Chassis                         4.00             1.0
     2 FAN Module
|    3 PowerSupply1 150W AC
v    4 PowerSupply2 150W AC
     5 Link 1 LC 13s
     6 Link 2 LC 13s
     7 Ethernet Port1
      ->>


>


ESC-prev.menu; !-main menu; &-exit; @-output; ?-help               1M/1C
-------------------------------------------------------------------------
```

*Figure 5-140. Typical **Inventory** Screen (FCD-155)*

The screen presents the list of the main components installed in the FCD-155 unit. For the main assembly (item 1 – **Chassis**), you can also read the software and hardware versions.

The screen has many additional fields, which can be displayed by scrolling to the right. The additional fields present logistics data, which may be needed by RAD technical support personnel when servicing the unit.

You can learn the keys used for navigation on this screen by typing **?** to display the help screen (a typical help screen is shown *Figure 5-141*).

The keys displayed on the screen depend on the position of the cursor within the screen at the time you asked for help: you will see only keys that can be used at that particular instant. To see all the supported keys, move the cursor to a cell in the middle of the Inventory table.

While the help screen is displayed, pressing any key returns you to the **Inventory** screen.

Note   *The navigation keys appearing on the **Inventory** help screen are standard navigation keys within tables, and therefore have similar functions on all the screens including tables.*

```
Table Hot Keys

^L - scroll left       Left Arrow - move left
^R - scroll right      Right Arrow - move right
Up Arrow - move up
^D - scroll down       Down Arrow - move down
TAB - select next changeable cell
G  <row number>,<col number> - go to cell

Press any key ...                                                  1M/1C
-------------------------------------------------------------------------
```

*Figure 5-141. Typical **Inventory Help** Screen*

Chapter 6

Configuring Typical Applications

This chapter provides configuration guidelines and typical configuration examples for FCD-155 systems. It is assumed that you are familiar with FCD-155 management, as described in *Chapter 4*.

6.1 Outline of Configuration Procedure

This section presents the steps needed to configure a new FCD-155.

Preliminary Configuration

The purpose of preliminary configuration is to enable management access by management stations, for example, RADview, Telnet hosts and Web browsers.

Step	Action	Using
1	Perform quick setup	Configuration›Quick Setup
2	Configure CONTROL port communication parameters and the desired terminal type	Configuration›System›Control Ports *or* Configuration›System›Control Ports›Serial Port Configuration›System›Control Ports›Terminal
3	Configure management authorizations for FCD-155	Configuration›System›Control Ports ›Terminal› Change Password
4	Configure FCD-155 management agent	Configuration›System›Management›Host IP
5	Configure FCD-155 management access	Configuration›System›Management›Management Access
6	Configure specific management stations (optional)	Configuration›System›Management›Manager List
7	Set FCD-155 real-time clock (optional)	Configuration›System›Date & Time Update
8	Define FCD-155 logistics information	Configuration›System›Management›Device Info

For additional instructions, refer to *Chapter 4* and to the appropriate section of *Chapter 5*.

Configuration of Transmission Characteristics

The purpose of transmission parameters configuration is to configure the services provided by the FCD-155. Skip steps not relevant to your FCD-155 version and/or to its application mode in your network.

Step	Action	Using
1	Reload the factory-default parameters.	**Configuration›System›Factory Default**
2	Use quick setup to define FCD-155 main characteristics. Skip configuration of parameters that you intend to configure manually, e.g., the number of ports to be enabled. If DHCP is used for management IP address assignment, use Step 4	**Configuration›Quick Setup**
3	Configure the out-of-band management ports: • Configure CONTROL port communication parameters and supervisory terminal options • For FCD-155E: configure the Ethernet MNG port, when supported	**Configuration›System›Control Ports** *or* **Configuration›System›Control Ports›Serial Port** **Configuration›System›Control Ports›Terminal** **Configuration›System›Control Ports›ETH**
4	Configure the additional FCD-155 management agent parameters	**Configuration›System›Management›Host IP**
5	Configure FCD-155 management access	**Configuration›System›Management›Management Access**
6	Configure specific management stations	**Configuration›System›Management›Manager List**
7	Set FCD-155 real-time clock	**Configuration›System›Date & Time Update**
8	Define FCD-155 logistics information	**Configuration›System›Management›Device Info**
9	Configure FCD-155E station clock port, when in use	**Configuration›Physical Ports›Station Clock**
10	Configure FCD-155 STM-1 or OC-3 physical ports: • Configure port parameters. For the FCD-155E, you must configure separate parameters for each link • Configure the timing mode for the SDH/SONET subsystem • Configure the DCC parameters, to enable inband management via DCC. For the FCD-155E, you must configure separate parameters for each link For FCD-155E only: Configure the protection type, and the protection parameters	**Configuration›Physical Ports›STM-1** or **OC-3›** **Configuration›Physical Ports›STM-1** or **OC-3›Link 1** and/or **Link 2** **Configuration›Physical Ports›STM-1** or **OC-3›Clock Parameters** **Configuration›Physical Ports›STM-1** or **OC-3›DCC Configuration** **Configuration›Physical Ports›STM-1** or **OC-3›Link 1** and/or **Link 2›DCC Configuration** **Configuration›Physical Ports›STM-1** or **OC-3 ›APS›Protection** **Configuration›Physical Ports›STM-1** or **OC-3›APS**
11	Configure FCD-155 physical LAN ports	**Configuration›Physical Ports›LAN** *or* **Configuration›Physical Ports›Ethernet**

Step	Action	Using
12	Configure FCD-155 physical PDH ports: • Configure the common parameters • Configure the individual port parameters (at this stage, you can also enable/disable ports configured by means of the **Quick Setup** screen)	**Configuration › Physical Ports › PDH › Common Parameters** **Configuration › Physical Ports › PDH › Port Parameters**
	Configure FCD-155E physical PDH ports: • Configure the common parameters • Configure the individual port parameters (at this stage, you can also enable/disable ports configured by means of the **Quick Setup** screen)	**Configuration › Physical Ports › E1/T1** or **E3/T3 › Common Parameters** **Configuration › Physical Ports › E1/T1** or **E3/T3 › Port Parameters**
13	When using PDH ports as timing reference, configure FCD-155 system timing (not supported by FCD-155E): • Main (master) timing source • Fallback timing source	 **Configuration › Physical Ports › STM-1** or **OC-3 › Master Timing Source** and **Master Rx Clock** **Configuration › Physical Ports › STM-1** or **OC-3 › Fallback Timing Source** and **Fallback Rx Clock**
14	Configure FCD-155 virtual STM-1 or STS-3 port	**Configuration › Virtual Ports › STM-1** or **STS-3**
15	Configure FCD-155 virtual concatenation groups	**Configuration › Virtual Ports › VCAT › VCG 1** to **VCG 8,** or **All VCG**
16	Configure FCD-155 GFP multiplexing (when function is used)	**Configuration › Virtual Ports › VCAT › GFP Mux** (type **a** to add a new GFP mux)
17	Perform mapping: • For FCD-155E: select the link on which mapping will be performed • Map the virtually concatenated groups not processed by any GFP mux • Map the primary group of the defined GFP mux • Map active PDH ports (option), and disconnect unused VCs/VTs • For FCD-155E: map protection ports for the active virtually concatenated groups and PDH ports • For FCD-155E: map the cross-connections (bypass) between the two links	**Configuration › System › Mapping › Link 1** or **Link 2** **Configuration › System › Mapping › Link x** (select defined **VCG** entities) **Configuration › System › Mapping ›** (select defined **VCG** entities) **Configuration › System › Mapping › Link x** (select **VCG** defined as primary group of the defined GFP mux) **Configuration › System › Mapping** (select **VCG** defined as primary group of the defined GFP mux) **Configuration › System › Mapping › Link x** (select **None** for each unused VC/VT) **Configuration › System › Mapping** (select **None** for each unused VC/VT) **Configuration › System › Mapping › Link x** (select **None** for each unused VC/VT) **Configuration › System › Mapping › Link x** (select **None** for each unused VC/VT)
18	Configure general bridge characteristics	**Configuration › Applications › Bridge**

Step	Action	Using
19	Configure general bridge STP parameters, when STP or RSTP is enabledused	**Configuration›Applications›Bridge›Spanning Tree Protocol**
20	Configure bridge port characteristics and associated STP parameters	**Configuration›Applications›Bridge›Bridge Port**
21	Configure port-based VLANs in accordance with system requirements (only when the FCD-155 does not include the GbE option)	**Configuration›Applications›Bridge›Port Membership›**
22	Configure general QoS parameters	**Configuration›Applications›QoS**
23	Configure per-port QoS parameters	**Configuration›Applications›QoS›Port Mapping**
24	Configure layer 2 QoS (priority) parameters	**Configuration›Applications›QoS›Layer 2 Mapping**
25	Configure layer 3 QoS (DSCP/ToS) parameters	**Configuration›Applications›QoS›Layer 3 Mapping**
26	Configure link aggregation in accordance with system requirements:	
	• Select a link aggregation (trunk) ID	**Configuration›Applications›Link Aggregation,** and press **F** or **B** to scroll to the desired ID
	• Configure the LAN ports, or VCG ports, included in this trunk	**Configuration›Applications›Link Aggregation›LAN Ports** or **VCG Ports**
27	Save the updated database	Type **#** and confirm. If errors are reported, use the **Monitoring›Display Sanity Errors and Warnings** screen to collect the error information, and then refer to *Chapter 7* for explanations and corrective measures

6.2   Configuring a Typical Application

Overview

This section presents the configuration steps needed to configure the FCD-155 for use in a typical application. The FCD-155 unit used in this example is a single-link FCD-155 with 2 LAN interfaces, and 4 E1/T1 G.703 PDH interfaces.

The system configuration required by this application, which uses both the LAN and PDH interfaces, is described in *Figure 6-1.*
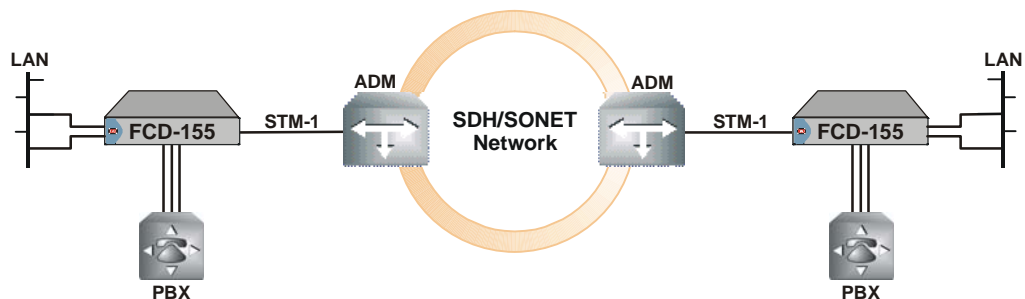
Figure 6-1. FCD-155 Application Example

The main application requirements are as follows:

- Transport four E1 trunks over the SDH network.

- Transport the traffic from two LAN ports configured as a trunk over the SDH network, using GFP encapsulation.

- Lock the FCD-155 master timing to the clock recovered from the SDH network line signal.

Before Starting

To avoid problems that may be caused by previous configurations still stored in the FCD-155, reload the factory-default configuration using the **Configuration›System›Factory Default**, and then activate the default configuration using the **#** (save) command.

Preliminary Configuration

After loading the factory defaults, the supervision terminal can be used to configure the FCD-155.

Use the default supervision terminal parameters: **115.2 kbps, one start bit, eight data bits, no parity,** and **one stop bit**. Select **VT-100 emulation**, the **full-duplex** mode, **echo off**, and **disable any type of flow control**.

If more information on this preliminary configuration are needed, you can find detailed instructions in *Section 3.2*.

Rapid Configuration Using the Quick Setup Screen

The **Quick Setup** screen is used to configure three types of parameters:

- FCD-155 management IP address (mandatory). This address can also be defined or modified by means of the **Configuration›System›Management›Host IP** screen.

- Number of active ports of each type (mandatory).

- Set of virtually concatenated groups using low-order VCs/VTs (optional).

Configuring ports by means of the **Quick Setup** screen has the advantage that the ports are automatically enabled (their **Admin Status** is set to **Enable**) and they are also automatically mapped within the SDH frame of link 1 in accordance with the factory defaults.

Reaching the Quick Setup Screen

The **Quick Setup** screen is reached as illustrated in *Figure 6-2*.

```
                              FCD-155/2U/4E1
Main Menu

 1. Inventory       >
 2. Configuration  >
 3. Monitoring      >
 4. Diagnostics     >
 5. File Utilities >


>
Please select item <1 to 5>2


ESC-prev.menu; !-main menu; &-exit; @-output                           1M/1C
-----------------------------------------------------------------------------
```

A. Step 1

```
                              FCD-155/2U/4E1
Configuration

 1. Quick Setup          >
 2. System               >
 3. Physical Ports       >
 4. Virtual Ports        >
 5. Applications         >
 6. Select configuration>   (Off Line)


>


ESC-prev.menu; !-main menu; &-exit; @-output                           1M/1C
-----------------------------------------------------------------------------
```

B. Step 2

Figure 6-2. Reaching the Quick Setup Screen

Configure FCD-155 by Means of Quick Setup Screen

A typical **Quick Setup** screen with default values for an FCD-155 using the SDH network interface is shown below.

Note

- *Since this FCD-155 has 4 E1 interfaces, the **Quick Setup** screen includes the **Number of External PDH Ports** field (this field is displayed only if the FCD-155 is equipped with E1 or T1 PDH interfaces).*

- *For an FCD-155 with a single Ethernet port, the **Quick Setup** screen includes only items 1, 2, 3 and 5.*

The **Quick Setup** screen for an FCD-155 using the SONET network interface is similar, except that item **5** is **Number of VT1.5s per Group**, and the allowed range is up to 64.

```
                              FCD-155/2U/4E1
Configuration>Quick Setup

 1. Set Host IP address           ... (0.0.0.0)
 2. Set Subnet Mask               ... (0.0.0.0)
 3. Set Default Gateway           ... (0.0.0.0)
 4. Number of External LAN Ports [1 - 2]... (2)
 5. Number of External PDH Ports [1 - 4]... (0)
 6. Number of Virtual Groups     [1 - 2]... (0)
 7. Number of VC12's per Group   [0 - 63]... (0)
 8. Encapsulation                 >   (GFP)

>


ESC-prev.menu; !-main menu; &-exit; @-output                       1M/1C
-------------------------------------------------------------------------
```

*Figure 6-3. Typical **Quick Setup** Screen*

➤ **Configure a parameter on the Quick Setup screen:**

1. Select the corresponding item by typing its number.

2. Press **‹Enter›**.

    You can then type the desired value in the same line.

3. To confirm your entry, press **‹Enter›.**

➤ **Configure the FCD-155 management IP address:**

1. Select item **1: Set Host IP** address.

2. Enter the IP address of the FCD-155 management agent, in the dotted quad format.

3. Press **‹Enter›**.

4. Select item **2: Set Subnet Mask.**

5. Enter the subnet mask to be used by the FCD-155 management agent.

6. Press **‹Enter›**.

7. If a default gateway is used, select item **3: Set Default Gateway**. Otherwise, use the default value, **0.0.0.0**.

8. Enter the prescribed IP address of the default gateway.

9. Press **‹Enter›**.

```
                          FCD-155/2U/4E1
Configuration>Quick Setup

 1. Set Host IP address          ... (172.17.191.131)
 2. Set Subnet Mask              ... (255.255.255.0)
 3. Set Default Gateway          ... (172.17.191.1)
 4. Number of External LAN Ports [1 - 2]... (2)
 5. Number of External PDH Ports [1 - 4]... (0)
 6. Number of Virtual Groups     [1 - 4]... (0)
 7. Number of VC12's per Group   [0 - 63]... (0)
 8. Encapsulation                >   (GFP)

>


ESC-prev.menu; !-main menu; &-exit; @-output                        1M/1C
-------------------------------------------------------------------------
```

➤ **Configure the number of external PDH ports:**

When using an FCD-155 with PDH interfaces, always start by defining the number of active PDH E1 interfaces. Each active E1 PDH interface requires one VC-12 in the STM-1 frame.

1. Select item 5: Number of External PDH Ports.

2. Change the number to four external PDH ports, and then press ‹Enter›.

```
                          FCD-155/2U/4E1
Configuration>Quick Setup

 1. Set Host IP address          ... (172.17.191.131)
 2. Set Subnet Mask              ... (255.255.255.0)
 3. Set Default Gateway          ... (172.17.191.1)
 4. Number of External LAN Ports [1 - 2]... (2)
 5. Number of External PDH Ports [1 - 4]... (4)
 6. Number of Virtual Groups     [1 - 8]... (0)
 7. Number of VC12's per Group   [0 - 63]... (0)
 8. Encapsulation                >   (GFP)

>


ESC-prev.menu; !-main menu; &-exit; @-output                        1M/1C
-------------------------------------------------------------------------
```

Note   *Each time you press ‹Enter›, FCD-155 checks your selection. If it is not correct, it is rejected (the previous value remains unchanged) and you see the ERROR indicator in the top right-hand corner.*

➤ **Configure the number of external LAN ports:**

1. Select item 4: Number of External LAN Ports.

2. Define two LAN ports, and then press ‹Enter›.

```
                          FCD-155/2U/4E1
Configuration>Quick Setup

 1. Set Host IP address          ... (172.17.191.131)
 2. Set Subnet Mask              ... (255.255.255.0)
 3. Set Default Gateway          ... (172.17.191.1)
 4. Number of External LAN Ports [1 - 2]... (2)
 5. Number of External PDH Ports [1 - 4]... (4)
 6. Number of Virtual Groups     [1 - 4]... (0)
 7. Number of VC12's per Group   [0 - 63]... (0)
 8. Encapsulation                >   (GFP)

>


ESC-prev.menu; !-main menu; &-exit; @-output                       1M/1C
-------------------------------------------------------------------------------
```

➤ **Configure the number of virtual groups:**

1. Select item 6: Number of Virtual Groups.

2. In this example, two virtual concatenation groups will be used, with link aggregation to form a trunk. Enter **2** and then press ‹**Enter**›.

```
                          FCD-155/2U/4E1
Configuration>Quick Setup

 1. Set Host IP address          ... (172.17.191.131)
 2. Set Subnet Mask              ... (255.255.255.0)
 3. Set Default Gateway          ... (172.17.191.1)
 4. Number of External LAN Ports [1 - 6]... (2)
 5. Number of External PDH Ports [1 - 4]... (4)
 6. Number of Virtual Groups     [1 - 4]... (2)
 7. Number of VC12's per Group   [0 - 63]... (0)
 8. Encapsulation                >   (GFP)



>

ESC-prev.menu; !-main menu; &-exit; @-output                       1M/1C
-------------------------------------------------------------------------------
```

➤ **Configure the number of VC12's per Group:**

1. Select item 7: Number of VC12's per Group.

2. Define 25 VC-12s (sufficient for an average LAN traffic load of 50 Mbps), and then press ‹**Enter**›.

```
                             FCD-155/2U/4E1
Configuration>Quick Setup

 1. Set Host IP address          ... (172.17.191.131)
 2. Set Subnet Mask              ... (255.255.255.0)
 3. Set Default Gateway          ... (172.17.191.1)
 4. Number of External LAN Ports [1 - 6]... (2)
 5. Number of External PDH Ports [1 - 4]... (4)
 6. Number of Virtual Groups     [1 - 8]... (2)
 7. Number of VC12's per Group   [0 - 63]... (25)
 8. Encapsulation                >   (GFP)

>


ESC-prev.menu; !-main menu; &-exit; @-output                          1M/1C
--------------------------------------------------------------------------------
```

> ➤ **To save and activate the new configuration:**

> 1. Type **#**.

> 2. You will be requested to confirm: type **y** to confirm the action.

> You need not change the **Encapsulation** mode, and the framing type.

Configuring the "Long Way"

As an alternative to the configuration activities performed by means of the **Quick Setup** screen, you can select the various parameters using the specific screen (reached under the **Configuration** menu) for each parameter. This approach permits better control over some parameters, and can also be used to modify existing configurations and expand applications.

> ➤ **Configure a virtually concatenated group:**

> 1. Select item 4: Virtual Ports.

```
                             FCD-155/2U/4E1
Configuration

 1. Quick Setup           >
 2. System                >
 3. Physical Ports        >
 4. Virtual Ports         >
 5. Applications          >
 6. Select configuration>    (Off Line)

>


ESC-prev.menu; !-main menu; &-exit; @-output                          1M/1C
--------------------------------------------------------------------------------
```

2. Select item **2: VCAT**.

```
                        FCD-155/2U/4E1
Configuration>Virtual Ports

 1. STM-1                    >
 2. VCAT>


>


ESC-prev.menu; !-main menu; &-exit; @-output                        1M/1C
-----------------------------------------------------------------------------
```

3. Select the number of virtually concatenated group to be created, for example, select **VCG 1**.

```
                        FCD-155/2U/4E1
Configuration>Virtual Ports>VCAT

 1. VCG 1    >
 2. VCG 2    >
 3. VCG 3    >
 4. VCG 4    >
 5. VCG 5    >
 6. VCG 6    >
 7. VCG 7    >
 8. VCG 8    >
 9. All VCGs>
10. GFP Mux   []>


>


ESC-prev.menu; !-main menu; &-exit; @-output                        1M/1C
-----------------------------------------------------------------------------
```

4. Change the status of the group to **Enable**.

5. Assign 25 VC12s to the group using item **2: VC type** and item **4: Number of VCs**.

6. Change any additional parameters in accordance with the requirements, for example, assign a name to the VCG.

   The default VC parameters and the default GFP mux configuration are suitable for most applications.

7. Repeat the procedure for **VCG2**.

```
                        FCD-155/2U/4E1
Configuration>Virtual Ports>VCAT>VCG 1

 1. Admin Status            (Enable)
 2. VC type           >    (VC12)
 3. LCAS                   (No)
 4. Number of VCs      [1 - 63]... (25)
 5. Encapsulation      >    (GFP)
 6. GFP Channel ID     [0 - ff]... (0)
 7. Max Differential Delay[10 - 64]... (64)
 8. VCG ID             >    (1)
 9. VCG Name           ... ()
10. VC Configuration   >
11. GFP Configuration  >

>


ESC-prev.menu; !-main menu; &-exit; @-output                    1M/1C
--------------------------------------------------------------------------
```

➤ **Configure the number of external PDH ports:**

1. On the Configuration menu select item 3: Physical Ports.

```
                        FCD-155/2U/4E1
Configuration

 1. Quick Setup          >
 2. System               >
 3. Physical Ports       >
 4. Virtual Ports        >
 5. Applications         >
 6. Select configuration>   (Off Line)

>


ESC-prev.menu; !-main menu; &-exit; @-output                    1M/1C
--------------------------------------------------------------------------
```

2. On the **Physical Ports** screen, select item **3: PDH**.

```
                        FCD-155/2U/4E1
Configuration>Physical Ports

 1. STM-1     >
 2. LAN       >
 3. PDH       >

>


ESC-prev.menu; !-main menu; &-exit; @-output                    1M/1C
--------------------------------------------------------------------------
```

3. On the **PDH** screen, select **Common Parameters.**

4. On the **Common Parameters** screen, select **Interface Parameters**: you can now select the line interface, balanced or unbalanced.

```
                            FCD-155/2U
Configuration>Physical Ports>PDH>Common Parameters


 1. VC Configuration      >
 2. Interface Parameters >

>


ESC-prev.menu; !-main menu; &-exit; @-output                        1M/1C
----------------------------------------------------------------------------
```

5. The **VC Configuration** parameters are suitable for most applications, therefore you can return to the **PDH** screen, and select **Port Parameters.** Now select the first port, **PDH1**.

```
FCD-155/2U/4E1
Configuration>Physical Ports>PDH


 1. Port1     >
 2. Port2     >
 3. Port3     >
 4. Port4     >
 5. All Ports>

>


ESC-prev.menu; !-main menu; &-exit; @-output                        1M/1C
----------------------------------------------------------------------------
```

6. Change the **Admin Status** of the port to **Enable;** for long lines, select **Long Haul** for the **Rx Gain.**

```
                            FCD-155/2U/4E1
Configuration>Physical Ports>PDH>Port 1

    LIU Usage(E1/T1)            >    (E1)
 1. Admin Status                     (Enable)
 2. Rx Clock Selection          >    (SDH)
 3. Rx Gain                     >    (Short Haul)
 4. Port Name                   ... ()
 5. VC configuration            >

>


ESC-prev.menu; !-main menu; &-exit; @-output                        1M/1C
----------------------------------------------------------------------------
```

7. The **VC Configuration** parameters are suitable for most applications, therefore return to the **PDH** screen, and repeat the previous Steps for the other three ports.

➤ **To assign VC-12s to group 1 and external PDH ports:**

1. On the **Configuration** screen, select item **2: System**.

```
                              FCD-155/2U/4E1
Configuration

 1. Quick Setup           >
 2. System                >
 3. Physical Ports        >
 4. Virtual Ports         >
 5. Applications          >
 6. Select configuration>    (Off Line)


>


ESC-prev.menu; !-main menu; &-exit; @-output                              1M/1C
-----------------------------------------------------------------------------
```

2. On the **System** menu, select item **1: Mapping**.

```
                              FCD-155/2U/4E1
Configuration>System

 1. Mapping              []>
 2. Management           >
 3. Control Ports        >
 4. Date & Time Update>
 5. Factory Default
 6. Reset Device


>


ESC-prev.menu; !-main menu; &-exit; @-output                              1M/1C
-----------------------------------------------------------------------------
```

3. You must select first the link (**Link 1** or **Link 2**) on which you want to map. In this case, select **Link 1.**

Note   In general, always use **Link 1**. For FCD-155E with two links, you cannot activate any type of protection when payload is mapped to the protection link: therefore, make sure that nothing is mapped on **Link 2**.

For FCD-155E, when protection is **None**, you can map the payload to any of the two links.

4. Assign VC-12s to the **VCG1** and **VCG2** (may appear as **VCG1** and **VCG2** on some software versions), and to the external ports (**Ex1** to **Ex4**) by moving the cursor to the desired VC-12s and then typing the number corresponding to its payload.

Note that after **Quick Setup**, the payload is already mapped. The following screen shows the default mapping.

```
                            FCD-155/2U/4E1
Configuration>System>Mapping


              TUG3 1                 TUG3 2                 TUG3 3
         TU1   TU2   TU3        TU1   TU2   TU3        TU1   TU2   TU3
 TUG2-1 VCG1  VCG1  VCG1       VCG1  VCG1  VCG1       VCG2  VCG2  VCG2
 TUG2-2 VCG1  VCG1  VCG1       VCG1  VCG2  VCG2       VCG2  VCG2  VCG2
 TUG2-3 VCG1  VCG1  VCG1       VCG2  VCG2  VCG2       VCG2  VCG2  Ex1
 TUG2-4 VCG1  VCG1  VCG1       VCG2  VCG2  VCG2       Ex2   Ex3   Ex4
 TUG2-5 VCG1  VCG1  VCG1       VCG2  VCG2  VCG2       None  None  None
 TUG2-6 VCG1  VCG1  VCG1       VCG2  VCG2  VCG2       None  None  None
 TUG2-7 VCG1  VCG1  VCG1       VCG2  VCG2  VCG2       None  None  None


 1. VCG1    3. Ex1     5. Ex3     7. None
 2. VCG2    4. Ex2     6. Ex4

>


# - Save; % - Undo
ESC-prev.menu; !-main menu; &-exit; @-output; ?-help                    1M/1C
-------------------------------------------------------------------------------
```

➤   **Configure the Bridge Parameters:**

1.   Open the Configuration ›Applications menu.

```
                            FCD-155/2U/4E1
Configuration>Applications

 1. Bridge           >
 2. Qos              >
 3. Link Aggregation >

>


# - Save; % - Undo
ESC-prev.menu; !-main menu; &-exit; @-output                            1M/1C
-------------------------------------------------------------------------------
```

2.   Select **Bridge**.

3.   To use link aggregation, select **Unaware** for the **VLAN Mode**. You may also
     adjust the **Aging Time** and **Scheduling Mode** if your application has special
     requirements.

```
                                FCD-155/2U/4E1
Configuration>Applications>Bridge

 1. VLAN Mode                      >    (Unaware)
 2. Aging Time (Seconds)[16 - 4... (300)
 3. Scheduling Mode                >    (WFQ)
 4. Bridge Port                    >
 5. Port Membership                >
 6. MAC Table                      >
 7. Spanning Tree Protocol         >
 8. Loop Detection VLAN ID[1-4094] > (4091)

>


# - Save; % - Undo
ESC-prev.menu; !-main menu; &-exit; @-output                      1M/1C
-------------------------------------------------------------------------------
```

4. Now configure the **Bridge Port** parameters for four ports. You need four ports to be active (**Enable**) in this application: two ports for LAN port 1 and LAN port 2, and two ports for VCG 1 and VCG 2. For each port, you may also want to enable STP.

    For this purpose, sequentially select **Bridge Port** four times, and configure the required parameters for the four ports. The following screen shows the parameters for **Bridge Port 1.**

```
                                FCD-155/2U/4E1
Configuration>Applications>Bridge >Bridge Port

    Port State                  >    (N/A)
 1. Bridge Port                 >    (Port 1)
 2. STP Mode                    >    (Enable)

>


# - Save; % - Undo
ESC-prev.menu; !-main menu; &-exit; @-output                      1M/1C
-------------------------------------------------------------------------------
```

5. The next step is to define a port-based VLAN including the four ports: select **Port Membership** on the **Bridge** screen, and then type **a** to add a new VLAN (you may also edit an existing but unused VLAN: to scroll, type **f** or **b**).

    ▪ You can assign any desired name to the VLAN.

    ▪ Select **2: Egress LAN Ports** to display the LAN port selection screen.

    ▪ Type **a** twice to add blank rows for two LAN ports: in the first select LAN port 1, and in the second – LAN port 2. When done, type **4: Save All** and then press **‹Enter›.** The new definition appears on the **Port Membership** screen.

    ▪ Select **3: Egress VCG Ports** and repeat the procedure for VCG1 and VCG2. The final configuration is shown below.

```
                              FCD-155/2U                                          ALRM
Configuration>Applications>Bridge>Port Membership

 1. Name                  ... (VlanPort1)
 2. Egress LAN Ports      >   (1,2)
 3. Egress VCG Ports      >   (1,2)
 4. Internal Management       (Yes)

>

# - Save; % - Undo; A - add; D - del; B - back; F - forw

ESC-prev.menu; !-main menu; &-exit; @-output                              1M/1C
-----------------------------------------------------------------------------
```

6. Configure the link aggegation: select **Link Aggregation** on the **Applications** menu.

```
                              FCD-155/2U/4E1
Configuration>Applications>Link Aggregation

    LAG ID     ... (1)
 1. LAN Ports >   (-)
 2. VCG Ports >   (-)

>

# - Save; % - Undo; B - back; F - forw
ESC-prev.menu; !-main menu; &-exit; @-output                              1M/1C
-----------------------------------------------------------------------------
```

7. The next step is to define two trunks, one including the two LAN ports, and another the VCG1 and VCG2 ports. Note the **LAG ID** at the top of the screen: there are 8 identifiers, and the first one is selected.

   ▪ Note the **LAG ID** at the top of the screen: there are 8 identifiers, and the first one is selected. If necessary, change the number by pressing **f** or **b**.

   ▪ After the correct **LAG ID** is displayed, select **1: LAN Ports** to display the LAN port selection screen.

   ▪ Type **a** twice to add blank rows for two LAN ports: in the first select LAN port 1, and in the second – LAN port 2. When done, type **4: Save All** and then press **‹Enter›.** The new definition appears on the **Link Aggregation** screen.

```
                          FCD-155/2U/4E1
Configuration>Applications>Link Aggregation


    LAG ID    ... (1)
 1. LAN Ports >   (1,2)
 2. VCG Ports >   (-)

>


# - Save; % - Undo; B - back; F - forw
ESC-prev.menu; !-main menu; &-exit; @-output                      1M/1C
-----------------------------------------------------------------------
```

- Now select a different **LAG ID**, and then repeat the procedure for VCG1 and VCG2. The final configuration is shown below.

```
                          FCD-155/2U/4E1
Configuration>Applications>Link Aggregation


    LAG ID    ... (2)
 1. LAN Ports >   (-)
 2. VCG Ports >   (1,2)

>


# - Save; % - Undo; B - back; F - forw
ESC-prev.menu; !-main menu; &-exit; @-output                      1M/1C
-----------------------------------------------------------------------
```

8. You may now want to configure specific QoS parameters. For this purpose, select **QoS** on the **Applications** menu.

9. The basic QoS parameters include the classification modes:

   - The default for the basic classification is **Per Port**; the alternative is **None**, which disables the functions.

   - The types of classifications are selected by means of the **Layer 2 Classification** (**None** or in accordance with the priority tag per ITU-T Rec. G.802.1q) and/or **Layer 3 Classification** (**None** or in accordance with the **DSCP** value per RFC791). When both **Layer 2 Classification** and **Layer 3 Classification** are enabled, the order in which the priority is determined is selected by means of the **Order** field: Layer 2 first (**L2&L3**) or Layer 3 first (**L3&L2**).

```
                            FCD-155/2U/4E1
Configuration>Applications>Qos

 1. Basic Classification   >    (Per Port)
 2. Layer 2 Classification >    (802.1p)
 3. Layer 3 Classification >    (DSCP)
 4. Order                  >    (L2&L3)
 5. Port Mapping           >
 6. Layer 2 Mapping        >
 7. Layer 3 Mapping        >

>


# - Save; % - Undo
ESC-prev.menu; !-main menu; &-exit; @-output                         1M/1C
-------------------------------------------------------------------------------
```

10. The additional QoS parameters are used as follows:

- **Port Mapping**: assign the egress traffic for each bridge port to one of the FCD-155 Ethernet switch egress queues, or traffic classes (a total of 2 queues for the GbE switch, and 4 queues for the basic Ethernet switch).

- **Layer 2 Mapping**: assign each 802.1q priority to a traffic class

- **Layer 3 Mapping**: assign each DSCP value to a traffic class.

➤ **Configure the FCD-155 management parameters:**

1. On the **Configuration** screen, select item **2: System**.

2. On the **System** screen, select item **2: Management**.

```
                            FCD-155/2U/4E1
Configuration>System>Management
 1. Mapping                [ ]>
 2. Management             >
 3. Control Ports          >
 4. Date & Time Update     >
 5. Factory Default
 6. Reset Device

>

ESC-prev.menu; !-main menu; &-exit; @-output                         1M/1C
-------------------------------------------------------------------------------
```

3. On the **Management** screen, select item **2: Host IP**.

```
                              FCD-155/2U/4E1
Configuration>System>Management

 1. Device Info        >
 2. Host IP            >
 3. Manager List    []>
 4. Management Access>

>

ESC-prev.menu; !-main menu; &-exit; @-output                                1M/1C
--------------------------------------------------------------------------
```

> 4. Define the parameters as explained in the preliminary configuration section of *Chapter 3*.

➤ **To save and activate the new configuration:**

- Type **#** and then type **y** to confirm the action.

Chapter 7

Troubleshooting and Diagnostics

This chapter describes the FCD-155 diagnostic functions. The diagnostic functions available on the FCD-155 include:

- Alarm and event collection

- Collection of performance monitoring data

- Diagnostic tests for checking transmission paths

- *Ping* for IP connectivity testing. For FCD-155E, *traceroute* is also supported

These functions can be used to identify problems in the network incorporating FCD-155 units, test the proper operation of each FCD-155 unit, and locate rapidly the cause of the fault: within the FCD-155 itself, in its connections to the network or to a user's equipment unit, or in the another network component.

If you need additional support for this product, see *Section 7.8* for technical support information.

7.1   Performance Monitoring

The FCD-155 enables collecting transmission performance data for its various ports. The collected data enables the system administrator to monitor the transmission performance, and thus the quality of service provided to users, for statistical purposes.

In addition, when problems are reported by users served by FCD-155, the collected data can be used for diagnostic purposes, because it can help identify the source of the problem.

Performance monitoring data are collected for the following objects:

- Physical ports: network (SDH or SONET) ports, DCC (when used), LAN ports and PDH ports.

- Virtual SDH/SONET ports: each VC-4 or STS-3, VC-3 or STS-1 and VC-11/VC-12 or VT-1.5 port, and each virtual concatenation group for LAN traffic.

The data is continuously collected during equipment operation.

For SDH/SONET and PDH ports, the basic performance data is calculated for each second, and accumulated and displayed over a 15-minute (900 second) interval. The data accumulated within the last 24-hour interval is also stored and displayed.

Monitoring Menu Structure

When using the supervisory terminal, the access to the performance monitoring functions is via the **Monitoring** menu.

Most of the monitoring functions are available in the same format on both the FCD-155E and FCD-155. Differences are usually due to the following:

1. For the FCD-155E , it is always necessary to select a specific network link (or virtual port associated with a specific link) before performing the desired action.

   Therefore, after selecting a type of ports on the main **Monitoring** screen, the next step is to select a network link or its virtual ports. This is made by an additional screen.

2. Functions supported only by the FCD-155E , for example, station clock, APS, etc. Such functions are described in separate screens.

Figure 7-1 to *Figure 7-5* show the structure of the **Monitoring** menu for the main FCD-155E and FCD-155 versions. Ignore menu options not relevant to your particular FCD-155 version.

Monitoring

1. System
2. Virtual Ports
3. Physical Ports

Active Alarms

Event Log

Display Sanity

System

MAC Address
1. Active Alarms
2. Event Log
3. Clear Event Log
4. Display Sanity
5. Remote Agents

Remote Agents

Port Status

Port Statistics

1. Current Interval
2. Select Interval
3. Total

VC-4

1. Port Status
2. Port Statistics

Port Status

Virtual Ports

1. Link 1
2. Link 2
3. VCAT

Link 1

1. VC-4
2. VC-3
3. VC-12

VC-3

1. Port Status
2. Port Statistics

Port Statistics

1. Current Interval
2. Select Interval
3. Total

Current Interval

Select Interval

Total

With T1 Ports

Link 1

1. VC-4
2. VC-3
3. VC-11/VC-12

VC-12 *or*
VC-11/VC-12

1. Port Status
2. Port Statistics

Port Status

Port Statistics

1. Current Interval
2. Select Interval
3. Total

VCAT

1. VCG 1
2. VCG 2
3. VCG 3
4. VCG 4
5. VCG 5
6. VCG 6
7. VCG 7
8. VCG 8

VCG 1 - 8

1. LAN Counters
2. Traffic Rate
3. WAN Intervals
4. LCAS Path Info

LAN Counters

Traffic Rate

WAN Intervals

1. Current Interval
2. Select Interval
3. Total

Current Interval

Select Interval

Total

LCAS Path Info

Physical Ports

1. STM-1
2. Ethernet
3. E1/T1   *or*   E3/T3
4. Station Clock
5. Timing

See
Part 2

Figure 7-1. **Monitoring** *Menu for FCD-155E (SDH Versions with PDH Ports) (Part 1 of 2)*
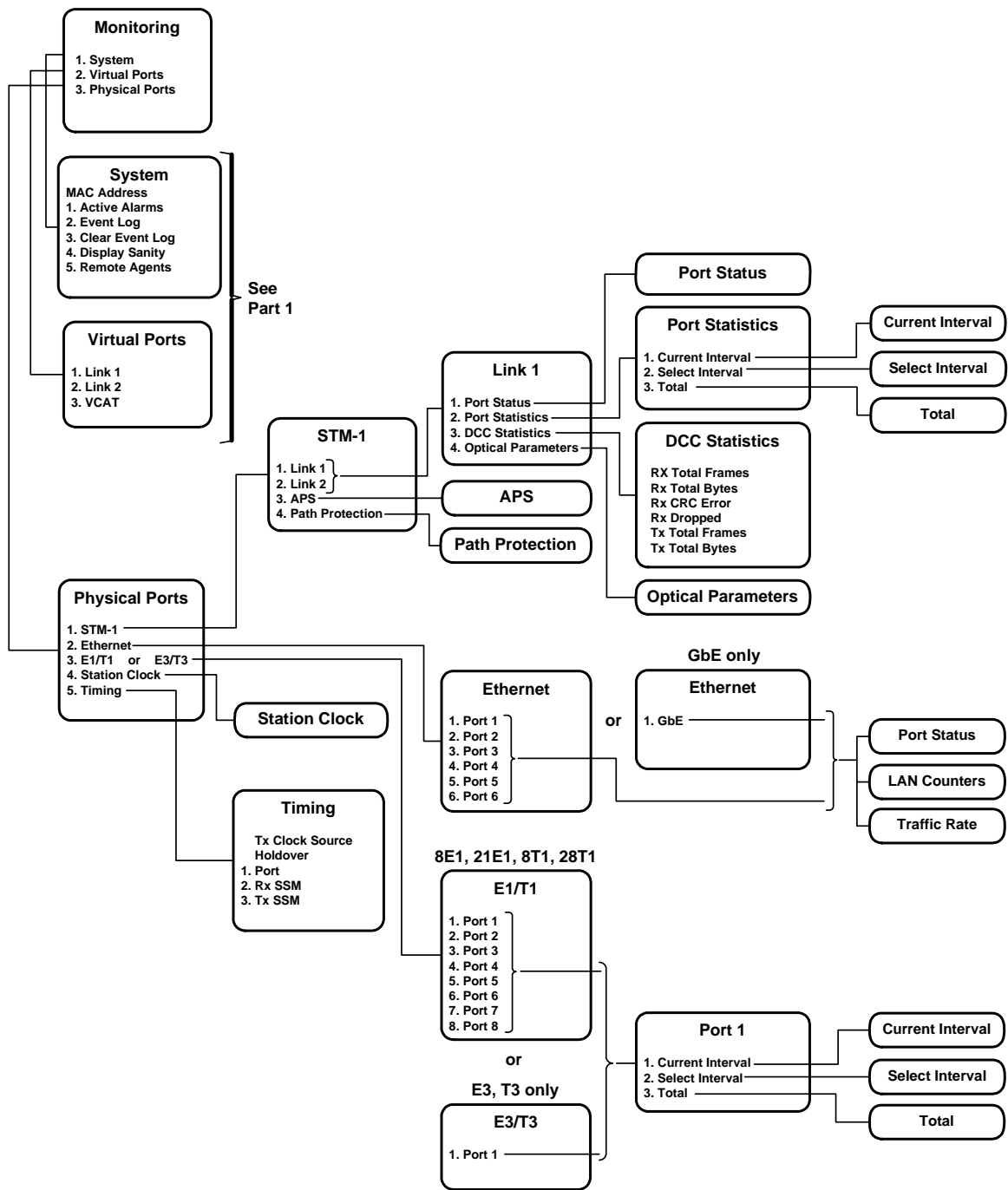
Figure 7-2. **Monitoring** *Menu for FCD-155E (SDH Versions with PDH Ports) (Part 2 of 2)*
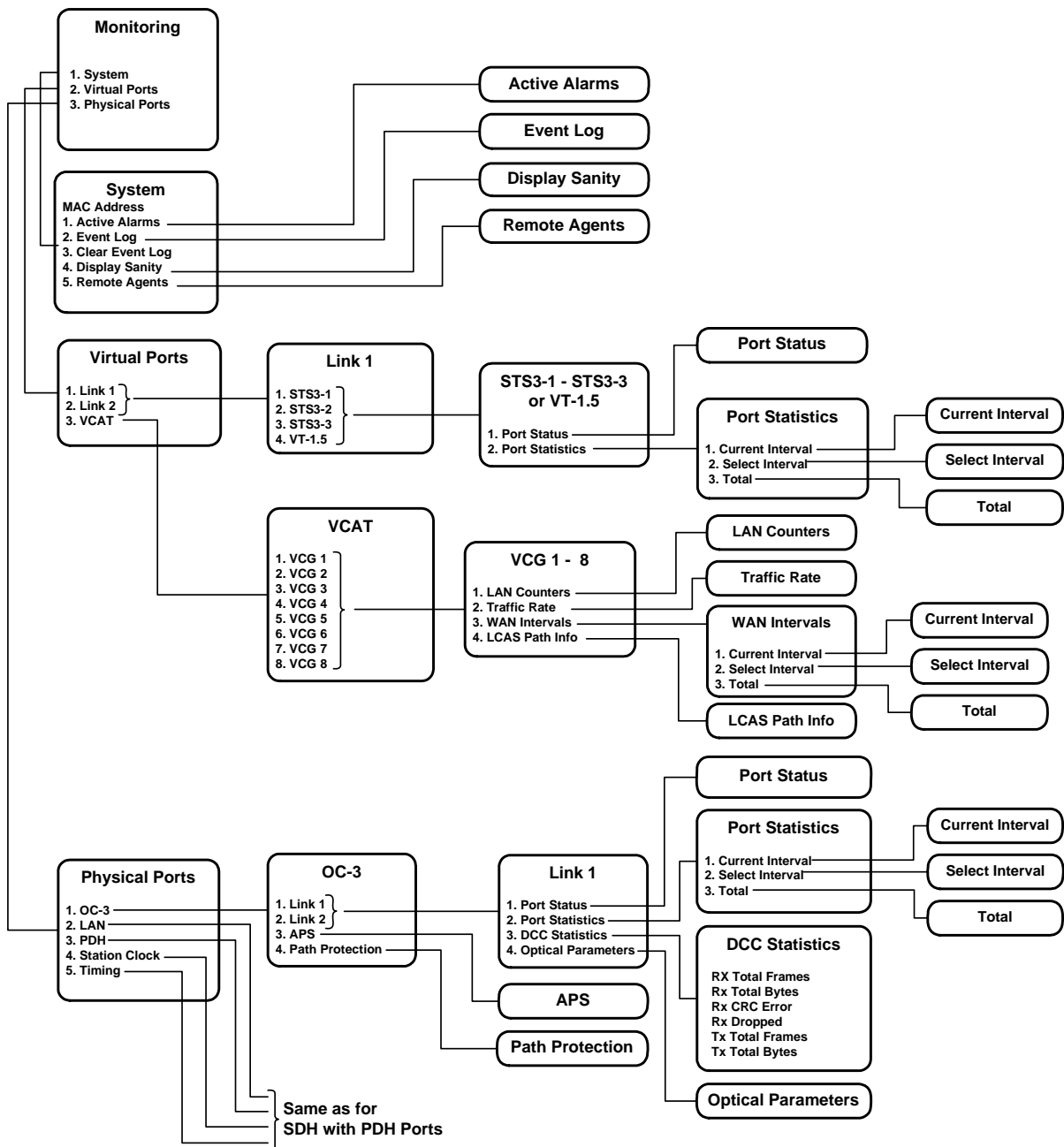
*Figure 7-3. Typical **Monitoring** Menu for FCD-155E (SONET Versions)*
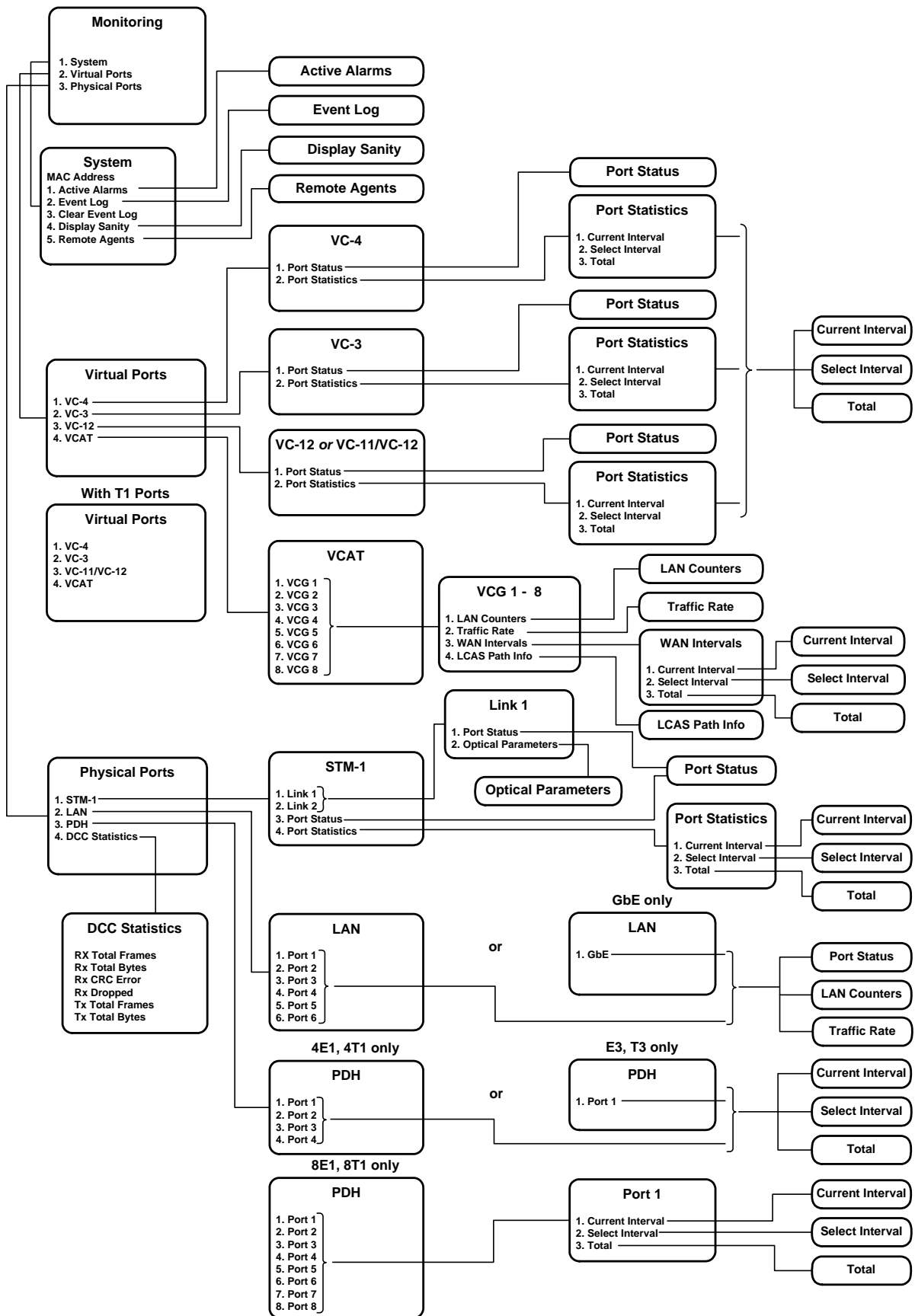
*Figure 7-4. Typical **Monitoring** Menu for FCD-155 (SDH Versions with PDH Ports)*
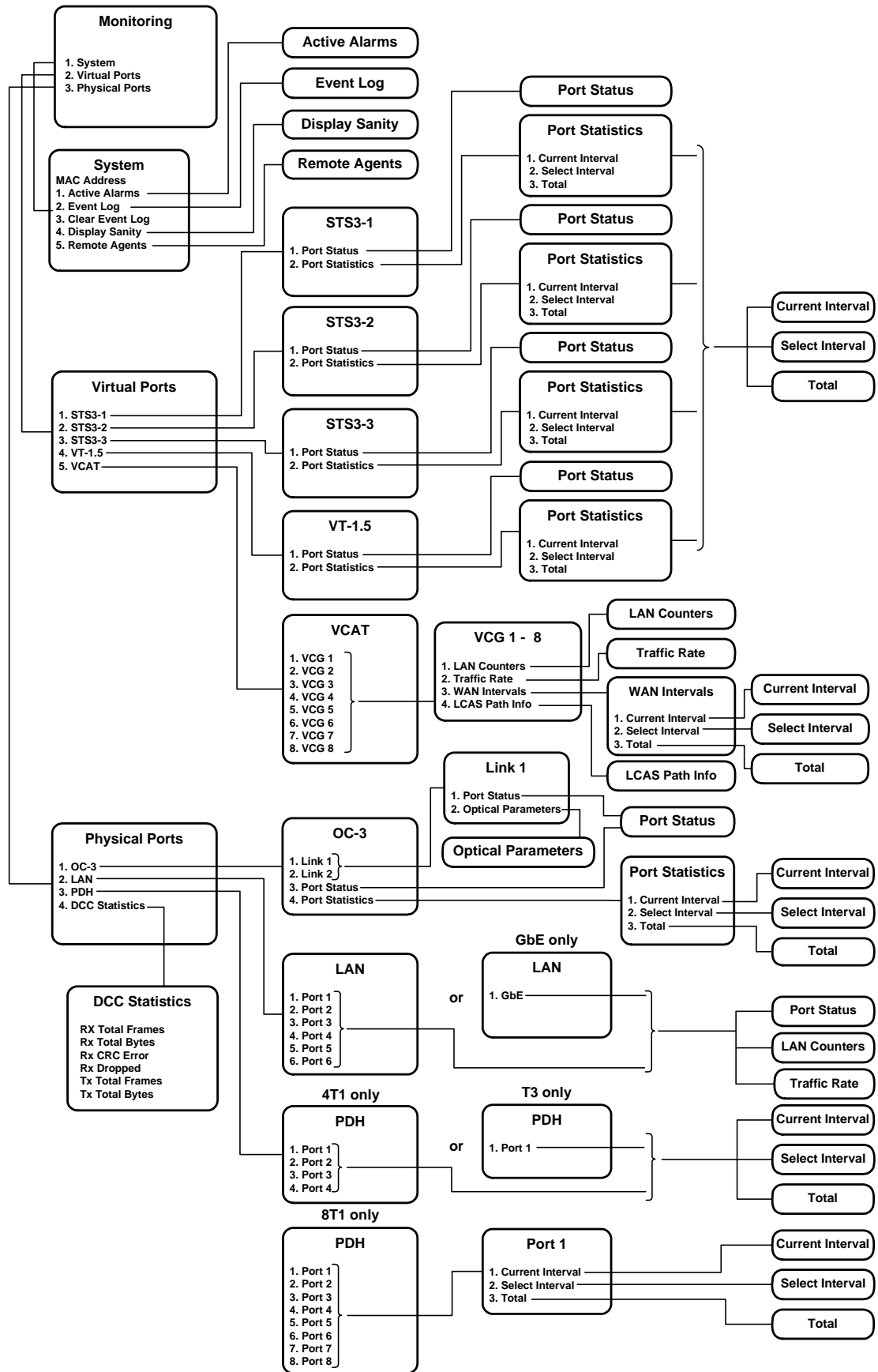
*Figure 7-5. Typical **Monitoring** Menu for FCD-155 (SONET Versions)*

Selecting a Monitoring Task

Purpose

Select the type of monitoring activity.

Reached from

Monitoring

A typical task selection screen is shown in *Figure 7-6*.

```
                              FCD-155
Monitoring
 1. System         >
 2. Virtual Ports >
 3. Physical Ports>

>

ESC-prev.menu; !-main menu; &-exit; @-debug                           1M/1C
------------------------------------------------------------------------------
```

Figure 7-6. Monitoring – Task Selection Screen

➤ **To select a type of monitoring activity:**

Type its number and then press ‹Enter›.

System Monitoring Tasks

Purpose

Perform system monitoring activities. Refer to *Section 7.4* for detailed instructions.

Reached from

Monitoring>System

Select a System Monitoring Task

A typical **System** monitoring submenu is shown in *Figure 7-7*.

```
                                   FCD-155
Monitoring>System

     MAC Address      ... (00-20-D2-26-4B-7E)
 1. Active Alarms    []
 2. Event Log        []
 3. Clear Event Log
 4. Display Sanity  >
 5. Remote Agents   >

>


ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
------------------------------------------------------------------------------
```

*Figure 7-7. Typical **System** Submenu*

➤ **To select the desired system monitoring task:**

- Type the number of the desired task, and then press **‹Enter›**.

Selecting a Virtual Port Monitoring Task (SDH Network Interfaces)

Purpose

Select the type of virtual ports for which monitoring information will be displayed.

Reached from

Monitoring›Virtual Ports

A typical **Virtual Ports** submenu for an FCD-155 with SDH network interfaces is shown in *Figure 7-8*.

- For FCD-155E, the first step is to select a link (*Figure 7-8.A*)

- For FCD-155, the link selection screen is skipped.

Note   *For FCD-155 with single Ethernet port, item **4: VCAT** is not available.*

```
                                   FCD-155
Monitoring>Virtual Ports

 1. Link 1 >
 2. Link 2 >
 3. VCAT   >

>

ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
------------------------------------------------------------------------------
```

A. Typical Link Selection Screen for FCD-155E

```
                                    FCD-155
Monitoring>Virtual Ports>Link 1

 1. VC4          >
 2. VC-3         >
 3. VC-12        >
 4. VCAT

>

ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
-------------------------------------------------------------------------
```

B. Typical Task Selection Screen (FCD-155)

Figure 7-8. Typical **Virtual Ports** Submenu (SDH Network Interfaces)

Note   When an FCD-155 using SDH network interfaces is equipped with T1 ports, performance monitoring information is collected for both VC-11s and VC-12s. The screen then displays **VC-11/VC-12**, instead of **VC-12**.

➤ **To select the type of virtual ports:**

Type the desired number and then press ‹**Enter**›.

For FCD-155E, you must first select a network link, and then select a type of virtual ports for monitoring.

Displaying VC-4 Virtual Ports Parameters

Purpose

Display performance monitoring information for the VC-4 level.

The information is collected over 15-minute intervals, and up to 97 of the most current intervals are stored for retrieval. The performance monitoring information is lost when the FCD-155 is powered down.

Reached from

Monitoring›Virtual Ports

Typical **VC-4** port task selection screens for FCD-155 and FCD-155E are shown in *Figure 7-9* and *Figure 7-10*. The type of port is identified in the screen header.

```
                              FCD-155
Monitoring>Virtual Ports>VC4


 1. Port Status      >
 2. Port Statistics >

>


ESC-prev.menu; !-main menu; &-exit                                    1M/1C
-------------------------------------------------------------------------------
```

*Figure 7-9. Typical **VC-4 Port** Task Selection Screen (FCD-155)*

```
                              FCD-155
Monitoring>Virtual Ports>Link 1>VC4


 1. Port Status      >
 2. Port Statistics >

>


ESC-prev.menu; !-main menu; &-exit                                    1M/1C
-------------------------------------------------------------------------------
```

*Figure 7-10. Typical **VC-4 Port** Task Selection Screen (FCD-155E)*

➤ **To display the status of the VC-4 virtual port:**

1. Type **1** on the **VC-4 Port** task selection screen and then press **<Enter>**.

2. You will see the **Port Status** screen. A typical **Port Status** screen is shown in *Figure 7-11.*

The parameters displayed on the **Port Status** screen are explained in *Table 7-1*.

*Table 7-1. VC-4 **Port Status** Virtual Port Status Parameters*

Parameter	Description
J1 Received	Displays the received J1 string
C2 Received	Displays the received C2 byte (signal label)

```
                              FCD-155
Monitoring>Virtual Ports>VC4>Port Status

 1. J1 Received          ... (F;X)
 2. C2 Received          ... (120)

>


ESC-prev.menu; !-main menu; &-exit; @-debug                           1M/1C
-------------------------------------------------------------------------------
```

*Figure 7-11. Typical VC-4 **Port Status** Virtual Port Screen*

➤ **To display the VC-4 virtual port statistics:**

1. Type **2** on the **VC-4 Port** task selection screen and then press **‹Enter›**.

2. You will see the **VC-4** statistics interval selection screen. A typical **VC-4** interval selection screen is shown in *Figure 7-12*.

```
                            FCD-155
Monitoring>Virtual Ports>VC4>Port Statistics

 1. Current Interval>
 2. Select Interval >
 3. Total           >

>

ESC-prev.menu; !-main menu; &-exit; @-debug                        1M/1C
---------------------------------------------------------------------------
```

*Figure 7-12. Typical **VC-4** Interval Selection Screen*

➤ **To display VC-4 performance monitoring data for the current interval:**

1. Type **1** and then press **‹Enter›**.

2. You will see the **Current Interval** performance monitoring screen for the VC-4. A typical screen is shown in *Figure 7-13*.

The information displayed on the performance monitoring screen is explained in *Table 7-2*.

Table 7-2. Performance Monitoring Data

Parameter	Description
Interval Number	The number of the 15-minute interval to be displayed, in the range of 1 to 96.
	The default value is **0** (zero), which designates the current interval. However, you can also select another interval, by typing **1** and then pressing **‹Enter›**: you can then enter the desired interval number, up to the number displayed in the **Valid Intervals** field.
Valid Intervals	The number of intervals (up 96 intervals) for which performance monitoring information can be displayed.
Elapsed Time	The elapsed time (in seconds) since the beginning of the current interval, in seconds. The range is 1 to 900 seconds.

Parameter	Description
ES	Displays the number of errored seconds (ES) in the current interval. An errored second is any second containing one or more of the following types of errors: • Severely Errored Frame (SEF) defect (also called Out-of-Frame (OOF) event): ▪ A SEF defect is declared after detection of four contiguous errored frame alignment words. ▪ The SEF defect is terminated when two contiguous error-free frame words are detected. • Loss of Signal (LOS) defect: ▪ A LOS defect is declared after when no transitions are detected in the incoming line signal (before descrambling) during an interval of 2.3 to 100 microseconds. ▪ The LOS defect is terminated after a 125-microsecond interval (one frame) during which no LOS defect is detected. • Loss of Pointer (LOP) defect: ▪ A LOP defect is declared after no valid pointer is detected in eight consecutive frames. The LOP defect will not be reported while an AIS signal is present. ▪ The LOP defect is terminated after a valid pointer is detected. • Alarm Indication Signal (AIS) received in the SDH overhead. • Coding Violation (CV): a coding violation is declared when a Bit Interleaved Parity (BIP) error is detected in the incoming signal. The BIP information is collected using the B1 byte in the Section Overhead.
SES	Displays the number of severely errored seconds (SES) in the current interval. A SES is any second during which multiple error events of the types taken into consideration for an ES have occurred.
UAS(SEFS)	Displays the number of unavailable seconds (UAS(SEFS)) in the current interval. An unavailable second is any second in which one or more SEF defects have been detected.
CV	Displays the number of coding violations (CV) in the current interval.

```
                              FCD-155
...>Virtual Ports>VC4>Port Statistics>Current Interval


 1. Interval Number [0 - 96]... (0)
 2. Valid Intervals [0 - 96]... (6)
 3. Elapsed time     ... (00:07:38)
 4. ES               ... (0)
 5. SES              ... (0)
 6. UAS(SEFS)        ... (0)
 7. CV               ... (0)

>


C - Clear
ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
----------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

*Figure 7-13. Typical **Current Interval** VC-4 Performance Monitoring Screen*

The information displayed on the screen for the current interval is automatically refreshed every few seconds.

You can clear the displayed parameters (that is, reset the displayed performance monitoring counters) by typing **C**. Note however that clearing the data does not clear the VC-4 data collected for other intervals or for other VCs, nor the number of valid intervals and the start time.

➤ **To display VC-4 performance monitoring data on a selected interval:**

1. Type **2** on the **VC-4** interval selection screen (*Figure 7-12*) and then press ‹Enter›.

2. You will see the **Select Interval** performance monitoring screen for the VC-4. A typical screen is shown in *Figure 7-14*.

```
                              FCD-155
...>Virtual Ports>VC4>Port Statistics>Select Interval


 1. Interval Number [0 - 96]... (1)
 2. Valid Intervals [0 - 96]... (6)
 3. Elapsed time     ... (00:15:00)
 4. ES               ... (0)
 5. SES              ... (0)
 6. UAS(SEFS)        ... (0)
 7. CV               ... (0)

>


C - Clear
ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
----------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

*Figure 7-14. Typical **Select Interval** VC-4 Performance Monitoring Screen*

3. Select the desired interval, by typing **1** and pressing **‹Enter›**: you can then enter the desired interval number, up to the number displayed in the **Valid Intervals** field.

4. After pressing **‹Enter›**, the data displayed on the screen is updated in accordance with your selection.

For a description of the displayed parameters, refer to *Table 7-2*.

You can clear the displayed parameters (that is, reset the displayed performance monitoring counters for the selected interval) by typing **C**. Note however that clearing the data does not clear the data collected for other intervals and for other types of VCs, nor the number of valid intervals and the start time.

➤ **To display the totaled VC-4 performance monitoring data:**

1. Type **3** on the **VC-4** interval selection screen (*Figure 7-12*) and then press **‹Enter›**.

2. You will see the **Total** performance monitoring screen for the VC-4. A typical screen is shown in *Figure 7-15*.

Note that the number of the 15-minute intervals to be displayed is by default **97**, which means *all the intervals*. However, you can also select a specific interval for display (the same result as selecting **Select Interval**):

•   Type **1** on the screen shown in *Figure 7-15* and then press **‹Enter›**.

•   Now type the desired interval number, up to the number displayed in the **Valid Intervals** field, and then press **‹Enter›**.

For a description of the displayed parameters, refer to *Table 7-2*.

You can clear the displayed parameters (that is, reset the displayed VC-4 performance monitoring counters for all the intervals) by typing **C**. Note however that clearing the VC-4 performance monitoring data does not clear the number of valid intervals, nor the start time.

```
                          FCD-155
...>Virtual Ports>VC4>Port Statistics>Total


 1. Interval Number [0 - 96]... (97)
 2. Valid Intervals [0 - 96]... (6)
 3. Elapsed time     ... (00:15:00)
 4. ES               ... (0)
 5. SES              ... (0)
 6. UAS(SEFS)        ... (0)
 7. CV               ... (0)


>


C - Clear
ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
----------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

Figure 7-15. Typical **Total** VC-4 Performance Monitoring Screen

Displaying VC-3 Virtual Ports Parameters

Purpose

Display performance monitoring information for the VC-3 level. You can display performance monitoring statistics only on connected (mapped) VC-3 ports.

The information is collected over 15-minute intervals, and up to 97 of the most current intervals are stored for retrieval. The performance monitoring information is lost when the FCD-155 is powered down.

Reached from

Monitoring>Virtual Ports

➤ **To select a VC-3 port:**

1. Type the number of the desired VC-3 for which the port statistics data is displayed.

   The allowed range is 1 to 3, however only connected ports may be selected. If you select an unconnected port, the **Valid Intervals** field will display **Error**.

2. You will see the **VC-3** task selection screen. *Figure 7-16* shows a typical screen.

```
                              FCD-155
Monitoring>Virtual Ports>VC-3

 1. Port Status       >
 2. Port Statistics  >

>

The statistic is for connected ports
ESC-prev.menu; !-main menu; &-exit; @-debug                       1M/1C
----------------------------------------------------------------------------
```

Figure 7-16. Typical **VC-3** *Virtual Port Task Selection Screen*

➤ **To display the status of a VC-3 virtual port:**

1. Type **1** on the **VC-3 Port** task selection screen and then press **<Enter>**.

2. You will see the **Port Status** screen. A typical **Port Status** screen is shown in *Figure 7-17.*

```
                              FCD-155
Monitoring>Virtual Ports>VC-3>Port Status


 1. VC Port                 (1 – 3) (1)
 2. J1 Received        ... (F;X)
 3. C2 Received        ... (0)


>


ESC-prev.menu; !-main menu; &-exit; @-debug                            1M/1C
-----------------------------------------------------------------------------
```

*Figure 7-17. Typical VC-3 **Port Status** Virtual Port Screen*

The information displayed on the **Port Status** screen includes the following items:

- Item **1 – VC Port**: used to select the VC-3 port for which the port statistics data is displayed. The allowed range is 1 to 3, however only connected ports may be selected. If you select an unconnected port, the **Valid Intervals** field displays **Error**.

- The other items are explained in *Table 7-1*.

➤ **To display the VC-3 virtual port statistics:**

1. Type **2** on the **VC-3 Port** task selection screen and then press **‹Enter›**.

2. You will see the **VC-3** statistics interval selection screen. *Figure 7-18* shows a typical **VC-3** interval selection screen.

```
                              FCD-155
Monitoring>Virtual Ports>VC-3>Port Statistics


 1. Current Interval>
 2. Select Interval >
 3. Total           >


>


ESC-prev.menu; !-main menu; &-exit; @-debug                            1M/1C
-----------------------------------------------------------------------------
```

*Figure 7-18. Typical **VC-3** Interval Selection Screen*

➤ **To display VC-3 performance monitoring data for the current interval:**

1. Type **1** on the **VC-3** interval selection screen and then press **‹Enter›**.

2. You will see the **Current Interval** port statistics screen for VC-3s. A typical screen is shown in *Figure 7-19*.

```
                                FCD-155
...>Virtual Ports>VC-3>Port Statistics>Current Interval

 1. VC Port          [1 - 3] ... (1)
 2. Interval Number [0 - 96]... (0)
 3. Valid Intervals ... (6)
 4. Elapsed time     ... (00:00:00)
 5. ES               ... (0)
 6. SES              ... (0)
 7. UAS(SEFS)        ... (0)
 8. CV               ... (0)

>

C - Clear
ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
-------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

*Figure 7-19. Typical **Current Interval** Port Statistics Screen for VC-3s*

The information displayed for the current interval port statistics screen includes the following items:

- Item **1 – VC Port**: used to select the VC-3 port for which the port statistics data is displayed. The allowed range is 1 to 3, however only connected ports may be selected. If you select an unconnected port, the **Valid Intervals** field displays **Error**.

- The other items are explained in *Table 7-2*.

➤ **To display VC-3 performance monitoring data on a selected interval:**

Type **2** on the **VC-3** interval selection screen and then press ‹**Enter**›.

Except for first selecting a specific VC-3 port, use the procedure described on *page 7-14* for VC-4.

➤ **To display totaled VC-3 performance monitoring data:**

Type **3** on the **VC-3** interval selection screen and then press ‹**Enter**›.

Except for first selecting a specific VC-3 port, use the procedure described on *page 7-14* for VC-4.

Displaying VC-12 or VC-11/VC-12 Virtual Ports Parameters

Purpose

Display performance monitoring information for the VC-12 level. You can display performance monitoring statistics only on connected (mapped) VC-12s.

Note   *When an FCD-155 using SDH network interfaces is equipped with T1 ports, the performance monitoring information is collected for both VC-11 and VC-12. The screen header is then changed to **VC-11/VC-12**.*

The information is collected over 15-minute intervals, and up to 97 of the most current intervals are stored for retrieval. The performance monitoring information is lost when the FCD-155 is powered down.

Reached from

Monitoring>Virtual Ports

A typical **VC-12** task selection screen is shown in *Figure 7-20*.

```
                            FCD-155
Monitoring>Virtual Ports>VC-11/VC12


 1. Port Status       >
 2. Port Statistics   >


>


The statistic is for connected ports
ESC-prev.menu; !-main menu; &-exit; @-debug                           1M/1C
-----------------------------------------------------------------------
```

*Figure 7-20. Typical **VC-12** Virtual Port Task Selection Screen (FCD-155 with E1 Ports)*

➤ **To display the status of a VC-12 or VC-11 virtual port:**

1. Type **1** on the **VC-12 or VC-11/VC-12** port task selection screen and then press **‹Enter›**.

2. You will see the **Port Status** screen. A typical **Port Status** screen is shown in *Figure 7-21.*

```
                            FCD-155
Monitoring>Virtual Ports>VC-11/VC12>Port Status

 1. VC Port                      (1 – 63) (1)
 2. J2 Received            ... (F;X)
 3. V5 (Bits 5-7) Received   ... (0)


>

ESC-prev.menu; !-main menu; &-exit; @-debug                           1M/1C
-----------------------------------------------------------------------
```

*Figure 7-21. Typical VC-12 **Port Status** Virtual Port Screen (FCD-155 with E1 Ports)*

The information displayed on the **Port Status** screen includes the following items:

- Item **1 – VC Port**: used to select the VC-12 or VC-11 port for which the port statistics data is displayed. The allowed range is 1 to 63 when the FCD-155 is equipped with E1 ports, and 1 to 84 for an FCD-155 with T1 ports. Note however that only connected ports may be selected. If you select an unconnected port, the **Valid Intervals** field displays **Error**.

- The other items are explained in *Table 7-3*.

*Table 7-3. VC-12 **Port Status** Virtual Port Status Parameters*

Parameter	Description
J2 Received	Displays the received J2 string
V5 (Bits 5-7) Received	Displays the bits 5 to 7 of the received V5 byte, which serve as signal label

➤ **To display the VC-12 or VC-11 virtual port statistics:**

1. Type **2** on the **VC-12 or VC-11 Port** task selection screen and then press **‹Enter›**.

2. You will see the **VC-12 or VC-11** statistics interval selection screen. A typical **VC-12** interval selection screen is shown in *Figure 7-22*.

```
                              FCD-155
Monitoring>Virtual Ports>VC-11/VC12>Port Statistics


 1. Current Interval>
 2. Select Interval >
 3. Total           >

>


ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
------------------------------------------------------------------------------

```

*Figure 7-22. Typical **VC-12** Interval Selection Screen*

➤ **To display VC-12 or VC-11 performance monitoring data for the current interval:**

1. Type **1** and then press **‹Enter›**.

2. You will see the **Current Interval** port statistics screen for VC-12s or VC-11s. A typical screen is shown in *Figure 7-23*.

```
                              FCD-155
...>Virtual Ports>VC-11/VC12>Port Statistics>Current Interval

 1. VC Port         [1 - 63]... (1)
 2. Interval Number [0 - 96]... (0)
 3. Valid Intervals ... (6)
 4. Elapsed time    ... (00:00:00)
 5. ES              ... (0)
 6. SES             ... (0)
 7. UAS(SEFS)       ... (0)
 8. CV              ... (0)

>

C - Clear
ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
------------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

*Figure 7-23. Typical **Current Interval** Port Statistics Screen for VC-12s*

The information displayed for the current interval port statistics screen includes the following items:

- Item **1 – VC Port**: used to select the VC-12 port for which the port statistics data is displayed. The allowed range is 1 to 63, when the FCD-155 is equipped with E1 ports, and 1 to 84 for an FCD-155 with T1 ports. Note however that only connected ports may be selected. If you select an unconnected port, the **Valid Intervals** field displays **Error**.

- The other items are explained in *Table 7-2*.

➤ **To display VC-12 or VC-11 performance monitoring data on a selected interval:**

Type **2** and then press **‹Enter›**.

Except for first selecting a specific VC-12 or VC-11 port, use the procedure described on *page 7-14* for VC-4.

➤ **To display totaled VC-12 or VC-11 performance monitoring data:**

Type **3** and then press **‹Enter›**.

Except for first selecting a specific VC-12 or VC-11 port, use the procedure described on *page 7-14* for VC-4.

Selecting Virtual Ports for Monitoring (SONET Networks)

Purpose

Select the type of virtual ports for which monitoring information will be displayed by FCD-155 with SONET network interface.

Reached from

Monitoring›Virtual Ports

A typical **Virtual Ports** submenu for an FCD-155 with SONET network interface is shown in *Figure 7-24*. For FCD-155E, the screen includes separate fields for the STS-1s of each network link.

Note   *FCD-155 with single Ethernet port does not support virtual concatenation, and therefore item **5: VCAT** does not appears for this FCD-155 version.*

```
                                   FCD-155
Monitoring>Virtual Ports

  1. STS 3-1                      >
  2. STS 3-2                      >
  3. STS 3-3                      >
  4. VT-1.5                       >
  5. VCAT    >


>


ESC-prev.menu; !-main menu; &-exit; @-debug                            1M/1C
------------------------------------------------------------------------------
```

*Figure 7-24. Typical **Virtual Ports** Submenu (FCD-155 with SONET Network Interfaces)*

➤ **To select the type of virtual ports:**

1. Type the number corresponding to the desired port type and then press **‹Enter›**.

2. After selecting the desired port type, use the same procedures described for FCD-155 using SDH network interfaces:

   ▪ For STS-1, use the procedures described in *Displaying VC-3 Virtual Ports Parameters* for VC-3.

   ▪ For VT-1.5, use the procedures described in *Displaying VC-12 or VC-11/VC-12 Virtual Ports Parameters* for VC-11 and VC-12. The allowed port number range is 1 to 84.

Displaying STS Virtual Ports Parameters (SONET)

Purpose

Display performance monitoring information for the STS-1 level. You can display performance monitoring statistics only on connected (mapped) STS-1 ports.

The information is collected over 15-minute intervals, and up to 97 of the most current intervals are stored for retrieval. The performance monitoring information is lost when the FCD-155 is powered down.

Reached from

Monitoring›Virtual Ports

➤ **To select an STS port:**

1. Type the number of the desired STS-1 for which the port statistics data is displayed. The allowed range is 1 to 3, however only connected ports may be selected. If you select an unconnected port, the **Valid Intervals** field will display **Error**.

2. You will see the **STS** task selection screen. A typical **STS** task selection screen is shown in *Figure 7-25*.

```
                             FCD-155
Monitoring>Virtual Ports>STS3-1


 1. Port Status       >
 2. Port Statistics   >


>


The statistic is for connected ports
ESC-prev.menu; !-main menu; &-exit; @-debug                              1M/1C
-----------------------------------------------------------------------------
```

*Figure 7-25. Typical **STS** Virtual Port Task Selection Screen*

➤ **To display the status of an STS virtual port:**

1. Type **1** on the **STS** port task selection screen and then press **‹Enter›**.

2. You will see the **Port Status** screen.

    A typical **Port Status** screen is shown in *Figure 7-26.* The parameters displayed on the **Port Status** screen are explained in *Table 7-1*.

```
                             FCD-155
Monitoring>Virtual Ports>STS3-1>Port Status


    J1 Received       ... ()
    C2 Received       ... (72)

>


ESC-prev.menu; !-main menu; &-exit; @-debug                              1M/1C
-----------------------------------------------------------------------------
```

*Figure 7-26. Typical STS **Port Status** Virtual Port Screen*

➤ **To display the STS virtual port statistics:**

1. Type **2** on the **STS** port task selection screen and then press **‹Enter›**.

2. You will see the **STS** statistics interval selection screen. A typical **STS** interval selection screen is shown in *Figure 7-27*.

```
                             FCD-155
Monitoring>Virtual Ports>STS3-1>Port Statistics


 1. Current Interval>
 2. Select Interval >
 3. Total           >

>


ESC-prev.menu; !-main menu; &-exit; @-debug                              1M/1C
-----------------------------------------------------------------------------
```

*Figure 7-27. Typical **STS** Interval Selection Screen*

➤ **To display STS-1 performance monitoring data for the current interval:**

1. Type **1** on the **STS** statistics interval selection screen and then press **‹Enter›**.

2. You will see the **Current Interval** port statistics screen for STS-1s. A typical screen is shown in *Figure 7-28*.

```
                         FCD-155
...>Virtual Ports>STS3-1>Port Statistics>Current Interval
 1. VC Port          [1 - 3] ... (1)
 2. Interval Number [0 - 96]... (0)
 3. Valid Intervals ... (6)
 4. Elapsed time     ... (00:00:00)
 5. ES               ... (0)
 6. SES              ... (0)
 7. UAS(SEFS)        ... (0)
 8. CV               ... (0)

>


C - Clear
ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
-----------------------------------------------------------------------
Automatic Refresh Is Activated !
```

*Figure 7-28. Typical **Current Interval** Port Statistics Screen for STS-1*

The information displayed for the current interval port statistics screen includes the following items:

- Item **1 – VC Port**: used to select the STS-1 port for which the port statistics data is displayed. The allowed range is 1 to 3, however only connected ports may be selected. If you select an unconnected port, the **Valid Intervals** field displays **Error**.

- The other items are explained in *Table 7-2*.

➤ **To display STS-1 performance monitoring data on a selected interval:**

Type **2** on the **STS** statistics interval selection screen and then press **‹Enter›**.

Except for first selecting a specific STS-1 port, use the procedure described on *page 7-14* for VC-4.

➤ **To display totaled STS-1 performance monitoring data:**

Type **3** on the **STS** statistics interval selection screen and then press **‹Enter›**.

Except for first selecting a specific STS-1 port, use the procedure described on *page 7-14* for VC-4.

Displaying VT-1.5 Virtual Ports (SONET Network Interfaces)

Purpose

Display performance monitoring information for the VT-1.5 level. You can display performance monitoring statistics only on connected (mapped) VT-1.5s.

The information is collected over 15-minute intervals, and up to 97 of the most current intervals are stored for retrieval. The performance monitoring information is lost when the FCD-155 is powered down.

Reached from

Monitoring>Virtual Ports

A typical **VT-1.5** task selection screen is shown in *Figure 7-29*.

```
                              FCD-155
Monitoring>Virtual Ports>VT-1.5

 1. Port Status      >
 2. Port Statistics  >

>

The statistic is for connected ports

ESC-prev.menu; !-main menu; &-exit; @-debug                    1M/1C
-----------------------------------------------------------------------
```

*Figure 7-29. Typical **VT-1.5** Virtual Port Task Selection Screen*

➤ **To display the status of a VT-1.5 virtual port:**

1. Type **1** on the **VT-1.5 Port** task selection screen and then press **‹Enter›**.

2. You will see the **Port Status** screen. A typical **Port Status** screen is shown in *Figure 7-30.*

The information displayed on the **Port Status** screen includes the following items:

- Item **1 – VT Port**: used to select the VT-1.5 port for which the port statistics data is displayed. The allowed range is 1 to 84, however only connected ports may be selected. If you select an unconnected port, the **Valid Intervals** field displays **Error**.

- The other items are explained in Typical **DHCP Status** Screen. Item 2 – **J2 Received** is displayed only for groups.

```
                              FCD-155
Monitoring>Virtual Ports>VT-1.5>Port Status

 1. VT Port                    (1 – 84) (1)
 2. J2 Received           ... (0)
 3. V5 (Bits 5-7) Received   ... (0)

>

ESC-prev.menu; !-main menu; &-exit; @-debug                    1M/1C
-----------------------------------------------------------------------
```

*Figure 7-30. Typical VT-1.5 **Port Status** Virtual Port Screen*

➤ **To display the VT-1.5 virtual port statistics:**

1. Type **2** on the **VT-1.5 Port** task selection screen and then press **‹Enter›**.

2. You will see the **VT-1.5** statistics interval selection screen. A typical **VT-1.5** interval selection screen is shown in *Figure 7-31*.

```
                            FCD-155
Monitoring>Virtual Ports>VT-1.5>Port Statistics


 1. Current Interval>
 2. Select Interval >
 3. Total            >

>


ESC-prev.menu; !-main menu; &-exit; @-debug                           1M/1C
---------------------------------------------------------------------------

```

*Figure 7-31. Typical **VT-1.5** Interval Selection Screen*

➤ **To display VT-1.5 performance monitoring data for the current interval:**

1. Type **1** and then press **‹Enter›**.

2. You will see the **Current Interval** port statistics screen for VT-1.5s. A typical screen is shown in *Figure 7-32*.

```
                            FCD-155
...>Virtual Ports>VT-1.5>Port Statistics>Current Interval

 1. VT Port [1 - 84]... (1)
 2. Interval Number ... (0)
 3. Valid Intervals ... (6)
 4. Elapsed time    ... (00:00:00)
 5. ES              ... (0)
 6. SES             ... (0)
 7. UAS(SEFS)       ... (0)
 8. CV              ... (0)


>

C - Clear
ESC-prev.menu; !-main menu; &-exit; @-debug                           1M/1C
---------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

*Figure 7-32. Typical **Current Interval** Port Statistics Screen for VT-1.5s*

The information displayed for the current interval port statistics screen includes the following items:

• Item **1 – VT Port**: used to select the VT-1.5 port for which the port statistics data is displayed. The allowed range is 1 to 84, however only connected ports may be selected. If you select an unconnected port, the **Valid Intervals** field displays **Error**.

• The other items are explained in *Table 7-2*.

➤ **To display VT-1.5 performance monitoring data on a selected interval:**

Type **2** and then press **‹Enter›**.

Except for first selecting a specific VT-1.5 port, use the procedure described on *page 7-14* for VC-4.

➤ **To display totaled VT-1.5 performance monitoring data:**

Type **3** and then press **‹Enter›**.

Except for first selecting a specific VT-1.5 port, use the procedure described on *page 7-14* for VC-4.

Selecting a Virtually Concatenated Group for Monitoring

Purpose

Select the virtually concatenated group for which performance monitoring statistics will be displayed.

Note | *The FCD-155 with single Ethernet port does not support virtually concatenated groups, and therefore this screen is not available.*

You can display statistics only for connected (mapped) groups.

Reached from

Monitoring›Virtual Ports›VCAT

A typical **VCAT** group selection screen is shown in *Figure 7-33*.

```
                             FCD-155
Monitoring>Virtual Ports>VCAT


 1. VCG 1     >
 2. VCG 2     >
 3. VCG 3     >
 4. VCG 4     >
 5. VCG 5     >
 6. VCG 6     >
 7. VCG 7     >
 8. VCG 8     >


>
The statistic is for connected ports


ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
----------------------------------------------------------------------------
```

*Figure 7-33. Typical **VCAT** Group Selection Screen*

The number of groups displayed depends on the number of LAN ports:

- For FCD-155 with 2 LAN ports, the number of groups is 1 to 4.

- For FCD-155 with GbE or transparent LAN ports, the number of groups is 1 to 8.

➤ **To select a virtually concatenated group for display of performance monitoring statistics:**

Type its number and then press ‹Enter›:

- If the group is configured and mapped, you will see the corresponding **VCG** screen, used to select the type of performance monitoring statistics

- If the group is not mapped, you will see an empty **VCG** screen.

Selecting a VCG Monitoring Task

Purpose

Select the type of performance monitoring statistics for a selected virtually concatenated group.

Reached from

Monitoring›Virtual Ports›VCAT

VCGs 1 to 4

A typical **VCG** statistics selection screen for a group in the range of 1 to 4 is shown in *Figure 7-34*. The selected group is identified in the screen header.

```
                              FCD-155
Monitoring>Virtual Ports>VCAT>VCG 1

 1. LAN Counters    >
 2. Traffic Rate    >
 3. Wan Intervals   >
 4. LCAS Path Info []

>


ESC-prev.menu; !-main menu; &-exit; @-debug                           1M/1C
------------------------------------------------------------------------------
```

*Figure 7-34. Typical **VCG** Statistics Selection Screen (Groups 1 to 4)*

Note   *The **LCAS Path Info** option is available only when LCAS is used on the selected group.*

➤ **To select the type of performance monitoring statistics for a virtually concatenated group:**

Type the corresponding number and then press ‹Enter›.

VCGs 5 to 8

A typical **VCG** statistics screen for a group in the range of 5 to 8 is shown in *Figure 7-35*. The selected group is identified in the screen header.

```
                                  FCD-155
Monitoring>Virtual Ports>VCAT>VCG 5


 1. Wan Intervals  >
 2. LCAS Path Info []

>


ESC-prev.menu; !-main menu; &-exit; @-debug                              1M/1C
-------------------------------------------------------------------------------
```

*Figure 7-35. Typical **VCG** Statistics Selection Screen (Groups 5 to 8)*

➤ **To select the type of performance monitoring statistics for a virtually concatenated group:**

Type the corresponding number and then press ‹**Enter**›.

Displaying LAN Counter (VCG) Parameters

Purpose

Display performance monitoring statistics for the external LAN ports (basic and optional GbE ports) connected to a selected virtually concatenated group.

Note   *The information related to the optional transparent LAN ports, ETH 3 to ETH 6, is presented on the LAN physical ports monitoring screens (see Selecting an Ethernet LAN (Physical Ports) for Monitoring section).*

Reached from

Monitoring›Virtual Ports›VCAT›VCG

Figure 7-36 shows a typical **LAN Counters** screen for a virtually concatenated group.

The information displayed on the screen, which is accumulated continuously, is automatically refreshed every few seconds. You can clear the displayed statistics (that is, reset the displayed performance monitoring counters) by typing **C**. The counters are also reset when the FCD-155 is powered up.

```
                                  FCD-155
...>Virtual Ports>VCAT>VCG 1>Lan Counters


    Rx Total Frames       ... (0)            Tx Total Frames      ... (107)
    Rx Unicast Frames     ... (0)            Tx Unicast Frames    ... (0)
    Rx Broadcast Frames   ... (0)            Tx Non Unicast Frames... (0)
    Rx Multicast Frames   ... (0)            Tx Total Bytes       ... (0)
    Rx Total Bytes        ... (0)            ...
    Rx Correct Frames     ... (0)            ...
    Rx Filtered           ... (0)            Rx 256b-511b Frames ... (0)
    Rx 64b Frames         ... (0)            Rx 512b-1023b Frames... (0)
    Rx 65b-127b Frames    ... (0)            Rx 1024b-max Frames ... (0)
    Rx 128b-255b Frames   ... (0)            Last Reset Time...(0 day 02:47:42)
>


C - Clear
ESC-prev.menu; !-main menu; &-exit; @-debug                           1M/1C
---------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

*Figure 7-36. Typical **LAN Counters** Screen (Group)*

The performance monitoring counters displayed on the **LAN Counters** screen are explained in *Table 7-4*. In addition to these counters, you can also read the time (as retrieved from the FCD-155 internal real-time clock) at which the counters have been last reset.

*Table 7-4. Group **LAN Counters** Performance Monitoring Statistics*

Parameter	Description
Rx Total Frames	Total number of frames received through the corresponding LAN port
Rx Unicast Frames	Total number of good unicast frames received through the corresponding LAN port
Rx Broadcast Frames	Total number of good broadcast frames received through the corresponding LAN port
Rx Multicast Frames	Total number of good multicast frames received through the corresponding LAN port
Rx Pause Frames	Total number of **pause** frames (used for flow control) received through the corresponding LAN port
Rx Correct Frames	Total number of good frames received through the corresponding LAN port
Rx Total Bytes	Total number of data octets carried by all frames received through the corresponding LAN port

Parameter	Description
Rx Filtered	If the QoS criteria based on IEEE 802.1Q are not used on this port: Total valid frames received that are not forwarded to a destination port. These are frames for which there is no destination port, or are not forwarded due to the state of the port. Valid frames discarded due to lack of buffer space are not included. If the QoS criteria based on IEEE 802.1Q are used on this port: Total valid frames received (tagged or untagged) that were discarded because of unknown VLAN ID
Rx Frames 64b	Total number of 64-byte frames received through the corresponding LAN port
Rx Frames 65b-127b	Total number of frames with size of 65 to 127 bytes received through the corresponding LAN port
Rx Frames 128b-255b	Total number of frames with size of 65 to 127 bytes received through the corresponding LAN port
Rx Frames 256b-511b	Total number of frames with size of 256 to 511 bytes received through the corresponding LAN port
Rx Frames 512b-1023b	Total number of frames with size of 512 to 1023 bytes received through the corresponding LAN port
Rx Frames 1024b-max	Total number of frames with size of 1024 to 1518 or 1536 bytes received through the corresponding LAN port
Tx Total Bytes	Total number of data octets carried by all the good frames transmitted by the corresponding LAN port
Tx Total Frames	Total number of good frames transmitted by the corresponding LAN port
Tx Unicast Frames	Total number of good unicast frames transmitted by the corresponding LAN port
Tx Broadcast Frames	Total number of good broadcast frames transmitted by the corresponding LAN port
Tx Multicast Frames	Total number of good multicast frames transmitted by the corresponding LAN port

Displaying the Traffic Rate

The traffic rate shows the maximum and current rate in kbps for the receive and transmit traffic.

➤ **To display the Traffic Rate of a VCG port:**

Type **2** in *Figure 7-34,* and then press **‹Enter›**.

A typical Traffic Rate screen is shown in *Figure 7-37.* The current and maximum transmit and receive rates are displayed in kbps.

```
                              FCD-155E
...>Virtual Ports>VCAT>VCG 1>Traffic Rate


      Maximum Rx Traffic (Kbps)... (0)
      Current Rx Traffic (Kbps)... (0)
      Maximum Tx Traffic (Kbps)... (0)
      Current Tx Traffic (Kbps)... (0)

>


ESC-prev.menu; !-main menu; &-exit; @-debug                         1M/1C
-----------------------------------------------------------------------------
```

Figure 7-37. Typical Traffic Rate Screen for VCG Port

Displaying WAN Intervals Virtual Ports Parameters

Purpose

Display performance monitoring statistics for the WAN side of the selected virtually concatenated group. The WAN side statistics depend on the encapsulation mode selected for the group: LAPS or GFP.

Note   *When using GFP multiplexing, only the statistics of the primary group can be displayed. This is sufficient for performance monitoring, because these statistics represent the WAN side transmission performance for all the groups handled by the corresponding GFP multiplexer.*

The statistics are collected over 15-minute intervals, and up to 97 of the most current intervals are stored for retrieval. The performance monitoring information is lost when the FCD-155 is powered down.

Reached from

Monitoring>Virtual Ports>VCAT>VCG

A typical **WAN Intervals** selection screen is shown in *Figure 7-38*.

```
                              FCD-155
Monitoring>Virtual Ports>VCAT>VCG 1>WAN Intervals

 1. Current Interval>
 2. Select Interval >
 3. Total           >

>


ESC-prev.menu; !-main menu; &-exit; @-debug                         1M/1C
-----------------------------------------------------------------------------
```

*Figure 7-38. Typical **WAN Intervals** Selection Screen*

➤ **To display WAN side performance monitoring data for the current interval:**

1. Type **1** and then press **‹Enter›**.

2. You will see the first page of the **Current Interval** performance monitoring screen for the WAN side. The **Current Interval** screen includes a large number of items and therefore it consists of two pages:

   ▪ To continue from the first page to the second page, type **n** (next)

   ▪ To return from the second page to the first page, type **p** (previous).

➤ **To display WAN side performance monitoring data on a selected interval:**

Type **2** and then press **‹Enter›**.

➤ **To display totaled WAN side performance monitoring data:**

Type **3** and then press **‹Enter›**.

➤ **To clear the accumulated statistics (reset all the counters, except items 2, 3, 4):**

Type **C** and then press **‹Enter›**.

WAN Side Statistics – LAPS Encapsulation

The two pages of a typical WAN side statistics screen for a virtually concatenated group using LAPS encapsulation are shown in *Figure 7-39* and *Figure 7-40*. The WAN side statistics parameters for groups using LAPS encapsulation are described in *Table 7-5*.

```
                          FCD-155
..>Virtual Ports>VCAT>VCG 1>WAN Intervals>Current Interval

 1. Interval Number                      [0 - 96]... (0)
 2. Valid Intervals                      [0 - 96]... (1)
 3. Elapsed time                         ... (00:08:40)
 4. Number of Total Rx Frames            ... (0)
 5. Number of Total Tx Frames            ... (0)
 6. Rx Payload Max length violation      ... (0)
 7. Rx Payload Min length violation      ... (0)
 8. FCS error                            ... (0)
 9. Receive Abort Frames                 ... (0)
10. Byte De-stuffing violations          ... (0)
... (N)
>
C - Clear
ESC-prev.menu; !-main menu; &-exit; @-debug                       1M/1C
-------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

Figure 7-39. Typical WAN Side Statistics Screen – LAPS Encapsulation (First Page)

```
                              FCD-155
..>Virtual Ports>VCAT>VCG 1>WAN Intervals>Current Interval

... (P)
11. Receive address field mismatch counter... (0)
12. Receive control field mismatch counter... (0)
13. Receive SAPI field mismatch counter   ... (0)


>
C - Clear
ESC-prev.menu; !-main menu; &-exit; @-debug                           1M/1C
------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

Figure 7-40. Typical WAN Side Statistics Screen – LAPS Encapsulation (Second Page)

Table 7-5. WAN Side Statistics – LAPS Encapsulation

Parameter	Description
Interval Number	The number of the 15-minute interval to be displayed, in the range of 1 to 96.
	To select a different interval, type **1** and then press ‹ **Enter** ›: you can then enter the desired interval number, up to the number displayed in the **Valid Intervals** field.
Valid Intervals	The number of intervals (up 96 intervals) for which performance monitoring information can be displayed.
Elapsed Time	The elapsed time (in seconds) since the beginning of the current interval, in seconds. The range is 1 to 900 seconds.
Number of Total Rx Frames	Total number of frames received from the WAN
Number of Total Tx Frames	Total number of frames transmitted to the WAN
Rx Payload Max Length violation	Total number of frames received with payload fields exceeding the maximum allowed number of bytes
Rx Payload Min Length violation	Total number of frames received with payload fields shorter than the minimum allowed number of bytes
FCS Error	Total number of frames received with frame checksum errors
Receive Abort Frames	Total number of frames whose reception has been aborted
Byte De-stuffing Violations	Total number of byte destuffing violations detected during the processing of received frames
Receive Address Field Mismatch Counter	Total number of valid received LAPS frames with mismatching address field

Table 7-5. WAN Side Statistics – LAPS Encapsulation (Cont.)

Parameter	Description
Receive Control Field Mismatch Counter	Total number of valid received LAPS frames with mismatching control field
Receive SAPI Field Mismatch Counter	Total number of valid received LAPS frames with mismatching SAPI field

WAN Side Statistics – GFP Encapsulation

The two pages of a typical WAN side statistics screen for a virtually concatenated group using GFP encapsulation are shown in *Figure 7-41* and *Figure 7-42*.

The WAN side statistics parameters for groups using GFP encapsulation are described in *Table 7-6*.

```
                          FCD-155
...>Virtual Ports>VCAT>VCG 1>WAN Intervals>Current Interval

 1. Interval Number                    [0 - 96]... (0)
 2. Valid Intervals                    [0 - 96]... (7)
 3. Elapsed time                       ... (00:08:25)
 4. Number of Total Rx Frames          ... (0)
 5. Number of Total Tx Frames          ... (0)
 6. Rx Payload Max length violation    ... (0)
 7. FCS error                          ... (0)
 8. Receive Idle frame error           ... (0)
 9. Receive cHEC single bit error      ... (0)
10. Receive PTI mismatch               ... (0)
... (N)
>


C - Clear
ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
--------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

Figure 7-41. Typical WAN Side Statistics Screen – GFP Encapsulation (First Page)

```
                              FCD-155
...>Virtual Ports>VCAT>VCG 1>WAN Intervals>Current Interval

... (P)
11. Receive EXI mismatch                  ... (0)
12. Receive UPI mismatch                  ... (0)
13. Receive tHEC single bit error         ... (0)
14. Receive tHEC multi bit error          ... (0)
15. Receive CID mismatch                  ... (0)
16. Receive eHEC single bit error         ... (0)
17. Receive eHEC multi bit error          ... (0)


>


C - Clear
ESC-prev.menu; !-main menu; &-exit; @-debug                              1M/1C
-------------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

Figure 7-42. Typical WAN Side Statistics Screen – GFP Encapsulation (Second Page)

Table 7-6. WAN Side Statistics – GFP Encapsulation

Parameter	Description
Interval Number	The number of the 15-minute interval to be displayed, in the range of 1 to 96.
	To select a different interval, type **1** and then press ‹ **Enter** ›: you can then enter the desired interval number, up to the number displayed in the **Valid Intervals** field.
Valid Intervals	The number of intervals (up 96 intervals) for which performance monitoring information can be displayed.
Elapsed Time	The elapsed time (in seconds) since the beginning of the current interval, in seconds. The range is 1 to 900 seconds.
Start Time	The time at which the current interval was initiated, in accordance with the FCD-155 internal real-time clock.
	Since the FCD-155 time may not be coordinated with the network management station time, or they may be located in different time zones, you should compare the FCD-155 internal time (displayed by means of the **Configuration – System – Date & Time Update**) with the station time.
Number of Total Rx Frames	Total number of GFP frames received from the WAN
Number of Total Tx Frames	Total number of GFP frames transmitted to the WAN
Rx Payload Max Length violation	Total number of GFP frames received with payload fields exceeding the maximum allowed number of bytes
FCS Error	Total number of GFP frames received with frame checksum errors
Receive Idle Frame Error	Total number of GFP IDLE frames received with errors error

Table 7-6. WAN Side Statistics – GFP Encapsulation (Cont.)

Parameter	Description
Receive cHEC Single Bit Error	Total number of received GFP frames that are detected to have only single-bit errors in the GFP Core header (cHEC field)
Receive PTI Mismatch	Total number of received GFP frames with a mismatch in the PTI field (i.e., PTI value not corresponding to the Client Data or Management frame)
Receive EXI Mismatch	Total number of received GFP frames with a mismatch in the EXI field (i.e., value of EXI is not equal to NULL or LINEAR modes).
Receive UPI Mismatch	Total number of received GFP frames with a mismatch in the UPI field (i.e., EXI value not equal to 00000001).
Receive tHEC Single Bit Error	Total number of received GFP frames with single-bit errors only in the GFP Type header (tHEC field).
Receive tHEC Multi Bit Error	Total number of received GFP frames with multi-bit errors in the GFP Type header (tHEC field).
Receive CID Mismatch	Total number of received GFP frames with a mismatch or unsupported value in the GFP CID field
Receive eHEC Single Bit Error	Total number of received GFP frames with only single-bit errors in the GFP Extension header (eHEC field).
Receive eHEC Multi Bit Error	Total number of received GFP frames that are detected to only have multi-bit errors in the GFP Extension header (eHEC field).

Displaying LCAS Path Info Virtual Ports Parameters

Purpose

Display information on the LCAS status for the selected virtually concatenated group.

This information is displayed only for virtually concatenated groups configured to use LCAS.

Reached from

Monitoring›Virtual Ports›VCAT›VCG

A typical **LCAS Path Info** selection screen is shown in *Figure 7-43*.

```
                              FCD-155
Monitoring>Virtual Ports>VCAT>VCG 1>LCAS PATH info

 Index VC Number   Source State    Sink State
 0      L1 1:1:1      Add             Fixed
 1      L1 1:1:2      Add             Fixed
 2      L1 1:1:3      Add             Fixed

>


ESC-prev.menu; !-main menu; &-exit; @-debug ; ?-help                   1M/1C
----------------------------------------------------------------------------
```

Figure 7-43. Typical **LCAS Path Info** *Screen (FCD-155E)*

The parameters displayed by means of the **LCAS Path Info** screen are as follows:

Index
Displays the index number of the VC within the selected virtually concatenated group. The index number is automatically assigned.

VC Number
Identifies the position of the corresponding VC or VT within the STM-1 or STS-3 frame, using the **TUG-3:TUG-2:TU** format described in the *Port Identification* section starting on page *7-70*.

For FCD-155E, the VC Number also includes the identification of the link, **L1**, **L2**, or **L3**.

Source State
Displays the state of the corresponding VC or VT on the local end of the path serving the selected virtually concatenated group (that is, the end located on the FCD-155 to which the supervisory terminal is connected):

- **FIXED** – the end uses the fixed bandwidth (not LCAS)

- **ADD** – the corresponding VC or VT is about to be added to the virtually concatenated group

- **NORM** – normal transmission state

- **EOS** – end-of-sequence indication

- **IDLE** – the corresponding VC or VT is not part of the virtually concatenated group, or is about to be removed from the group

- **DNU** – *do not use* the corresponding VC or VT, for example, because the sink side reported a failure.

The state is correct at the time the command to display this screen has been received by the FCD-155.

Sink State
Same as above for the sink side (remote end of the path).

For each current parameter value, you can also see the allowed range of values.

Selecting a Physical Port for Monitoring – FCD-155 Versions

Purpose

Select the type of physical port for which monitoring information will be displayed.

Reached from

Monitoring>Physical Ports

The items appearing on the **Physical Ports** selection screen depend on the specific FCD-155 version:

- A typical **Physical Ports** submenu for an FCD-155 with SDH network interface is shown in *Figure 7-44*.

Note	- *Item **2 – LAN** is not included for FCD-155 with single Ethernet port.*
	- *Item **3 – PDH** is included only for FCD-155 units equipped with PDH interfaces.*

- A typical submenu for an FCD-155 with SONET network interface is shown in *Figure 7-45*.

```
                                  FCD-155
Monitoring>Physical Ports
 1. STM-1            >
 2. LAN              >
 3. PDH              >
 4. DCC Statistics   >


>


ESC-prev.menu; !-main menu; &-exit; @-debug                              1M/1C
-----------------------------------------------------------------------------
```

*Figure 7-44. Typical **Physical Ports** Submenu (FCD-155 with SDH Network Interface)*

```
                                  FCD-155
Monitoring>Physical Ports
 1. OC-3            >
 2. LAN             >
 3. PDH             >
 4. DCC Statistics >


>


ESC-prev.menu; !-main menu; &-exit; @-debug                              1M/1C
-----------------------------------------------------------------------------
```

*Figure 7-45. Typical **Physical Ports** Submenu (FCD-155 with SONET Network Interface)*

Selecting a Physical Port for Monitoring (FCD-155E)

Purpose

Select the type of physical port for which monitoring information will be displayed.

Reached from

Monitoring>Physical Ports

The items appearing on the **Physical Ports** selection screen depend on the specific FCD-155E version:

- A typical **Physical Ports** submenu for an FCD-155E with SDH network interface is shown in *Figure 7-46*.

- A typical submenu for an FCD-155E with SONET network interface is shown in *Figure 7-45*.

```
                             FCD-155E/APS
Monitoring>Physical Ports


 1. STM-1            >
 2. Ethernet         >
 3. E1/T1            >
 4. Station Clock    >
 5. Timing           >

>


ESC-prev.menu; !-main menu; &-exit; @-debug                           1M/1C
-----------------------------------------------------------------------------
```

*Figure 7-46. Typical **Physical Ports** Submenu (FCD-155E with SDH Network Interface and E1/T1 Ports)*

```
                             FCD-155E/APS
Monitoring>Physical Ports


 1. OC-3             >
 2. Ethernet         >
 3. E1/T1            >
 4. Station Clock    >
 5. Timing           >

>


ESC-prev.menu; !-main menu; &-exit; @-debug                           1M/1C
-----------------------------------------------------------------------------
```

*Figure 7-47. Typical **Physical Ports** Submenu (FCD-155E with SONET Network Interface and T1 Ports)*

➤ **To select the type of physical ports:**

Type the desired number and then press **‹Enter›**.

Displaying STM-1 or OC-3 Physical Ports Parameters (FCD-155)

Note

The following screens use the FCD-155 dual link version as examples.

Purpose

Display information on the optical interface characteristics and status, and performance monitoring statistics for the STM-1 or STS-3 physical port (in accordance with the network interface type used by the specific FCD-155 version).

The performance monitoring statistics are collected over 15-minute intervals, and up to 97 of the most current intervals are stored for retrieval. The performance monitoring information is lost when the FCD-155 is powered down.

Reached from

Monitoring›Physical Ports›STM-1 Port

A typical **Port** task selection screen is shown in *Figure 7-48.* The type of port, STM-1 or OC-3, is identified in the screen header (*Figure 7-48* shows an STM-1 screen). The number of links, 1 or 2, depends on the FCD-155 version.

```
                              FCD-155
Monitoring>Physical Ports>STM-1

 1. Link 1          >
 2. Link 2          >
 3. Port Status     >
 4. Port Statistics>


>


ESC-prev.menu; !-main menu; &-exit                               1M/1C
--------------------------------------------------------------------------
```

*Figure 7-48. Typical **STM-1 Port** Task Selection Screen (FCD-155)*

Selecting the Link Parameters Type

A typical **Link** information selection submenu is shown in *Figure 7-49*.

The submenu provides two options:

- **Port Status** – displays the status information retrieved from the SFP installed for the corresponding port.

- **Optical Parameters** – displays the current values of the optical parameters retrieved from the SFP installed for the corresponding port.

➤ **To select the type of link physical port information to be displayed:**

Type the desired number, **1** or **2,** in *Figure 7-48,* and then press **‹Enter›**.

```
                              FCD-155
Monitoring>Physical Ports>STM-1>Link 1


 1. Port Status        >
 2. Optical Parameters  >

>


ESC-prev.menu; !-main menu; &-exit                               1M/1C
--------------------------------------------------------------------------
```

*Figure 7-49. Typical **Link** Information Selection Submenu*

Displaying Link Port Status

➤ **To display the link port Optical Parameters screen:**

Type **1** in *Figure 7-49,* and then press **<Enter>**.

A typical link **Port Status** screen is shown in *Figure 7-50*. The information displayed on the screen is explained in *Table 7-7*.

Note

*If no SFP is inserted, you will see only **SFP not inserted**, without any information fields.*

```
                              FCD-155
...>Physical Ports>STM-1>Link 1>Port Status


    Connector Type      >   (LC)
    Manufacturer Name  ... (Infineon FO GmbH)
    Typical Max. Range ... (15 km)
    Wave Length        ... (1310 nm)
    Fiber Type         ... (SM)

>


ESC-prev.menu; !-main menu; &-exit; @-debug                     1M/1C
--------------------------------------------------------------------------
```

*Figure 7-50. Typical **Port Status** Screen (FCD-155E)*

*Table 7-7. STM-1 or OC-3 Link **Port Status** (Physical Ports) Parameters*

Parameter	Description
Connector Type	Displays the SFP connector type: **LC, SC, or FC**
Manufacturer Name	Displays the original manufacturer's name
Typical Max. Range	Displays the maximum range expected to be achieved over typical optical fibers, in km
Wave Length	Displays the nominal operating wavelength of the SFP, in nm
Fiber Type	Displays the type of optical fiber for which the SFP is optimized: **Single Mode** or **Multi Mode**

Displaying Link Port Optical Parameters

➤ **To display the link port Optical Parameters screen:**

Type **2** in *Figure 7-49,* and then press **‹Enter›**.

A typical link **Optical Parameters** screen is shown in *Figure 7-51*. The information displayed on the screen is explained in *Table 7-8*.

```
                             FCD-155
...>Physical Ports>STM-1>Link 1>Optical Parameters


    SFP Inserted         >   (Yes)
    Tx Power (dBm)       ... (-12)
    Rx Power (dBm)       ... (-10)
    Laser Bias (mA)      ... (27)
    Laser Temperature(C) ... (48)


>


ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
--------------------------------------------------------------------------
```

*Figure 7-51. Typical Link **Optical Parameters** Screen*

*Table 7-8. Typical Link **Optical Parameters***

Parameter	Description
SFP Inserted	Displays whether an SFP is installed in the port connector. If no SFP is inserted, the next fields are not displayed
Tx Power	The current optical power, in dBm, transmitted by the SFP
Rx Power	The current optical power, in dBm, received by the SFP
Laser Bias	The measured laser bias current, in mA
Laser Temperature	The measured laser temperature, in °C

Displaying Network Interface Status

➤ **To display the network interface Port Status screen:**

Type **3** in *Figure 7-49,* and then press **‹Enter›**.

A typical **Port Status** screen is shown in *Figure 7-52.* The type of port, STM-1 or OC-3, is identified in the screen header. The parameters displayed on the **Port Status** screen are explained in *Table 7-9*.

*Table 7-9. STM-1 or OC-3 **Port Status** (Physical Ports) Parameters*

Parameter	Description
Active Link	Displays the number of the network link that carries the traffic: **Link 1** or **Link 2** (may appear only for FCD-155 units with two network interfaces)
Link 1	Displays the status of network link 1: • **Normal** – normal operation • **Signal Loss** – loss of signal
Link 2	Same as **Link 1** for FCD-155 units with two network interfaces
Section Status	Displays the SDH or SONET section status: • **Normal** – normal operation • **LOS** – loss of signal • **LOF** – loss of frame alignment • **LOS and LOF** – loss of signal and loss of frame alignment
Line Status	Displays the SDH or SONET line (physical layer) status: • **Normal** – normal operation • **AIS** – reception of AIS (alarm indication signal) • **RDI** – reception of RDI (remote defect indication) • **AIS and RDI** – reception of AIS and RDI

```
                              FCD-155
Monitoring>Physical Ports>STM-1>Port Status


     Active Link   >    (Link 1)
     Link 1        >    (Normal)
     Link 2        >    (Normal)
     Section Status>    (Normal)
     Line Status   >    (Normal)

>


ESC-prev.menu; !-main menu; &-exit; @-debug                              1M/1C
------------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

*Figure 7-52. Typical STM-1 or OC-3 **Port Status** (Physical Ports) Screen*

Displaying Network Interface Port Statistics

➤ **To display the port statistics interval selection screen:**

1. Type **4** in *Figure 7-49,* and then press **‹Enter›**.

2. You will see the **Port Statistics** interval selection screen. The type of port, STM-1 or OC-3, is identified in the screen header. A typical **Port Statistics** interval selection screen is shown in *Figure 7-53*.

```
                              FCD-155
Monitoring>Physical Ports>STM-1>Port Statistics


 1. Current Interval>
 2. Select Interval >
 3. Total           >

>


ESC-prev.menu; !-main menu; &-exit                                      1M/1C
-----------------------------------------------------------------------------
```

Figure 7-53. Typical Interval Selection Screen

➤ **To display STM-1 or OC-3 port performance monitoring data for the current interval:**

1. Type **1** on the **Port Statistics** screen and then press **‹Enter›**.

2. You will see the **Current Interval** screen for an STM-1 or OC-3 port. A typical screen is shown in *Figure 7-54*. The items displayed for the current interval screen are explained in *Table 7-2*.

```
                              FCD-155
...>Physical Ports>STM-1>Port Statistics >Current Interval

 1. Interval Number [0 - 96]... (0)
 2. Valid Intervals [0 - 96]... (0)
 3. Elapsed time     ... (00:11:45)
 4. ES               ... (0)
 5. SES              ... (0)
 6. UAS(SEFS)        ... (705)
 7. CV               ... (0)


>


C - Clear
ESC-prev.menu; !-main menu; &-exit                                      1M/1C
-----------------------------------------------------------------------------
```

Figure 7-54. Typical **Current Interval** *Screen for STM-1 or OC-3 Physical Port*

➤ **To display STM-1 or OC-3 port performance monitoring data on a selected interval:**

Type **2** on the **Port Statistics** screen and then press **‹Enter›**.

➤ **To display totaled STM-1 or OC-3 port performance monitoring data:**

Type **3** on the **Port Statistics** screen and then press **‹Enter›**.

Displaying STM-1 or OC-3 Physical Ports Parameters (FCD-155E)

Purpose

Display information on the optical interface characteristics and status, protection status, and performance monitoring statistics for the STM-1 or OC-3 physical ports (in accordance with the network interface type used by the specific FCD-155E version).

The performance monitoring statistics are collected over 15-minute intervals, and up to 97 of the most current intervals are stored for retrieval. The performance monitoring information is lost when the FCD-155E is powered down.

Reached from

Monitoring>Physical Ports>STM-1

A typical **Port** task selection screen for FCD-155E version is shown in *Figure 7-55.* The type of port, STM-1 or OC-3, is identified in the screen header (*Figure 7-55* shows a screen for an STM-1 port).

```
                            FCD-155E/APS
Monitoring>Physical Ports>STM-1

 1. Link 1          >
 2. Link 2          >
 3. APS             >
 4. Path Protection>

>

ESC-prev.menu; !-main menu; &-exit                                1M/1C
------------------------------------------------------------------------
```

*Figure 7-55. Typical **STM-1** Task Selection Screen (FCD-155E)*

Displaying the Link Parameters

A typical **Link** information selection submenu is shown in *Figure 7-56*.

The submenu provides four options:

- **Port Status** – displays the status information retrieved from the SFP installed for the corresponding port. This screen is similar to the FCD-155 **Port Status** screen (*Figure 7-50* on page *7-42*).

- **Port Statistics** – displays the performance monitoring statistics for the selected port. This screen is similar to the FCD-155 **Port Statistics** screen (*Figure 7-53* on page *7-45*).

- **DCC Statistics** – displays the performance monitoring statistics for the DCC of the selected port. A typical screen is shown in *Figure 7-57*. Refer to page *7-65* for a description of the various parameters.

- **Optical Parameters** – displays the current values of the optical parameters retrieved from the SFP installed for the corresponding port. This screen is similar to the FCD-155 **Optical Parameters** screen (*Figure 7-51* on page *7-43*).

```
                              FCD-155E/APS
Monitoring>Physical Ports>STM-1>Link 1


 1. Port Status>
 2. Port Statistics>
 3. DCC  Statistics>
 4. Optical parameters>


>


ESC-prev.menu; !-main menu; &-exit                                      1M/1C
-------------------------------------------------------------------------------
```

*Figure 7-56. Typical **Link** Selection Screen (FCD-155E)*

```
                              FCD-155E/APS
Monitoring>Physical Ports>STM-1>Link 1>DCC  Statistics


    Rx Total Frames      ... (0)
    Rx Total Bytes       ... (0)
    Rx CRC Error         ... (0)
    Rx Dropped           ... (0)
    Tx Total Frames      ... (0)
    Tx Total Bytes       ... (0)


>


ESC-prev.menu; !-main menu; &-exit                                      1M/1C
-------------------------------------------------------------------------------
```

*Figure 7-57. Typical **DCC Statistics** Screen (FCD-155E)*

Displaying Network Interface APS Status

➤ **To display the network interface APS screen:**

Type **3** in *Figure 7-55,* and then press **‹Enter›**.

A typical **APS** screen is shown in *Figure 7-58.* The type of port, STM-1 or OC-3, is identified in the screen header.

```
                              FCD-155E/APS
Monitoring>Physical Ports>STM-1>APS


    APS Mode                 (1+1 uni-directional)
    Current Working Port     (Link 1)


>


ESC-prev.menu; !-main menu; &-exit                                      1M/1C
-------------------------------------------------------------------------------
```

*Figure 7-58. Typical Network Interface **APS** (Physical Ports) Screen*

The **Port Status** screen provides the following information:

APS   Displays the selected APS mode.

Current Working Port   Displays the current working port, **Link 1** or **Link 2.**

Displaying Path Protection Status

➤ **To display the network interface Path Protection screen:**

1. Type **4** in *Figure 7-55,* and then press **‹Enter›**.

   You will see a screen that displays the ports currently configured to use path
   protection. A typical **Path Protection** port selection screen is shown in
   Figure 7-59. The type of port, STM-1 or OC-3, is identified in the screen
   header.

```
                              FCD-155E/APS
Monitoring>Physical Ports>STM-1>Path Protection


 1. VCG 1
 2. VCG 2
 3. E1/T1

>

ESC-prev.menu; !-main menu; &-exit                                       1M/1C
-----------------------------------------------------------------------------
```

*Figure 7-59. Typical **Path Protection** Port Selection Screen (FCD-155E with E1/T1 Ports)*

2. Select the desired port, and then press **‹Enter›**:

   ▪ When you select **PDH**, the screen will display the path protection status
     for all the PDH ports

   ▪ For virtually concatenated groups, the screen will display the TUs assigned
     to the corresponding group and their mode.

   Figure 7-60 shows a **Path Protection** screen for PDH **(E1/T1)** ports, and
   Figure 7-61 shows a **Path Protection** screen for virtually concatenated groups.
   The **Path Protection** screen consists of a table with the following fields:

   Index   Automatically assigned entry index number.

   Working   Identifies the working TU: the number (**L**) of the link, followed by
                                the designation of the assigned TU (**TUG-3:TUG-2:TU-12**).

   Protection   Same information for the protection TU

   Mapped to   Indicates the virtually concatenated group, or PDH port type and
                                number, mapped to the path

```
                              FCD-155E/APS
Monitoring>Physical Ports>STM-1>Path Protection>E1/T1


 Index     Working               Protection            Payload
 1         L:TUG3:TUG2:TU12      L:TUG3:TUG2:TU12      E1-1
 2         L:TUG3:TUG2:TU12      L:TUG3:TUG2:TU12      E1-2
 3         L:TUG3:TUG2:TU12      L:TUG3:TUG2:TU12      E1-3
 4         L:TUG3:TUG2:TU12      L:TUG3:TUG2:TU12      E1-4


>


ESC-prev.menu; !-main menu; &-exit                                    1M/1C
------------------------------------------------------------------------------
```

*Figure 7-60. Typical **Path Protection** Screen for PDH **(E1/T1)** Ports (FCD-155E)*

```
                              FCD-155E/APS
Monitoring>Physical Ports>STM-1>Path Protection>VCG1


 Index     Working               Protection            Payload
 1         L:TUG3:TUG2:TU12      L:TUG3:TUG2:TU12      VCG1
 2         L:TUG3:TUG2:TU12      L:TUG3:TUG2:TU12      VCG1
 3         L:TUG3:TUG2:TU12      L:TUG3:TUG2:TU12      VCG1
 4         L:TUG3:TUG2:TU12      L:TUG3:TUG2:TU12      VCG1


>


ESC-prev.menu; !-main menu; &-exit                                    1M/1C
------------------------------------------------------------------------------
```

*Figure 7-61. Typical **Path Protection** Screen for **VCG** Ports (FCD-155E)*

Selecting an Ethernet LAN (Physical Ports) for Monitoring

Purpose

Select an Ethernet LAN port for display of performance monitoring statistics.

Statistics can be displayed only for enabled (active) ports.

Note   *This screen is not available for the FCD-155 with single Ethernet port.*

Reached from

Monitoring>Physical Ports>LAN

A typical **LAN** port selection screen for a FCD-155 is shown in *Figure 7-62* (for FCD-155E, the header shows **Ethernet**). The number of Ethernet LAN ports displayed on the screen corresponds the number of Ethernet LAN ports installed on the FCD-155 unit (2, 3 or 6).

```
                              FCD-155
Monitoring>Physical Ports>LAN

 1.  Port1     >
 2.  Port2     >
 3.  Port3     >
 4.  Port4     >
 5.  Port5     >
 6.  Port6     >

>


ESC-prev.menu; !-main menu; &-exit @ - output                         1M/1C
--------------------------------------------------------------------------
```

*Figure 7-62. Typical Ethernet **LAN** (Physical Ports) Port Selection Screen (FCD-155 with 6 LAN Ports)*

➤ **To select an Ethernet LAN port for display of performance monitoring statistics:**

Type its number and then press **‹Enter›**.

Displaying Port (Ethernet LAN Physical Ports) Parameters

Purpose

Display performance monitoring information for the selected Ethernet LAN physical port.

Note   *This screen is not available for the FCD-155 with single Ethernet port.*

Statistics can be displayed only for enabled ports: if the LAN port is not enabled, its monitoring display is empty.

The information is accumulated continuously while the FCD-155 operates, and is automatically refreshed every few seconds. The performance monitoring information is lost when the FCD-155 is powered down.

Reached from

Monitoring›Physical Ports›LAN

A typical **Port** task selection screen is shown in *Figure 7-63.* The selected port is identified in the screen header. The selections available on the screen depend on the port type: **Port Status** and **LAN Counters** are displayed for all the Ethernet LAN ports, whereas **SFP Parameters** is displayed only for a GbE port and **Traffic Rate** is displayed for non-GbE ports.

```
                              FCD-155
Monitoring>Physical Ports>LAN>Port1


  1. Port Status     >
  2. Lan Counters    >
  3. SFP Parameters >

>



ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
--------------------------------------------------------------------------
```

*Figure 7-63. Typical **LAN Port** Task Selection Screen (GbE Option)*

```
                              FCD-155
Monitoring>Physical Ports>LAN>Port1


  1. Port Status     >
  2. Lan Counters    >
  3. Traffic Rate    >

>



ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
--------------------------------------------------------------------------
```

*Figure 7-64. Typical **LAN Port** Task Selection Screen (LAN Port)*

➤ **To display the LAN port status:**

1. Type **1** in *Figure 7-63,* and then press **‹Enter›**.

2. You will see the **Port Status** screen for the selected Ethernet LAN port. Typical **Port Status** screens are shown in *Figure 7-65.*

The parameters displayed on the **Port Status** screen are explained in *Table 7-10*.

```
                              FCD-155
...>Physical Ports>LAN>Port1>Port Status


    Status>    (Up)
    Rate  >    (100 Mbps Full Duplex)

>


ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
--------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

A. 10/100 Mbps LAN Port

```
                               FCD-155
...>Physical Ports>LAN>GbE>Port Status


    Status             >    (Up)
    Rate               >    (1000 Mbps Full Duplex)
    Interface in use >     (Copper)

>


ESC-prev.menu; !-main menu; &-exit; @-debug                             1M/1C
-----------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

B. GbE Port Using Copper Interface

*Figure 7-65. Typical **Port Status** (Physical Ports) Screens*

*Table 7-10. **Port Status** (Physical Ports) Parameters*

Parameter	Description
Status	Displays the LAN port status: • **Up** – the port is connected to a LAN and operating normally • **Down** – the port does not carry traffic, e.g., because it is not connected to an active LAN
Rate	Displays the port current rate and mode: • **10Mbps half duplex** – Half-duplex operation at 10 Mbps. • **10Mbps full duplex** – Full-duplex operation at 10 Mbps. • **100Mbps half duplex** – Half-duplex operation at 100 Mbps. • **100Mbps full duplex** – Full-duplex operation at 100 Mbps. • **1000Mbps half duplex** – Half-duplex operation at 1000 Mbps (only for GbE port). • **1000Mbps full duplex** – Full-duplex operation at 1000 Mbps (only for GbE port).
Interface in Use	Displays the currently active interface of the GbE port: • **Copper** – 10/100/1000 Mbps copper interface. • **Fiber** – Optional optical interface.

➤ **To display the LAN port counters:**

1. Type **2** in *Figure 7-63,* and then press **‹Enter›**.

2. You will see the **LAN Counters** screen for the selected LAN port. For ETH ports 1 and 2, the **LAN Counters** screen includes a large number of items and therefore it consists of two pages:

   ▪ To continue from the first page to the second page, type **n** (next)

   ▪ To return from the second page to the first page, type **p** (previous).

   Typical **LAN Counters** screens are shown in *Figure 7-66* and *Figure 7-67.*

   The information displayed on the screen, which is accumulated continuously, is automatically refreshed every few seconds.

You can clear the displayed statistics (that is, reset the displayed performance monitoring counters) by typing **C**. The counters are also reset when the FCD-155 is powered up.

The performance monitoring counters displayed on the **LAN Counters** screen are explained in *Table 7-11*. In addition to these counters, you can also read the time (as retrieved from the FCD-155 internal real-time clock) at which the counters have been last reset.

```
                              FCD-155
...>Physical Ports>LAN>Port1>Lan Counters


    Rx Total Frames      ... (0)          Tx Unicast Frames    ... (0)
    Rx Unicast Frames    ... (0)          Tx Broadcast Frames  ... (0)
    Rx Broadcast Frames  ... (0)          Tx Multicast Frames  ... (0)
    Rx Multicast Frames  ... (0)          Tx Total Bytes       ... (0)
    Rx Total Bytes       ... (0)          Excessive Collision  ... (0)
    Rx Pause Frames      ... (0)          Multiple Collision   ... (0)
    Rx Filtered          ... (0)          Single Collision     ... (0)
    Rx Dropped           ... (0)          Late Collision       ... (0)
    Rx Jabber Frames     ... (0)          Total Collision      ... (0)
    Rx Invalid CRC Frames... (0)          ...
    Tx Total Frames      ... (0)          Rx Fragment Frames   ... (0)
... (N)
>


C - Clear
ESC-prev.menu; !-main menu; &-exit; @-debug                           1M/1C
--------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

A. First Page

```
                              FCD-155
...>Physical Ports>LAN>Port1>Lan Counters


... (P)
    Rx 64b Frames        ... (0)          Rx 512b-1023b Frames... (0)
    Rx 65b-127b Frames   ... (0)          Rx 1024b-max Frames ... (0)
    Rx 128b-255b Frames ... (0)           Last Reset Time...(0 day 07:41:36)
    Rx 256b-511b Frames ... (0)


>


C - Clear
ESC-prev.menu; !-main menu; &-exit; @-debug                           1M/1C
--------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

B. Second Page

*Figure 7-66. Typical **LAN Counters** (Physical Ports) Screens for LAN Ports 1 and 2*

```
                              FCD-155
...>Physical Ports>LAN>GbE>Lan Counters


    Rx Total Frames        ... (0)          Tx Unicast Frames      ... (0)
    Rx Unicast Frames      ... (0)          Tx Non Unicast Frames... (0)
    Rx Broadcast Frames    ... (0)          Tx Total Bytes         ... (0)
    Rx Multicast Frames    ... (0)          Excessive Collision    ... (0)
    Rx Total Bytes         ... (0)          Multiple Collision     ... (0)
    Rx Correct Frames      ... (0)          Single Collision       ... (0)
    Rx Filtered            ... (0)          Late Collision         ... (0)
    Rx Dropped             ... (0)          Total Collision        ... (0)
    Rx Jabber Frames       ... (0)          ...
    Rx Invalid CRC Frames... (0)            Rx Fragment Frames     ... (0)
    Tx Total Frames        ... (0)



C - Clear
ESC-prev.menu; !-main menu; &-exit; @-debug                            1M/1C
----------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

*Figure 7-67. Typical **LAN Counters** (Physical Ports) Screen for GbE Port*

*Table 7-11. **LAN Counters** (Physical Ports) Performance Monitoring Statistics*

Parameter	Description
Rx Total Frames	Total number of frames received through the corresponding LAN port
Rx Unicast Frames	Total number of good unicast frames received through the corresponding LAN port
Rx Broadcast Frames	Total number of good broadcast frames received through the corresponding LAN port
Rx Multicast Frames	Total number of good multicast frames received through the corresponding LAN port
Rx Pause Frames	Total number of **pause** frames (used for flow control) received through the corresponding LAN port
Rx Correct Frames	Total number of good frames received through the corresponding LAN port
Rx Total Bytes	Total number of data octets carried by all frames received through the corresponding LAN port
Rx Filtered (not supported by ports 3 to 6)	If the QoS criteria based on IEEE 802.1Q are not used on this port: Total valid frames received that are not forwarded to a destination port. These are frames for which there is no destination port, or are not forwarded due to the state of the port. Valid frames discarded due to lack of buffer space are not included. If the QoS criteria based on IEEE 802.1Q are used on this port: Total valid frames received (tagged or untagged) that were discarded because of unknown VLAN ID

*Table 7-11. **LAN Counters** (Physical Ports) Performance Monitoring Statistics (Cont.)*

Parameter	Description
Rx Dropped	Total number of valid frames received by the corresponding LAN port that have been discarded because of a lack of buffer space. This includes frames discarded at ingress, as well as those dropped due to priority and congestion considerations at the output queues.
	Frames dropped at egress due to excessive collisions are not included in this count, but are counted by the **Excessive Collision** counter
Rx Jabber Frames	Total number of frames received by the corresponding LAN port during jabber (such frames are frames with a data field length exceeding 1518 or 1536 bytes, and also having invalid CRC)
Rx Invalid CRC Frames	Total number of frames received by the corresponding LAN port which met the following conditions:
	• Frame data length is between 64 bytes, and 1518 or 1536 bytes (depending on mode)
	• Frame has invalid CRC
	• Collision event has not been detected
	• Late collision event has not been detected
Tx Total Frames	Total number of good frames transmitted by the corresponding LAN port
Tx Unicast Frames	Total number of good unicast frames transmitted by the corresponding LAN port
Tx Broadcast Frames	Total number of good broadcast frames transmitted by the corresponding LAN port
Tx Multicast Frames	Total number of good multicast frames transmitted by the corresponding LAN port
Tx Total Bytes	Total number of data octets carried by all the good frames transmitted by the corresponding LAN port
Excessive Collision	Total number of frames not transmitted by the corresponding LAN port, because the frame experienced 16 retransmission attempts and therefore has been discarded
Multiple Collision	Total number of frames successfully transmitted by the corresponding LAN port that experienced more than one collision
Single Collision	Total number of frames successfully transmitted by the corresponding LAN port that experienced exactly one collision.
Late Collision	Total number of times a collision at the corresponding LAN port has been detected later than 512 bit-times into the transmission of a frame
Total Collision	Total number of collisions detected at the corresponding LAN port

*Table 7-11. **LAN Counters** (Physical Ports) Performance Monitoring Statistics (Cont.)*

Parameter	Description
Rx Fragment Frames	Number of fragmented frames received at the corresponding LAN port (a fragmented frame is a frame with a data field length less than 64 bytes and invalid CRC, for which no collision event and no late collision event have not been detected during its reception)
Rx 64b Frames (not supported by ports 3 to 6)	Total number of 64-byte frames received through the corresponding LAN port
Rx Frames 65b-127b (not supported by ports 3 to 6)	Total number of frames with size of 65 to 127 bytes received through the corresponding LAN port
Rx Frames 128b-255b (not supported by ports 3 to 6)	Total number of frames with size of 65 to 127 bytes received through the corresponding LAN port
Rx Frames 256b-511b (not supported by ports 3 to 6)	Total number of frames with size of 256 to 511 bytes received through the corresponding LAN port
Rx Frames 512b-1023b	Total number of frames with size of 512 to 1023 bytes received through the corresponding LAN port
Rx Frames 1024b-max	Total number of frames with size of 1024 up to 1518 or 1536 bytes received through the corresponding LAN port

➤ **To display the SFP Parameters of a GbE port:**

Type **3** in *Figure 7-63,* and then press **‹Enter›**.

A typical **SFP Parameters** task selection screen is shown in *Figure 7-69.* The selected port is identified in the screen header. Use the procedure described in the *Selecting the Link Parameters Type* section on page *7-41* to read the SFP parameters.

```
                           FCD-155E
...>Physical Ports>LAN>Port1>SFP Parameters

 1. Port Status        >
 2. Optical Parameters >

>

ESC-prev.menu; !-main menu; &-exit; @-debug                        1M/1C
----------------------------------------------------------------------------
```

*Figure 7-68. Typical **SFP Parameters** Screen for GbE Port*

➤ **To display the Traffic Rate Parameters of a LAN port:**

Type **3** in *Figure 7-64,* and then press **‹Enter›**.

A typical Traffic Rate screen is shown in *Figure 7-69.* The current and maximum transmit and receive rates are displayed in kbps.

```
                              FCD-155E
...>Physical Ports>LAN>Port1> Traffic Rate


     Maximum Rx Traffic (Kbps)... (0)
     Current Rx Traffic (Kbps)... (0)
     Maximum Tx Traffic (Kbps)... (0)
     Current Tx Traffic (Kbps)... (0)


>


ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
--------------------------------------------------------------------------
```

Figure 7-69. Typical Traffic Rate Screen for LAN Port

Displaying PDH (E1, T1, E3 or T3 Physical Ports) Parameters

Purpose

Display the performance monitoring statistics for the PDH ports. The displayed
parameters depend on the PDH port type: E1, T1, E3 or T3.

Statistics can be displayed only for enabled ports: if the selected PDH port is not
enabled, its monitoring display is empty.

The information is accumulated continuously while the FCD-155 operates, and is
automatically refreshed every few seconds. The performance monitoring
information is lost when the FCD-155 is powered down.

Reached from

Monitoring>Physical Ports>PDH

FCD-155 with E1 or T1 PDH Ports

A typical **PDH** port selection screen for an FCD-155 with 4 E1 or 4 T1 interfaces is
shown in *Figure 7-70*. The screen for an FCD-155 with 8 E1 or T1 interfaces is
similar, except that the number of ports is 8.

For FCD-155E, the header specifies the ports type installed on the unit, that is,
E1/T1 or **E3/T3**.

```
                              FCD-155
Monitoring>Physical Ports>PDH

 1. Port1    >
 2. Port2    >
 3. Port3    >
 4. Port4    >


>


ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
--------------------------------------------------------------------------
```

*Figure 7-70. Typical E1 or T1 **PDH** Port Selection Screen (FCD-155E with 4 Ports Option)*

➤ **To select an E1 or T1 PDH port for display of performance monitoring statistics:**

1. Type the corresponding item number, and then press ‹ **Enter** ›.

2. You will see the **PDH** port statistics interval selection screen. A typical interval selection screen is shown in *Figure 7-71*.

```
                              FCD-155
Monitoring>Physical Ports>PDH>Port 1

 1. Current Interval>
 2. Select Interval >
 3. Total           >

>

ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
---------------------------------------------------------------------------

```

*Figure 7-71. Typical **PDH** Port Interval Selection Screen*

➤ **To display E1 or T1 PDH physical port performance monitoring data for the current interval:**

1. Type **1** and then press ‹ **Enter** ›.

2. You will see the **Current Interval** performance monitoring screen for the selected PDH port. Typical **PDH** screens for E1 ports are shown in *Figure 7-72*, and screens for T1 ports are shown in *Figure 7-73*. The selected port is identified in the screen header.

The information displayed on the screen, which is accumulated continuously, is automatically refreshed every few seconds.

You can clear the displayed statistics (that is, reset the displayed performance monitoring counters) by typing **C**. The counters are also reset when the FCD-155 is powered up.

The performance monitoring counters displayed on the E1 PDH **Port** screens are explained in *Table 7-2*, and those displayed on the T1 PDH **Port** screens are explained in *Table 7-12*. In addition to these counters, you can also read the time (as retrieved from the FCD-155 internal real-time clock) at which the counters have been last reset.

```
                                 FCD-155
...>Physical Ports>PDH>Port 1>Current Interval


 1. Interval Number [0 - 96]... (0)
 2. Valid Intervals [0 - 96]... (6)
 3. Elapsed time     ... (00:07:38)
 4. Start Time       ... (00:00:00)
 5. ES               ... (0)
 6. SES              ... (0)
 7. UAS(SEFS)        ... (0)
 8. CV               ... (0)

>


C - Clear
ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
--------------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

A. 4 E1 Ports

```
                                 FCD-155
...>Physical Ports>PDH>Port 1>Current Interval


 1. Interval Number [0 - 96]... (0)
 2. Valid Intervals [0 - 96]... (48)
 3. Elapsed time     ... (00:00:00)
 4. UAS              ... (0)
 5. LES              ... (0)

>


C - Clear
ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
--------------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

B. 8 E1 Ports

*Figure 7-72. Typical **Port** Performance Monitoring Screen for E1 PDH Physical Ports*

```
                                FCD-155
...>Physical Ports>PDH>Port 1>Current Interval


 1. Interval Number [0 - 96]... (0)
 2. Valid Intervals [0 - 96]... (16)
 3. Elapsed time    ... (00:10:30)
 4. UAS             ... (630)
 5. LES             ... (0)


>


C - Clear
ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
----------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

A. 4 T1 Ports

```
                                FCD-155
...>Physical Ports>PDH>Port 1>Current Interval


 1. Interval Number [0 - 96]... (0)
 2. Valid Intervals [0 - 96]... (48)
 3. Elapsed time    ... (00:00:00)
 4. UAS             ... (0)
 5. LES             ... (0)


>


C – Clear
ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
----------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

B. 8 T1 Ports

*Figure 7-73. Typical **Port** Performance Monitoring Screen for T1 PDH Physical Ports*

Table 7-12. T1 PDH Physical Port Performance Monitoring Data

Parameter	Description
Interval Number	The number of the 15-minute interval to be displayed, in the range of 1 to 96.
	The default value is **0** (zero), which designates the current interval. However, you can also select another interval, by typing **1** and then pressing <**Enter**>: you can then enter the desired interval number, up to the number displayed in the **Valid Intervals** field.
Valid Intervals	The number of intervals (up 96 intervals) for which performance monitoring information can be displayed.
Elapsed Time	The elapsed time (in seconds) since the beginning of the current interval, in seconds. The range is 1 to 900 seconds.
LES	Displays the number of Line Error Seconds (LES) in the current interval.
	A LES is any second during which one or more line code violation events have occurred.

Parameter	Description
UAS	Displays the number of unavailable seconds (UAS) in the current interval. An unavailable second is any second in which one or more Signal Loss or AIS defects have been detected.

➤ **To display E1 or T1 PDH port performance monitoring data on a selected interval:**

1. Type **2** on the E1 or T1 **PDH** port statistics interval selection screen, and then press ‹**Enter**›.

2. You will see the **Select Interval** performance monitoring screen for the PDH port. This screen is similar to the screens for the current interval, shown in *Figure 7-72* and *Figure 7-73*, respectively, except for its header, **Select Interval**.

3. Select the desired interval, by typing **1** and pressing ‹**Enter**›: you can then enter the desired interval number, up to the number displayed in the **Valid Intervals** field.

4. After pressing ‹**Enter**›, the data displayed on the screen is updated in accordance with your selection.

➤ **To display totaled E1 or T1 PDH port performance monitoring data:**

1. Type **3** on the E1 or T1 **PDH** port statistics interval selection screen and then press ‹**Enter**›.

2. You will see the **Total** performance monitoring screen for the selected PDH port. This screen is similar to the screens for the current interval, shown in *Figure 7-72* and *Figure 7-73*, respectively, except for its header, **Total**, and the number of the 15-minute intervals to be displayed, which is by default **97**, which means *all the intervals*.

   However, you can also select a specific interval for display (the same result as selecting **Select Interval**):

   ▪ Type **1** on the screen shown in *Figure 7-72* or *Figure 7-73* and then press ‹**Enter**›.

   ▪ Now type the desired interval number, up to the number displayed in the **Valid Intervals** field, and then press ‹**Enter**›.

FCD-155 with E3 or T3 PDH Ports

A typical **PDH** port selection screen for an FCD-155 with E3 or T3 port is shown in *Figure 7-74.*

```
                            FCD-155
Monitoring>Physical Ports>PDH

 1. Port1     >

>

ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
--------------------------------------------------------------------------
```

*Figure 7-74. Typical E3 or T3 **PDH** Port Selection Screen*

➤ **To select the E3 or T3 PDH port for display of performance monitoring statistics:**

1. Type **1** on the screen shown in *Figure 7-74* and then press ‹ **Enter** ›.

2. You will see the E3 or T3 **PDH** port statistics interval selection screen. A typical interval selection screen is shown in *Figure 7-75.*

```
                            FCD-155
Monitoring>Physical Ports>PDH>Port 1

 1. Current Interval>
 2. Select Interval >
 3. Total           >

>

ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
--------------------------------------------------------------------------
```

*Figure 7-75. Typical E3 or T3 **PDH** Port Interval Selection Screen*

➤ **To display E3 or T3 PDH physical port performance monitoring data for the current interval:**

1. Type **1** and then press ‹ **Enter** ›.

2. You will see the **Current Interval** performance monitoring screen for the selected PDH port. A typical **PDH** screen for E3 or T3 ports is shown in *Figure 7-76.*

```
                           FCD-155
...>Physical Ports>PDH>Port 1>Current Interval


 1. Interval Number [0 - 96]... (0)
 2. Valid Intervals [0 - 96]... (16)
 3. Elapsed time     ... (00:10:30)
 4. UAS              ... (630)
 5. LES              ... (0)


>


C - Clear
ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
-------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

*Figure 7-76. Typical **Port** Performance Monitoring Screen for E3 or T3 PDH Physical Ports*

The information displayed on the screen, which is accumulated continuously, is automatically refreshed every few seconds.

You can clear the displayed statistics (that is, reset the displayed performance monitoring counters) by typing **C**.

The statistics displayed on the E3 or T3 PDH **Port** screen are explained in *Table 7-12*.

➤ **To display E3 or T3 PDH port performance monitoring data on a selected interval:**

1. Type **2** on the E3 or T3 **PDH** port statistics interval selection screen, and then press **‹Enter›**.

2. Use the procedure described above for E1 or T1 PDH ports.

➤ **To display totaled E1 or T1 PDH port performance monitoring data:**

1. Type **3** on the E1 or T1 **PDH** port statistics interval selection screen and then press **‹Enter›**.

2. Use the procedure described above for E1 or T1 PDH ports.

Displaying Station Clock (Physical Ports) Parameters (FCD-155E)

Purpose

Display the station clock physical port parameters. This function is supported only for the FCD-155E .

Reached from

Monitoring›Physical Ports›Station Clock

A typical **Station Clock** screen is shown in *Figure 7-77.*

```
                                FCD-155E/APS
Monitoring>Physical Ports>Station Clock


    Status      >   (Normal)
    Cable Type >   (Balance)


>


ESC-prev.menu; !-main menu; &-exit; @-debug                              1M/1C
-----------------------------------------------------------------------------
```

*Figure 7-77. Typical **Station Clock** Screen (FCD-155E)*

The screen consists of a table with the following fields:

Status	Displays the station clock status:
	• **Normal** – normal operation
	• **Loss of Signal** – the receive clock signal is missing.
Cable Type	Displays the cable connected to the station clock connector:
	• **Balance** – the connected cable is intended for operation with the balanced interface
	• **Unbalance** – the connected cable is intended for operation with unbalanced interface.

Displaying Timing Subsystem (Physical Ports) Parameters (FCD-155E)

Purpose

Display information on the operating mode of the FCD-155E timing subsystem.

Reached from

Monitoring>Physical Ports>Timing

A typical **Timing** screen is shown in *Figure 7-78.* The parameters displayed on the screen are explained in *Table 7-13*.

```
                               FCD-155E/APS
Monitoring>Physical Ports>Timing


    Tx Clock Source >    (INTERNAL)
    Holdover         >   (No)
 1. Port             >   (LINK 1)
 2. Rx SSM           >   (SEC)
 3. Tx SSM           >   (SEC)


>


ESC-prev.menu; !-main menu; &-exit; @-debug                              1M/1C
-----------------------------------------------------------------------------
```

*Figure 7-78. Typical **Timing** Screen (FCD-155E)*

*Table 7-13. **Timing** Parameters*

Parameter	Function
Tx Clock Source	Displays the nodal transmit clock reference
Holdover	Indicates whether the nodal timing generation circuit is in the hold-over mode. The hold-over mode is used when the circuit cannot use an external timing reference signal
Port	Used to select a port (**Link 1**, **Link 2** or **Station**), to display its SSM.
RX SSM	Displays the SSM carried by the received signal of the selected port. To view the list of supported SSM, type **2: RX SSM**
TX SSM	Displays the SSM inserted by the selected port in the transmit signal. To view the list of supported SSM, type **3: TX SSM**

Displaying Physical Ports DCC Statistics Parameters

Purpose

Display the performance monitoring statistics for the DCC.

This option is relevant only when the FCD-155 uses inband management.

The information is accumulated continuously while the FCD-155 operates, and is automatically refreshed every few seconds. The performance monitoring information is lost when the FCD-155 is powered down.

Reached from

Monitoring›**Physical Ports**›**DCC Statistics**

➤ **To display the DCC performance monitoring statistics:**

1. Type **3** or **4** on the **Physical Ports** submenu and then press **‹Enter›**.

2. You will see the **DCC Statistics** screen. A typical screen is shown in *Figure 7-79*.

The information displayed on the screen, which is accumulated continuously, is automatically refreshed every few seconds.

The statistics displayed on the **DCC Statistics** screen are explained in *Table 7-14*.

```
                          FCD-155
Monitoring>Physical Ports>DCC Statistics


    Rx Total Frames... (0)
    Rx Total Bytes ... (0)
    Rx CRC Error   ... (0)
    Rx Dropped     ... (0)
    Tx Total Frames... (8)
    Tx Total Bytes ... (104)


>


ESC-prev.menu; !-main menu; &-exit; @-debug                              1M/1C
------------------------------------------------------------------------------
Automatic Refresh Is Activated !
```

*Figure 7-79. Typical **DCC Statistics** Screen*

*Table 7-14. **DCC Statistics** Performance Monitoring Statistics*

Parameter	Description
Rx Total Frames	Total number of management packets received through the DCC
Rx Total Bytes	Total number of data octets carried by all the management packets received through the DCC
Rx CRC	Total number of management packets with invalid CRC received through the DCC
Rx Dropped	Total number of valid management packets received through the DCC that have been discarded because of a lack of buffer space. This includes frames discarded at ingress, as well as those dropped due to priority and congestion considerations at the output queues
Rx Total Frames	Total number of management packets transmitted through the DCC
Rx Total Bytes	Total number of data octets carried by all the management packets transmitted through the DCC

7.2   Detecting Errors

The FCD-155 includes an extensive subsystem that continuously checks the validity of the user's configuration activities and reports any conflicts and errors.

All the events detected by this subsystem are displayed in an event log.

Handling Error ("Sanity") Messages

Displaying Sanity Errors and Warnings

➤ **To display the list of sanity errors:**

1. Type **4** and then press **‹Enter›**.

2. You will see the **Display Sanity** task selection screen. A typical screen is shown in *Figure 7-80*.

```
                              FCD-155
Monitoring>System>Display Sanity

 1. Errors and Warnings[]

>

ESC-prev.menu; !-main menu; &-exit; @-debug                              1M/1C
-----------------------------------------------------------------------------
```

*Figure 7-80. Typical **Display Sanity** Task Selection Screen*

3. Type **1** and then press **‹Enter›**.

4. You will see the **Errors and Warnings** screen. A typical screen is shown in *Figure 7-81*.

```
                              FCD-155
Monitoring>System>Display Sanity>Errors and Warnings

 Index Port    Description
 1     GRP-01  ERROR  (020):ASSIGNMENT/NUMBER OF VC MISMATCH

>

ESC-prev.menu; !-main menu; &-exit; @-debug ; ?-help                     1M/1C
-----------------------------------------------------------------------------
```

*Figure 7-81. Typical **Errors and Warnings** Screen*

The information appearing on the **Errors and Warnings** screen is organized as a table with the following columns:

Index   Sequence number, automatically assigned.

Port   Identifies the FCD-155 physical or virtual port for which the error or warning has been detected. See the *Port Identification* section below.

Description   Text string that identifies the type (error or warning), the unique code, and a concise description of the alarm condition or event. Refer to *Table 7-15* for a description of sanity error codes.

After an error or warning condition is corrected, it is automatically removed from the screen.

Interpreting the Error ("Sanity") Messages

Table 7-15 lists the error messages generated by FCD-155 and explains their interpretation (these messages are often referred to as "sanity errors", because they are detected by the so-called sanity check automatically performed to confirm correct selection of parameters during FCD-155 configuration).

The messages are listed in ascending order of their codes.

Table 7-15. Error Messages

Code	Syntax	Meaning
0	LAST CHANGES NEED RESET	You must reset the FCD-155 for the new configuration changes to take effect.
1	Reserved for future use	N/A
2	INVALID MASTER CLOCK SOURCE	The port selected as master clock source is not connected. Check and correct as required
3	INVALID FALLBACK CLOCK SOURCE	The port selected as fallback clock source is not connected. Check and correct as required
4 to 10	Reserved for future use	N/A
11	BAD SUBNET MASK	The IP subnet mask must be compatible with the associated IP address, and must comprise a consecutive string of "1", followed by a string of "0"
12	BAD GATEWAY	The IP address of the gateway must be within the IP subnet of the IP port using the gateway
13 to 19	Reserved for future use	N/A
20	ASSIGNMENT/NUMBER OF VC MISMATCH	Mapping problem: the number of VCs or VTs assigned to a group or port during mapping does not match the number specified during the definition of the corresponding group
21 to 27	Reserved for future use	N/A
28	WRONG GFP MUX SCHEDULING	When using GFP multiplexing, the sum of the assigned bandwidth percentages defined for the GFP group members exceeds 100%
29	MUXED GROUP MUST USE GFP ENCAPSULATION	When using GFP multiplexing, all the groups defined as GFP mux members must be configured to use GFP encapsulation
30	CID MUST BE DIFFERENT IN GFP MUX MEMBERS	When using GFP multiplexing, each group configured as a GFP mux member must be assigned a unique channel ID (CID) number

Table 7-15. Error Messages (Cont.)

Code	Syntax	Meaning
31	SECONDARY MUX MEMBER MUST NOT BE MAPPED	When using GFP multiplexing, only the group defined as primary group can be mapped. It is not allowed to map groups configured as secondary GFP mux members
32	MUX GROUP CAN'T BE DUPLICATED	The specified group is configured as a member of more than one GFP mux group
33	VCAT NUMBER OF VCS LIMITED TO 64	The maximum number of virtual containers (VC-11, VC-12, or VT-1.5) that can be used by one virtually concatenated group cannot exceed 64
34	VLAN TAG IGNORED BECAUSE UNAWARE MODE	When the VLAN MODE is UNAWARE, the VLAN tags are ignored. This warning message notifies you that the configuration database includes VLANs: but the VLAN data will be ignored, because the FCD-155 does not support VLANs in this mode. The VLAN configuration data is not removed from the database, and therefore becomes effective again when the VLAN mode is changed to AWARE
35	MAX ETHERNET CAPACITY OVERFLOW	The payload routed to the internal Ethernet bus of an FCD-155E exceeds its capacity (the excess payload cannot be mapped). Check and correct the number and bandwidth of the virtually concatenated groups
36	MIX OF VC11/VC12 ON SAME TUG3 IS ILLEGAL	A TUG-3 can multiplex only one type of VCs (either VC-11s or VC-12s). Therefore, when using the SDH network interface on an FCD-155 with T1 ports, it is not allowed to map VCGs to a TUG-3 that carries PDH traffic, because T1 ports are transported in VC-11s, whereas VCGs are mapped in VC-12s

Display Information on Remote Agents

➤ **To display information on the remote agents learned by the FCD-155 management agent:**

1. Type **5** and then press **‹Enter›**.

2. You will see the **Remote Agents** screen. A typical **Remote Agents** screen is shown in *Figure 7-80*.

```
                                FCD-155
Monitoring>System>Remote Agents

 Index IP Address        Name        Phys Distance Log Distance
   1   172.21.208.24    RAD1          12              2

>


ESC-prev.menu; !-main menu; &-exit; @-debug ; ?-help                    1M/1C
----------------------------------------------------------------------------
```

*Figure 7-82. Typical **Remote Agents** Screen*

The information appearing on the **Remote Agents** screen is organized as a table with the following columns:

Index   Sequence number, automatically assigned.

IP Address   Displays the IP address of the remote agent.

Name   Displays the logical name of the remote agent.

Phys Distance   Displays the current number of hops in the path (through the management network) connecting the FCD-155 management agent to the corresponding remote agent.

Log Distance   Displays the logical distance (through the management network) to the remote agent. This parameter is a metric taken into consideration by routing protocols during the selection of optimal routes.

7.3   Port Identification

The various types of physical and virtual ports are identified as follows:

Link Port   **LINK** followed by its number, 1 or 2.

LAN Port   **ETH** followed by its number, 01 to 06.

VCG   **VCG** followed by its number, 01 to 08.

PDH Port   **E1**, **T1**, **E3**, or **T3** followed by its number, 01 to 04.

TU-11 or TU-12 Tributary	**TU** followed by its number. The number of the TU depends on the network interface type, and the VC carried by the TU:

- For TU-12 (SDH network interfaces) – refer to *Table 7-16*. For example, the VC-12 placed in tributary 1:3:6 is carried by TU-18.

- For TU-11 (SDH network interfaces) and VT-1.5 (SONET network interfaces) – refer to *Table 7-17*. For example, the VC-11 or VT-1.5 placed in tributary 2:1:4 is carried by TU-32.

TUG-3	**TUG3** followed by its number, 1, 2 or 3
VC-11, VC-12, VT-1.5	The position of the corresponding TU in the STM-1 or STS-3 frame, as listed in *Table 7-16* or *Table 7-17*, respectively.
VC-3 or STS-1	**TUG3** or **STS1** followed by its number: 1, 2 or 3.
VC-4 or STS-3	**VC4** or **STS3** .

Table 7-16. Identification of TU-12 Position in STM-1 Frame

TU Type	TUG-3 No. 1			TUG-3 No. 2			TUG-3 No. 3		
	TU 1	TU 2	TU 3	TU 1	TU 2	TU 3	TU 1	TU 2	TU 3
TUG-2 No. 1	1	2	3	22	23	24	43	44	45
TUG-2 No. 2	4	5	6	25	26	27	46	47	48
TUG-2 No. 3	7	8	9	28	29	30	49	50	51
TUG-2 No. 4	10	11	12	31	32	33	52	53	54
TUG-2 No. 5	13	14	15	34	35	36	55	56	57
TUG-2 No. 6	16	17	18	37	38	39	58	59	60
TUG-2 No. 7	19	20	21	40	41	42	61	62	63

Table 7-17. Identification of TU-11/VT-1.5 Position in STM-1/STS-3 Frame

TU Type	TUG-3 No. 1				TUG-3 No. 2				TUG-3 No. 3			
	TU 1	TU 2	TU 3	TU 4	TU 1	TU 2	TU 3	TU 4	TU 1	TU 2	TU 3	TU 4
TUG-2 No. 1	1	2	3	4	29	30	31	32	57	58	59	60
TUG-2 No. 2	5	6	7	8	33	34	35	36	61	62	63	64
TUG-2 No. 3	9	10	11	12	37	38	39	40	65	66	67	68
TUG-2 No. 4	13	14	15	16	41	42	43	44	69	70	71	72
TUG-2 No. 5	17	18	19	20	45	46	47	48	73	74	75	76
TUG-2 No. 6	21	22	23	24	49	50	51	52	77	78	79	80
TUG-2 No. 7	25	26	27	28	53	54	55	56	81	82	83	84

7.4　　　Handling Alarms

Alarm Collection and Reporting

Alarm Buffer

The FCD-155 continuously monitors critical signals and signal processing functions. In case a problem is detected, the FCD-155 generates time-stamped alarm messages that cover all the events. The time stamp is provided by an internal real-time clock.

For continuous system monitoring, the user can enable automatic transmission of alarm messages through the supervisory port. Alarm messages are also automatically sent as traps to the user-specified network management stations.

Internally, the FCD-155 stores alarms in an alarm buffer. This alarm buffer can store up to 255 alarm messages, together with their time stamps. The alarm history buffer is organized as a FIFO queue, therefore after 255 alarms are written into the buffer, new alarms overwrite the oldest alarms.

When the FCD-155 is powered down, the most recent 100 alarm messages are stored in non-volatile memory, and therefore are available when the FCD-155 is powered up again. When using the terminal, a Web browser or a Telnet host, the user also can clear (delete) the alarms stored in this buffer, after reading them.

The alarms can be read on-line by the network administrator using the network management station, a Telnet host, a Web browser or a supervision terminal. The network administrator can then use the various diagnostic tests to determine the causes of the alarm messages and to return the system to normal operation.

Alarm Relays

In addition to the alarm collection and reporting facility, the FCD-155 has two alarm relays with floating change-over contacts: one relay for indicating the presence of major alarms and the other for minor alarms. Each relay changes state whenever the first alarm is detected, and returns to its normal state when all the alarms of the corresponding severity disappear.

The relay contacts can be used to report internal system alarms to outside indicators, e.g., lights, buzzers, bells, etc. located on a bay alarm or remote monitoring panel.

All the events appearing on the **Event Log** screen are deleted.

Displaying Alarms and Events

Display Active Alarms

➤ **To display the active alarms:**

1. Type **1** and then press **‹Enter›**.

2. You will see the **Active Alarms** screen. A typical **Active Alarms** screen is shown in *Figure 7-83.*

```
                          FCD-155
Monitoring>System>Active Alarms

 Code Port       Description                      Severity  State   Count
 49               FAN FAILURE                     Minor     On      1
 86               RESET OCCURRED                  Event     On      2
|14    LINK-1    SIGNAL LOSS                      Major     On      1
v75    LINK-1    FLIP OCCURRED                    Event     On      1
 14    LINK-2    SIGNAL LOSS                      Major     On      1
 6     EXT       CLOCK CHANGE TO INTERNAL         Event     On      1
 34    EXT       FRAME LOSS                       Major     On      1
 69    EXT       CLOCK FAIL                       Major     Off     1
 77    EXT       CLK IS DIFF FROM MASTER CLK      Major     On      1
 50    ETH-01    LAN NOT CONNECTED                Major     On      1


>


ESC-prev.menu; !-main menu; &-exit; @-debug ; ?-help                      1M/1C
------------------------------------------------------------------------------
```

*Figure 7-83. Typical **Active Alarms** Screen*

The alarms appear on the **Active Alarms** screen in the order they have been recorded in the log (the last alarm appears at the end of the list).

The information displayed on the **Active Alarms** screen is organized as a table with the following columns:

Code   Unique alarm code. Refer to *Table 7-18* for a description of the alarm codes.

Port   Identifies the FCD-155 port which generated the alarm. See the *Port Identification* section below.

Description   Text string that provides a concise description of the alarm condition.

Severity   Alarm severity: **major** or **minor.**

State   Current state of alarm: **on** (still present) or **off** (no longer present).

Count   Total number of times the corresponding alarm has already been detected for that port.

Displaying the Event Log

➤ **To display the event log:**

1.   Open the **Monitoring** menu, and select **System**.

2.   Select **Event Log**. You will see the **Event Log** screen. A typical **Event Log** screen is shown in *Figure 7-84.*

```
                              FCD-155
Monitoring>System>Event Log

 Code Port    Description                      Status Date        Time
 50    ETH-02 LAN NOT CONNECTED                On     01-01-2004 10:00:25
 50    ETH-01 LAN NOT CONNECTED                Off    01-01-2004 10:34:25
 14    LINK-1 SIGNAL LOSS                      On     21-12-2004 00:00:02
 86           RESET OCCURRED                   On     21-12-2004 20:08:13


>


ESC-prev.menu; !-main menu; &-exit; @-debug ; ?-help                    1M/1C
----------------------------------------------------------------------------
```

*Figure 7-84. Typical **Event Log** Screen*

The events appear on the **Event Log** screen in the order they have been recorded in the log (the last event appears at the end of the list). The information is organized as a table with the following columns:

Code   Unique alarm code. Refer to *Interpreting Alarm Messages* section for a description of alarm and event codes.

Port   Identifies the FCD-155 port which generated the alarm or event. See the *Port Identification* section below.

Description   Text string that provides a concise description of the alarm condition or event.

State   Current state of alarm or event: **on** (still present) or **off** (no longer present).

Date   The date the alarm or event has been recorded in the log, in accordance with the internal real-time clock of the FCD-155.

Time   The **Time** the alarm or event has been recorded in the log, in accordance with the internal real-time clock of the FCD-155.

➤ **To clear the event log:**

Type **3** and then press **‹Enter›**.

Interpreting Alarm Messages

Table 7-18 lists the alarm messages generated by the FCD-155, specifies their type (event or state), and explains their interpretation. The alarm messages are listed in ascending order of their codes.

Note   *A state alarm is an alarm that is in the ON state while a certain condition is present, and automatically changes to OFF when the condition is no longer present. This type of alarm cannot be cleared (removed from the alarm buffer) while it is in the ON state.*

An event alarm is an alarm that records the occurrence of an event. This type of alarm can be cleared at any time.

Table 7-18. Alarm Messages

Code	Message	Default Severity	Interpretation
1	POWER SUPPLY 1 FAILURE	Major	FCD-155E reports failure of power supply module 1. Replace this power supply module. This alarm is also reported by FCD-155: since FCD-155 has an internal power supply, it is necessary to replace the whole unit
2	ALARM BUFFER OVERFLOW	Major	More than 255 alarms have been received, and therefore the new alarms are overwriting the oldest alarms (the first alarms) stored in the alarm buffer. Read the alarms and then clear the buffer
3	HARDWARE FAILURE	Major	A technical failure has been detected. Replace the FCD-155
4	Reserved for future use		
5	CLOCK CHANGE TO FALLBACK	Event	The FCD-155 has switched to the fallback clock source
6	CLOCK CHANGE TO INTERNAL	Event	The FCD-155 has switched to the internal clock source
7	CLOCK CHANGE TO MASTER	Event	The FCD-155 has returned to the master clock source
8, 9	Reserved for future use		
10	SP-PAR SWITCH IS ON	Minor	Section 1 of the internal switch SW1 is set to the OPEN position. This caused reloading of the default communication parameters for the supervisory terminal port (CONTROL connector). If it is no longer necessary to enforce the default parameter values, return this switch section to the CLOSE position
11, 12, 13	Reserved for future use		
14	SIGNAL LOSS	Major	The specified port of the FCD-155 reports loss of input signal
15 to 22	Reserved for future use		

Table 7-18. Alarm Messages (Cont.)

Code	Message	Default Severity	Interpretation
23	LINE CODE VIOLATION	Event	A bipolar violation (BPV) error has been detected by the specified PDH port. This alarm may also appear when an excessive zeroes error occurs (more than three consecutive error occurs (more than three consecutive error occurs (more than three consecutive "0"s for an E1 port, or more than 8 consecutive "0"s for a T1 port using B8ZS zero suppression)
24	AIS OCCURRED	Major	The Alarm Indication Signal (AIS), a framed "all ones" sequence, is received by the specified PDH port, VC or VT. AIS on an E1 link is declared when less than three spaces (i.e., 2 or less zeros) are detected in a sequence of 512 bits (256 μsec window). AIS on a T1 link (blue alarm) is declared when less than five spaces are detected in a 3-msec window
25	Reserved for future use		
26	UPPER LAYER CRITICAL ALARM	Major	A critical error has occurred on an upper layer for the specified VC-4/STS-1
27	PAYLOAD LABEL UNEQUIPPED	Major	The specified VC-4/STS-1 receives an unequipped payload label (signal label). This alarm condition may often occur while a new trail is being prepared
28	PATH TRACE ID MISMATCH (TIM)	Major	The path trace ID received from the far end does not match the expected ID for the specified VC-4/STS-1. This may indicate incorrect routing of the corresponding VC-4/STS-1
29	PAYLOAD LABEL MISMATCH (PLM)	Major	A payload label mismatch has been detected for the specified VC-4/STS-1. This may indicate incorrect routing of the corresponding VC. This alarm condition may often occur while a new trail is being prepared
30	REMOTE DEFECT INDICATION (RDI)	Major	RDI (Remote Defect Indication) is received from the remote equipment through the specified STM-1/OC-3 link
31	LOSS OF POINTER	Major	The STM loss of pointer (LOP) state is entered when N consecutive invalid pointers are received by the specified VC-4, STS-1, VC-3, VC-12, or VT-1.5 (N = 8, 9, ...). LOP state is exited when 3 equal valid pointers or 3 consecutive AIS indications are received
32	SIGNAL DEGRADED ERROR	Minor	The bit error rate of the received STM-1/OC-3, VC-4, STS-1, VC-3, VC-12, or VT-1.5 signal exceeds the preset signal-degraded threshold
33	EXCESSIVE BIT ERROR RATE	Major	The bit error rate of the received STM-1/OC-3, VC-4, STS-1, VC-3, VC-12, or VT-1.5 signal exceeds the preset excessive BER threshold

Table 7-18. Alarm Messages (Cont.)

Code	Message	Default Severity	Interpretation
34	FRAME LOSS	Major	The loss of frame (LOF) state is entered when an out-of-frame (OOF) state exists at the specified STM-1 port for up to 3 ms. If OOFs are intermittent, the timer is not reset to zero until an in-frame state persists continuously for 0.25 ms.
			The LOF state is exited when an in-frame state exists continuously for 1 to 3 ms
35	TX FAIL (TX PWR OUT OF RANGE)	Major	The laser TX power monitor reports a value that exceeds the high alarm level
36	TX DEGRADE (LASER BIAS)	Major	The laser bias monitor reports a value that exceeds the high alarm level, and may degrade the laser performance
37	Reserved for future use		
38	STM OUT OF FRAME	Major	Loss of frame alignment for the specified STM-1 port
39	Reserved for future use		
40	STM PATH TRACE UNEQUIPPED	Minor	The specified VC (VC-4, VC-3, STS-1, VC-12, VC-11 or VT-1.5), receives an unequipped path trace label. This alarm condition may often occur while a new trail is being prepared
41 to 48	Reserved for future use		
49	FAN FAILURE	Minor	The internal cooling fan of the FCD-155 does not operate. Replace the unit as soon as possible
50	LAN NOT CONNECTED	Major	The LAN interface of the FCD-155 is not connected to an active Ethernet LAN (this alarm will not appear when the corresponding LAN port is disabled by the user). Check the connection between the LAN port and the LAN media, or hub port, and make sure that the LAN equipment is operating normally, and at least one station is active on the LAN
51	TX LCAS ADD NORMAL TIMEOUT	Event	When using LCAS, time-out occurred when waiting to transmit an ADD NORMAL message
52	RX LOSS OF SEQUENCE	Event	The sequence number of a received LCAS message is out of sequence
53	RX LCAS CRC ERROR	Event	A CRC error has been detected in an LCAS message
54	Reserved for future use		
55	MAC RX FIFO BUFFER OVERFLOW	Event	The rate of frame ingress from the WAN (from the STM-1 link) exceeds the egress rate to the local LAN.
56 to 59	Reserved for future use		
60	RX LAPS/FRAME MISMATCH	Minor	This alarm indicates a mismatch in the ADDRESS, CONTROL or SAPI fields of the received LAPS/LAPF frame. This alarm is set (ON) after the detection of any one of these errors and is reset (OFF) after the user displays the statistics counters.

Table 7-18. Alarm Messages (Cont.)

Code	Message	Default Severity	Interpretation
61, 62	Reserved for future use		
63	NUMBER OF VCS UNDER MINIMUM	Major	When using LCAS, the number of active VCs per group can be changed dynamically. This alarm is set (ON) when the number of active VCs drops below the minimum configured value (defined in the Group Configuration menu), and is reset (OFF) after the failed VCs recover, or the configuration is changed
64	GFP OUT OF SYNC	Major	When GFP is used, the GFP multiplexer subsystem serving the LAN interface has lost synchronization to the incoming stream
65	DIFFERENTIAL DELAY EXCEEDS MAX	Major	This alarm is set (ON) when the differential delay exceeds the maximum delay configured in the database for the corresponding virtual group, and is reset (OFF) when the delay decreases below the maximum value.
66	TX LCAS ADD ACK TIMEOUT	Event	When using LCAS, time-out occurred when waiting to transmit an ADD ACK message
67	TX LCAS REMOVE ACK TIMEOUT	Event	When using LCAS, time-out occurred when waiting to transmit a REMOVE ACK message
68	GFP CHANNEL ID MISMATCH	Event	The GFP multiplexer subsystem detects an unexpected channel number (CID)
69	CLOCK FAIL	Major	The internal clock oscillator serving the STM-1 ports failed
70	LOSS OF MULTIFRAME	Major	Loss of multiframe synchronization occurred on the specified VC-4/STS-1/VC-3/VC-12/VT-1.5
71	Reserved for future use		
72	SOFTWARE DOWNLOAD FAIL	Event	Software downloading to the FCD-155 failed. Repeat the process
73	NETWORK LINE LOOPBACK	Major	The alarm is set (ON) when a network-initiated line loopback has been activated on the corresponding port. This loopback cannot be disconnected by the system management. The alarm is reset (OFF) after the loopback is deactivated
74	SOFTWARE DOWNLOAD	Event	Software is being downloaded to the FCD-155
75	FLIP OCCURRED	Event	Flipping to the alternate path occurred
76	REMOTE FAIL INDICATION	Major	A remote fail indication has been received by the specified VC-3, VC-12 or VT1.5.
77	CLK IS DIFF FROM MASTER CLK	Major	The FCD-155 is not using the clock source selected as master source. This indicates a major failure in the source which provided the master clock source
78	UPPER LAYER CRITICAL ALARM	Minor	A critical error has occurred on an upper layer for the specified VC-3, VC-12 or VT1.5.

Table 7-18. Alarm Messages (Cont.)

Code	Message	Default Severity	Interpretation
79	PAYLOAD LABEL UNEQUIPPED	Minor	The specified VC-3, VC-12 or VT1.5 receives an unequipped signal label. This alarm condition may often occur while a new trail is being prepared
80	PATH TRACE ID MISMATCH (TIM)	Minor	The path trace ID received from the far end for the specified VC-3, VC-12 or VT1.5 does not match the expected value. This may indicate incorrect routing of the corresponding VC or VT.
81	PAYLOAD LABEL MISMATCH (PLM)	Minor	A payload label mismatch has been detected for the specified VC-3, VC-12 or VT1.5. This may indicate incorrect routing of the corresponding VC or VT. This alarm condition may often occur while a new trail is being prepared
82	REMOTE DEFECT INDICATION(RDI)	Minor	RDI (remote defect indication) is received through the specified VC-4/STS-1/VC-3/VC-12/VT-1.5
83	SIGNAL DEGRADED ERROR	Minor	The bit error rate of the signal received through the specified VC or VT exceeds the preset signal-degraded threshold
84	EXCESSIVE BIT ERROR RATE	Minor	The bit error rate of the signal received through the specified VC or VT exceeds the preset excessive BER threshold
85	JITTER BUFFER OVERFLOW	Event	The specified jitter buffer reports an overflow event
86	RESET OCCURRED	Event	The FCD-155 has been reset
87	IP ADDRESS NOT ALLOCATED	Major	No IP address has been allocated by the DHCP server
88	CABLE TYPE MISMATCH	Major	The cable type connected to the E1 port connector is not suitable for the configured interface type. Check and correct in accordance with the equipment connected to the port connector
89	VC AIS OCCURRED	Major	The Alarm Indication Signal (AIS indication) is received through the Signal Label (C2) byte of the specified VC-4/STS-1
90 to 96	Reserved for future use		
97	SFP FAILURE	Major	The SFP module has been removed, or failed
98	FAR END CSF ERROR	Major	Far end CSF indication (detection of a CSF indication), displayed by ports with **Fault Propagation** enabled. This condition is cleared on receipt of the first valid GFP client data frame, or after failing to receive 3 CSF indications in 3 seconds
99	RESET TO ACTIVATE NEW SOFTWARE	Major	The alarm appears (ON state) after software download has been successfully completed, but the FCD-155 has not yet been reset. It disappears (OFF state) after resetting or restarting the FCD-155

Table 7-18. Name of Table (Cont.)

Code	Message	Default Severity	Interpretation
100	TX DEGRADE(LASER TEMPERATURE)	Major	The SFP laser temperature monitor reports a value that exceeds the high alarm threshold
101	CLOCK OUT OF RANGE	Major	The frequency of the timing reference clock is not within the allowed range
102	POWER SUPPLY 2 FAILURE	Major	FCD-155E reports failure of power supply module 2. Replace this power supply module
103	RX TRAIL FAILURE	Major	Failure indication associated with an VCG, generated when a fault condition is detected on the path serving the VCG. The reception of this indication triggers the fault propagation process. This failure indication is necessary only when LCAS is not used

7.5   Testing FCD-155

Overview

FCD-155 support diagnostic functions that enable testing FCD-155 for proper operation, and isolate the location of faults. Tests are available at the following levels:

- **External network port (STM-1 or OC-3) level**. The loopbacks that can be activated at this level include:

    - Local loopback, can be used to locate problems within the FCD-155.

    - Remote loopback, can be used for end-to-end testing of SDH/SONET signal paths.

    In addition, for FCD-155E you can also test the laser shut-down function of each optical port: enabling this test causes the laser transmitter of the corresponding port to turn off. This function can also be used to turn the laser off during maintenance, for personal safety.

- **Virtual ports loopbacks on a network port (STM-1 or OC-3)**. The loopbacks that can be activated on virtual ports at the network port level include:

    - Local loopback on selected VC/VT/STS-1 port of the desired network port. This tests the paths of PDH ports carried by the corresponding VC/VT/STS-1, and can help locate problems within the FCD-155.

    - Remote loopback on selected VC/VT/STS-1 port of the desired network port. Can be used for end-to-end testing of the PDH signal paths carried by the corresponding VC/VT/STS-1.

    - Activate a local loopback or a remote loopback on the selected VC/VT/STS-1 at the desired link port. This test can be used to test PDH signal paths carried by the corresponding VC/VT/STS-1.

It is not recommended to use the loopbacks for VC/VT/STS-1 carrying Ethernet traffic, or virtually concatenated groups.

- **PDH port/link level**. The loopbacks that can be activated at this level include:

  - Local loopbacks: used to locate problems within the PDH processing sections of the local FCD-155 and in the connections of the local user's equipment to the local FCD-155 PDH ports. For E1 and T1 ports, the user can select whether to send, or not, AIS in the upstream direction while the loopback is activated.

  - Remote loopbacks: used for end-to-end testing of PDH signal paths, including the link to the remote equipment and the connections of the remote user's equipment to the PDH ports.

  - For T1 PDH ports only: the user can enable the activation of the network-initiated line loopback (LLB), and can also cause each port to send the LLB activation/deactivation code, to control the LLB on the equipment connected to the port.

  - For all the PDH ports: BER testing, enables checking the transmission performance of the connection to the local user's equipment connected to the port.

  For units with multiple PDH interfaces, the user can select the PDH port(s) on which the loopbacks are activated, and can also specify a time-out interval after which the loopback is automatically deactivated.

- *Ping* for IP connectivity testing; FCD-155E also supports *traceroute* for IP connectivity troubleshooting.

External Network Port Loopbacks

Caution   All the network-side loopbacks are traffic-affecting.

Note   *The information presented below for external network ports is applicable to all the FCD-155 versions. The actual number and type of local ports (PDH or Ethernet) varies with the specific FCD-155 version.*

Local Loopback on External Network Port

The signal paths during a local loopback on the external network port for FCD-155 are shown in *Figure 7-85*.
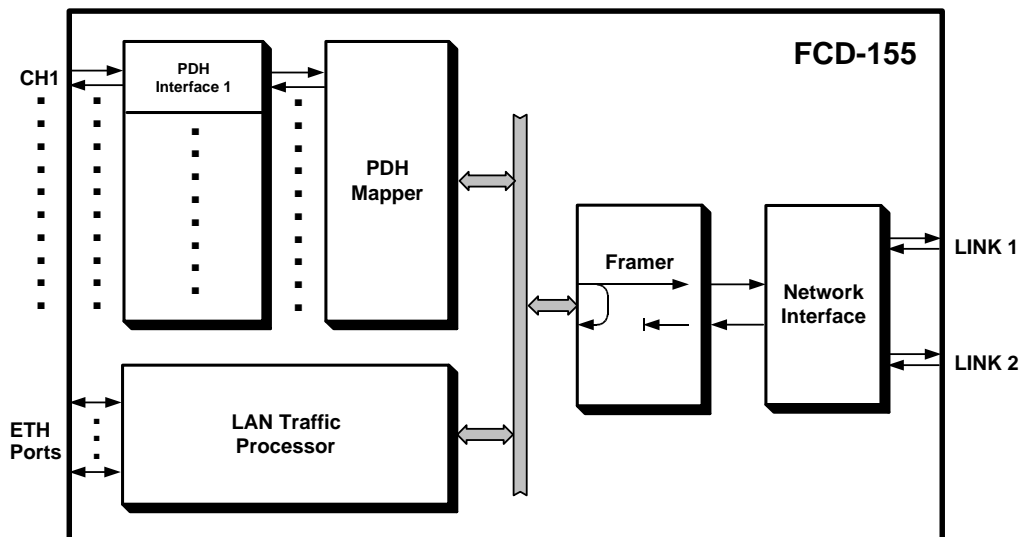
Figure 7-85. External Network Port Local Loopback, Signal Paths (FCD-155)

The signal paths during a local loopback on the external network port for FCD-155E are shown in *Figure 7-86*.
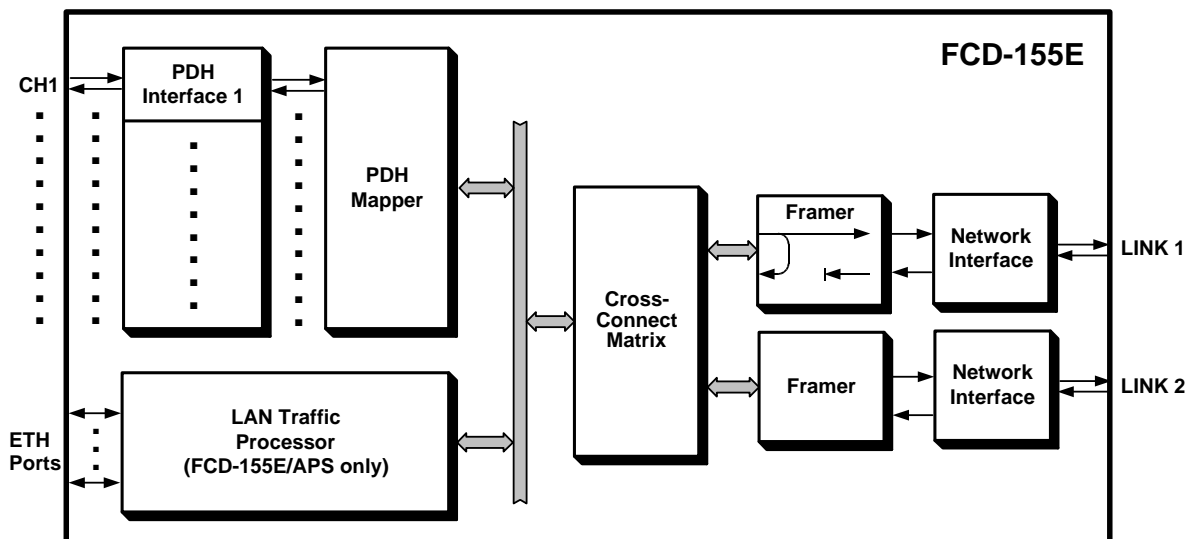
Figure 7-86. External Network Port Local Loopback, Signal Paths (FCD-155E)

As shown in *Figure 7-85* or *Figure 7-86*, the local loopback is activated within the SDH/SONET framer, and therefore the loopback signal paths do not include the network interface.

When the local loopback is activated, the framed SDH or SONET transmit signal is returned to the input of the framer receive path at a point just before the output to the network interface subsystem. To provide a keep-alive signal to the transmission equipment serving the link under test while the loopback is activated, the transmit signal is also sent to the network interface.

While the loopback is activated, the local FCD-155 must receive its own signal, and thus it must be frame-synchronized (its SYNC LOSS LOC and REM indicators must be off), irrespective of the state of the network interface indicators.

In addition, each FCD-155 local port (LAN or PDH) must also receive its own signal:

- For PDH ports, the result is that the port interfaces are synchronized and do not generate alarm indications. Moreover, the signal received from the user's equipment connected to the port is also returned to the user.

- Ethernet LAN ports, however, cannot receive their own signal: this usually causes a permanent state of collision while the local loopback is activated. Therefore, if the FCD-155 LAN ports are connected to active LANs, *disconnect the cables from the FCD-155 LAN ports before activating the local loopback and reconnect them after the loopback is deactivated*.

Remote Loopback on External Network Port

The signal paths during a remote loopback on the external network port of an FCD-155 are shown in *Figure 7-87*.
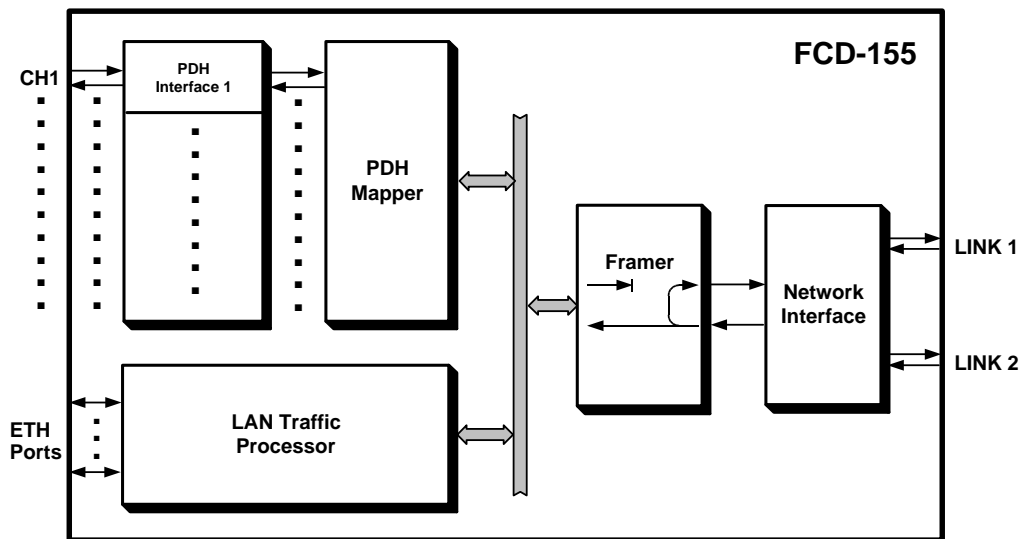
Figure 7-87. External Network Port Remote Loopback, Signal Paths (FCD-155)

The signal paths during a remote loopback on the external network port of an FCD-155E are shown in *Figure 7-88*.
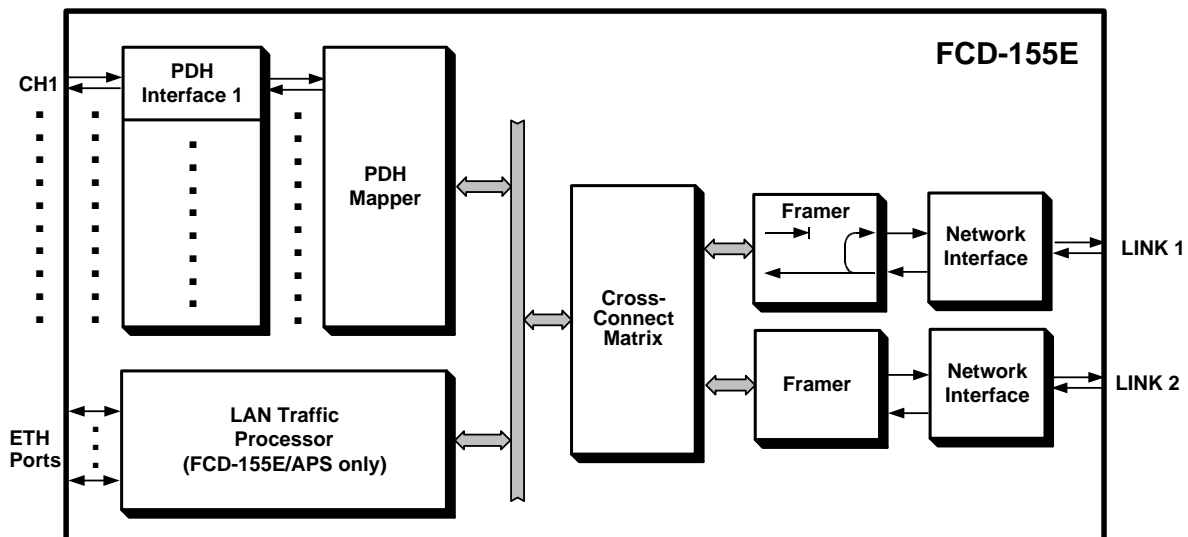
Figure 7-88. External Network Port Remote Loopback, Signal Paths (FCD-155E)

As shown in *Figure 7-87* or *Figure 7-88*, the remote loopback is activated within the network side circuits of the SDH/SONET framer, and therefore the loopback signal paths includes all the circuits of the local FCD-155 network interface, but very few of the framer circuits.

When the remote loopback is activated, the received SDH or SONET signal is processed by the receive path of the local FCD-155 network interface and then returned to the input of the transmit path of the network interface subsystem through the framer. Therefore, when the remote loopback is activated on the SDH ports, the receive signal is returned to the remote unit.

To correct transmission distortions, the returned signal is regenerated by the corresponding port circuits.

The remote loopback should be activated only after checking that the remote unit operates normally with its network port local loopback. In this case, the remote unit must receive its own signal, and thus it must be frame-synchronized. The effect on the ports of the remote unit is mixed, as explained above for the local loopback.

To provide a keep-alive signal, the received signal remains connected to the receive path of the local FCD-155. Assuming that the local FCD-155 unit also operates normally when its network port local loopback is activated, then if the port status of the active network port is normal, the local FCD-155 should be synchronized (its SYNC LOSS LOC indicator should be off).

The remote loopback should be activated at only one of the two FCD-155 connected in a link, otherwise an unstable situation occurs.

Laser Shut-Down Test (FCD-155E)

The laser shut-down test, supported by FCD-155E, is used to test the laser shut-down function of each optical port.

Normally, the transmit path laser is turned on when the **Admin Status** of the port is **Enable** and is turned off only when the status is changed to **Disable**. The capability to turn the transmit laser off (shut down) is used by the ALS function,

when enabled for the corresponding port; it can also be used to temporarily turn the laser off during maintenance, for personal safety.

Note   *When the laser is turned off and protection is enabled, the APS function will switch the traffic to the other network port.*

When the test is activated, the transmit laser of the corresponding port is commanded to turn off. This will turn the ON LINE indicator of the corresponding port off (the general TST indicator will also light, to indicate that a test has been activated). To turn the laser back on, deactivate the test.

Loopbacks on Virtual Ports at the Network Link Level (FCD-155E only)

Caution   All the network-side loopbacks are traffic-affecting for the tested signal paths.

Note   *The information presented below for network ports is applicable to all FCD-155E versions. The actual number and type of local ports (PDH or Ethernet) varies with the specific FCD-155E version.*

Local Loopback on VC/VT/STS-1

The signal paths during a VC/VT/STS-1 local loopback on a network port are shown in *Figure 7-89*.
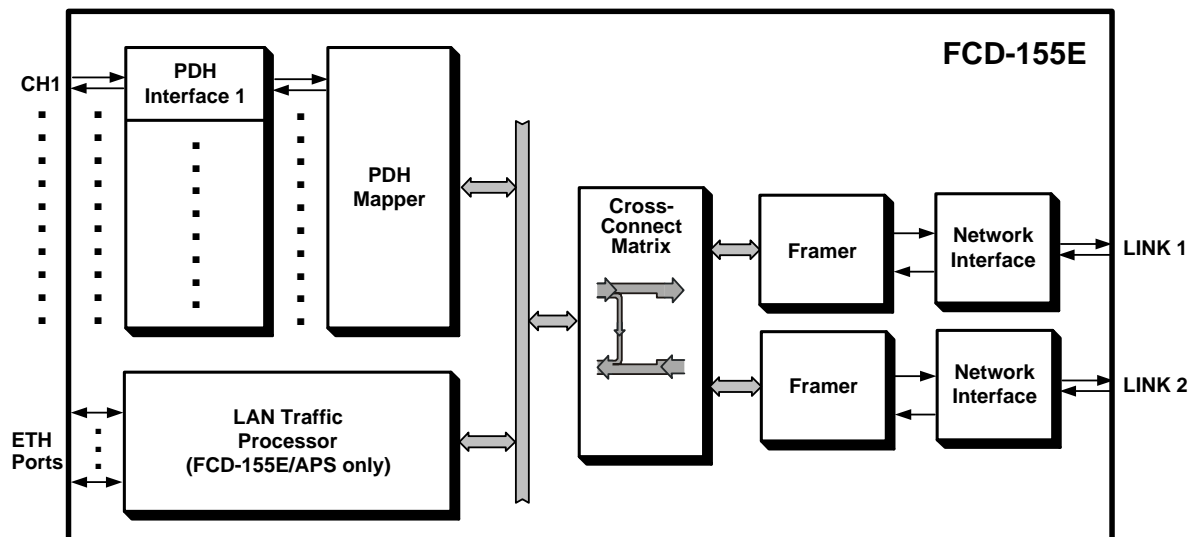
Figure 7-89. Local Loopback on VC/VT/STS-1 Port, Signal Paths (FCD-155E)

As shown in *Figure 7-89*, the local loopback is activated within the cross-connect matrix, and therefore the loopback signal paths do not include the network interface.

When the local loopback is activated, the VC-11/VC-12/VC-3/STS-1 transmit signal is toward the local port(s) from which the payload has been received. To provide a keep-alive signal to the transmission equipment serving the link under test while the loopback is activated, the transmit signal is also sent to the network interface.

While the loopback is activated, the originating local port must receive its own signal, irrespective of the state of the network interface:

- For PDH ports, the result is that the port interfaces are synchronized and do not generate alarm indications. Moreover, the signal received from the user's equipment connected to the port is also returned to the user.

- Ethernet LAN ports (even when using virtual concatenation), however, cannot receive their own signal: this usually causes a permanent state of collision while the local loopback is activated. Therefore, if the FCD-155E LAN ports are connected to active LANs, *disconnect the cables from the FCD-155E LAN ports before activating the local loopback and reconnect them after the loopback is deactivated*.

Remote Loopback on VC/VT/STS-1

The signal paths during a VC, VT or STS-1 remote loopback on a network port are shown in *Figure 7-90*.
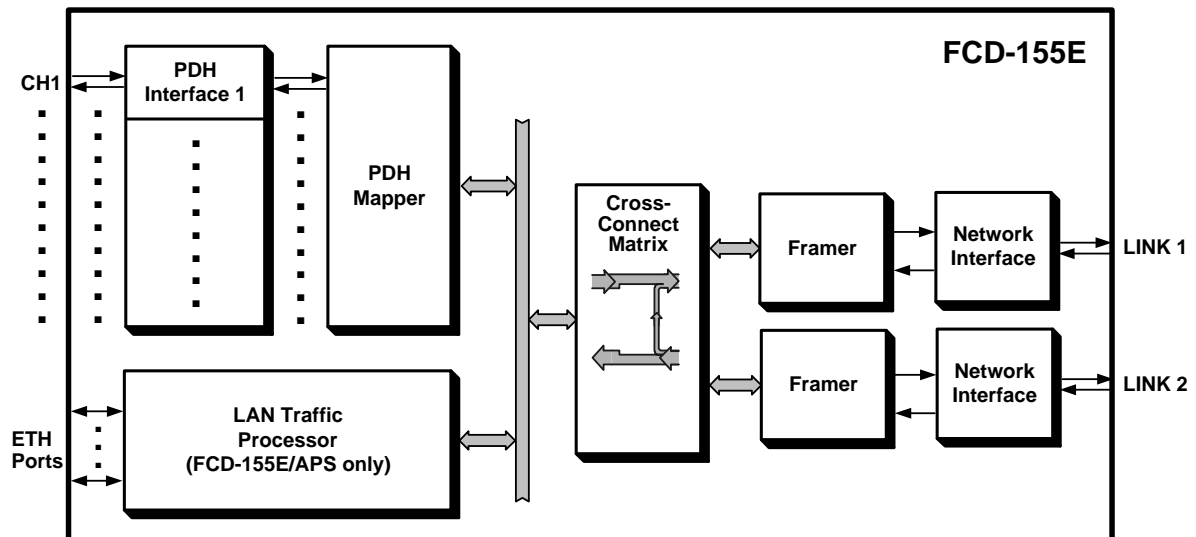
Figure 7-90. Remote Loopback on VC/VT/STS-1 Port, Signal Paths (FCD-155E)

As shown in *Figure 7-90*, the remote loopback is activated within the cross-connect matrix, and therefore the loopback signal paths includes all the circuits of the local FCD-155E network interface but very few of the other circuits.

When the remote loopback is activated, the received VC-11, VC-12, VC-3 or STS-1 signal is processed by the receive path of the local FCD-155E network interface, including its framer, and is then returned to the input of the transmit path of the network interface subsystem through the cross-connect matrix. Therefore, when the remote loopback is activated on the VC/VT/STS-1 port, the corresponding receive signal is returned to the remote unit.

The remote loopback should be activated only after checking that the remote unit operates normally with its network port local loopback. In this case, the remote unit must receive its own signal, and thus it must be frame-synchronized. The effect on the ports of the remote unit is mixed, as explained above for the network port local loopback.

To provide a keep-alive signal, the received signal remains connected to the receive path of the local FCD-155E.

The remote loopback should be activated at only one of the two FCD-155E connected in a link, otherwise an unstable situation occurs.

E1 and T1 PDH Port Loopbacks and Tests

Notes

1. *The information presented below for E1 and T1 ports is applicable to all the FCD-155 versions with E1 and T1 ports.*

2. *Unless specifically noted otherwise, the PDH loopbacks can be activated on both E1 and T1 ports.*

Local Loopback on E1/T1 PDH Port

The signal paths during a local loopback on an E1 or T1 PDH port are shown in *Figure 7-91*.
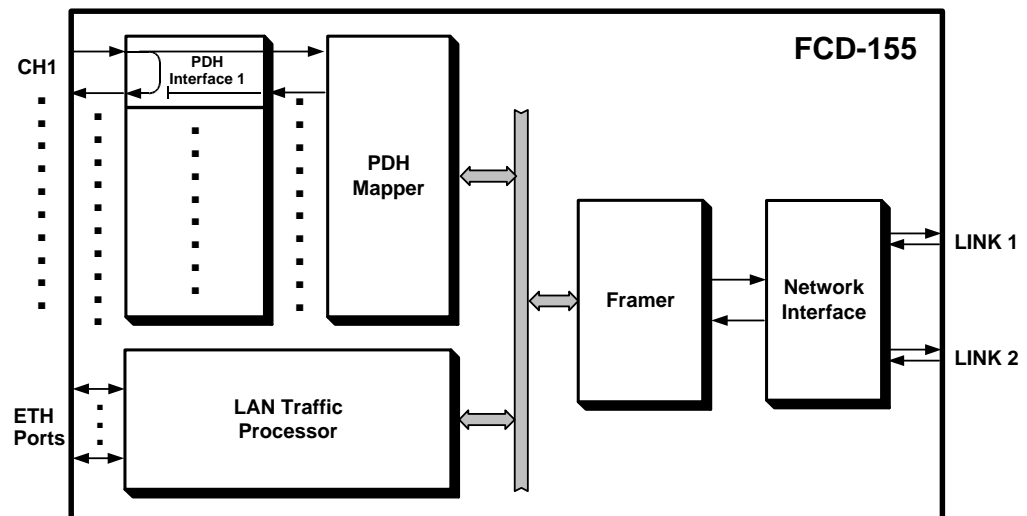
Figure 7-91. Local Loopback on E1/T1 PDH Port, Signal Paths

As shown in *Figure 7-91*, when a local loopback is activated on a PDH port, the line interface unit (LIU) of that port returns the transmit signal received from the local user's equipment connected to the tested port via the receive path of the same port.

While the loopback is activated, the signal received from the remote PDH port is ignored. The signal received from the local user's equipment remains connected to the PDH mapper and it is transmitted to the remote PDH port.

To ensure that the user's equipment is capable of providing a good signal, the local loopback should be activated on the FCD-155 port only after checking that the user's equipment operates normally while its own local loopback is activated.

In this case, if the LOS indicator of the tested port is off, then while the local loopback is activated on the local FCD-155 port, the user's equipment must receive its own signal, and thus it must be frame-synchronized.

Local Loopback with Upstream AIS on E1/T1 PDH Port

The local PDH port loopback with upstream AIS (shown in *Figure 7-92*) is similar to the local PDH port loopback described above, except that the user's signal is disconnected from the link, and is replaced by an AIS signal.

This enables the remote equipment connected to the tested port to recognize an abnormal condition (in this case, a test loopback).
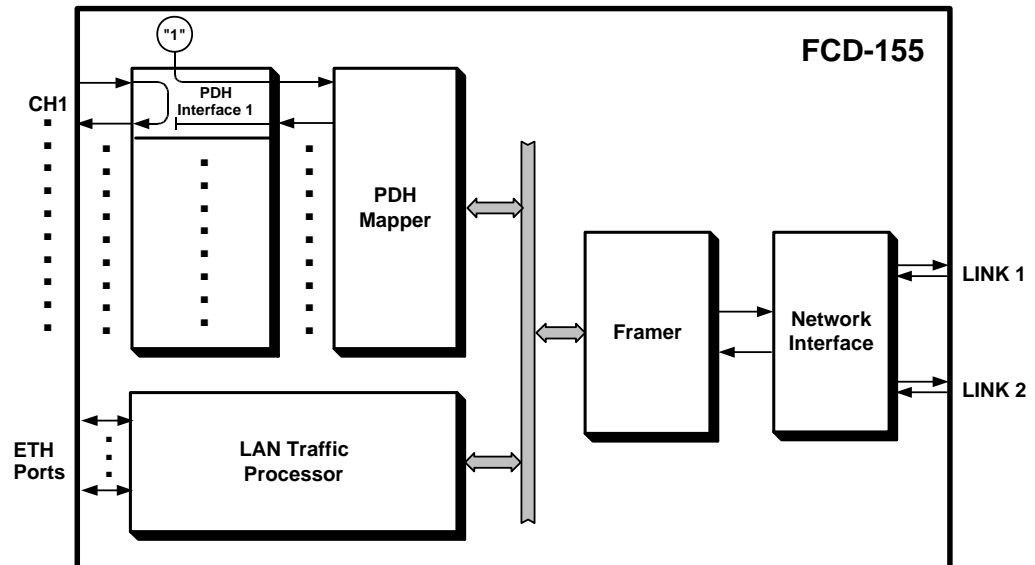
Figure 7-92. Local Loopback with Upstream AIS on E1/T1 PDH Port, Signal Paths

Remote Loopback on E1/T1 PDH Port

The signal paths during a remote PDH port loopback are shown in *Figure 7-93*.

As shown in *Figure 7-93*, when a remote loopback is activated on a local PDH port, the recovered and regenerated receive signal of the port is returned by the port LIU to the input of the port transmit path at a point just before the output to the external interface, and is sent to the remote PDH port through the SDH/SONET link.
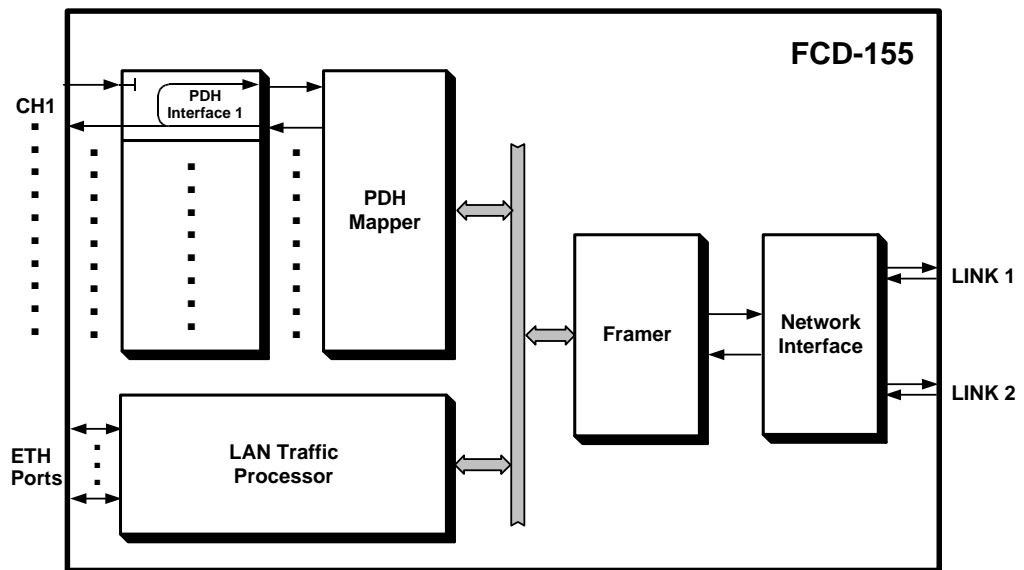
Figure 7-93. Remote Loopback on E1/T1 PDH Port, Signal Paths

While the loopback is activated, the transmit signal arriving from the local user's equipment is ignored.

To ensure that the remote equipment is capable of providing a good signal, the remote loopback should be activated on the local FCD-155 PDH port only after checking that the remote PDH port operates normally while its own local loopback is activated.

With the remote loopback is activated on the local FCD-155 port, the user's equipment connected to the remote PDH port must receive its own signal, and thus it must be frame-synchronized. The local user's equipment, however, does not receive any signal from the FCD-155 port and it will report loss of incoming signal.

Network-Activated Line Loopback (LLB) (T1 Ports only)

The network line loopback is a local loopback activated within the line interface (LIU) of a T1 port, after receiving the appropriate code from the network. The loopback signal paths are shown in *Figure 7-94*.
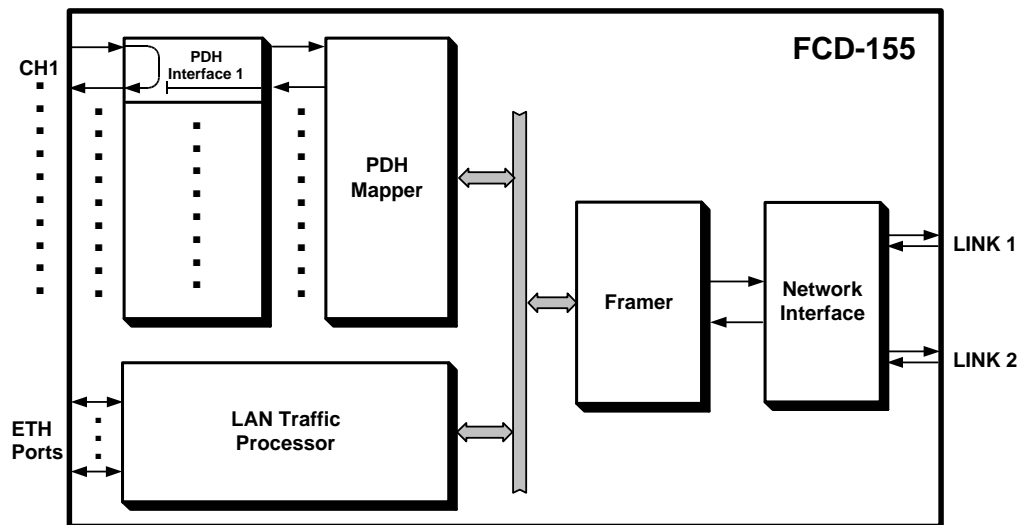
Figure 7-94. Network-Activated Line Loopback (LLB), Signal Paths

The network line loopback is activated when the port interface detects the continuous transmission of the repeating sequence 10000..... for at least 5 seconds, and is deactivated by the transmission of the sequence 100...... for at least 5 seconds.

The dedicated detector used to detect the LLB activation code can be disabled by the user: in this case, the port will not respond to LLB activation commands. As shown in *Figure 7-94*, when a network-activated line loopback is activated on a T1 PDH port, the LIU of that port returns the transmit signal received from the local user's equipment via the receive path of the same port.

While the loopback is activated, the signal received from the remote PDH port is ignored. The signal received from the local user's equipment remains connected to the PDH mapper and it is transmitted to the remote PDH port.

Activating LLB on the User's Equipment (T1 Ports only)

The user can request the activation of an LLB on the user's equipment connected to a T1 PDH port, by sending the appropriate activation code. The signal paths for this test are shown in *Figure 7-95*.
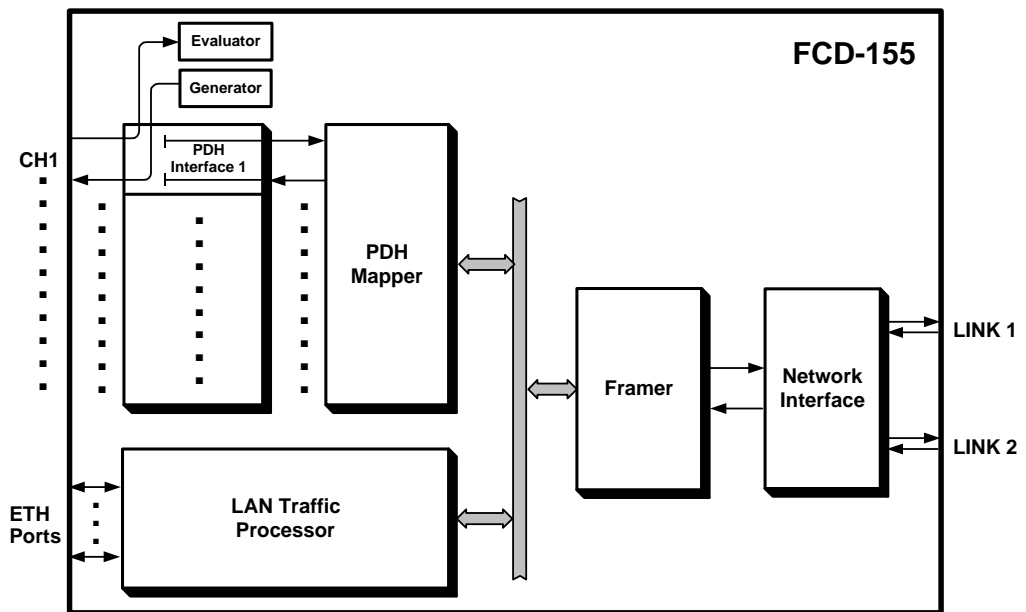
Figure 7-95. Activating LLB on the User's Equipment, Signal Paths

The activation of the LLB is detected by an evaluator, which detects the return of the LLB activation sequence. After the LLB is activated, the user's equipment starts returning the signal sent by the PDH port.

The LLB is cancelled by sending the deactivation sequence.

Local BERT on E1/T1 PDH Port

Note

Figure 7-96 shows an FCD-155 with 8E1 or 8T1 interfaces and 2 LAN ports. However, the information presented below is applicable to all the FCD-155 versions with E1 or T1 ports.

The BERT is used to check for proper data transmission to the equipment connected to the local E1 or T1 PDH port, and obtain a qualitative evaluation of data transmission without using external test equipment.

During this test, the local BER system is connected to the local E1 or T1 port interface, as shown in *Figure 7-96*. The bit error rate is measured by applying the test sequence generated by the sequence generator to the input of the transmit path:

- For E1 ports, the test sequence is the 2^{15}-1 pseudo-random sequence per ITU-T Rec. O.151

- For T1 ports, the test sequence is the 2^{20}-1 pseudo-random sequence per ITU-T Rec. O.151 (QRSS).

The transmitted data is returned by means of a loopback somewhere along the data path (e.g., by activating a remote loopback on the user's equipment) to the receive path of the E1 or T1 port, and routed to the test sequence evaluator.

The evaluator compares the received data, bit by bit, to the original data and detects any difference (bit error). The total number of errors detected are counted and can be displayed to the user.

The user can read the accumulated test time and the number of errors detected since the test has been started, together with information on the current status of the test sequence evaluator (synchronized or not).
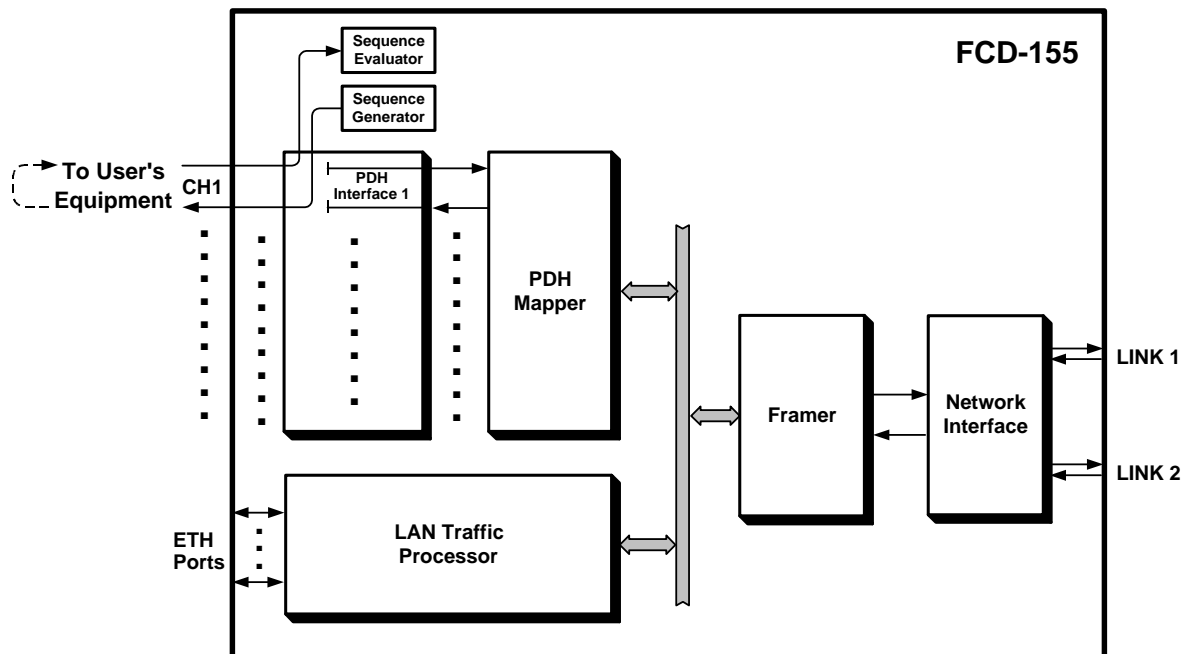
Figure 7-96. Local BERT Test on E1 or T1 PDH Port, Signal Paths

E3 and T3 PDH Port Loopbacks and Tests

Note   *Figure 7-97 through Figure 7-99 show an FCD-155 version with E3 or T3 interfaces and 2 LAN ports. However, the information presented below for E3 and T3 ports is applicable to all the FCD-155 versions with E3 or T3 ports.*

Local Loopback on E3/T3 PDH Port

The signal paths during a local loopback on a local E3/T3 PDH port are shown in *Figure 7-97*.

The signal paths while the local loopback on a local E3/T3 PDH port is activated are similar to those described on page *7-87* for the local loopback on E1/T1 PDH port.
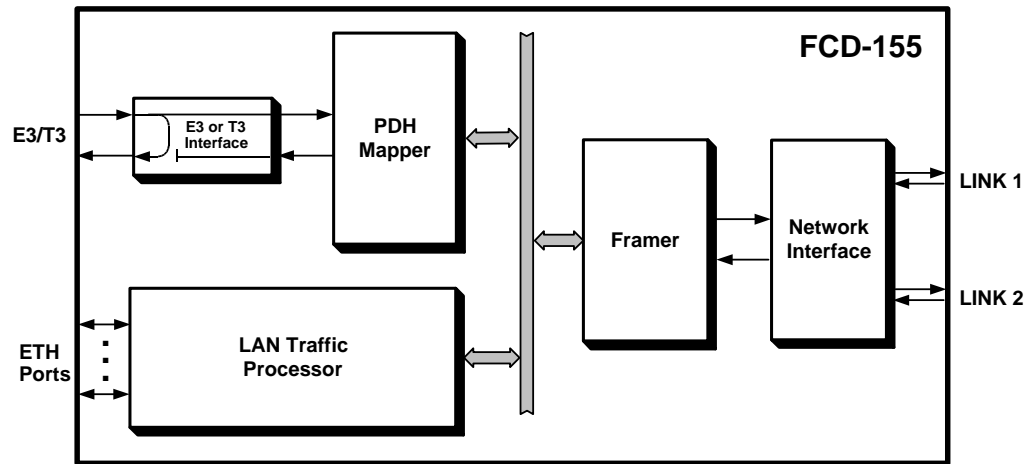
Figure 7-97. Local Loopback on E3/T3 PDH Port, Signal Paths

Remote Loopback on E3/T3 PDH Port

The signal paths during a remote loopback on E3/T3 PDH port are shown in *Figure 7-98*.
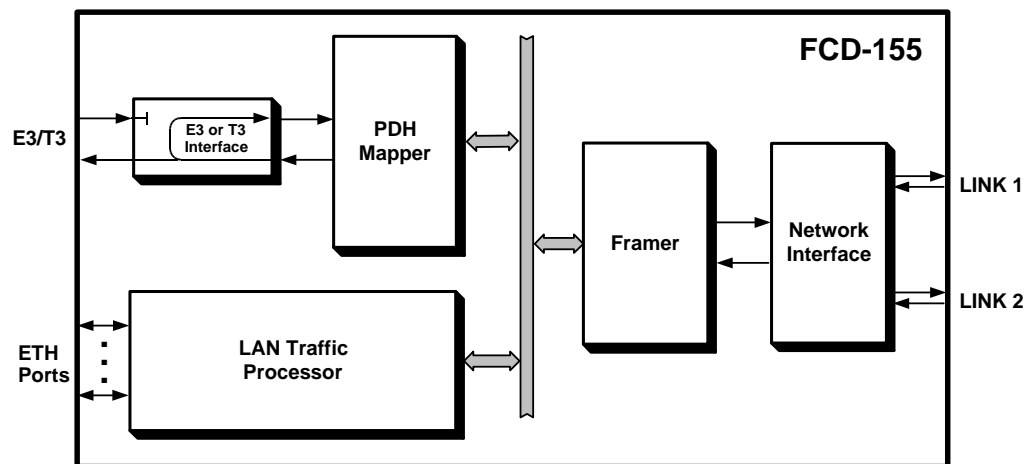
Figure 7-98. Remote Loopback on E3/T3 PDH Port, Signal Paths

The signal paths while the remote loopback on a remote E3/T3 PDH port is activated are similar to those described on page *7-88* for the remote loopback on E1/T1 PDH port.

Remote Loopback with Downstream AIS on E3/T3 PDH Port

The signal paths during a remote loopback on E3/T3 PDH port with downstream AIS are shown in *Figure 7-99*.

As shown in *Figure 7-99*, this loopback is similar to the remote loopback, except that an AIS signal is sent toward the local user's equipment, to enable detecting the abnormal condition caused by the loopback. Nevertheless, the local user's equipment will lose frame synchronization.
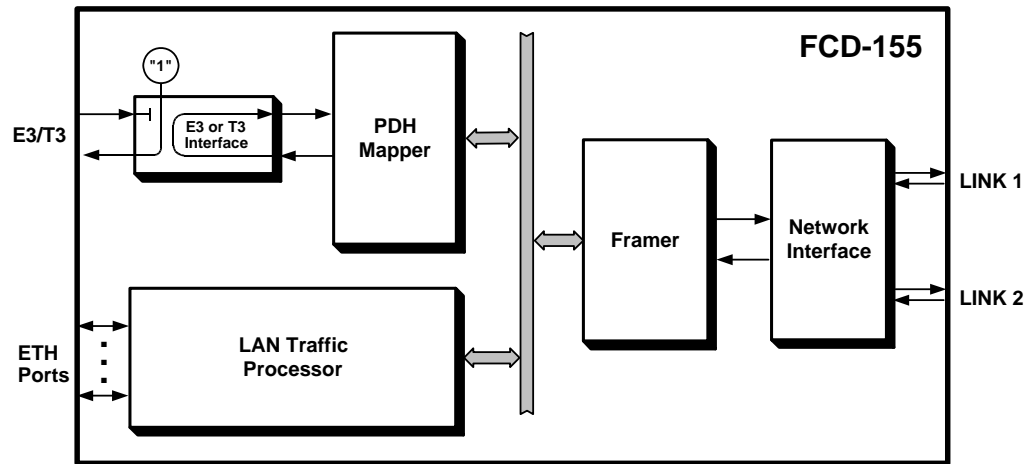
Figure 7-99. Remote Loopback with Downstream AIS on E3/T3 PDH Port, Signal Paths

Local BERT on E3/T3 PDH Port

The BERT is used to check for proper data transmission to the equipment connected to the local E3 or T3 PDH port, and obtain a qualitative evaluation of data transmission without using external test equipment.

During this test, the local BER system is connected to the local E3 or T3 port interface, as shown in *Figure 7-100*.
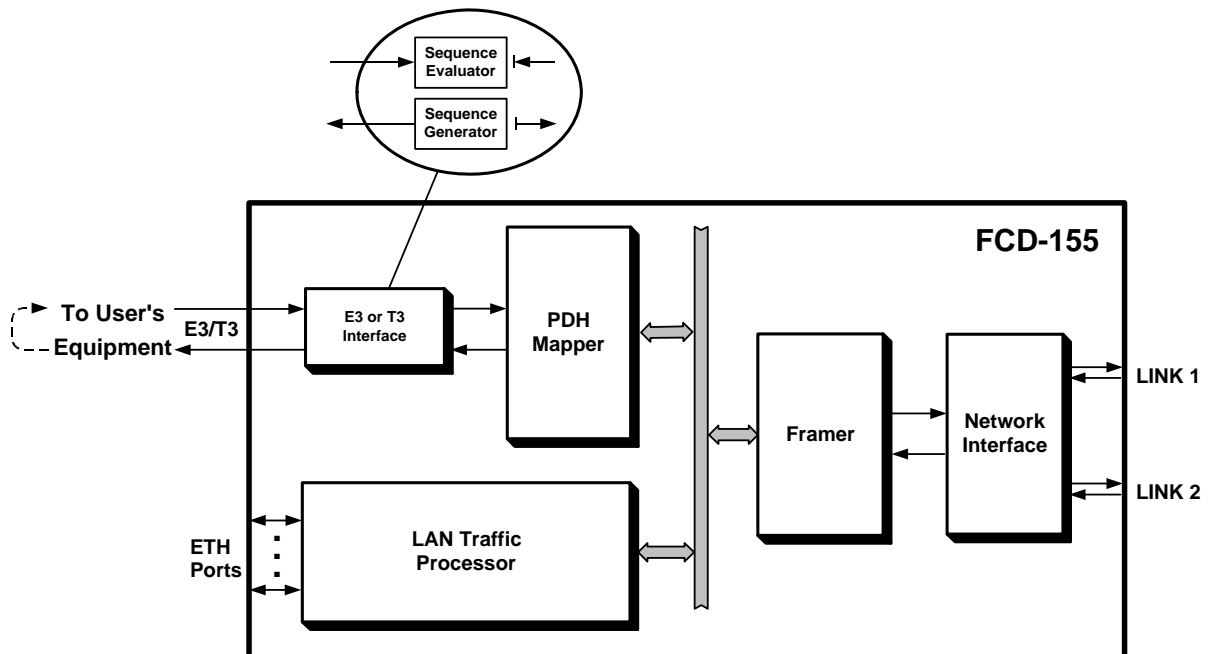
Figure 7-100. Local BERT Test on E3/T3 PDH Port, Signal Paths

The bit error rate is measured by applying the test sequence generated by the sequence generator to the input of the transmit path.

The user can select the appropriate test sequence: pseudo-random sequences per ITU-T Rec. O.151 (2^{15}-1 or 2^{23}-1), or alternating marks and spaces (ALT).

The transmitted data is returned by means of a loopback somewhere along the data path (e.g., by activating a remote loopback on the user's equipment) to the receive path of the E3 or T3 port, and routed to the test sequence evaluator.

The evaluator compares the received data, bit by bit, to the original data and detects any difference (bit error). The total number of errors detected are counted and can be displayed to the user.

The user can read the accumulated test time and the number of errors detected since the test has been started, together with information on the current status of the test sequence evaluator (synchronized or not).

To check that the tested path is "live", the user can inject errors at a desired (calibrated) rate in the test sequence. The available error injects rates are 10^{-1}, 10^{-2}, 10^{-3}, 10^{-4}, 10^{-5}, 10^{-6} and 10^{-7}; single errors can also be injected. Theses errors will be counted are regular errors by the test sequence evaluator, thereby increasing the user's confidence in the measured performance.

Ping Function

The FCD-155 and FCD-155E support the *ping* function, part of the ICMP protocol. This function enables checking IP connectivity between an FCD-155 LAN port and a remote IP host.

When sending pings from the FCD-155, the ping source address is the Ethernet LAN port address defined by the user.

The user can select the destination IP address, the number of pings and the size of the packets being transmitted. For FCD-155, the user can also specify the desired time-out interval to automatically end the test in case it cannot be completed before the time-out expires (for example, because no response is received from the destination, or the transmission of the requested number of pings has not been completed).

The FCD-155 enables the user to monitor the progress of pinging.

After completing the test, the FCD-155 displays two types of information:

- Packet transmission reliability: the total number of ping packets sent and the number received, and their difference (the number of lost packets)

- For FCD-155 only: transmission delays: minimum and maximum round trip times, and the average round trip time for the received packets.

Traceroute Function

The FCD-155E supports the *traceroute* function, an IP utility based on the use of *ping*.

The *traceroute* function can be used to find the path through the IP network to a user-specified IP address. The results list the IP addresses of all the ports that forward IP traffic to the specified IP address.

7.6   Using the Diagnostics Menu

The test functions described in *Section 7.6* are operated by means of the *Diagnostics* menu. *Figure 7-101* to *Figure 7-104* show the structure of the *Diagnostics* menu for the main FCD-155 versions. Ignore menu options not relevant to your particular FCD-155 version.

Figure 7-101. **Diagnostics** *Menu for FCD-155E (SDH Versions with PDH Ports)*

Diagnostics

1. SONET Ports
2. E1/T1 Ports
3. Ping Test

Link 1

1. Physical Port
2. LVC

Physical Port

1. No Test
2. Local Loopback
3. Remote Loopback
4. Laser Shutdown

SONET Ports

1. Link 1
2. Link 2

LVC

	STS1 1				STS1 2				STS1 3			
	TU1	TU2	TU3	TU4	TU1	TU2	TU3	TU4	----	----	----	----
TUG2-1	None	None	None	None	None	None	None	None	|			|
TUG2-2	None	None	None	None	None	None	None	None	|			|
TUG2-3	None	None	None	None	None	None	None	None	|	None		|
TUG2-4	None	None	None	None	None	None	None	None	|			|
TUG2-5	None	None	None	None	None	None	None	None	|			|
TUG2-6	None	None	None	None	None	None	None	None	|			|
TUG2-7	None	None	None	None	None	None	None	None	----	----	----	----

1. None   3. RLB
2. LLB

8T1, 28T1

E1/T1 Ports

1. Port 1
2. Port 2
3. Port 3
4. Port 4
5. Port 5
   .
   .
   .
   .
   .

Port1

1. Test Type
2. Bert Results

Test Type

1. Test
2. Timeout

Test

Timeout

Bert Results

Bert Pattern
Receive Error Bit Count
Pattern Synchronization
Test Period
1. Single Error (Block Err)

or

T3 only

E3/T3 Ports

1. Port 1

Port1

1. Test Type
2. Bert Results

Test Type

1. Test
2. Timeout
3. Bert Pattern
4. Inject Error Rate

Test

Timeout

Bert Pattern

Inject Error Rate

Bert Results

Receive Bit Count
Receive Error Bit Count
Pattern Synchronization
Test Period
1. Single Error (Block Err)

Ping

1. Destination IP Address
2. Number of Frames to Send
3. Send Ping

Ping

1. Destination IP Address
2. Number of Frames to Send
3. Send Ping
- -
   .
   .
PING - Sent 100, Received 98, Lost 2

Ping Test

1. Ping
2. Trace Route

Trace Route

1. Destination IP Address
2. Display Trace Route

Display Trace Route

Figure 7-102. **Diagnostics** *Menu for FCD-155E (SONET Versions)*

Diagnostics

1. External Port
2. PDH Ports
3. Ping Test

External Port

1. No Test
2. Local Loopback
3. Remote Loopback

4E1, 4T1 only

PDH Ports

1. Port 1
2. Port 2
3. Port 3
4. Port 4

Port1

1. Test Type

Test Type

1. Test
2. Timeout

or

E3, T3 only

PDH Ports

1. Port 1

Port1

1. Test Type
2. Bert Results

Test Type

1. Test
2. Timeout
3. Bert Pattern
4. Inject Error Rate

Test

Timeout

Bert Pattern

Inject Error Rate

Bert Results

Receive Bit Count
Receive Error Bit Count
Pattern Synchronization
Test Period
1. Single Error (Block Err)

or

8E1, 8T1 only

PDH Ports

1. Port 1
2. Port 2
3. Port 3
4. Port 4
5. Port 5
6. Port 6
7. Port 7
8. Port 8

Port1

1. Test Type
2. Bert Results

Test Type

1. Test
2. Timeout

Test

Timeout

Bert Results

Bert Pattern
Receive Error Bit Count
Pattern Synchronization
Test Period
1. Single Error (Block Err)

Ping Test

1. Command
2. Ping IP Address
3. Number of Requests
4. Packet Size
5. Time Out
6. Packets Sent
7. Packets Received
8. Packets Lost
9. Min Round Trip Time
10. Max Round Trip Time
11. Average Round Trip Time

Figure 7-103. Diagnostics Menu for FCD-155 (SDH Versions with PDH Ports)

Diagnostics

1. External Port
2. PDH Ports
3. Ping Test

External Port

1. No Test
2. Local Loopback
3. Remote Loopback

4T1 only

PDH Ports

1. Port 1
2. Port 2
3. Port 3
4. Port 4

Port1

1. Test Type

Test Type

1. Test
2. Timeout

or

T3 only

PDH Ports

1. Port 1

Port1

1. Test Type
2. Bert Results

Test Type

1. Test
2. Timeout
3. Bert Pattern
4. Inject Error Rate

Test

Timeout

Bert Pattern

Inject Error Rate

Bert Results

Receive Bit Count
Receive Error Bit Count
Pattern Synchronization
Test Period
1. Single Error (Block Err)

or

8T1 only

PDH Ports

1. Port 1
2. Port 2
3. Port 3
4. Port 4
5. Port 5
6. Port 6
7. Port 7
8. Port 8

Port1

1. Test Type
2. Bert Results

Test Type

1. Test
2. Timeout

Test

Timeout

Bert Results

Bert Pattern
Receive Error Bit Count
Pattern Synchronization
Test Period
1. Single Error (Block Err)

Ping Test

1. Command
2. Ping IP Address
3. Number of Requests
4. Packet Size
5. Time Out
6. Packets Sent
7. Packets Received
8. Packets Lost
9. Min Round Trip Time
10. Max Round Trip Time
11. Average Round Trip Time

*Figure 7-104. **Diagnostics** Menu for FCD-155 (SONET Versions)*

Diagnostics Task Selection Screen

Purpose

Select the type of diagnostic activity to be performed.

Reached from

Diagnostics

A typical **Diagnostics** task selection screen for FCD-155 is shown in Note the **PDH** option is included only when the FCD-155 is equipped with PDH interfaces.

For FCD-155E, a similar screen is displayed (*Figure 7-105.B*), except that **PDH** is replaced by the type of ports installed on the unit, **E1/T1** or **E3/T3**.

The screen displays the state of tests (for example, no loopback is activated on the SDH ports in *Figure 7-105*). While a test is active, the TEST indicator is displayed in the right-hand corner of the screen.

```
                              FCD-155
Diagnostics


 1. External Port >   (No Test)
 2. PDH Ports     >   (None)
 3. Ping Test     >

>


ESC-prev.menu; !-main menu; &-exit; @-debug                            1M/1C
------------------------------------------------------------------------------
```

A.Typical SDH Screen – FCD-155 with PDH Interfaces

```
                              FCD-155
Diagnostics


 1. SDH Ports     >
 2. PDH Ports     >
 3. Ping Test     >

>


ESC-prev.menu; !-main menu; &-exit; @-debug                            1M/1C
------------------------------------------------------------------------------
```

B. Typical SDH Screen – FCD-155E with PDH Interfaces

*Figure 7-105. Typical **Diagnostics** Task Selection Screen (SDH – FCD-155 with PDH Interfaces)*

➤ **To select a diagnostics task:**

Type the corresponding item number and then press ‹**Enter**›.

Diagnostics – SDH or SONET Ports Screen for FCD-155E

Purpose

Perform test loopbacks on the FCD-155E network interface. At any time, only one loopback may be active on any link.

Refer to *Section 7.5* for a description of test loopbacks.

Reached from

Diagnostics>**SDH** or **SONET**

➤ **To select the target link:**

1. On the **Diagnostics** task selection screen shown in *Figure 7-105*, select **SDH Ports** or **SONET Ports**. A typical link selection screen for FCD-155E is shown in *Figure 7-106.*

```
                              FCD-155E
Diagnostics>SDH Ports

 1. Link 1 >    (No Test)
 2. Link 2 >    (No Test)

>

ESC-prev.menu; !-main menu; &-exit; @-debug                      1M/1C
------------------------------------------------------------------------------
```

*Figure 7-106. Typical **SDH Ports** or **SONET Ports** Link Selection Screen (FCD-155E)*

2. Select the desired link on the **SDH Ports** or **SONET Ports** screen.

3. You will see the task selection screen for the corresponding link. A typical screen is shown in *Figure 7-107*.

The current state of the loopbacks for the selected SDH or SONET physical port is identified on the screen, for example, **No Test**.

```
                              FCD-155E
Diagnostics>SDH Ports>Link 1

 1. Physical Port >    (No Test)
 2. LVC             []>

>

ESC-prev.menu; !-main menu; &-exit; @-debug                     1 M/ 1 C
------------------------------------------------------------------------------
```

*Figure 7-107. Typical **Link** Task Selection Screen (FCD-155E)*

Use – Physical Port Loopbacks

➤ **To change the state of a physical port loopback:**

1. Select **Physical Port** on the task selection screen of the selected link. A typical **Physical Port** test selection screen is shown in *Figure 7-108*.

```
                               FCD-155E
Diagnostics>SDH Ports>Link 1>Physical Port (No Test)


 1. No Test
 2. Local Loopback
 3. Remote Loopback
 4. Laser Shutdown

>


ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
--------------------------------------------------------------------------
```

*Figure 7-108. Typical **Physical Port** Test Selection Screen (FCD-155E)*

2. To activate a physical port loopback, type its number (**2** for local loopback, **3** for remote loopback), and then press **‹Enter›**.

    The loopback control screen closes, the new loopback is displayed on the screen, and the TEST indicator appears at the top righ-hand corner.

3. To deactivate a physical port loopback, select **No Test**, and then press **‹Enter›**. The loopback control screen closes, the new loopback is displayed on the screen, and the TEST indicator disappears (unless another test is active on the FCD-155E).

➤ **To perform the laser shut down test:**

1. Select **4 - Laser Shutdown**, and then press **‹Enter›**.

2. The test is activated, and the ON LINE indicator of the active port turns off.

3. To cancel the laser shut down, select **No Test**, and then press **‹Enter›**.

Use – Virtual Port Loopbacks (LVC)

➤ **To activate a LVC loopback:**

1. Select **LVC** on the task selection screen of the selected link.

    A typical **LVC** loopback control screen for a FCD-155E with SDH network interface is shown in *Figure 7-109.A*; a typical screen for a FCD-155E with SONET network interface is shown in *Figure 7-109.B*.

2. Move the selection block to the desired VC on the screen, and then type the number of the desired loopback state:

    -   **2** for **LLB** (local loopback)

    -   **3** for **RLB** (remote loopback)

    -   **1** for cancelling any current loopback.

3. When done, press **‹Enter›**. The new state of the loopbacks for the selected VC appearrs on the screen.

4. Repeat the procedure until all the desired loopbacks are activated/cancelled.

```
                                  FCD-155E
Diagnostics>SDH Ports>Link 1>LVC                                        TEST


              TUG3  1                 TUG3  2              TUG3   3
        TU1    TU2    TU3       TU1    TU2    TU3      ---   ----   ---
 TUG2-1 LLB    None   None      None   None   None     |                |
 TUG2-2 None   None   None      None   None   None     |                |
 TUG2-3 None   None   None      None   None   None     |        None    |
 TUG2-4 None   None   None      None   None   None     |                |
 TUG2-5 None   None   None      None   None   None     |                |
 TUG2-6 None   None   None      None   None   None     |                |
 TUG2-7 None   None   None      None   None   None    ---   ----   ---


1. None    2. LLB    3. RLB

>

ESC-prev.menu; !-main menu; &-exit; @-debug; ?-help              1 M/ 1 C
-------------------------------------------------------------------------------
```

A. SDH Screen

```
                                  FCD-155E
Diagnostics>SONET Ports>Link 1>LVC                                      TEST


              STS1  1                       STS1  2                STS1   3
        TU1    TU2    TU3    TU4     TU1    TU2    TU3    TU4    ----   ----   ----
 TUG2-1 None   None   None   None    None   None   None   None    |               |
 TUG2-2 None   None   None   None    None   None   None   None    |               |
 TUG2-3 None   None   None   None    None   None   None   None    |      None     |
 TUG2-4 None   None   None   None    None   None   None   None    |               |
 TUG2-5 None   None   None   None    None   None   None   None    |               |
 TUG2-6 None   None   None   None    None   None   None   None    |               |
 TUG2-7 None   None   None   None    None   None   None   None   ----   ----   ----


1. None    2. LLB    3. RLB

>

ESC-prev.menu; !-main menu; &-exit; @-debug; ?-help              1 M/ 1 C
-------------------------------------------------------------------------------
```

B. SONET Screen

*Figure 7-109. Typical **LVC** Loopback Control Screens (FCD-155E)*

Diagnostics – External SDH or SONET Screen for FCD-155

Purpose

Perform test loopbacks on the FCD-155 network interface. At any time, only one loopback may be active.

Since the FCD-155 has only one link, loopbacks may disconnect the management path. Therefore, the loopback duration is automatically limited to 3 minutes (this is indicated by a prompt appearing at the bottom of the screen). After this interval, the loopback is deactivated.

Refer to *Section 7.5* for a description of test loopbacks.

Reached from

Diagnostics>External Port

➤   **To change the state of a loopback:**

1. To activate a link loopback, type its number (**2** for local loopback, **3** for remote loopback), and then press ‹Enter›.

2. The loopback control screen closes, and the new loopback is displayed on the diagnostic selection screen (*Figure 7-110*).

    Note the prompt that notifies you that the loopback duration is limited to 3 minutes.

```
                             FCD-155
Diagnostics>SDH Ports>Link 1 (No Test)

 1. No Test
 2. Local Loopback
 3. Remote Loopback

>

ESC-prev.menu; !-main menu; &-exit; @-debug                            1M/1C
-------------------------------------------------------------------------------
```

*Figure 7-110. Typical **External Port** Loopback Control Screen (FCD-155)*

➤   **To end the current test:**

•   To deactivate the current test, type **1 – No Test** on the diagnostic selection screen (*Figure 7-110*), and then **press ‹Enter›.**

    The loopback control screen closes, and **No Test** is displayed on the diagnostic selection screen.

Diagnostics – PDH, E1/T1, or E3/T3 Ports Screen

Purpose

Perform test loopbacks on an FCD-155 PDH interface. At any time, only one loopback may be active on any interface.

Refer to *Section 7.5* for a description of test loopbacks.

This option is available only when the FCD-155 is equipped with PDH interfaces. Tests may be activated only on active PDH ports.

Reached from

Diagnostics > Physical Ports > PDH

FCD-155 with E1 or T1 PDH Ports

A typical E1 or T1 **PDH Ports** selection screen is shown in *Figure 7-111.*

For FCD-155E, **PDH** is replaced by the type of ports installed on the unit, **E1/T1** or **E3/T3**.

```
                                FCD-155
Diagnostics>PDH Ports

 1. Port  1 (Remote Loopback)>
 2. Port  2 (Remote Loopback)>
 3. Port  3 (Remote Loopback)>
 4. Port  4 (Remote Loopback)>
 5. Port  5 (Remote Loopback)>
 6. Port  6 (Remote Loopback)>
 7. Port  7 (Remote Loopback)>
 8. Port  8 (Remote Loopback)>

>

ESC-prev.menu; !-main menu; &-exit; @-debug                        1M/1C
-------------------------------------------------------------------------
```

*Figure 7-111. Typical E1 or T1 **PDH Ports** Selection Screen*

➤ **To select an E1 or T1 PDH port for testing:**

1. To select a port, type its number and then press **‹Enter›**.

2. You will see the **Port Test Type** selection screen for the selected port. For FCD-155E, **PDH** is replaced by the type of ports installed on the unit, **E1/T1** or **E3/T3**.

   The selected port number appears in the screen header. A typical screen is shown in *Figure 7-112*.

```
                                FCD-155
Diagnostics>PDH Ports>Port  1 (None)


 1. Test Type    >
 2. Bert Results >

>


ESC-prev.menu; !-main menu; &-exit; @-debug                              1M/1C
-------------------------------------------------------------------------------
```

*Figure 7-112. Typical E1 or T1 **Port Test Type** Selection Screen (FCD-155)*

➤ **To select the desired test activity for an E1 or T1 PDH port:**

1. Type **1** on the **Port Test Type** selection screen and then press **‹Enter›**.

2. You will see the **Test Type** control screen for the selected port. A typical screen is shown in *Figure 7-113*. The screen shows the state of loopbacks for the selected port and the current loopback time-out value.

3. Type the number corresponding to the desired activity and then press **‹Enter›**.

```
                                FCD-155
Diagnostics>PDH Ports>Port  1 (None)>Test Type

 1. Test            >   (Local Bert)
 2. Timeout         >   (Infinite)

>


ESC-prev.menu; !-main menu; &-exit; @-debug                              1M/1C
-------------------------------------------------------------------------------
```

*Figure 7-113. Typical E1 or T1 **Test Type** Control Screen*

➤ **To change the state of a test or loopback on an E1 or T1 PDH port:**

1. To activate a test or loopback, type **1** on the **Test Type** control screen.

2. You will see the test and loopback control screen for the selected port. Typical screens for E1 or T1 ports are shown in *Figure 7-114.* The selected port number, and the state of any active loopback, appear in the screen header.

Note   *If you select an E1 or T1 PDH port defined as inactive, you will see **Error** for the loopback state.*

3. To activate a test or loopback, type its number and then press **‹Enter›**. The test and loopback control screen closes, the new selection is displayed on the **Test Type** control screen (*Figure 7-113*), and the TEST indicator appears in the screen headers.

4. To deactivate the currently active test or loopback, type **1 – No Test** on the
    Test control screen. The test and loopback control screen closes, and **No test**
    is displayed on the **Test Type** control screen (*Figure 7-113*).

```
                          FCD-155
...>PDH Ports>Port 1 (Local Bert)>Test Type>Test (No Test)


 1. No Test
 2. Local Loopback
 3. Remote Loopback
 4. Local Bert
 5. Local Loop Upstream Ais

>


ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
--------------------------------------------------------------------------
```

A. E1 PDH Ports

```
                          FCD-155
...>PDH Ports>Port  1 (Local Bert)>Test Type>Test (No Test)


 1. No Test
 2. Local Loopback
 3. Remote Loopback
 4. Network Loopback
 5. Local Bert
 6. Local Loop Upstream Ais

>


ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
--------------------------------------------------------------------------
```

B. T1 PDH Ports

*Figure 7-114. Typical E1 or T1 **Test** Control Screens*

➤ **To select the test time-out interval:**

1. To change the selected port time-out interval, type **2** on the **Test Type**
    control screen.

2. You will see the **Timeout** control screen for the selected port. A typical screen
    is shown in *Figure 7-113*. The current time-out interval appears in the screen
    header.

3. To select a time-out interval, type its number and then press ‹**Enter**›. The
    Timeout control screen closes, and the new interval is displayed on the **Test
    Type** control screen (*Figure 7-113*).

➤ **To read the E1 or T1 BER test results:**

1. Type **2** on the **Port** test activity selection screen and then press ‹**Enter**›.

2. You will see the **BERT Results** control screen for the E1 or T1 port. A typical
    screen is shown in *Figure 7-115*.

The information presented on the screen includes:

Bert Pattern   Displays the type of BER test sequence: this is the QRSS pattern (2^{20}-1 pseudorandom sequence).

Receive Error Bert Count   The total number of errors detected during the test.

Pattern Synchronization   Displays the current synchronization state of the error evaluator:

- **Sync** – normal operation, errors can be reliably detected.

- **Sync Loss** – loss of synchronization. This may cause incorrect results.

Test Period   Displays the total time the BER test is running.

The information displayed on the screen is automatically updated.

```
                            FCD-155
Diagnostics>PDH Ports>Port  1 (Local Bert)>Bert Results


    Bert Pattern             >   (QRSS20)
    Receive Error Bit Count ... (0)
    Pattern Synchronization >   (Sync Loss)
    Test Period             ... (0 day 00:00:00)
 1. Single Error(Block Err)     (Inject)

>


ESC-prev.menu; !-main menu; &-exit; @-debug                              1M/1C
------------------------------------------------------------------------------
```

*Figure 7-115. Typical E1 or T1 **BERT Results** Screen*

3. To check that the link is alive when the number of errors is low (a common occurrence on good links), inject an error by typing **1** and pressing **‹Enter›**: the **BERT Results** screen should reflect this error.

4. To stop the BER test, type **1** on the **Test Type** control screen (*Figure 7-113*), select **No Test**, and then press **‹Enter›**.

FCD-155 with E3 or T3 PDH Port

➤ **To select the desired activity for the E3 or T3 PDH port:**

A typical E3 or T3 **PDH Ports** selection screen is shown in *Figure 7-116.*

For FCD-155E, **PDH** is replaced by the type of ports installed on the unit, **E1/T1** or **E3/T3**.

```
                                FCD-155
Diagnostics>PDH Ports


 1. Port 1>

>

ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
---------------------------------------------------------------------------
```

*Figure 7-116. Typical E3 or T3 **PDH Ports** Selection Screen*

1. Type **1** on the **PDH Ports** selection screen and then press ‹**Enter**›.

2. You will see the test activity control screen for the E3 or T3 port. A typical screen is shown in *Figure 7-117*.

3. Type the number corresponding to the desired activity and then press ‹**Enter**›.

```
                                FCD-155
Diagnostics>PDH Ports>Port  1 (Remote Loop Downstream Ais)

 1. Test Type    >
 2. Bert Results >

>

ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
---------------------------------------------------------------------------
```

*Figure 7-117. Typical E3 or T3 **Port** Test Activity Selection Screen*

➤ **To select an E3 or T3 test activity:**

1. Type **1** on the **Port** test activity selection screen and then press ‹**Enter**›.

2. You will see the **Test Type** control screen for the E3 or T3 port. A typical screen is shown in *Figure 7-118*. The screen shows the state of loopbacks for the E3 or T3 port, and the current loopback time-out value; it also provides selections for BER test control and configuration.

3. Type the number corresponding to the desired activity and then press ‹**Enter**›.

```
                              FCD-155
Diagnostics>PDH Ports>Port  1 (Remote Loop Downstream Ais)>Test Type

 1. Test              >    (Local Loopback Upstream Ais)
 2. Timeout           >    (Infinite)
 3. Bert Pattern      >    (2^15-1)
 4. Inject Error Rate>     (None)


>


ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
----------------------------------------------------------------------------
```

*Figure 7-118. Typical E3 or T3 **Test Type** Control Screen*

➤ **To change the state of a loopback on an E3 or T3 PDH port:**

1. To activate a loopback, type **1** on the **Test Type** control screen.

2. You will see the loopback control screen for the E3 or T3 port. A typical screen for an E3 port is shown in *Figure 7-119.* The state of any active loopback appears in the screen header.

Note   *If the E3 or T3 PDH port is defined as inactive, you will see **Error** for the loopback state.*

3. To activate a loopback, type its number and then press **‹Enter›**. The loopback control screen closes, the new loopback is displayed on the **Test Type** control screen (*Figure 7-118*), and the TEST indicator appears in the screen headers.

4. To deactivate the currently active loopback, type **1 – No Test** on the **Test** control screen. The loopback control screen closes, and **No test** is displayed on the **Test Type** control screen (*Figure 7-118*).

```
                              FCD-155
...>PDH Ports>Port 1 (Remote Loop Downstream Ais)>Test Type>Test (No Test)

 1. No Test
 2. Local Loopback
 3. Remote Loopback
 4. Local Bert
 5. Remote Loopback Downstream Ais

>


ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
----------------------------------------------------------------------------
```

*Figure 7-119. Typical **Test** Control Screen for E3 or T3 PDH Ports*

➤ **To select the E3 or T3 PDH port time-out interval:**

1. To change the port time-out interval, type **2** on the **Test Type** control screen.

2. You will see the **Timeout** control screen for the selected port. A typical screen is shown in *Figure 7-113*. The current time-out interval appears in the screen header.

3. To select a time-out interval, type its number and then press ‹Enter›. The **Timeout** control screen closes, and the new interval is displayed on the **Test Type** control screen (*Figure 7-118).*

➤ **To perform a BER test on the E3 or T3 port:**

1. Configure the BER test pattern by selecting item **3** on the **Test Type** control screen.

2. You will see the **BERT Pattern** control screen. A typical screen is shown in *Figure 7-120*. For FCD-155E, **PDH** is replaced by the type of ports installed on the unit, **E1/T1** or **E3/T3**. The current test pattern appears in the screen header.

```
                            FCD-155
...>PDH Ports>Port 1 (Remote Loop Downstream Ais)>Test Type>Bert Pattern(ALT)

 1. 2^15-1
 2. 2^23-1
 3. ALT

>


ESC-prev.menu; !-main menu; &-exit; @-debug                           1M/1C
----------------------------------------------------------------------------
```

*Figure 7-120. Typical **BERT Pattern** Control Screen for E3 or T3 PDH Ports*

3. To select a test pattern, type its number, and then press ‹Enter›. The **BERT Pattern** control screen closes, and the new interval is displayed on the **Test Type** control screen (*Figure 7-118).*

4. To start the BER test, type **4** on the **Test Type** control screen and then press ‹Enter›.

5. To stop the BER test, type **1** on the **Test Type** control screen and then press ‹Enter›.

➤ **To read the E3 or T3 BER test results:**

1. Type **1** on the **Port** test activity selection screen and then press ‹Enter›.

2. You will see the **BERT Results** control screen for the E3 or T3 port. A typical screen is shown in *Figure 7-121*.

The information presented on the screen includes:

Receive Bit Count   The total number of bits transmitted during the test.

Receive Error Count   The total number of errors detected during the test.

Pattern Synchronization   Displays the current synchronization state of the error evaluator:

- **Sync** – normal operation, errors can be reliably detected.

- **Sync Loss** – loss of synchronization. This may cause incorrect results.

The information displayed on the screen is automatically updated.

```
                            FCD-155
Diagnostics>PDH Ports>Port 1 (Remote Loop Downstream Ais)>Bert Results


    Receive Bit Count           ... (10000000)
    Receive Error Count         ... (1)
    Pattern Synchronization     >   (Sync)
    Test Period                 ... (0 day 00:30:21)
 1. Single Error (Block Error)      (Inject)

>


ESC-prev.menu; !-main menu; &-exit; @-debug                            1M/1C
-----------------------------------------------------------------------------
```

Figure 7-121. Typical E3 or T3 BERT Results Screen

3. To check that the link is alive when the number of errors is low (a common occurrence on good links), inject an error by typing **1** and pressing **‹Enter›:** the **BERT Results** screen should reflect this error.

Diagnostics – Ping Test

Purpose

Test IP connectivity from the FCD-155 management subsystem to a desired IP destination.

For a description of the *ping* function, refer to *Appendix C*.

Using the Ping Function – FCD-155

For FCD-155, the **Ping Test** is activated directly from the **Diagnostics** menu.

A typical **Ping Test** screen is shown in *Figure 7-122*.

```
                                    FCD-155
Diagnostics>Ping Test

 1. Command                        (Execute)
 2. Ping IP address         ... (0.0.0.0)
 3. Number of Requests      [1 - 255]... (5)
 4. Packet size             [1 - 255]... (32)
 5. Time Out                [1 - 255]... (5)
 6. Packets Sent            ... (0)
 7. Packets Received        ... (0)
 8. Packets Lost            ... (0)
 9. Min Round Trip Time(ms)    ... (0)
10. Max Round Trip Time(ms)    ... (0)
11. Average Round Trip Time(ms)... (0)


>
ESC-prev.menu; !-main menu; &-exit; @-debug                            1M/1C
----------------------------------------------------------------------------
```

*Figure 7-122. Typical **Ping Test** Screen (FCD-155)*

➤ **To check IP connectivity:**

1. Define the ping parameters:

   ▪ Type **2** and then press ‹**Enter**›. Enter the destination IP address in the **Destination IP** field, and then press ‹**Enter**› again.

   ▪ Type **3** and then press ‹**Enter**›. Enter the total number of ping requests to be sent in the **Number of Requests** field, and then press ‹**Enter**› again.

   ▪ Type **4** and then press ‹**Enter**›. Enter the size, in bytes, of the ping packets that will be sent in the **Packet Size** field, and then press ‹**Enter**›.

   ▪ Type **5** and then press ‹**Enter**›. Specify the maximum time, in seconds, allocated to sending the specified number of pings in the **Time out** field, and then press ‹**Enter**› again.

2. Type **1** and then press ‹**Enter**› to start sending pings and collect the results.

3. The lower part of the screen starts showing the progress of the ping. The following information is displayed:

   ▪ **Packets Sent** – shows the total number of pings sent. The number advances until all the pings are sent, or until the specified time-out interval expires.

   ▪ **Packets Received** – displays the number of ping responses received before the time-out interval expires.

   ▪ **Packets Lost** – after all the pings have been sent or the specified time-out interval expires, displays the number of unanswered ping requests.

   ▪ **Success** – displays the percentage of successfully received ping responses, relative to the total number sent.

   ▪ **Min Round Trip Time (ms)** – displays the minimum measured time between the transmission and reception of a ping, in milliseconds.

- **Max Round Trip Time (ms)** – displays the minimum measured time between the transmission and reception of a ping, in milliseconds.

- **Average Round Trip Time (ms)** – displays the average time calculated for all the successfully received ping responses, in milliseconds.

Using the Ping Function – FCD-155E

For FCD-155E, selecting **Ping** on the **Diagnostics** menu displays a selection submenu, shown in *Figure 7-123,* where you can select the **Ping Test** function.

```
                              FCD-155E
Diagnostics>Ping Test

 1. Ping            >
 2. Trace Route     >

>

ESC-prev.menu; !-main menu; &-exit; @-debug                          1M/1C
------------------------------------------------------------------------------

```

*Figure 7-123. Typical **Ping Test** Screen (FCD-155E)*

A typical **Ping Test** screen for FCD-155E is shown in *Figure 7-124*.

```
                              FCD-155E
Diagnostics>Ping Test>Ping

 1. Destination IP Address          ... (0.0.0.0)
 2. Number of Frames to Send[10 - 100]... (0)
 3. Send Ping

>

ESC-prev.menu; !-main menu; &-exit; @-debug                         1 M/ 1 C
------------------------------------------------------------------------------

```

*Figure 7-124. Typical **Ping** Screen (FCD-155E)*

➤ **To check IP connectivity:**

1. Define the ping parameters:

   - Type **1** and then press ‹**Enter**›. Enter the destination IP address in the **Destination IP** field, and then press ‹**Enter**› again.

   - Type **2** and then press ‹**Enter**›. Enter the total number of ping requests to be sent in the **Number of Requests** field, and then press ‹**Enter**› again.

     Note that selecting **0** will cause continuous pinging.

2. Type **3** and then press ‹**Enter**› to start sending pings and collect the results.

3. The lower part of the screen starts showing the progress of the ping. After the ping is completed, you will see the following information:

- **Sent** – shows the total number of pings sent. The number advances until all the pings are sent, or until the specified time-out interval expires.

- **Received** – displays the number of ping responses received before the time-out interval expires.

- **Lost** – after all the pings have been sent or the specified time-out interval expires, displays the number of unanswered ping requests.

Diagnostics – Traceroute (FCD-155E)

For FCD-155E, selecting **Ping** on the **Diagnostics** menu displays a selection submenu, shown in *Figure 7-123,* where you can select the **Traceroute** function.

A typical **Traceroute** screen is shown in *Figure 7-125*.

➤ **To check IP connectivity:**

1. To define the destination IP address, type **1: Destination IP**. Enter the destination IP address in the **Destination IP** field, and then press **‹Enter›** again.

2. To display the results, type **2: Display Trace Route** and then press **‹Enter›**. After a short time, you will see the list of IP address ports discovered by the **Traceroute** function.

```
                            FCD-155
Diagnostics>Ping Test>Trace Route


 1. Destination IP Address . . . (0.0.0.0)
 2. Display Trace Route

>
ESC-prev.menu; !-main menu; &-exit; @-debug                               1M/1C
-------------------------------------------------------------------------------
```

*Figure 7-125. Typical **Trace Route** Screen (FCD-155E)*

7.7   Troubleshooting

In case a problem occurs, check the displayed alarm messages and refer to the *Interpreting Alarm Messages* section for their interpretation.

If the problem cannot be corrected by performing the actions listed in *Table 7-15*, refer to *Table 7-19.* Identify the trouble symptoms and perform the actions listed under "Corrective Measures" in the order given, until the problem is corrected.

Table 7-19. Troubleshooting Chart

No.	Trouble Symptoms	Probable Cause	Corrective Measures
1	FCD-155 does not turn on	1. No power	Check that the power cable is properly connected to the FCD-155 POWER connector.
			Check that both ends of the power cable are properly connected.
			Check that power is available at the power outlet serving the FCD-155.
		2. Blown fuse	For an AC-powered FCD-155, check and if necessary replace its fuse (located in a compartment within its power connector: a replacement fuse is stored within the same compartment).
			Replace FCD-155 if fuse blows again
		3. Defective FCD-155	Replace FCD-155
2	The LOS indicator of an external (network link) port of the local FCD-155 lights	1. Cable connection problems	Check for proper connections of the cables to the FCD-155 LINK TX and RX connector. Repeat check at the remote equipment.
		2. Incorrect setting of internal SDH/SONET jumper	Have authorized technical support personnel check and if necessary correct the setting of the SDH/SONET selection jumper.
		3. External problem	Activate the SDH ports remote loopback at the local FCD-155. If the remote equipment connected to the FCD-155 network port does not receive its own signal, check its operation and replace if necessary
		4. Defective FCD-155	Replace FCD-155
3	The SYNC LOSS LOC indicator of the local FCD-155 lights	1. Loss of link signal	Check that the ACTIVE indicator of a network link port lights and that its LOS indicator is off. If not, refer to No. 2 above
		2. External problem	Activate the SDH ports local loopback at the local FCD-155. If the SYNC LOSS LOC indicator turns off, the problem is external
		3. Defective FCD-155	Replace FCD-155

Table 7-19. Troubleshooting Chart (Cont.)

No.	Trouble Symptoms	Probable Cause	Corrective Measures
4	The AIS indicator of a local PDH port lights. For 8E1 or 8T1 option, the LOS/AIS lights in yellow. For 21E1 or 28T1 option, the ALM lights in yellow	1. External problem	The remote equipment sends AIS. If problem persists, request troubleshooting of the remote equipment
5	The SYNC LOSS indicator of a PDH port of the local FCD-155 lights, while the SYNC LOSS LOC indicator of the local FCD-155 is off. For 8E1 or 8T1 option, the LOS/AIS lights in red. For 21E1 or 28T1 option, the ALM lights in red	1. External problem	Activate the PDH port local loopback at the local FCD-155. If the SYNC LOSS LOC indicator turns off, the problem is external
		2. Defective FCD-155	Replace FCD-155 if defective
6	The equipment attached to the LAN port of the local FCD-155 cannot communicate with other equipment on the WAN	1. Configuration problems	Check the LAN port configuration, and the other FCD-155 parameters that affect processing of LAN traffic
		2. Problem in connection to LAN	Check that the LINK indicator of the corresponding LAN port lights. If not, check for proper connection of the cable to the LAN port. Also check that at least one node is active on the LAN, and that the hub or Ethernet switch to which the FCD-155 LAN port is connected is powered
		3. External problem	Check the external equipment (e.g., default gateway and other routers) that process the traffic coming from the local FCD-155 LAN port
		4. Defective FCD-155	Replace FCD-155

7.8 Frequently Asked Questions

Q: What is the switching time of the STM-1/OC-3 network link to the redundant link?

A: Less than 50 msec. Only FCD-155 units with two network ports support this function.

Q: Does FCD-155 support ITU-T Rec. G.957 and G.958 standards?

A: FCD-155 supports ITU-T Rec. G. 957. FCD-155E also supports some of the G.958 functions.

Q: Is it possible to view the utilization of a virtually concatenated group?

A: No. This requires using an external analyzer.

Q: How many virtually concatenated groups are supported by FCD-155?

A: For FCD-155 versions without any LAN option (including versions equipped with two Ethernet LAN ports), the total number of virtually concatenated groups supported by the FCD-155 is 4.

For FCD-155 equipped with a GbE LAN port, the total number of virtually concatenated groups supported by the FCD-155 is 8.

For FCD-155 equipped with 4 transparent ports, or with 6 LAN ports (2 passing through the Ethernet switch and 4 transparent ports), the total number of virtually concatenated groups supported by the FCD-155 is 8, where 4 are available to the 2 Ethernet ports, and 4 are permanently assigned to the transparent ports.

Q: How can an FCD-155 be accessed/configured if the password is forgotten?

A: To access the FCD-155 when its password is not known, it is necessary to reload its software, including the factory-default configuration. Note that in this case the product configuration will be lost!

Use the following procedure (see *Appendix B* for details):

1. Enter the **Boot Manager** menu.

2. Select **Format Flash**.

3. Select **Download Files by XModem**.

4. Download the relevant software version using the XModem protocol.

5. Now you can access the FCD-155 using the default password (1234).

Q: Does the FCD-155 have add/drop capabilities?

A: Certain versions of FCD-155 and FCD-155E can be orderedE: this option supports the ADM (add/drop) function. FCD-155 versions operate only as a terminal multiplexer, and requires using an external ADM, for example, the R-STM-1E offered by RAD.

Q: Does FCD-155 support IVL?

A: No, FCD-155 supports SVL. The differences between IVL and SVL are as follows:

- IVL means Independent VLAN Learning: if a MAC address is learned in one VLAN, that information will be used in the forwarding decision of that VLAN only, not by any other VLAN.

- SVL means Shared VLAN Learning: if a MAC address is learned in one VLAN, that information will be used in the forwarding decision of all VLANs in the bridge. This means that all VLANs defined on the bridge share the same filtering database. It also means that a MAC address cannot be associated with two different ports within the same bridge.

Q: Does FCD-155 supports VLANs (IEEE 802.1q)?

A: Yes, starting with software version 3, FCD-155 supports VLANs per IEEE 802.1Q.

VLAN support is configurable: the user can configure the FCD-155 for VLAN-unaware operation, in which case VLANs are not supported.

Q: Does FCD-155 supports Ethernet port trunking?

A: Starting with software version 3.5, FCD-155 supports Ethernet port trunking (also called link aggregation). Link aggregation allows to aggregate multiple ports (either LAN ports, or WAN ports, that is, virtually concatenated groups) into a single group, effectively combining their bandwidth to serve a single connection.

Q: What is the maximum Ethernet traffic that the user can map into SONET virtual tributaries?

A: Starting with FCD-155 version 3, the following maximum mapping capacities are available:

- Up to 84 VT-1.5

- 1 STS-1 and up to 56 VT-1.5

- 2 STS-1 and up to 28 VT-1.5,

- 3 STS-1

- 1 STS-3.

Q: What is the maximum Ethernet traffic that the user can map into SDH Virtual Containers?

A: Starting with FCD-155 version 3, the following maximum mapping capacities are available:

- Up to 63 VC-12

- Up to 84 VC-11

- 1 VC-3 and up to 42 VC-12/56 VC-11

- 2 VC-3 and up to 21 VC-12/28 VC-11

- 3 VC-3

- 1 VC-4

- Up to 84 VT-1.5

- 1 STS-1 and up to 56 VT-1.5

- 2 STS-1 and up to 28 VT-1.5

▪   3 STS-1.

Q: How can the FCD-155 be reconfigured with the factory default parameters?

A: Use the following procedure:

1. Power the FCD-155 up.

2. Log in using the user name: **su** (use **admin** for versions before 3.0) and then press **‹Enter›**.

3. Enter the password: **1234** and then press **‹Enter›.**

4. Choose **2: Configuration** and then press **‹Enter›**.

5. Choose **2: System** and then press **‹Enter›**.

6. Choose **5: Factory Default** and then press **‹Enter›**.

7. Are you sure you want to initialize default configuration?

8. Choose **# Save** and then press **‹Enter›**.

9. When prompted **Are you sure you want to update configuration**?, answer **Y** and then press **‹Enter›**.

Q: Is it possible to allocate VC-3 or STS-1 containers from the **Quick Setup** configuration screen?

A: No. The **Quick Setup** configuration screen allows to the user to allocate only bandwidth at the VC-12/VT-1.5 level. VC-3 or STS-1 must be configured manually: open the **Virtual Ports** and then use **VCAT** for configuration.

Q: Does FCD-155 support G.783 APS?

A: FCD-155 software version 2.0 and higher support redundancy for the network side STM-1/OC-3 link: it does not support bidirectional APS protection per ITU-T Rec. G.783, but does support unidirectional protection.

Starting with software version 4, FCD-155E also support MSP 1+1 unidirectional APS protection.

Q: What is the default user name and password for the FCD-155?

A: The default user name is **su** (use **admin** for versions before 3.0). The default password is **1234**.

Q: Does FCD-155 support the GFP (Generic Framing Procedure) protocol?

A: Yes, FCD-155 does support the GFP protocol.

7.9   Technical Support

Technical support for this product can be obtained from the local distributor from whom it was purchased.

For further information, please contact the RAD distributor nearest you or one of RAD's offices worldwide. This information can be found at www.rad.com (offices – About RAD › Worldwide Offices; distributors – Where to Buy › End Users).

Appendix A

Connection Data

A.1 CONTROL Connector

The CONTROL connector is a 9-pin D-type female connector with RS-232 asynchronous DCE interface, intended for direct connection to a supervision terminal. The connector is wired in accordance with *Table A-1*.

The connections to the CONTROL connector are made as follows:

* Connection to supervision terminal with 9-pin connector: by means of a straight cable (a cable wired point-to-point).

* Connection to supervision terminal with 25-pin connector: by means of a cable wired in accordance with *Figure A-1*.

* Connection to modem with 25-pin connector (for communication with remote supervision terminal): by means of a cable wired in accordance with *Figure A-1*

* Connection to modem with 9-pin connector (for communication with remote supervision terminal): by means of a crossed cable wired in accordance with *Figure A-2*.

Table A-1. CONTROL Connector Wiring

Pin	Function	Direction
1	Data Carrier Detect (DCD)	From FCD-155
2	Receive Data (RD)	From FCD-155
3	Transmit Data (TD)	To FCD-155
4	Data Terminal Ready (DTR)	To FCD-155
5	Signal Ground (SIG)	Common reference and DC power supply ground
6	Data Set Ready (DSR)	From FCD-155
7	Request to Send (RTS)	To FCD-155
8	Clear to Send (CTS)	From FCD-155
9	Ring Indicator (RI)	To FCD-155
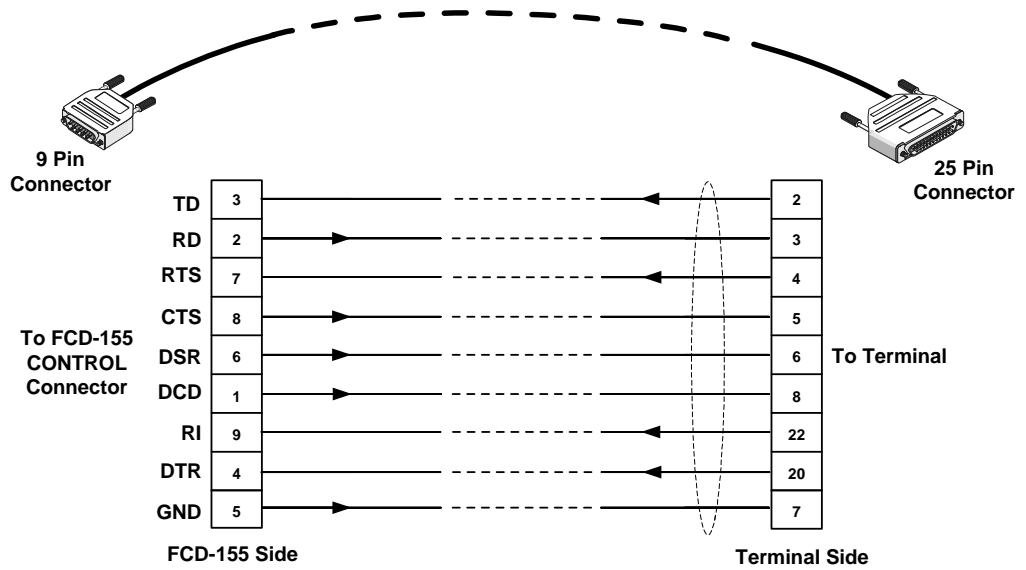
Figure A-1. 25-Pin Terminal Cable Wiring - Connection to CONTROL Connector
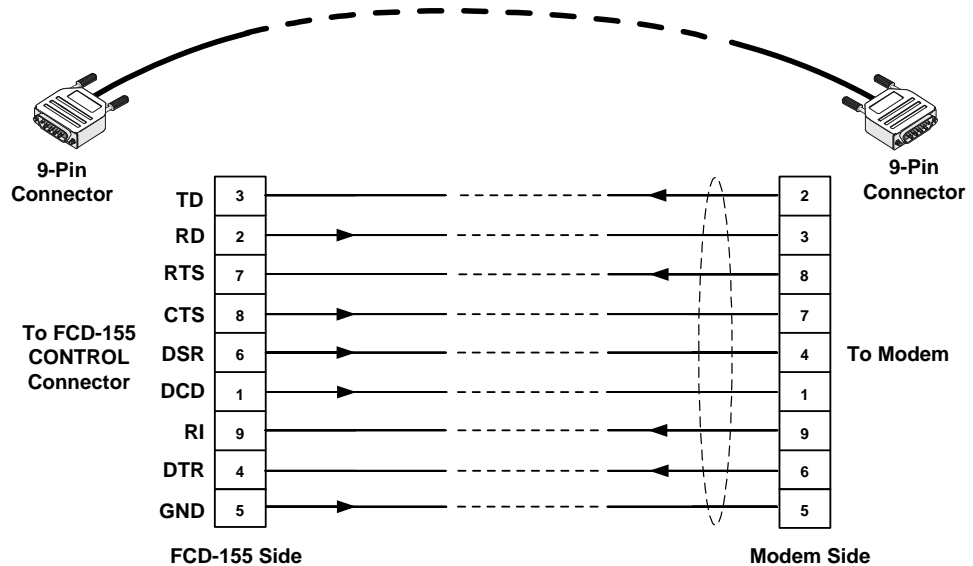
Figure A-2. 9-Pin Crossed Cable Wiring - Connection to CONTROL Connector

A.2   ALARM Connector

The ALARM connector is a 9-pin D-type female connector which provides
connections to the major and minor relay contacts, and a +5V auxiliary supply
voltage output. Connector pin functions are listed in *Table A-2*.

Caution   To prevent damage to relay contacts, it is necessary to limit, by external means,
the maximum current that may flow through the contacts (maximum allowed

current through closed contacts is 1 A). The maximum voltage across the open contacts must not exceed 60 VDC.

Table A-2. ALARM Connector Wiring

Pin	Function
1	Minor alarm relay – normally-open (NO) contact
2	Minor alarm relay – normally-closed (NC) contact
3	Ground
4	Major alarm relay – normally-open (NO) contact
5	Major alarm relay – normally- closed (NC) contact
6	Minor alarm relay – center contact
7	Not connected
8	+5V auxiliary output through 270 Ω series resistor
9	Major alarm relay – center contact

A.3   Ethernet Interface Connectors

ETH Connectors

The MNG and each of the two FCD-155 ETH ports has a 10/100BASE-TX Ethernet interface terminated in an RJ-45 connector. Each port supports the MDI/MDIX crossover function, and therefore it can be connected by any type of cable (straight or crossed) to any type of 10/100BASE-TX Ethernet port. The ports also correct for polarity reversal in the 10BASE-T mode.

Connector pin functions for the MDI state are listed in *Table A-3*. In the MDIX state, the receive and transmit pairs are interchanged.

Table A-3. MNG and ETH Interface Connector, Pin Functions

Pin	Designation	Function
1	TxD+	Transmit Data input, + wire
2	TxD–	Transmit Data input, – wire
3	RxD+	Receive Data output, + wire
4, 5	–	Not connected
6	RxD–	Receive Data output, – wire
7, 8	–	Not connected

LINK Connectors – Transparent Ethernet Option

Each of the four LINK connectors of the transparent Ethernet option has a 10/100BASE-TX Ethernet hub interface terminated in an RJ-45 connector. The port can be connected by a standard station cable to any type of 10/100BASE-TX Ethernet port. Connector pin functions are listed in *Table A-3*.

Table A-4. ETH Link 3 to 6 Interface Connectors, Pin Functions

Pin	Designation	Function
1	RxD+	Receive Data output, + wire
2	RxD–	Receive Data output, – wire
3	TxD+	Transmit Data input, + wire
4, 5	–	Not connected
6	TxD–	Transmit Data input, – wire
7, 8	–	Not connected

GbE Connectors

GbE Copper Interface Connector

The FCD-155 copper GbE port has a 10/100/1000BASE-T Ethernet interface terminated in an RJ-45 connector. This port supports the MDI/MDIX crossover function, and therefore it can be connected by any type of cable (straight or crossed) to any type of 10/100/1000BASE-TX Ethernet port. The port also corrects for polarity reversal in the 10BASE-T mode.

- When operating in the 10BASE-T or 100BASE-TX mode, the connector pin functions are as presented above for the ETH connectors.

- When operating in the 1000BASE-T mode, the connector pin functions for the MDI state are presented in *Table A-5*. In the MDIX state, the receive and transmit pairs are interchanged.

Table A-5. GbE Copper Interface Connector, Pin Functions

Pin	Designation	Function
1	BI_DAP	Pair A, + wire
2	BI_DAN	Pair A, – wire
3	BI_DBP	Pair B, + wire
4	BI_DCP	Pair C, + wire
5	BI_DCN	Pair C, – wire
6	BI_DBN	Pair B, – wire
7	BI_DDP	Pair D, + wire
8	BI_DDN	Pair D, – wire

GbE Fiber-Optic Interface

The FCD-155 GbE interface can be equipped by the user with a standard SFP plug-in, in accordance with the desired GbE interface.

If additional details are needed, contact your nearest authorized RAD business partner.

A.4   SDH/SONET Interface Connectors

The FCD-155 and FCD-155E SDH/SONET interfaces can be equipped by the user with a standard SFP plug-in, in accordance with the desired interface characteristics.

If additional details are needed, contact your nearest authorized RAD business partner.

A.5   PDH Interface Connectors

4-Port PDH Interface Option

E1 Ports

For FCD-155 units with the 4-port PDH option, each PDH E1 port has one RJ-45 eight-pin connector. Connector wiring is listed in *Table A-6.*

Table A-6. RJ-45 4 E1 PDH Port Connector, Pin Functions

Pin	Direction	Function
1	Input	Clock In (ring)
2	Input	Clock In (tip)
3	–	Not connected
4	Output	Clock Out (ring)
5	Output	Clock Out (tip)
6	–	Not connected
7	Output	Cable type sensing
8	Ground	Frame ground reference for cable type sensing

The RJ-45 connector is used for both the balanced and unbalanced interface. The connection to equipment with balanced interface is made by any standard RJ-45-to-RJ-45 cable.

To connect a port to equipment with unbalanced E1 interface, it is necessary to convert the RJ-45 connector to the standard pair of BNC female connectors used for unbalanced E1 interfaces. RAD offers a 15-cm long adapter cable, CBL-RJ45/2BNC/E1/X, which has one RJ-45 plug for connection to the RJ-45 connector and two BNC female connectors at the other end. Cable wiring is given in *Figure A-3*.

At any time, only one type of interface can be active in the FCD-155. The port interface senses the type of cable connected to the port: one of the contacts in the RJ-45 port connector (pin 7) is used to sense connection to pin 8 (frame ground). This connection is made only by the unbalanced adapter cable, and therefore connecting this cable to the port connector will cause the interface to switch to the unbalanced mode.
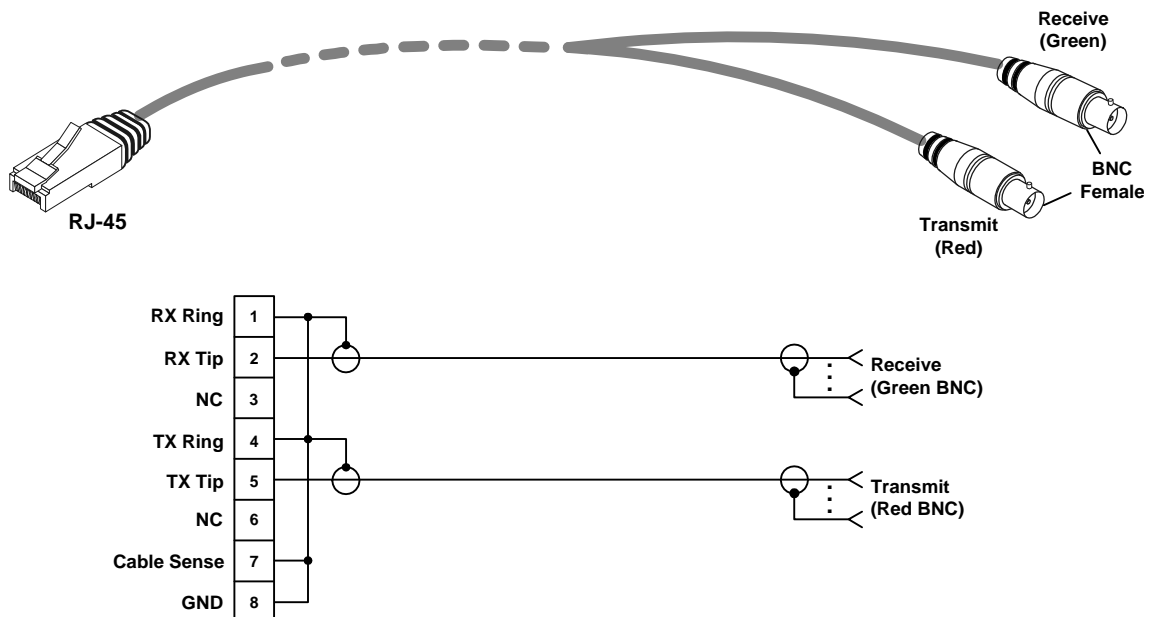
Figure A-3. Unbalanced Interface Adapter Cable, CBL-RJ45/2BNC/E1/X, Wiring Diagram

T1 Ports

Each 4 T1 port has one RJ-45 eight-pin connector, wired in accordance with *Table A-6*.

The connection to T1 equipment is made by any standard RJ-45-to-RJ-45 cable.

8-Port PDH Interface Option

E1 Ports

The FCD-155 with the 8 E1 G.703 ports option has a 44-pin D-type female connector, designated 8CH-G703, that carries all the 8 ports and supports both the unbalanced and balanced interfaces.

At any time, only one type of interface can be active in the FCD-155. The port interface senses the cable connected to the port. For this purpose, one of the contacts in the 8CH-G703 port connector (pin 15) is used to sense the connection of the unbalanced adapter cable: when the CBL-G703-8/COAX cable is connected, pin 15 is connected to one of the frame ground pins in the connector.

The following sections describe the two adapter cables, and the functions of the 8CH-G703 pins for each interface type.

CBL-G703-8/RJ45 Cable

The CBL-G703-8/RJ45 is a 2-meter long cable for use with the balanced interfaces.

Figure A-4 shows the cable construction. *Table A-7* presents the cable wiring and identifies the interface connector pin assignment.
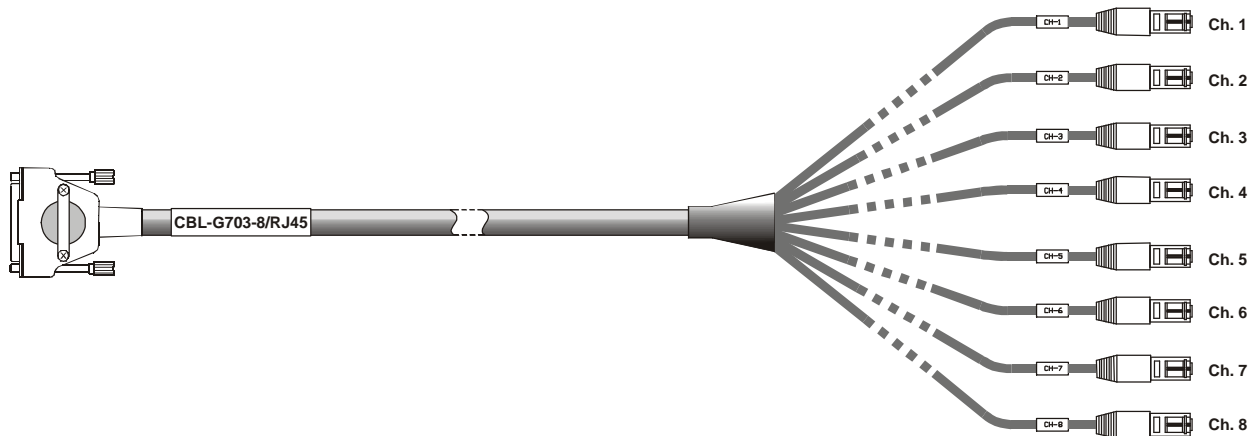
Figure A-4. CBL-G703-8/RJ45 Cable

Table A-7. CBL-G703-8/RJ45 Cable Wiring

Channel	RJ-45 Connector	44-Pin Connector		RJ-45 Connector Pins	Channel	RJ-45 Connector	44-Pin Connector		RJ-45 Connector Pins
		Pin	Function				Pin	Function	
1	CH-1	31	RX Ring	1	5	CH-5	37	RX Ring	1
		17	RX Tip	2			23	RX Tip	2
		16	TX Ring	4			22	TX Ring	4
		1	TX Tip	5			7	TX Tip	5
2	CH-2	33	RX Ring	1	6	CH-6	38	RX Ring	1
		32	RX Tip	2			39	RX Tip	2
		2	TX Ring	4			8	TX Ring	4
		3	TX Tip	5			9	TX Tip	5
3	CH-3	34	RX Ring	1	7	CH-7	40	RX Ring	1
		20	RX Tip	2			26	RX Tip	2
		19	TX Ring	4			25	TX Ring	4
		4	TX Tip	5			10	TX Tip	5
4	CH-4	35	RX Ring	1	8	CH-8	41	RX Ring	1
		36	RX Tip	2			42	RX Tip	2
		5	TX Ring	4			11	TX Ring	4
		6	TX Tip	5			12	TX Tip	5

CBL-G703-8/COAX Cable

The CBL-G703-8/COAX is a 2-meter long cable for use with the unbalanced interfaces. *Figure A-5* shows the cable construction. *Table A-8* presents the cable wiring and identifies the interface connector pin assignment. As listed in the table, in this cable pin 15 (cable type sensing) is wired to pin 30 (frame ground): this enables the FCD-155 to differentiate between the connection of this cable and the connection of the CBL-G703-8/RJ45 cable.

Table A-8. CBL-G703-8/COAX Cable Wiring

Channel	Function	44-Pin Connector Pin	44-Pin Connector Function	BNC Contact	Channel	Function	44-Pin Connector Pin	44-Pin Connector Function	BNC Contact
1	RX	31	Ring	Shield	5	RX	37	Ring	Shield
		29	Frame Ground				29	Frame Ground	
		17	Tip	Center			23	Tip	Center
		1	Tip	Center			7	Tip	Center
	TX	16	Ring	Shield		TX	22	Ring	Shield
		14	Frame Ground				14	Frame Ground	
2	RX	33	Ring	Shield	6	RX	38	Ring	Shield
		44	Frame Ground				44	Frame Ground	
		32	Tip	Center			39	Tip	Center
		3	Tip	Center			9	Tip	Center
	TX	2	Ring	Shield		TX	8	Ring	Shield
		30	Frame Ground				30	Frame Ground	
3	RX	34	Ring	Shield	7	RX	40	Ring	Shield
		29	Frame Ground				29	Frame Ground	
		20	Tip	Center			26	Tip	Center
		4	Tip	Center			10	Tip	Center
	TX	19	Ring	Shield		TX	25	Ring	Shield
		14	Frame Ground				14	Frame Ground	
4	RX	35	Ring	Shield	8	RX	41	Ring	Shield
		44	Frame Ground				44	Frame Ground	
		36	Tip	Center			42	Tip	Center
		6	Tip	Center			12	Tip	Center
	TX	5	Ring	Shield		TX	11	Ring	Shield
		30	Frame Ground				30	Frame Ground	
Cable Type Sensing		15	–	Shield	Frame Ground		30	–	Shield

T1 Ports

The 8 T1 G.703 ports option connector, 8CH-G703, is similar to that described above for the 8 E1 ports option.

In this case, only the CBL-G703-8/RJ45 cable can be used.
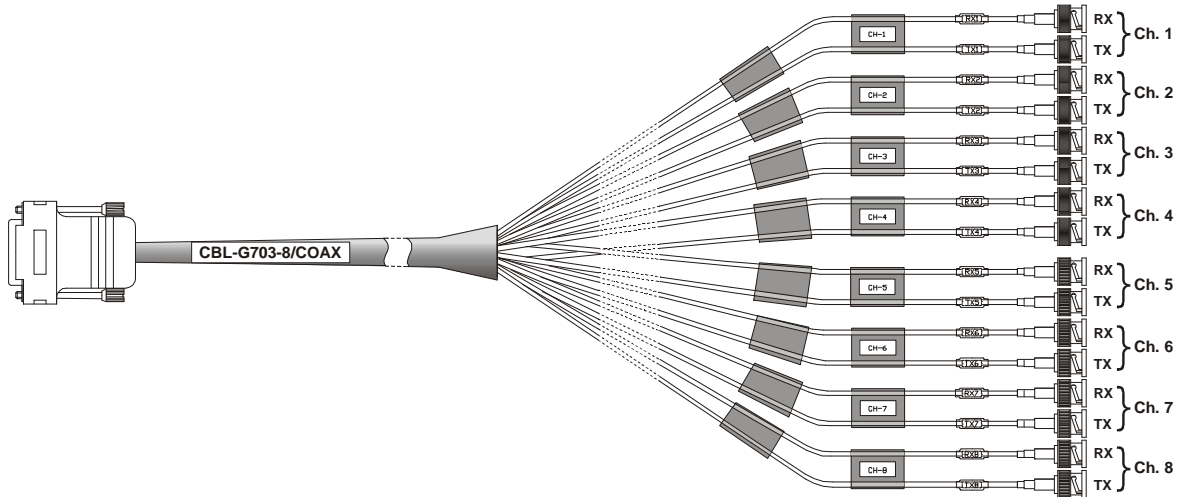
Figure A-5. CBL-G703-8/COAX Cable

CBL-G703-8/OPEN/2M, CBL-G703-8/OPEN/8M Cables

The CBL-G703-8/OPEN/2M and CBL-G703-8/OPEN/8M cables are terminated in free leads that can be connected to any terminal block or connector appropriate for your application.

Figure A-6 shows the cable construction. *Table A-9* presents the cable wiring and identifies the pair functions.

Table A-9. CBL-G703-8/OPEN/2M, 8M Cable Wiring

Channel	44-Pin Connector		Pair Color	Channel	44-Pin Connector		Pair Color
	Pin	Function			Pin	Function	
1	31	Ring	Green/White	5	37	Ring	Green/Violet
	17	Tip	White		23	Tip	White
	1	Tip	Orange/Black		7	Tip	Brown/White
	16	Ring	White		22	Ring	White
2	33	Ring	Orange/Grey	6	38	Ring	White
	32	Tip	White		39	Tip	Green
	3	Tip	Orange/Green		9	Tip	Brown
	2	Ring	White		8	Ring	White
3	34	Ring	Blue/White	7	40	Ring	Blue/Green
	20	Tip	White		26	Tip	White
	4	Tip	Green/Brown		10	Tip	Orange
	19	Ring	White		25	Ring	White
4	35	Ring	White	8	41	Ring	White
	36	Tip	Blue/Orange		42	Tip	Blue/Brown
	6	Tip	Grey		12	Tip	Orange/White
	5	Ring	White		11	Ring	White
Cable Type Sensing	15	–	Blue	Frame Ground	30	–	White
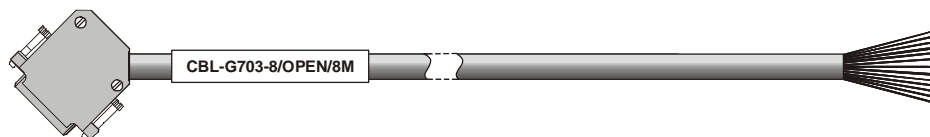
Figure A-6. CBL-G703-8/OPEN/2M, 8M Cable

21/28-Port PDH Interface Option (FCD-155E only)

E1 Ports

The 21/28 E1 G.703 ports option have two 44-pin D-type female connectors, designated CH.1-14 G.703 and CH.15-28 G.703. Each connector carries 14 ports and support both the unbalanced and balanced interfaces.

At any time, only one type of interface can be active in FCD-155E. The port interface senses the cable connected to the port. For this purpose, one of the contacts in each port connector (pin 21) is used to sense the connection of the unbalanced adapter cable: when the CBL-G703-14/COAX cable is connected, pin 21 is connected to the frame ground pin in the connector.

The following sections describe the two adapter cables, and the functions of the connector pins for each interface type.

CBL-G703-14/RJ45 Cable

The CBL-G703-14/RJ45 is a 2-meter long cable for use with the balanced interfaces.

Figure A-7 shows the cable construction. *Table A-10* presents the cable wiring and identifies the interface connector pin assignment.
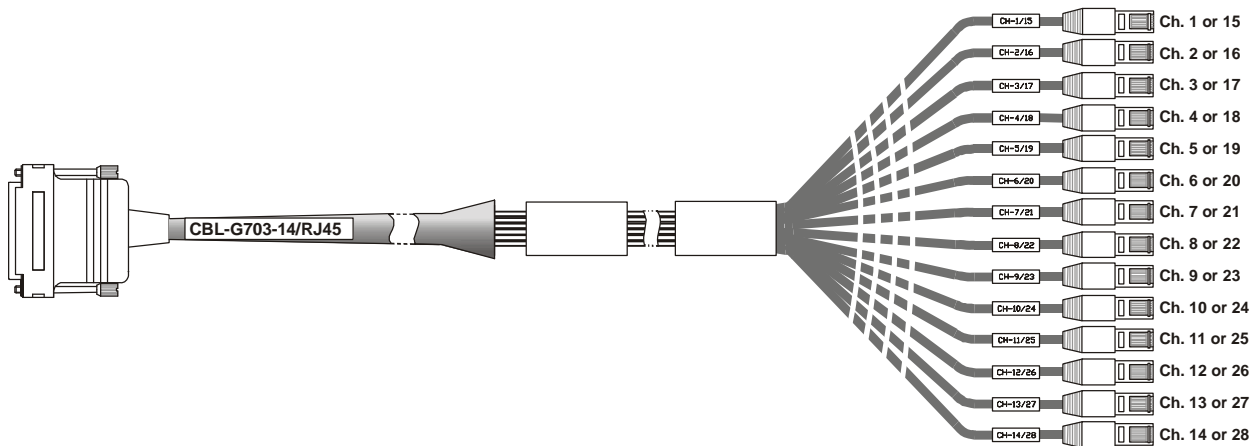
Figure A-7. CBL-G703-14/RJ45 Cable

Table A-10. CBL-G703-14/RJ45 Cable Wiring

Channel	RJ-45 Connector	62-Pin Connector		RJ-45 Connector Pins	Channel	RJ-45 Connector	62-Pin Connector		RJ-45 Connector Pins
		Pin	Function				Pin	Function	
1, 15	CH-1/15	2	RX Ring	1	8, 22	CH-8/22	12	RX Ring	1
		1	RX Tip	2			11	RX Tip	2
		23	TX Ring	4			33	TX Ring	4
		22	TX Tip	5			32	TX Tip	5
2, 16	CH-2/16	4	RX Ring	1	9, 23	CH-9/23	54	RX Ring	1
		3	RX Tip	2			53	RX Tip	2
		25	TX Ring	4			52	TX Ring	4
		24	TX Tip	5			51	TX Tip	5
3, 17	CH-3/17	46	RX Ring	1	10, 24	CH-10/24	14	RX Ring	1
		45	RX Tip	2			13	RX Tip	2
		44	TX Ring	4			35	TX Ring	4
		43	TX Tip	5			34	TX Tip	5
4, 18	CH-4/18	6	RX Ring	1	11, 25	CH-11/25	16	RX Ring	1
		5	RX Tip	2			15	RX Tip	2
		27	TX Ring	4			37	TX Ring	4
		26	TX Tip	5			36	TX Tip	5
5, 19	CH-5/19	8	RX Ring	1	12, 26	CH-12/26	58	RX Ring	1
		7	RX Tip	2			57	RX Tip	2
		29	TX Ring	4			56	TX Ring	4
		28	TX Tip	5			55	TX Tip	5
6, 20	CH-6/20	50	RX Ring	1	13, 27	CH-13/27	18	RX Ring	1
		49	RX Tip	2			17	RX Tip	2
		48	TX Ring	4			39	TX Ring	4
		47	TX Tip	5			38	TX Tip	5
7, 21	CH-7/21	10	RX Ring	1	14, 28	CH-14/28	61	RX Ring	1
		9	RX Tip	2			40	RX Tip	2
		31	TX Ring	4			60	TX Ring	4
		30	TX Tip	5			59	TX Tip	5

CBL-G703-14/COAX Cable

The CBL-G703-14/COAX is a 2-meter long cable for use with the unbalanced interfaces.

Figure A-8 shows the cable construction. *Table A-11* presents the cable wiring and identifies the interface connector pin assignment. As listed in the table, in this cable pin 21 (cable type sensing) is wired to pin 42 (frame ground): this enables the FCD-155E to differentiate between the connection of this cable and the connection of the CBL-G703-14/RJ45 cable.
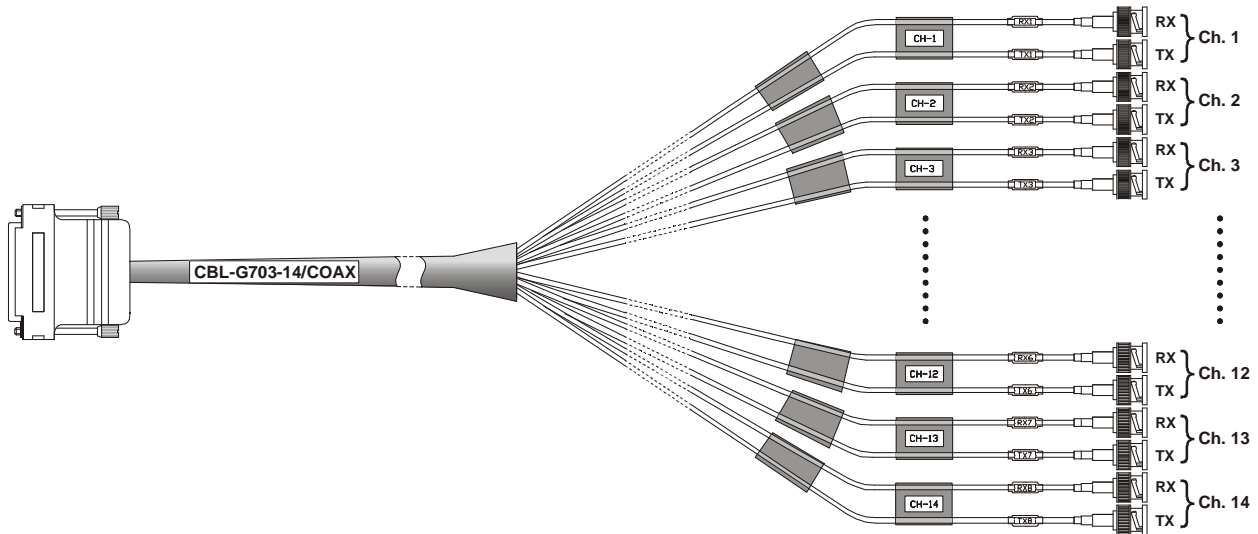
Figure A-8. CBL-G703-14/COAX Cable

Table A-11. CBL-G703-14/COAX Cable Wiring

Channel	Function	62-Pin Connector		BNC Contact	Channel	Function	62-Pin Connector		BNC Contact
		Pin	Function				Pin	Function	
1, 15	RX	2	Ring	Shield	8, 22	RX	12	Ring	Shield
		20	Frame Ground				20	Frame Ground	
		1	Tip	Center			11	Tip	Center
		22	Tip	Center			32	Tip	Center
	TX	23	Ring	Shield		TX	33	Ring	Shield
		42	Frame Ground				42	Frame Ground	
2, 16	RX	4	Ring	Shield	9, 23	RX	54	Ring	Shield
		20	Frame Ground				20	Frame Ground	
		3	Tip	Center			53	Tip	Center
		24	Tip	Center			51	Tip	Center
	TX	25	Ring	Shield		TX	52	Ring	Shield
		42	Frame Ground				42	Frame Ground	
3, 17	RX	46	Ring	Shield	10, 24	RX	14	Ring	Shield
		20	Frame Ground				20	Frame Ground	
		45	Tip	Center			13	Tip	Center
		43	Tip	Center			34	Tip	Center
	TX	44	Ring	Shield		TX	35	Ring	Shield
		42	Frame Ground				42	Frame Ground	
4, 18	RX	6	Ring	Shield	11, 25	RX	16	Ring	Shield
		20	Frame Ground				20	Frame Ground	
		5	Tip	Center			15	Tip	Center
		26	Tip	Center			36	Tip	Center
	TX	27	Ring	Shield		TX	37	Ring	Shield
		42	Frame Ground				42	Frame Ground	
5, 19	RX	8	Ring	Shield	12, 26	RX	58	Ring	Shield
		20	Frame Ground				20	Frame Ground	
		7	Tip	Center			57	Tip	Center
		28	Tip	Center			55	Tip	Center
	TX	29	Ring	Shield		TX	56	Ring	Shield
		42	Frame Ground				42	Frame Ground	

| Channel | Function | 62-Pin Connector | | BNC Contact | Channel | Function | 62-Pin Connector | | BNC Contact |
		Pin	Function				Pin	Function	
6, 20	RX	50	Ring	Shield	13, 27	RX	18	Ring	Shield
		20	Frame Ground				20	Frame Ground	
		49	Tip	Center			17	Tip	Center
		47	Tip	Center			38	Tip	Center
	TX	48	Ring	Shield		TX	39	Ring	Shield
		42	Frame Ground				42	Frame Ground	
7, 21	RX	10	Ring	Shield	14, 28	RX	61	Ring	Shield
		20	Frame Ground				20	Frame Ground	
		9	Tip	Center			40	Tip	Center
		30	Tip	Center			59	Tip	Center
	TX	31	Ring	Shield		TX	60	Ring	Shield
		42	Frame Ground				42	Frame Ground	
Cable Type Sensing		21	GND	–	Frame Ground		20	GND – RX Side	–
							42	GND – TX Side	–

CBL-G703-14/OPEN Cable

The CBL-G703-14/OPEN/2M and CBL-G703-14/OPEN/8M cables are terminated in free leads that can be connected to any terminal block or connector appropriate for your application.

Figure A-9 shows the cable construction. Table A-12 presents the cable wiring and identifies the pair functions.
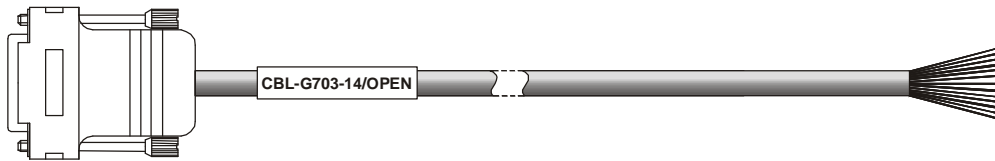
Figure A-9. CBL-G703-14/OPEN Cable

Table A-12. CBL-G703-14/OPEN Cable Wiring

Channel	62-Pin Connector Pin	62-Pin Connector Function	Pair Color	Channel	62-Pin Connector Pin	62-Pin Connector Function	Pair Color
1	2	RX Ring	White	8	12	RX Ring	White
	1	RX Tip	Blue		11	RX Tip	White/Green
	23	TX Ring	White		33	TX Ring	White
	22	TX Tip	Orange		32	TX Tip	Green /Brown
2	4	RX Ring	White	9	54	RX Ring	White
	3	RX Tip	Green		53	RX Tip	Grey/Green
	25	TX Ring	White		52	TX Ring	White
	24	TX Tip	Brown		51	TX Tip	White/Brown
3	46	RX Ring	White	10	14	RX Ring	White
	45	RX Tip	Grey		13	RX Tip	Grey/Brown
	44	TX Ring	White		35	TX Ring	White
	43	TX Tip	White/Blue		34	TX Tip	White/Grey
4	6	RX Ring	White	11	16	RX Ring	Yellow
	5	RX Tip	Orange/Blue		15	RX Tip	Blue
	27	TX Ring	White		37	TX Ring	Yellow
	26	TX Tip	Green/Blue		36	TX Tip	Orange
5	8	RX Ring	White	12	58	RX Ring	Yellow
	7	RX Tip	Brown/Blue		57	RX Tip	Green
	29	TX Ring	White		56	TX Ring	Yellow
	28	TX Tip	Grey/Blue		55	TX Tip	Brown
6	50	RX Ring	White	13	18	RX Ring	Yellow
	49	RX Tip	White/Orange		17	RX Tip	Grey
	48	TX Ring	White		39	TX Ring	Yellow
	47	TX Tip	Orange/Green		38	TX Tip	White/Blue
7	10	RX Ring	White	14	61	RX Ring	Yellow
	9	RX Tip	Orange/Brown		40	RX Tip	Orange/Blue
	31	TX Ring	White		60	TX Ring	Yellow
	30	TX Tip	Grey/Orange		59	TX Tip	Green/Blue
				Cable Type	21	–	Orange
				Frame Ground	20	GND	Brown/Blue

T1 Ports

The 21/28 T1 G.703 ports option connectors, CH.1-14 G.703 and CH.15-28 G.703, are similar to that described above for the 21/28 E1 ports option.

In this case, only the CBL-G703-14/RJ45 cable can be used.

Patch Panel Adapters (FCD-155E with 21/28 Ports Option only)

RAD offers special patch panels, suitable for installation in standard 19 in. racks, which simplify the connection of user's equipment to the FCD-155E E1 and T1 ports. These patch panels serve as adapters that provide separate connectors for each port that is, RJ-45 connectors for balanced E1 and T1 interfaces and BNC connectors for unbalanced E1 interfaces. Standard cables can then be used to connect the user's equipment to the patch panel connectors.

Two types of patch panels are offered:

- **OP-A/ADAPTOR/28RJ**: 1U-high patch panel for balanced interfaces. Has 28 RJ-45 connectors, one for each port

- **OP-A/ADAPTOR/21BNC/1551**: 2U-high patch panel for unbalanced interfaces. Has 28 pairs of BNC connectors, one pair for each port.

The panels provide only transparent connections: they do not provide any impedance matching, and therefore it is necessary to use the panel type corresponding to the selected port interface.

Both patch panels have two 64-pin TELCO connectors on their rear panels, for connection via adapter cables to the FCD-155E connectors. The panels are supplied with two CBL-TELCO-TELCO cables. RAD offers suitable adapter cables, designated CBL-G703-14/PATCH, having a length of 2 meter, for connecting the FCD-155E to the patch panel.

Each panel serves one FCD-155E unit with the 21/28 ports option, and requires two adapter cables.

OP-A/ADAPTOR/21BNC/1551 Description

Figure A-10 shows a general view of the OP-A/ADAPTOR/21BNC/1551 patch panel.

- The rear side of the panel has two 64-pin TELCO connectors, designated I/O 1 and I/O 2, for connection to the FCD-155E E1 port connectors by means of two supplied CBL-TELCO-TELCO cables and the CBL-G703-14/PATCH cables. Three grounding screws are also located on the rear side: a grounding screw for the panel itself, and two screws for connecting the cable shields. For convenience, matching cable lugs are supplied for each grounding screw.

- The front side has 28 pairs of BNC connectors, one pin for each port:

  - TX – serves as the port transmit (output) connector

  - RX – serves as the port receive (input) connector.
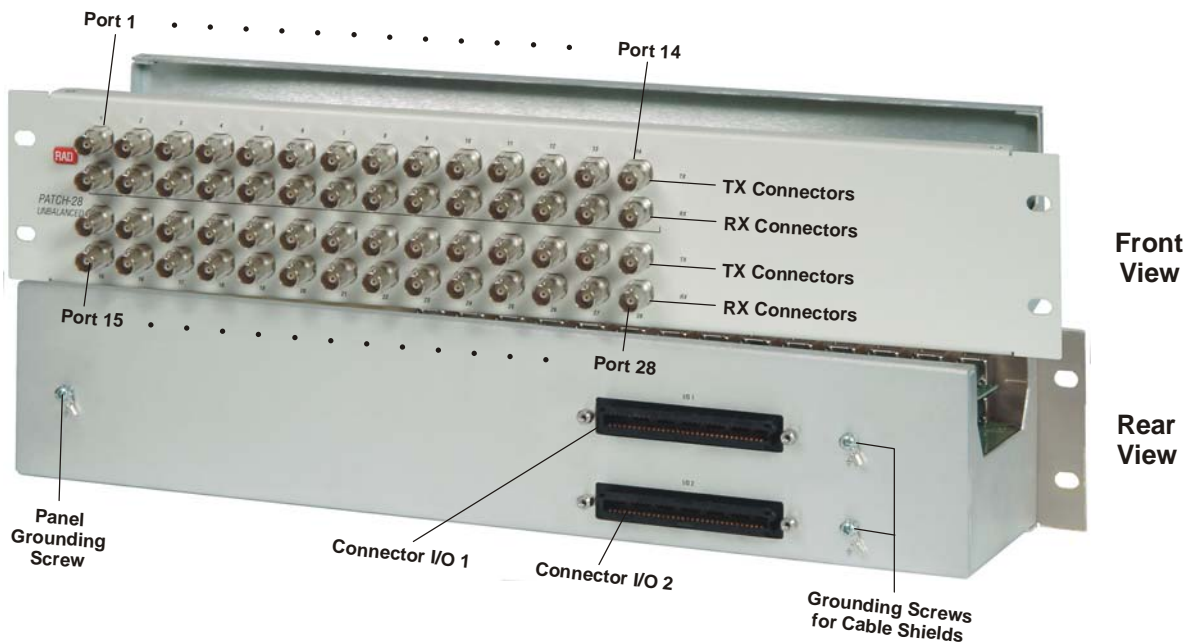
Figure A-10. OP-A/ADAPTOR/21BNC/1551 Patch Panel

OP-A/ADAPTOR/28RJ Description

Figure A-11 shows a general view of the OP-A/ADAPTOR/28RJ patch panel.

- The rear side of the panel has two 64-pin TELCO connectors, designated I/O 1 and I/O 2, for connection to the FCD-155E E1 port connectors by means of two supplied CBL-TELCO-TELCO cables and the CBL-G703-14/PATCH cables. Three grounding screws are also located on the rear side: a grounding screw for the panel itself, and two screws for connecting the cable shields. For convenience, matching cable lugs are supplied for each grounding screw.

- The front side has 28 RJ-45 connectors, one for each port.
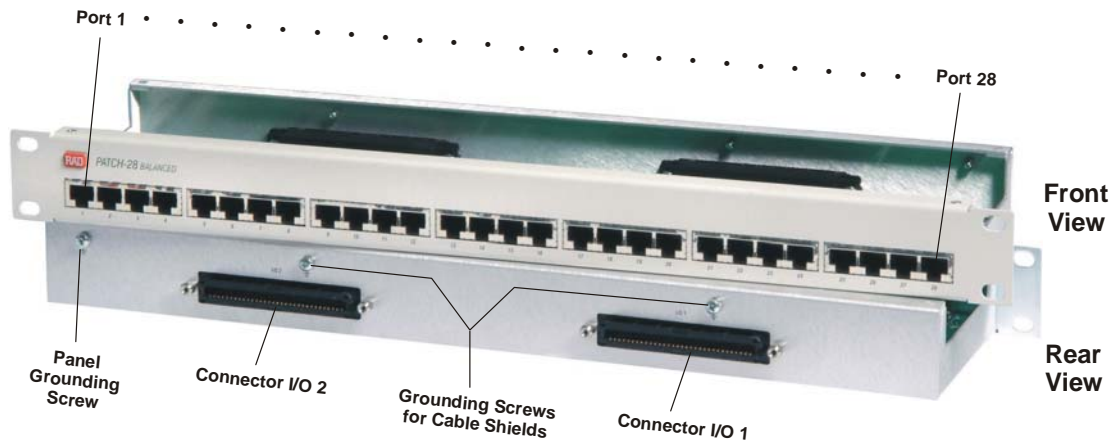
Figure A-11. OP-A/ADAPTOR/28RJ Patch Panel

Patch Panel Adapter Cable, CBL-G703-14/PATCH

RAD offers dedicated adapter cables, CBL-G703-14/PATCH, which are used to connect the patch panel to the FCD-155E.

Figure A-12 shows the CBL-G703-14/PATCH cable structure. The cable, which is 2-meter long, has one 62-pin D-type male connector, which connect to the CH.1-14 or CH.15-28 connector of an FCD-155E module. The other cable side ends into two 64-pin TELCO connectors, designated I/O 1 and I/O 2, which connect to the corresponding patch panel connectors. The cable shields at the patch panel side are terminated in cable lugs, for connection to the dedicated patch panel cable shield servers.
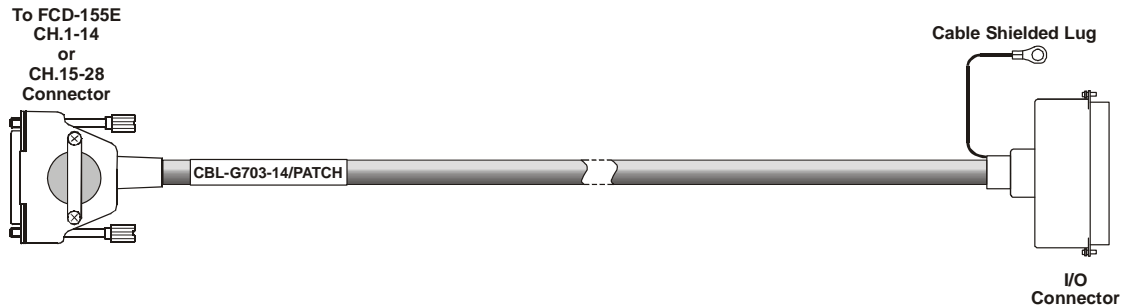
Figure A-12. CBL-G703-14/PATCH Cable

Table A-13 provides the wiring of the CBL-G703-14/PATCH cable.

Table A-13. CBL-G703-14/PATCH Cable Wiring

Channel	62-Pin Connector		I/O Connector Pins	Channel	62-Pin Connector		I/O Connector Pins
	Pin	Function			Pin	Function	
1, 15	2	RX Ring	2	8, 22	12	RX Ring	16
	1	RX Tip	34		11	RX Tip	48
	23	TX Ring	1		33	TX Ring	15
	22	TX Tip	33		32	TX Tip	47
2, 16	4	RX Ring	4	9, 23	54	RX Ring	18
	3	RX Tip	36		53	RX Tip	50
	25	TX Ring	3		52	TX Ring	17
	24	TX Tip	35		51	TX Tip	49
3, 17	46	RX Ring	6	10, 24	14	RX Ring	20
	45	RX Tip	38		13	RX Tip	52
	44	TX Ring	5		35	TX Ring	19
	43	TX Tip	37		34	TX Tip	51
4, 18	6	RX Ring	8	11, 25	16	RX Ring	22
	5	RX Tip	40		15	RX Tip	54
	27	TX Ring	7		37	TX Ring	21
	26	TX Tip	39		36	TX Tip	53
5, 19	8	RX Ring	10	12, 26	58	RX Ring	24
	7	RX Tip	42		57	RX Tip	56
	29	TX Ring	9		56	TX Ring	23
	28	TX Tip	41		55	TX Tip	55

Channel	62-Pin Connector		I/O Connector Pins	Channel	62-Pin Connector		I/O Connector Pins
	Pin	Function			Pin	Function	
6, 20	50	RX Ring	12	13, 27	18	RX Ring	26
	49	RX Tip	44		17	RX Tip	58
	48	TX Ring	11		39	TX Ring	25
	47	TX Tip	43		38	TX Tip	57
7, 21	10	RX Ring	14	14, 28	61	RX Ring	28
	9	RX Tip	46		40	RX Tip	60
	31	TX Ring	13		60	TX Ring	27
	30	TX Tip	45		59	TX Tip	59
					21	For future use	31
					42	For future use	63

E3 and T3 Ports

The FCD-155 E3 and T3 ports have two 75 Ω BNC connectors, one for the receive input and the other for the transmit output.

A.6   ST. CLK Connector (FCD-155E only)

Connector Data

The ST. CLK port has one RJ-45 eight-pin connector that serves both the balanced and unbalanced interface. Connector wiring is listed in *Table A-14*.

Table A-14. ST. CLK Connector, Pin Functions

Pin	Direction	Function
1	Input	Clock In (ring)
2	Input	Clock In (tip)
3	–	Not connected
4	Output	Clock Out (ring)
5	Output	Clock Out (tip)
6	–	Not connected
7	Output	Cable type sensing
8	Ground	Frame ground reference for cable type sensing

Adapter Cable

To connect the ST. CLK port to equipment with unbalanced clock interface, it is necessary to convert the RJ-45 connector to the standard pair of BNC female connectors used for unbalanced interfaces.

For this purpose, RAD offers a 15-cm long adapter cable, CBL-RJ45/2BNC/E1/X (the same cable needed for connection to the 4 E1 PDH ports). This cable, which has one RJ-45 plug for connection to the ST. CLK connector and two BNC female connectors at the other end, supports automatic detection of the cable type as explained for the 4 E1 PDH ports on page *A-5*. Cable wiring is given in *Figure A-3*.

A.7   Power Connectors
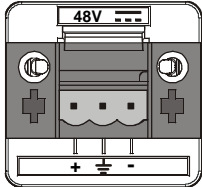
AC Power Connector

AC-powered units have one standard IEC three-pin socket, with integral fuse, for connection to AC power.

DC Power Connector

DC-powered units have one three-pin DC power connector for connection of the -48 VDC supply voltage. Connector wiring is listed in *Table A-15*, together with a view of the connector itself.

Table A-15. DC Connector Pin Functions

Pin	Function	
1	Ground (0V)	
2	Chassis (Frame) Ground	
3	-48 VDC	

Appendix B

Updating Software

This appendix presents procedures for downloading software to the FCD-155.

The procedures appearing in this appendix can be used to:

1. Update the FCD-155 software when a new release becomes available.

2. Download again the software in case the stored software has been corrupted.

3. Download software to a new or repaired FCD-155.

B.1   Downloading Options

Using File Utilities Menu

The recommended software downloading method, explained in *Section B.2*, is downloading by means of the TFTP protocol, using the **File Utilities** menu reached from the main menu.

Network administrators can use this procedure to distribute new software releases to all the managed FCD-155 units in the network from a central location.

When using TFTP from the **File Utilities** menu, you can select to delay the activation of the new software, by disabling the automatic reboot after software downloading is successfully completed. In this case, the activation occurs when you reset the FCD-155, or when the FCD-155 is turned OFF and then back ON.

This permits synchronizing the software update across a site or network, and select a time of minimal disruption to traffic flow.

Using the Boot Menu

Software downloading may also be performed using the boot menu, as explained in *Section B.3*. The boot menu can be reached while FCD-155 performs initialization, for example, after power-up.

You may need to start the loading from the boot menu when it is not possible to activate TFTP from the **File Utilities** menu (for example, because the FCD-155 software has not yet been downloaded or is corrupted).

Note   *It is recommended that only authorized personnel use the boot menu procedures, because this menu provides many additional options that are intended for use only by technical support personnel.*

The boot menu enables downloading two types of files:

- Boot manager files. The boot manager is a critical function that controls the power-up initialization and ensures that the application program is automatically run upon power-up. The boot manager also includes several utilities (some of them are used to download files, as explained in this Appendix). This type of file is seldom updated.

  Downloading a boot manager file should be performed only by technical support personnel.

- Application files. These files carry the regular version updates. The following sections provide instructions for downloading application files.

Two software downloading options are available from the boot menu:

- Downloading using the Xmodem protocol. This is usually performed by downloading from a PC directly connected to the FCD-155 CONTROL port.

- Downloading using the TFTP protocol. This is usually performed by downloading from a host connected to a FCD-155 Ethernet port (MNG, or ETH 1/ETH 2 port), or from a remote location that provides an IP communication path to one of these FCD-155 ports.

Note   *Unless otherwise specified, all the parameter values appearing in the following screens are given for illustration purposes only, and do not reflect recommended values.*

B.2   Software Updating Using File Utilities Menu

Preparations for Using TFTP

The following conditions must be fulfilled before the TFTP protocol can be used for software downloading:

1. The required suite of protocols (which includes as minimum the TCP/IP stack, and the TFTP server and client software) must be installed on the other computer (the computer used to download files and/or accept uploaded files).

2. The FCD-155 must be assigned IP parameters for its management entity (IP address, the associated subnet mask and a default gateway IP address) using **Configuration›System›Management›Host IP** (see *Chapter 4* for detailed instructions).

3. You must obtain the IP address of the other computer.

4. The TFTP protocol runs over IP, therefore it is necessary to ensure IP connectivity between the FCD-155 and the other computer. For example:

   - The Ethernet port of the other computer may be directly connected to the FCD-155 MNG, or ETH 1/ETH 2 port. In this case, their IP addresses must be in the same subnet.

- Port MNG, ETH 1/ETH 2 of the FCD-155, and the other computer may be attached to the same LAN.

- The FCD-155 and the other computer may be attached to interconnected LANs (the connection may be provided through the SDH/SONET network).

Note

IP connectivity can be checked using standard tools such as ping.

5. If you intend to initiate TFTP transfer using a supervisory terminal connected to the FCD-155 CONTROL connector, make sure the FCD-155 supervisory port is properly configured. This is performed by means of the **Configuration>System>Control Ports** (see *Chapter 4* for detailed instructions).

Alternatively, you may use a Telnet host that can communicate with the FCD-155 either through the MNG, or ETH 1/ETH 2 port, or through the WAN (network) port.

Software Downloading Procedure

Before Starting

1. Obtain the list of distribution files to be downloaded, and check that the required distribution files are stored on the TFTP server. Valid files have the extension **.IMG**.

2. Make sure that the TFTP server can communicate with the FCD-155, for example, by sending *ping*s to the IP address assigned to the FCD-155.

Downloading Procedure

1. Open the File Utilities menu

2. Start the TFTP process by selecting item 1: **S/W & File Transfer** on the **File Utilities** menu. You will see the **S/W & File Transfer** submenu.

```
                            FCD-155

S/W & File Transfer

 1. TFTP                                >

>

File Transfer operations

ESC-prev.menu; !-main menu; &-exit; @-Output                    1 user(s)
------------------------------------------------------------------------------
```

3. On the **S/W & File Transfer** submenu, select item 1 – **TFTP** to display the TFTP screen.

```
                                   FCD-155
TFTP

 1. File Name                         ... ()
 2. Server IP                         ... (0.0.0.0)
 3. Command                           >

>

TFTP operations

ESC-prev.menu; !-main menu; &-exit; @-Output                          1 user(s)
--------------------------------------------------------------------------------
```

4. On the **TFTP** screen, select each of the items to define the parameters needed to perform the TFTP transfer:

   ▪ Select item 1: **File Name**, and enter the name of the desired software distribution file (make sure to include the path, when necessary). When done, press ‹**Enter**› to continue.

   ▪ Select item 2: **Server IP,** and enter the IP address of the server that will download the software distribution file. Enter the desired IP address in the dotted quad format, and then ‹**Enter**› to continue.

   ▪ Select item 3: **Command**, and then select item 1: **swDwnLoad**, to start the software downloading.

Note   *You can also select* **2: swDwnLoad W/O Reboot**. *In this case, you must manually reset, or turn OFF and back ON, the FCD-155.*

```
                                   FCD-155
Command

 1. swDwnLoad
 2. swDwnLoad W/O Reboot
 3. configDwnLoad
 4. configUpLoad
 5. No Operation

>

Please select item <1 to 4>

ESC-prev.menu; !-main menu; &-exit; @-Output                          1 user(s)
--------------------------------------------------------------------------------
```

5. If no errors are detected, the downloading process starts, and the screen displays its relative progress.

6. After the transfer is successfully completed, the FCD-155 is automatically reset. After the resetting is successfully completed, you will see the FCD-155 log in screen again.

Note   *If the download failed, repeat the whole procedure.*

7. Log in with the default parameters as follows:

   ▪ In the **User Name** field, type the default user name, **su**, and then press **‹Enter›**

   ▪ In the **Password** field, type the default, **1234**, and then press **‹Enter›.**

8. You will see the main menu screen.

The FCD-155 now uses the downloaded software.

B.3   Software Downloading From the Boot Menu

Software Downloading Procedure Using Xmodem Protocol

Before starting, copy the prescribed software file to the PC disk.

Preparations for Using Xmodem Protocol

1. Connect the serial RS-232 communication port of a PC running a terminal emulation program (for example, the HyperTerminal utility available with most Microsoft Inc. Windows™ releases) to the FCD-155 CONTROL connector. Select the emulated terminal type as VT-100.

2. Configure the communication parameters of the selected serial port for asynchronous communication for 115.2 kbps, no parity, one start bit, eight data bits and one stop bit. Turn flow control off.

3. If the FCD-155 operates, disconnect its power.

Procedure – FCD-155E

1. Start the terminal emulation program in accordance with the configuration parameters described above.

2. When ready, connect the power to the FCD-155E, and immediately start pressing the **‹Enter›** key many times in sequence until you see the boot manager screen.

Note   *If you miss the timing, the FCD-155 will perform a regular reboot process (this process starts with **Loading** and ends with a **Running** message).*

3. A typical screen for a FCD-155E is shown below (the exact version and date displayed by your unit may be different).

```
Boot version 2.00 (Jun  5 2005)
Boot manager version 10.00 (Jun  5 2005)

0 - Exit boot-manager
1 - Dir
2 - Set active software copy
3 - Delete software copy
4 - Download boot manager or an application by XMODEM
5 - Format Flash
6 - Show basic hardware information
7 - Reset board
8 - System configuration
9 - Download boot manager or an application by TFTP
Press the ESC key to return to the main menu
Select:
```

1. Type **4: Download boot manager or an application by XMODEM**. You are now prompted to select the type of file to be downloaded.

```
Choose the software you want to work on
0 - boot-manager
1 - application file

Select: 1
```

2. Type **1** to download an FCD-155E software update.

3. You will see a message that requests the partition number to which the new software is to be downloaded, and offers a recommended value.

4. If there is no special reason to select a different value, type the recommended number and then press **‹Enter›.** A typical display is shown below:

```
Select Copy number for download ( 1 )
Select: 1
```

5. The process starts, and you will see:

```
Erasing Partition please wait ....
Please start the XMODEM download.
```

6. Start the transfer in accordance with the program you are using. For example, if you are using the Windows HyperTerminal utility:

   ▪ Select **Transfer** in the HyperTerminal menu bar, and then select **Send File** on the **Transfer** menu.

   ▪ You will see the **Send File** window:

      ▫ Select the prescribed FCD-155E software file name (you may use the **Browse** function to find it).

      ▫ In the **Protocol** field, select **Xmodem.**

   ▪ When ready, press **Send** in the **Send File** window. You can now monitor the progress of the downloading in the **Send File** window.

Note   *If downloading fails, repeat the whole procedure.*

7. When the downloading process is successfully completed, you will see a sequence of messages similar to the following:

```
Loading ...
Decompressing to RAM.

Processing archive: FLASH
Extracting FCD155.BIN
.........................................................
............................................................... CRC OK
Running ...
****************************************************************
* In order to start working - press the ENTER button for few times*
****************************************************************
```

8. At this stage, press the **‹ESC›** key to go to the main menu.

9. Press **‹Enter›** to display the FCD-155E log-in screen.

10. Log in with the default parameters as follows:

  ▪ In the **User Name** field, type the default user name, **su**, and then press **‹Enter›**

  ▪ In the **Password** field, type the default, **1234**, and then press **‹Enter›.**

11. You will see the main menu screen.

The FCD-155E now uses the downloaded software.

Procedure – FCD-155

1. Start the terminal emulation program in accordance with the configuration parameters described above.

2. When ready, connect the power to the FCD-155, and immediately start pressing the **‹Enter›** key many times in sequence until you see the boot manager screen. A typical screen is shown below (the exact version and date displayed by your FCD-155 may be different).

Note   *If you miss the timing, the FCD-155 will perform a regular reboot process (this process starts with **Loading** and ends with a **Running** message).*

```
RAD FCD155 Boot Version 2.10 (Sep 29 2003)
RAD Boot Manager Version 6.01 (Sep 29 2003)

0 - Exit Boot-Manager
1 - Dir
2 - Set Active Software Copy
3 - Delete Software Copy
4 - Download Files or an Application by XMODEM
5 - Format flash
6 - Show basic hardware information
7 - Perform Reset to the board
8 - System Configuration.
9 - Download an Application by TFTP
Press the ESC key to go back to the Main Menu.

Select:
```

3. Type **4**. You will see a message that requests the partition number to which the new software is to be downloaded, and offers a recommended value.

4. Continue as explained above for FCD-155E, *Step 4* to *Step 11*.

Software Downloading Procedure Using TFTP Protocol

Note

For FCD-155 units, it is not possible to initiate file transfer using TFTP from the boot menu. When it is necessary to use this function, it must be enabled using an internal switch. Contact your nearest authorized RAD business partner for details.

⚠
Warning

No internal settings, adjustment, maintenance, and repairs may be performed by either the operator or the user; such activities may be performed only by skilled service personnel who are aware of the hazards involved. Always observe standard safety precautions during installation, operation, and maintenance of this product, and the safety precautions in *Chapter 2*.

Preparations for Using TFTP Protocol

The preparations needed for using the TFTP protocol from the boot menu are similar to the preparations needed to download software from the **File Utilities** menu (see *Preparations for Using TFTP* section on page *B-2*).

The main difference is the method used to define the IP parameters for the FCD-155 management entity (IP address, the associated subnet mask and a default gateway IP address): if the current parameters are not correct or assume their default values, the parameters must be defined from the boot menu.

➤ **To define management IP parameters from the boot menu:**

1. Disconnect all the user cables from the FCD-155 MNG, or ETH 1/ETH 2 connectors.

2. Connect only the Ethernet cable from the TFTP server to the FCD-155 MNG, or ETH 1/ETH 2 connector.

3. Use the procedure described on page *B-5* to display the boot menu.

```
Boot version 2.00 (Jun  5 2005)
Boot manager version 10.00 (Jun  5 2005)

0 - Exit boot-manager
1 - Dir
2 - Set active software copy
3 - Delete software copy
4 - Download boot manager or an application by XMODEM
5 - Format Flash
6 - Show basic hardware information
7 - Reset board
8 - System configuration
9 - Download boot manager or an application by TFTP
Press the ESC key to return to the main menu

Select: 8

IP Address [172.17.171.139]: 168.119.10.101
IP Mask [255.255.255.0]: 255.255.255.0
Default Gateway Address [172.17.171.1]: 168.119.10.1
```

4. Type **8: System configuration** and then press ‹ **Enter** › to start the configuration of the FCD-155 management IP parameters, as needed for TFTP transfer.

5. The parameters are displayed in consecutive lines. For each parameter, you can accept the current values by simply pressing ‹ **Enter** › to continue, or type a new value:

   ▪ **IP Address**: used to select the IP address of the FCD-155 management entity. To change the current value, type the desired IP address in the dotted quad format, and then ‹ **Enter** › to continue.

   ▪ **IP Mask**: used to select the IP subnet mask of the management entity. To change the current value, type the IP subnet mask address in the dotted quad format, and then ‹ **Enter** › to continue.

   ▪ **Default Gateway Address**: used to define the IP address of the default gateway to be used by the FCD-155 management entity. Make sure to select an IP address within the subnet of the FCD-155 management IP address. To change the current value, type the desired IP address in the dotted quad format, and then ‹ **Enter** › to end the configuration.

   If no default gateway is needed, for example, because the TFTP server is attached to the same LAN as the FCD-155, enter **0.0.0.0**.

6. After pressing ‹ **Enter** ›, you will see again the boot menu.

7. Select **7: Reset board** to reset the FCD-155. The new parameters take effect only after the resetting is completed.

Downloading Procedure

➤ **To download software from the boot menu using TFTP:**

1. On the boot menu, select **9: Download boot manager or an application by TFTP** and then press ‹**Enter**› to start the TFTP transfer.

2. You will see **Enter TFTP timeout in case of failure**, followed by the current default time-out value (in seconds):

   ▪ To select the default, press ‹**Enter**›

   ▪ To change, type the desired time-out and then press ‹**Enter**›.

3. After you see **Enter the Target File Name**, enter the name of the desired software distribution file (make sure to include the path, when necessary). When done, press ‹**Enter**› to continue.

4. You will see **Enter the Server IP address**: enter the IP address of the server that will download the software distribution file, using the dotted quad format, and then press ‹**Enter**› to continue.

```
Boot version 2.00 (Jun 5 2005)
Boot manager version 10.00 (Jun 5 2005)

0 - Exit boot-manager
1 - Dir
2 - Set active software copy
3 - Delete software copy
4 - Download boot manager or an application by XMODEM
5 - Format Flash
6 - Show basic hardware information
7 - Reset board
8 - System configuration
9 - Download boot manager or an application by TFTP
Press the ESC key to return to the main menu

Select:9

Enter TFTP timeout in case of failure [20 sec]: 40
Enter the target file name [MP4100.img]:
Enter the server IP address [172.17.174.50]:
```

5. You are now prompted to select the type of file to be downloaded.

   Type **1** to download a FCD-155 software update.

```
Choose the software you want to work on
0 - boot-manager
1 - application file

Select: 1
```

6. If no errors are detected, the downloading process starts, and the screen displays its relative progress.

7. After the transfer is successfully completed, the FCD-155 is automatically reset and loads the new software.

Note   *If downloading failed, repeat the whole procedure.*

Checking Proper Operation with Downloaded Software

1. Change the PC communication parameters to the default values (115.2 kbps, no parity, one start bit, eight data bits, one stop bit, flow control off).

2. Press ‹Enter› to display the FCD-155 log-in screen.

3. Log in with the default parameters as follows:

   ▪ In the **User Name** field, type the default user name, **su**, and then press ‹Enter›

   ▪ In the **Password** field, type the default, **1234**, and then press ‹**Enter**›.

4. You will see the main menu screen.

The FCD-155 now uses the downloaded software.

Appendix C

Operating Environment

This appendix presents a concise description of the FCD-155 operating environment, to provide the background information required for understanding the FCD-155 configuration and performance monitoring parameters.

This appendix covers the following issues:

- PDH environment – *Section C.1*
- SDH environment – *Sections C.2* through *C.6*
- SONET environment – *Section C.7*
- Virtual concatenation – *Section C.8*
- Ethernet transmission technology – *Section C.9*.
- IP environment – *Section C.10*
- Management using SNMP – *Section C.11.*

C.1   PDH Environment

Scope

This section presents information on the main characteristics of the Plesiochronous Digital Hierarchy (PDH) signals. *Table C-1* shows the PDH multiplexing hierarchies used in the main geographical areas.

Table C-1. PDH Multiplexing Hierarchy

Multiplex Level	Europe	North America (USA)	Japan
1	E1 – 2.048 Mbps	DS1 – 1.544 Mbps	JT1 – 1.544 Mbps
2	E2 – 8.448 Mbps	DS2 – 6.312 Mbps	6.312 Mbps
3	E3 – 34.368 Mbps	DS3 – 44.736 Mbps	32.064 Mbps
4	E4 – 139.264 Mbps	DS4NA – 139.264 Mbps	97.729 Mbps

FCD-155 can transport E1, T1, E3 and T3 signals. Considering that the FCD-155 prepares the PDH data streams for transport through the SDH/SONET network on a bit-by-bit basis (unframed mode), this section presents only the line signal characteristics of the supported PDH signals.

E1 Line Signal Characteristics

E1 signal characteristics are specified in ITU-T Rec. G.703. The nominal data rate of the E1 signal is 2.048 Mbps. The E1 line signal is encoded in the High-Density Bipolar 3 (HDB3) code.

HDB3 is based on the alternate mark inversion (AMI) code. In the AMI code, "1"s are alternately transmitted as positive and negative pulses, whereas "0"s are transmitted as a zero voltage level. To prevent the transmission of long strings of "0"s, which do not carry timing information, the HDB3 coding rules restrict the maximum length of a "0" string that can be transmitted through the line to three pulse intervals. Longer strings of "0"s are encoded at the transmit end to introduce non-zero pulses.

To allow the receiving end to detect the artificially-introduced pulses and enable their removal to restore the original data string, the encoding introduces intentional coding violations in the sequence transmitted to the line. The receiving end detects these violations and when they appear to be part of an encoded "0" string – it removes them.

Coding violations may also be caused by transmission errors. Therefore, any coding violations that cannot be interpreted as intentional coding violations can be counted, to obtain information on the quality of the transmission link.

T1 Line Signal Characteristics

T1 signal characteristics are specified in ANSI T1.403 and ITU-T Rec. G.703. The nominal data rate of the T1 signal is 1.544 Mbps. The basic T1 line signal is coded using the alternate mark inversion (AMI) rules, explained above.

The AMI format cannot transmit long strings of "zeros", because such strings do not carry timing information. Therefore, the AMI signal source must generate a signal with guaranteed minimum "1" density. The minimum average "1" density required by the applicable standards is 1:8. Therefore, when a T1 signal is transmitted over an AMI line, each frame timeslot must include at least one "1" bit. This effectively reduces user data rate to 56 kbps per timeslot, and precludes the provision of clear channel capability (CCC).

To circumvent this problem, modified line codes are used, that perform zero suppression by substituting special codes for long "0" strings. The generally accepted zero suppression methods are B7 and B8ZS.

FCD-155 uses the B8ZS zero suppression method, because only this method provides clear channel capability, and the "1" density requirement no longer restricts user data characteristics. This means that each T1 frame timeslot can support the full 64 kbps.

E3 Line Signal Characteristics

The nominal data rate of the E3 signal is 34.368 Mbps. The E3 line signal is coded using the High-Density Bipolar 3 (HDB3) coding rules.

T3 Line Signal Characteristics

The T3 line operates at a nominal rate of 44.736 Mbps. The T3 line signal is coded using the B3ZS zero suppression coding rules. B3ZS coding is similar to HDB3, except that it limits the maximum length of zero strings to 2.

C.2   SDH Implementation Principles

This section describes the implementation principles for the Synchronous Digital Hierarchy (SDH), as a background for the detailed presentation of the SDH signal structures. In the following explanations, the following terms are used to describe SDH networks:

- Network node. The SDH network node is a facility at which signals built in accordance with the SDH frame structure are generated and/or terminated. Therefore, a network node provides a convenient access point to add or drop payload signals, e.g., PDH tributary signals, for transmission over the SDH network.

- SDH transport system. An SDH transport system provides the technical means to transfer SDH signals between two network nodes.

- SDH network. An SDH network is formed by interconnecting the required number of network nodes by means of SDH transport systems.

Basic SDH Principles

The Synchronous Digital Hierarchy (SDH) is implemented on the basis of two principles:

1. Direct synchronous multiplexing of individual tributary signals within the structure of the higher-rate multiplexed signal.

2. Transparent transporting of each individual tributary signal through the network, without any disassembly except at the two network nodes that exchange information through that particular signal.

To enable synchronous multiplexing, SDH equipment is designed to permit efficient and reliable synchronization of the whole network to a single timing reference.

Direct Multiplexing Approach

Direct multiplexing means that individual tributary signals can be inserted and removed into the SDH multiplexed signal without intermediate multiplexing and demultiplexing steps. This capability results in the following characteristics:

- Efficient signal transport, as the same SDH transport system can carry various types of payloads (tributary signals).

- Flexible routing, because any tributary can be inserted and removed into the SDH signal as a single unit, without affecting in any way the other tributary signals carried by the same SDH signal. This permits to build cost-effective

add/drop multiplexers, the key component of flexible networks, instead of implementing digital cross-connect systems as entities separated from multiplexing equipment.

In addition, the SDH signal structure includes sufficient overhead for management and maintenance purposes, and therefore provides the network operator full control over all the operational aspects of SDH networks and equipment units. This overhead permits the integration of the network management and maintenance functions within the transport network itself.

General Structure of SDH Signals

The SDH signal is a serial signal stream with a frame structure. *Figure C-1* shows the general structure of SDH signals.

The SDH frame structure is formed by byte-interleaving the various signals carried within its structure. Each SDH frame starts with framing bytes, which enable equipment receiving the SDH data stream to identify the beginning of each frame. The location of the other bytes within this frame structure is determined by its position relative to the framing byte.

The organization of the frame can be easily understood by representing the frame structure as a rectangle comprising boxes arranged in N rows and M columns, where each box carries one byte. In accordance with this representation, the framing byte appears in the top left-hand box (the byte located in row 1, column 1), which by convention is referred to as byte 1 of the SDH frame.

The frame bytes are transmitted bit by bit, sequentially, starting with those in the first row (see arrow in *Figure C-1*). After the transmission of a row is completed, the bits in the next lower row are transmitted. The order of transmission within each row is from left to right. After transmission of the last byte in the frame (the byte located in row N, column M), the whole sequence repeats - starting with the framing byte of the following frame.
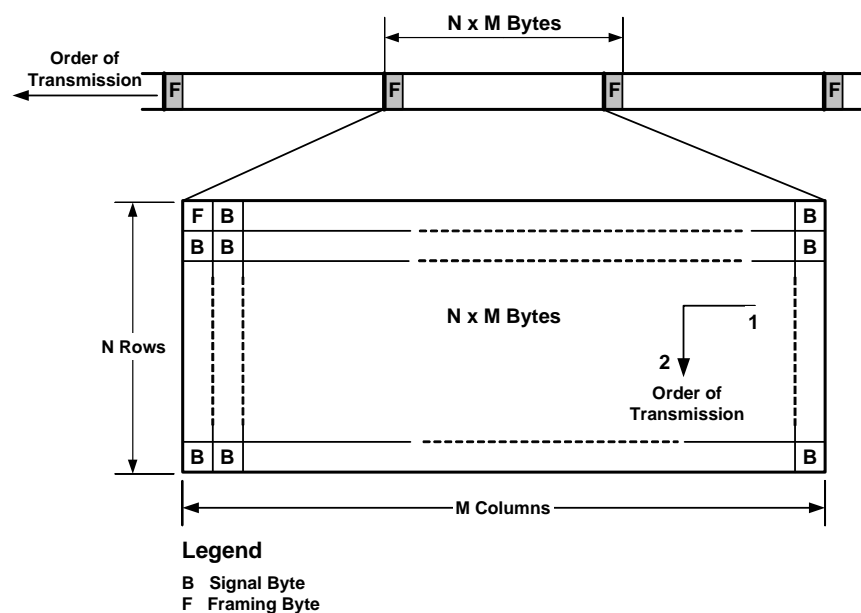
Figure C-1. General Structure of SDH Signals

SDH Frame Organization

As shown in *Figure C-2*, an SDH frame comprises two distinct parts:

- Section Overhead (SOH)

- Virtual Container (VC).
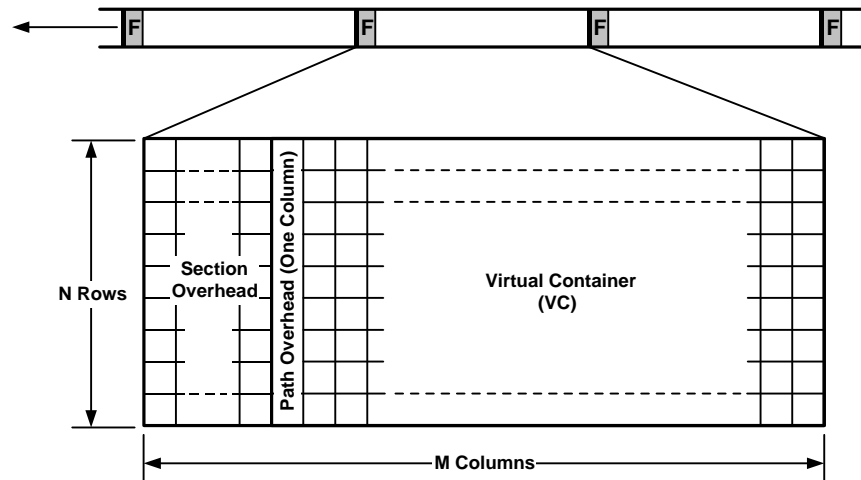
Figure C-2. SDH Frame Organization

Section Overhead

In SDH networks, the term **section** refers to the link between two consecutive SDH equipment units of the same type (see *Section C.4*).

Some signal carrying capacity is allocated in each SDH frame for the section overhead. This provides the facilities (alarm monitoring, bit error monitoring, data communications channels, etc.) required to support and maintain the transportation of a VC between nodes in an SDH network.

The section overhead pertains only to an individual SDH transport system. This means that the section overhead is generated by the transmit side of a network node, and is terminated at the receive side of the next network node.

Therefore, when several SDH transport systems are connected in tandem, the section overhead is not transferred together with the payload (VC) between the interconnected transport systems.

Virtual Container (VC)

The VC is an envelope (i.e., a special type of signal structure, or frame) that is used to transport a tributary signal across the SDH network.

The path followed by a VC within the network may include any number of nodes, therefore the VC may be transferred from one SDH transport system to another, many times on its path through the network. Nevertheless, in most cases the VC is assembled at the point of entry to the SDH network and disassembled only at the point of exit.

Since the VC is handled as an envelope that is opened only at the path end points, some of its signal carrying capacity is dedicated to path overhead. The path overhead provides the facilities (e.g., alarm and performance monitoring),

required to support and maintain the transportation of the VC between the end points.

VC Assembly/Disassembly Process

The concept of a tributary signal being inserted into a virtual container, to be transported end-to-end across a SDH network, is fundamental to the operation of SDH networks. This process of inserting the tributary signal into the proper locations of a VC is referred to as "mapping".

In all the SDH signal structures, the carrying capacity provided for each individual tributary signal is always slightly greater than that required by the tributary rate. Thus, the mapping process must compensate for this difference. This is achieved by adding stuffing bytes, e.g., path overhead bytes, to the signal stream as part of the mapping process. This increases the bit rate of the composite signal to the rate provided for tributary transport in the SDH structure.

At the point of exit from the SDH network, the tributary signal must be recovered from the virtual container, by removing the path overhead and stuffing bits. This process is referred to as "demapping". After demapping, it is necessary to restore the original data rate of the recovered tributary data stream.

C.3   STM-1 Frame Structure

FCD-155 handles the base-level SDH signal, which is called Synchronous Transport Mode Level 1 (STM-1).

Description of STM-1 Frame

Figure C-3 shows the STM-1 frame structure.
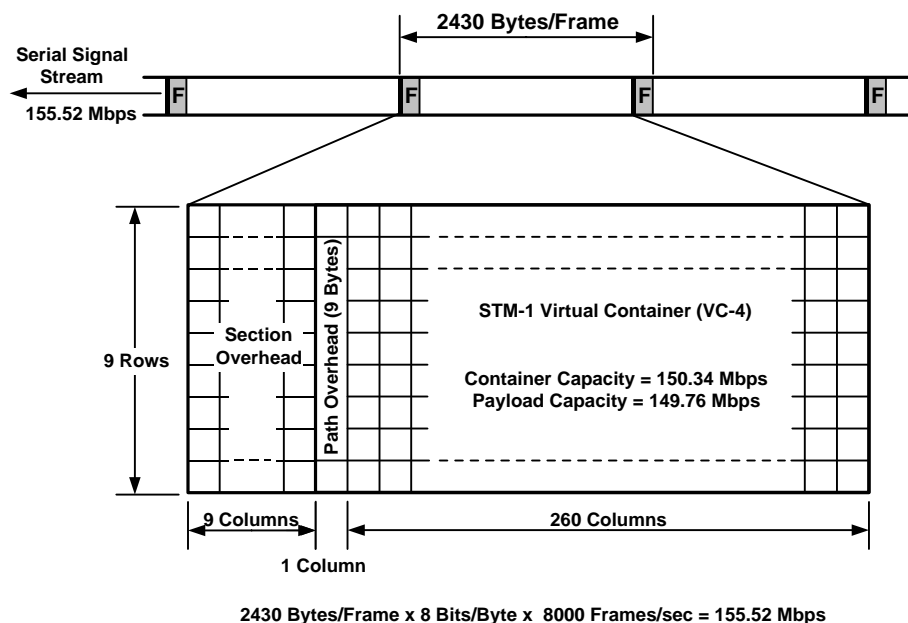
Figure C-3. STM-1 Frame Structure

STM-1 frames are transmitted at a fixed rate of 8000 frames per second.

Note   *At a transmission rate of 8000 frames per second, each byte supports a data rate of 64 kbps.*

The STM-1 signal frame comprises 9 rows by 270 columns, resulting in a total signal capacity of 2430 bytes (19440 bits per frame). Considering the STM-1 frame repetition rate, 8000 frames per second, this yields a bit rate of 155.520 Mbps.

The STM-1 frame comprises the following parts:

- **Section Overhead**. The STM-1 section overhead occupies the first nine columns of the STM-1 frame, for total of 81 bytes.

- **Virtual Container**. The remaining 261 columns of the STM-1 frame, which contain a total of 2349 bytes, are allocated to the virtual container. The virtual container itself comprises a container for the payload signal (260 columns), preceded by one column of path overhead.

  The virtual container carried in an STM-1 frame is referred to as a Virtual Container Level 4, or VC-4. VC-4, which is transported unchanged across the SDH network, provides a channel capacity of 150.34 Mbps.

  The VC-4 structure includes one column (9 bytes) for the VC-4 path overhead, leaving 260 columns of signal carrying capacity (149.76 Mbps). This carrying capacity is sufficient for transporting a 139.264 Mbps tributary signal (the fourth level in the PDH signal hierarchy). The VC-4 signal carrying capacity can also be subdivided, to permit the transport of multiple lower-level PDH signals.

Pointers

In *Figure C-3*, the VC-4 appears to start immediately after the section overhead part of the STM-1 frame.

Actually, to facilitate efficient multiplexing and cross-connection of signals in the SDH network, VC-4 structures are allowed to float within the payload part of STM-1 frames. This means that the VC-4 may begin anywhere within the STM-1 payload part. The result is that in most cases, a given VC-4 begins in one STM-1 frame and ends in the next.

Were the VC-4 not allowed to float, buffers would be required to store the VC-4 data up to the instant it can be inserted in the STM-1 frame. These buffers (called slip buffers), which are often used in PDH multiplex equipment, introduce long delays. Moreover, they also cause disruptions in case a slip occurs.

Identifying VC-4 Beginning in the STM-1 Frame

When a VC-4 is assembled into the STM-1 frame, a pointer (byte) located in the section overhead of the STM-1 frame indicates the location of the first byte (J1) of the VC-4 that starts in that STM-1 frame.

Using Pointers to Correct Timing Differences

SDH network are intended to operate as synchronous networks. Ideally, this means that all SDH network nodes should derive their timing signals from a single master network clock. However, in practical applications, network implementation must accommodate timing differences (clock offsets). These may be the result of an SDH node losing network timing reference and operating on its standby clock, or it may be caused by timing differences at the boundary between two separate SDH networks.

The VC-4 is allowed to float freely within the space made available for it in the STM-1 frame, therefore phase adjustments can be made as required between the VC-4 and the STM-1 frame.

To accommodate timing differences, the VC-4 can be moved (justified), positively or negatively three bytes at time, with respect to the STM-1 frame. This is achieved by simply recalculating and updating the pointer value at each SDH network node. In addition to clock offsets, updating the pointer will also accommodate any other adjustment required between the input SDH signal rate and the timing reference of the SDH mode.

Pointer adjustments introduce jitter. Excessive jitter on a tributary signal degrades signal quality and may cause errors. Therefore, SDH networks must be designed to permit reliable distribution of timing to minimize the number of pointer adjustments.

C.4   SDH Overhead Data

SDH Overhead Data Types

In SDH networks, a transmission path can include three equipment functions:

- **SDH terminal multiplexer** – which performs the insertion/removal of tributary signals into SDH frames

- **SDH cross-connect switch** – permits to change the routing of tributary signals carried in SDH frames

- **Regenerator** – used to increase the physical range of the transmission path.

The resulting structure of an SDH transmission path is shown in *Figure C-4.*
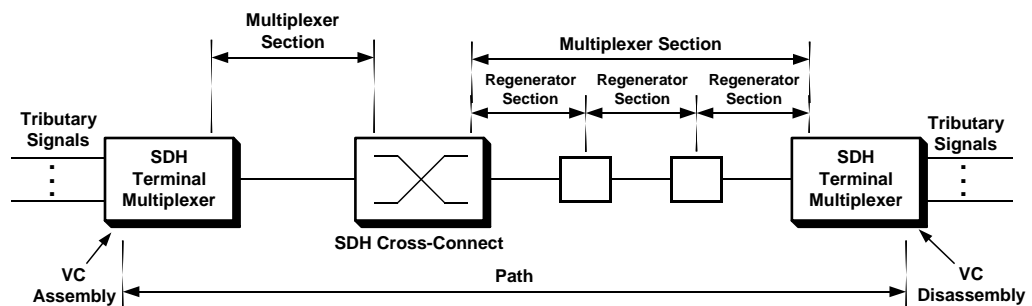
Figure C-4. Structure of Transmission Path in SDH Network

As shown in *Figure C-4*, a transmission path can comprise three types of segments:

- **Multiplexer section** – a part of a transmission path located between a terminal multiplexer and an adjacent SDH cross-connect equipment, or between two adjacent SDH terminal multiplexers.

- **Regenerator section** – a part of a transmission path located between a terminal multiplexer or SDH cross-connect equipment and the adjacent regenerator, or between two adjacent regenerators. A multiplexer section can include up to three regenerator sections.

- **Path** – the logical connection between the point at which a tributary signal is assembled into its virtual container, and the point at which it is disassembled from the virtual container.

To provide the support and maintenance signals associated with transmission across each segment, each of these segments is provided with its own overhead data, hence three types of overhead data:

- **Section overhead**, carried in the first nine columns of the STM-1 frame:

  - Multiplexer section (MS) overhead – carried in overhead rows 5 to 9

  - Regenerator section (RS) overhead – carried in overhead rows 1 to 3

  - AU pointers– carried in overhead row 4.

- **Path overhead**, carried in the first column of a VC-4. The path overhead carried in the VC-4 is called high-order path overhead; see *Section C.5* for a description of the low-order path overhead.

Figure C-5 shows the detailed structure of the overhead data in STM-1 frames.

Section Overhead — **Path Overhead**

Regenerator Section Overhead (Rows 1 - 3)									Path Overhead
Framing A1	Framing A1	Framing A1	Framing A2	Framing A2	Framing A2	ID C1			Path Trace J1
BIP-8 B1			Orderwire E1			User F1			BIP-8 B3
DCC D1			DCC D2			DCC D3			Signal Label C2
Pointer H1			Pointer H2			Pointer H3	Pointer H3	Pointer H3	Path Status G1
B2	BIP-24 B2	B2	APS K1			APS K2			User Channel F2
DCC D4			DCC D5			DCC D6			Multiframe H4
DCC D7			DCC D8			DCC D9			Z3
DCC D10			DCC D11			DCC D12			Z4
Z1	Z1	Z1	Z2	Z2	Z2	Orderwire E2			Z5

AU Pointers (Row 4) corresponds to the Pointer H1/H2/H3 row.
Multiplex Section Overhead (Rows 5 - 9).

☐ Bytes reserved for future use

Figure C-5. Organization of STM-1 Overhead Data

Regenerator Section Overhead (RSOH)

A regenerator section of an SDH network comprises the transmission medium and associated equipment between a network element and the adjacent regenerator, or between two adjacent regenerators. The associated equipment includes the aggregate interfaces and SDH processing equipment which either originates or terminates the regenerator section overhead.

The functions of the various bytes carried in the STM-1 regenerator section overhead are described below.

Framing (A1, A2 Bytes)

The six framing bytes carry the framing pattern, and are used to indicate the start of an STM-1 frame.

Channel Identifier (C1 Byte)

The C1 byte is used to identify STM-1 frames within a higher-level SDH frame (STM-N, where the standardized values of N are 4, 16, etc.). The byte carries the binary representation of the STM-1 frame number in the STM-N frame.

Parity Check (B1 Byte)

A 8-bit wide bit-interleaved parity (BIP-8) checksum is calculated over all the bits in the STM-1 frame, to permit error monitoring over the regenerator section. The

computed even-parity checksum is placed in the RSOH of the following STM-1 frame.

Data Communication Channel (D1, D2, D3 Bytes)

The 192 kbps Data Communication Channel (DCC) provides the capability to transfer network management and maintenance information between regenerator section terminating equipment.

Orderwire Channel (E1 Byte)

The E1 byte is used to provide a local orderwire channel for voice communications between regenerators and remote terminal locations.

User Communication Channel (F1 byte)

The F1 byte is intended to provide the network operator with a channel that is terminated at each regenerator location, and can carry proprietary communications.

The information transmitted on this channel can be passed unmodified through a regenerator, or can be overwritten by data generated by the regenerator.

AU Pointers (H1, H2, H3 bytes)

The AU (Administration Unit) pointer bytes are used to enable the transfer of STM-1 frames within STM-N frames, and therefore are processed by multiplexer section terminating equipment. Separate pointers are provided for each STM-1 frame in an STM-N frame.

AU pointer function is to link between the section overhead and the associated virtual container(s).

Multiplexer Section Overhead (MSOH)

A multiplexer section of an SDH network comprises the transmission medium, together with the associated equipment (including regenerators) that provide the means of transporting information between two consecutive network nodes (e.g., SDH multiplexers). One of the network nodes originates the multiplexer section overhead (MSOH) and the other terminates this overhead.

The functions of the various bytes carried in the STM-1 multiplexer section overhead are described below.

Parity Check (B2 Bytes)

A 24-bit wide bit-interleaved parity (BIP) checksum is calculated over all the bits in the STM-1 frame (except those in the regenerator section overhead). The computed checksum is placed in the MSOH of the following STM-1 frame.

Protection Switching (K1, K2 Bytes)

The K1 and K2 bytes carry the information needed to activate/deactivate the switching between the main and protection paths on a multiplexer section.

Data Communication Channel (D4 to D12 Bytes)

Bytes D4 to D12 provide a 576 kbps data communication channel (DCC) between multiplexer section termination equipment. This channel is used to carry network administration and maintenance information.

Orderwire Channel (E2 Byte)

The E2 byte is used to provide a local orderwire channel for voice communications between multiplexer section terminating equipment.

Alarm Signals

Alarm information is included as part of the MSOH. These functions are explained in *Section C.6.*

VC-4 Path Overhead Functions

The path overhead (POH) is contained within the virtual container portion of the STM-1 frame. The POH data of the VC-4 occupies all the 9 bytes of the first column. The functions of the various bytes carried in the VC-4 path overhead are described below.

Path Trace Message (J1 Byte)

The J1 byte is used to repetitively transmit a 64-byte string (message). The message is transmitted one byte per VC-4 frame.

A unique message is assigned to each path in an SDH network. Therefore, the path trace message can be used to check continuity between any location on a transmission path and the path source.

Parity Check (B3 Byte)

An 8-bit wide bit-interleaved parity even checksum, used for error performance monitoring on the path, is calculated over all the bits of the previous VC-4. The computed value is placed in the B3 byte.

Signal Label (C2 Byte)

The signal label byte, C2, indicates the structure of the VC-4 container. The signal label can assume 256 values, however two of these values are of particular importance:

- The all "0"s code represents the *VC-4 unequipped* state (i.e., the VC-4 does not carry any tributary signals)

- The code "00000001" represents the *VC-4 equipped* state.

Path Status (G1 Byte)

The G1 byte is used to send status and performance monitoring information from the receive side of the path terminating equipment to the path originating equipment. This allows the status and performance of a path to be monitored from either end, or at any point along the path.

Multiframe Indication (H4 byte)

The H4 byte is used as a payload multiframe indicator, to provide support for complex payload structures, for example payload structures carrying multiple tributary units (TUs – see *Section C.5*). If, for example, the TU overhead is distributed over four TU frames, these four frames form a TU multiframe structure. The H4 byte then indicates which frame of the TU multiframe is present in the current VC-4.

User Communication Channel (F2 Byte)

The F2 byte supports a user channel that enables proprietary network operator communications between path terminating equipment.

Alarm Signals

Alarm and performance information is included as part of the path overhead. These functions are explained in *Section C.6.*

C.5   SDH Tributary Units

The VC-4 channel capacity, 149.76 Mbps, has been defined specifically for the transport of a fourth level (139.264 Mbps) PDH multiplex signal.

To enable the transport and switching of lower-rate tributary signals within the VC-4, several special structures, called Tributary Units (TUs), have been defined. The characteristics of each TU type have been specifically selected to carry one of the standardized PDH signal rates. In addition, a fixed number of whole TUs may be mapped within the container area of a VC-4.

Tributary Unit Frame Structure

The structure of the tributary unit frame is rather similar to the SDH frame structure. With reference to *Figure C-2*, the tributary unit frame also includes a section overhead part and a virtual container part, which comprises a container and path overhead.

In general, the tributary unit frame is generated in three steps:

- A low rate tributary signal is mapped into the TU "container"

- Low-path path overhead is added before the container, to form the corresponding virtual container (VC-11, VC-12, VC-2 or VC-3, depending on the TU type)

- A TU pointer is added to indicate the beginning of the VC within the TU frame. This is the only element of TU section overhead.

The TU frame is then multiplexed into a fixed location within the VC-4.

Because of the byte interleaving method, a TU frame structure is distributed over four consecutive VC-4 frames. It is therefore more accurate to refer to the structure as a TU multiframe. The phase of the multiframe structure is indicated by the H4 byte contained in the VC-4 path overhead.

Tributary Unit Types

As mentioned above, specific containers (C), virtual containers (VC) and associated TU structures have been defined for each standard PDH multiplex signal level. These structures are explained below:

- **TU-11**: Each TU-11 frame consists of 27 bytes, structured as 3 columns of 9 bytes. At a frame rate of 8000 Hz, these bytes provide a transport capacity of 1.728 Mbps and will accommodate the mapping of a North American DS1 signal (1.544 Mbps). 84 TU-11s may be multiplexed into the STM-1 VC-4.

- **TU-12**: Each TU-12 frame consists of 36 bytes, structured as 4 columns of 9 bytes. At a frame rate of 8000 Hz, these bytes provide a transport capacity of 2.304 Mbps and will accommodate the mapping of a CEPT 2.048 Mbps signal. 63 TU-12s may be multiplexed into the STM-1 VC-4.

- **TU-2**: Each TU-2 frame consists of 108 bytes, structured as 12 columns of 9 bytes. At a frame rate of 8000 Hz, these bytes provide a transport capacity of 6.912 Mbps and will accommodate the mapping of a North American DS2 signal. 21 TU-2s may be multiplexed into the STM-1 VC-4.

- **TU-3**: Each TU-3 frame consists of 774 bytes, structured as 86 columns of 9 bytes. At a frame rate of 8000 Hz, these bytes provide a transport capacity of 49.54 Mbps and will accommodate the mapping of a CEPT 34.368 Mbps signal or a North American 44.768 DS3 signal. Three TU-3s may be multiplexed into the STM-1 VC-4.

Figure C-6 illustrates the assembly (multiplexing) of TUs in the VC-4 structure, for the specific case of the TU-12. For other multiplexing options, see *Figure C-7*.

As shown in *Figure C-6,* 63 TU-12s can be packed into the 260 columns of payload capacity (i.e., the C-4 container) provided by a VC-4. This leaves 8 columns in the C-4 container unused. These unused columns result from intermediate stages in the TU-12 to VC-4 multiplexing process, and are filled by fixed stuffing bytes.
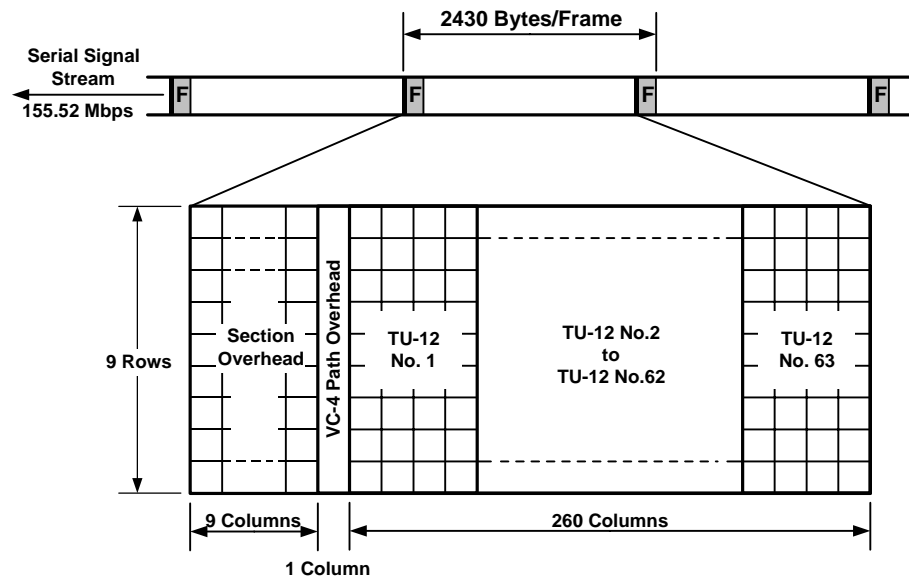
Figure C-6. VC-4 Carrying TU-12 Payload

SDH Multiplexing Hierarchy

Figure C-7 shows a general view of the SDH multiplexing hierarchy. The hierarchy illustrates all the both the European and North American PDH multiplex levels (see *Table C-1* for details on the PDH multiplexing hierarchy).

Figure C-7 also shows the utilization of additional SDH signal structures:

- TUG: tributary unit group, is the structure generated by combining several lower level tributaries into the next higher level tributary. For example, TUG-2 is generated by combining 3 TU-12 or 4 TU-11, and TUG-3 is generated by combining 7 TUG-2.

- AU: administrative unit, is a structure that includes a VC and a pointer to the beginning of the VC. For example, AU-3 contains one VC-3 and includes a pointer to the beginning of the VC.

- AUG: administrative unit group, is the structure generated by combining several lower level administrative units into the next higher level administrative unit. For example, AUG for the STM-1 level is generated by combining 3 AU-3 (several AUG can be combined for generating STM-N (N = 4, 16, etc.) structures).

Note   *For simplicity, reference is made only to VCs (the actual structure needed to transport a VC can be found from the SDH or SONET multiplexing hierarchy).*

The flexibility of the SDH multiplexing approach is illustrated by the many paths that can be used to build the various signal structures. For example, *Figure C-7* shows that the STM-1 signal can be generated by the following multiplexing paths:

- Each E1 signal is mapped into a VC-12, which is then encapsulated in a TU-12.

- Each group of 3 TU-12 is combined to obtain a TUG-2 (3 E1 signals per TUG-2)

- Seven TUG-2 are combined to obtain one TUG-3 (21 E1 signals per TUG-3). TUG-3 is carried in a VC-3

- Three VC-3 are combined to generate one VC-4 (63 E1 signals per VC-4). The STM-1 signal carries one VC-4.
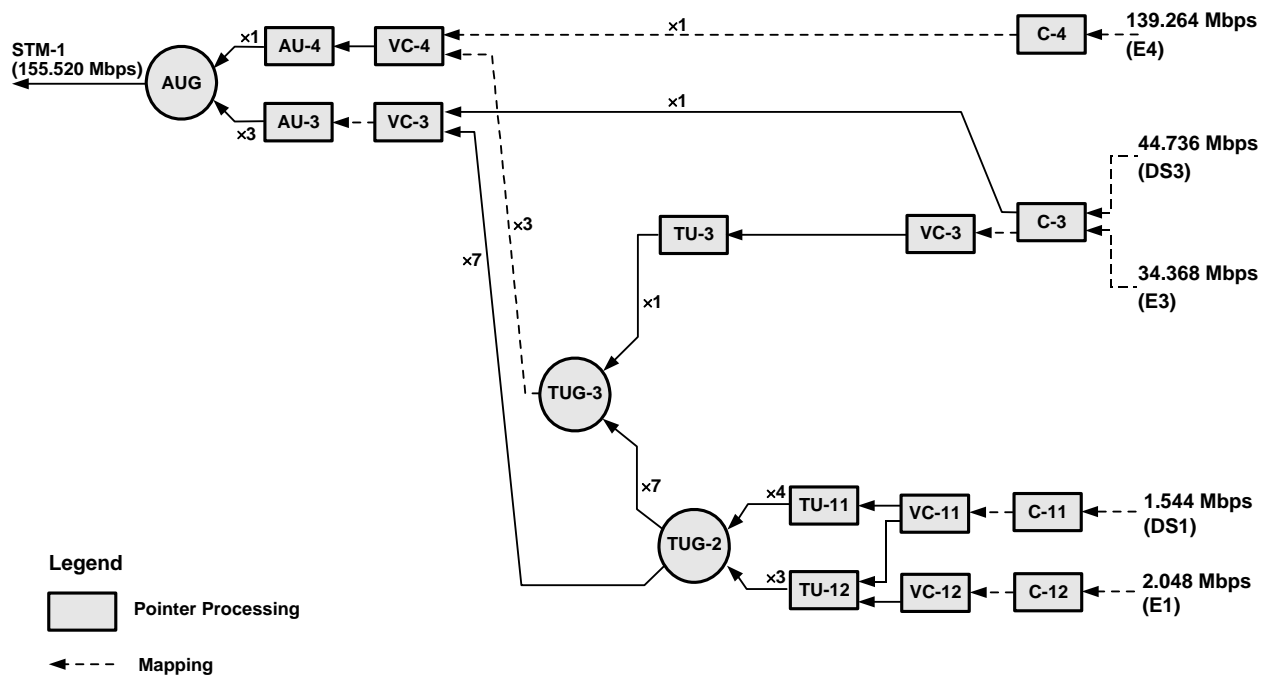
Figure C-7. SDH Multiplexing Hierarchy

C.6   SDH Maintenance Signals

SDH Maintenance Signals

The maintenance signals transmitted within the SDH signal structure are explained in *Table C-2*.

Table C-2. SDH Maintenance Signal Definitions

Signal	Description
Loss of Signal (LOS)	LOS state entered when received signal level drops below the value at which an error ratio of 10· is predicted.
	LOS state exited when 2 consecutive valid framing patterns are received, provided that during this time no new LOS condition has been detected
Out of Frame (OOF)	OOF state entered when 4 or 5 consecutive SDH frames are received with invalid (errored) framing patterns. Maximum OOF detection time is therefore 625 μs.
	OOF state exited when 2 consecutive SDH frames are received with valid framing patterns
Loss of Frame (LOF)	LOF state entered when OOF state exists for up to 3 ms. If OOFs are intermittent, the timer is not reset to zero until an in-frame state persists continuously for 0.25 ms.
	LOF state exited when an in-frame state exists continuously for 1 to 3 ms

Signal	Description
Loss of Pointer (LOP)	LOP state entered when N consecutive invalid pointers are received where N = 8, 9 or 10. LOP state exited when 3 equal valid pointers or 3 consecutive AIS indications are received. *Note* The AIS indication is an "all 1's" pattern in pointer bytes.
Multiplexer Section AIS	Sent by regenerator section terminating equipment (RSTE) to alert downstream MSTE of detected LOS or LOF state. Indicated by STM signal containing valid RSOH and a scrambled "all 1's" pattern in the rest of the frame. Detected by MSTE when bits 6 to 8 of the received K2 byte are set to "111" for 3 consecutive frames. Removal is detected by MSTE when 3 consecutive frames are received with a pattern other than "111" in bits 6 to 8 of K2.
Far End Receive Failure (FERF or MS-FERF)	Sent upstream by multiplexer section terminating equipment (MSTE) within 250 μs of detecting LOS, LOF or MS-AIS on incoming signal. Optionally transmitted upon detection of excessive BER defect (equivalent BER, based on B2 bytes, exceeds $10^{\cdot}$). Indicated by setting bits 6 to 8 of transmitted K2 byte to "110". Detected by MSTE when bits 6 to 8 of received K2 byte are set to "110" for 3 consecutive frames. Removal is detected by MSTE when 3 consecutive frames are received with a pattern other than "110" in bits 6 to 8 of K2. Transmission of MS-AIS overrides MS-FERF
AU Path AIS	Sent by MSTE to alert downstream high order path terminating equipment (HO PTE) of detected LOP state or received AU Path AIS. Indicated by transmitting "all 1's" pattern in the H1, H2, H3 pointer bytes plus all bytes of associated VC-3 and VC-4). Detected by HO PTE when "all 1's" pattern is received in bytes H1 and H2 for 3 consecutive frames. Removal is detected when 3 consecutive valid AU pointers are received
High Order Path Remote Alarm Indication (HO Path RAI, also known as HO Path FERF)	Generated by high order path terminating equipment (HO PTE) in response to received AU path AIS. Sent upstream to peer HO PTE. Indicated by setting bit 5 of POH G1 byte to "1". Detected by peer HO PTE when bit 5 of received G1 byte is set to "1" for 10 consecutive frames. Removal detected when peer HO PTE receives 10 consecutive frames with bit 5 of G1 byte set to "0"
TU Path AIS	Sent downstream to alert low order path terminating equipment (LO PTE) of detected TU LOP state or received TU path AIS. Indicated by transmitting "all 1's" pattern in entire TU-1, TU-2 and TU-3 (i.e., pointer bytes V1-V3, V4 byte, plus all bytes of associated VC-1, VC-2 and VC-3 loaded by "all 1's" pattern). Detected by LO PTE when "all 1's" pattern received in bytes V1 and V2 for 3 consecutive multiframes. Removal is detected when 3 consecutive valid TU pointers are received. *Note* TU Path AIS is only available when generating and/or receiving "floating mode" tributary unit payload structures.

Signal	Description
Low Order Path Remote Alarm Indication (LO Path RAI, also known as LO Path FERF)	Generated by low order path terminating equipment (LO FTE) in response to received TU Path AIS. Sent upstream to peer LO PTE.
	Indicated by setting bit 8 of LO POH V5 byte to "1".
	Detected by peer LO PTE when bit 8 of received V5 byte is set to "1" or 10 consecutive multiframes. Removal detected when peer LO PTE receives 10 consecutive multiframes with bit 8 of V5 byte set to "0".
	Note LO Path RAI is only available when generating and/or receiving "floating mode" tributary unit payload structures.

Response to Abnormal Conditions

This section describes the response to the wide range of conditions that can be detected by the maintenance means built into the SDH frames, and the flow of alarm and indication signals.

Figure C-8 provides a graphical representation of the flow of alarm and indication signals through an SDH transmission path.
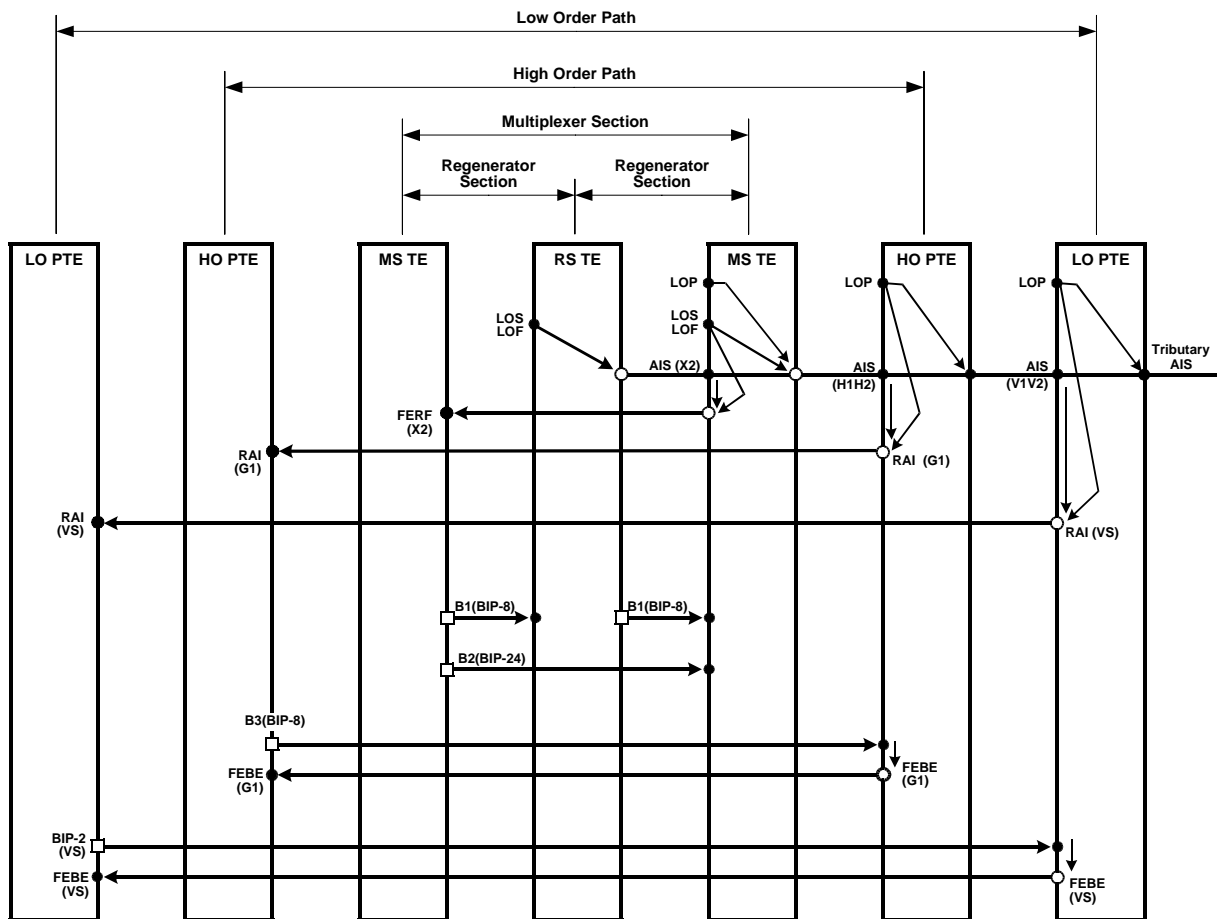
Legend

- ● Collection
- ○ Transmission
- □ Generation

LO	Low Order
HO	High Low Order

PTE	Path Terminating Equipment
RS TE	Regenerator Section Terminating Equipment
MS TE	Multiplexer Section Terminating Equipment

Figure C-8. Flow of Alarm and Indication Signals through an SDH Transmission Path

Flow of Alarm and Response Signals

The major alarm conditions such as Loss of Signal (LOS), Loss of Frame (LOF), and Loss of Pointer (LOP) cause various types of Alarm Indication Signals (AIS) to be transmitted downstream.

In response to the detection of an AIS signals, and detection of major receiver alarm conditions, other alarm signals are sent upstream to warn of trouble downstream:

- Far End Receive Failure (FERF) is sent upstream in the multiplexer overhead after multiplexer section AIS, or LOS, or LOF has been detected by equipment terminating in a multiplexer section span;

- A Remote Alarm Indication (RAI) for a high order path is sent upstream after a path AIS or LOP condition has been detected by equipment terminating a path

- A Remote Alarm Indication (RAI) for a low order path is sent upstream after low order path AIS or LOP condition has been detected by equipment terminating a low order path.

Performance Monitoring

Performance monitoring at each level in the maintenance hierarchy is based on the use of the byte interleaved parity (BIP) checksums calculated on a frame by frame basis. These BIP checksums are sent downstream in the overhead associated with the regenerator section, multiplexer section and path maintenance spans.

In response to the detection of errors using the BIP checksums, the equipment terminating the corresponding path sends upstream Far End Block Error (FEBE) signals.

C.7   SONET Environment

SONET (Synchronous Optical Network) is an alternative standard to SDH, widely used in North America and other parts of the world. SONET uses similar implementation principles, and even the frame structures are quite similar to those used by SDH. Therefore, the following description is based on the information already presented for SDH in *Sections C.2* through *C.6*.

Figure C-9 shows the SONET multiplexing hierarchy.
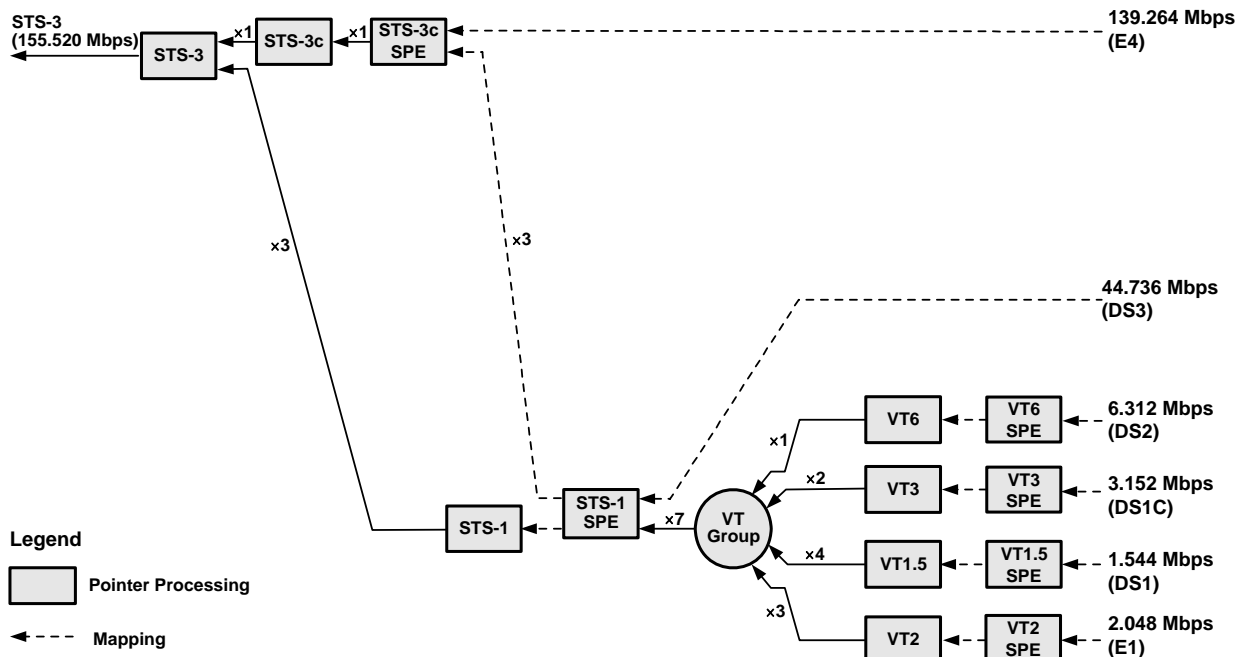
Figure C-9. SONET Multiplexing Hierarchy

The designations of the main signal structures in the SONET hierarchy are as follows:

- Containers are replaced by Synchronous Payload Envelopes (SPE) for the various virtual tributaries (VTs)

- Virtual containers (VCs) are replaced by virtual tributaries (VTs), however the rates are similar to those used in the SDH hierarchy

- Tributary unit groups (TUGs) are replaced by virtual tributary groups

- The VC-3 level is replaced by the Synchronous Transport Signal level 1 (STS-1), and has the same rate (51.840 Mbps). The corresponding optical line signal format is designated OC-1 (an electrical line signal is also defined, EC-1)

- 3 STS-1 can be combined to obtain one Synchronous Transport Signal level 3 (STS-3) at the same rate as STM-1 (155.520 Mbps). Alternately, a concatenated STS-3 structure (STS-3c) is used to carry a single E4 signal. The corresponding optical line signal is designated OC-3.

C.8   Using Virtual Concatenation

Purpose and Main Features

Virtual concatenation is a method that enables carrying payload at other data rates (for example, Ethernet signals), beyond the data rates listed in *Table C-1*, without wasting bandwidth. In this approach, the contiguous bandwidth of the payload signal is divided into several streams, each having the rate necessary for insertion into individual VCs or SPEs.

With virtual concatenation, the individual VCs or SPEs are transported over the SDH or SONET network in the usual way, and then recombined to restore the original payload signal at the end point of the transmission path, using a technology similar to inverse multiplexing.

Virtual concatenation has the following main advantages:

- Scalability: allows bandwidth to be selected in relatively small increments, as required to match the desired payload data rate.

- Efficiency: the resulting signals are easily routed through a SDH/SONET network, without wasting bandwidth, and therefore allows for more efficient utilization of the bandwidth available on existing networks.

- Compatibility: virtual concatenation requires only the end nodes to be aware of the containers being virtually concatenated, and therefore is transparent to the core network elements.

- Resiliency: individual members of a virtually concatenated group can be freely routed across the network.

Implementation

Virtual concatenation is implemented mainly by appropriate management measures, with hardware support needed only at the end points of a transmission path. The processing is as follows:

1. At the source end, the inverse multiplexing subsystem splits the payload signal into several streams at a rate suitable for transmission over the desired type of VC (VC-12, VC-3 or VC-4) or SPE. The required information (type and number of VCs or SPEs) are defined when the virtually concatenated group (VCG) is defined.

Note   *FCD-155 management uses the concise term virtual group, instead of virtually concatenated group.*

2. The resulting streams are mapped to the desired VCs/SPEs, also configured by management. The Path Overhead (POH) byte carried by all the group members is used to transfer to the far endpoint the information needed to identify:

   ▪ The relative time difference between arriving members of the virtual group.

   ▪ The sequence number of each arriving member.

3. Each member of the virtual group is independently transmitted through the network. The network need not be aware of the type of payload carried by the virtual members of the group.

4. At the receiving end, the phase of the incoming VCs/SPEs is aligned and then the original payload data stream is rebuilt. This requires using a memory of appropriate size for buffering all the arriving members of the group at the receiving end. The memory size depends on the maximum expected delay, therefore to minimize latency the maximum delay to be compensated can be defined by management.

Table C-3 lists the bandwidth that can be provided by the virtual concatenation containers built using the virtual concatenation method.

Table C-3. Virtual Concatenation Container Bandwidth

SDH Designation of Member Containers	SONET Designation of Member Containers	Maximum Number of Containers in Group	Minimum Resulting Bandwidth (Mbps)	Maximum Resulting Bandwidth (Mbps)	Bandwidth Selection Granularity (Mbps)
VC-11	VT1.5	64	1.600000	102.400000	1.600000
VC-12	VT2	64	2.176000	139.264000	2.176000
–	VT3	64	3.328000	212.992000	3.328000
VC-2	VT6	64	6.784000	434.176000	6.784000
VC-3	STS-1 SPE	256	48.384000	12386.304000	48.384000
VC-4	STS-3c SPE	256	149.760000	38388.560000	149.760000

C.9   Ethernet Transmission Technology

Introduction to Ethernet Transmission

One of the most successful digital transmission technologies is referred to by the generic term *Ethernet*. The Ethernet technology is suitable for a wide range of physical media: coaxial cable, twisted pairs and optical fibers. The current standards for Ethernet transmission cover rates from 10 Mbps to 10 Gbps. In many office LANs, Ethernet runs at 10 Mbps and 100 Mbps (Fast Ethernet); 1000 Mbps (1 Gbps, also called Gigabit Ethernet, or GbE) is rapidly becoming commonplace.

The basic standards covering Ethernet LANs are included in the IEEE 802.3 family. In addition to the aspects covered by the IEEE 802.3 standards, there is a wide range of LAN standards (the IEEE 802 family) that cover other aspects of LAN transmission, for example, bridging, with particular emphasis on Ethernet LANs.

Ethernet standards (in their broadest interpretation) cover the physical and data link control layers (layers 1 and 2 in the OSI model; IP is a layer 3 protocol). The data link control layer is split into two sublayers: media access control (MAC) and logical link control (LLC).

Ethernet LAN Topologies

Ethernet LANs use a multidrop topology. The LANs can be implemented either in bus or star (hub-based) topology.

For the FCD-155, only the star (hub-based) topology is relevant.

Figure C-10 shows the general structure of a LAN using the star topology.
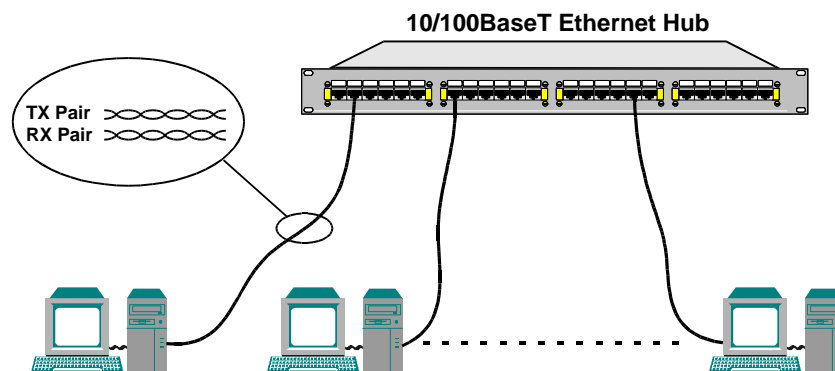
Figure C-10. Star (Hub-Based) Ethernet LAN Topology

In the star topology, all the nodes on the LAN are connected to a common unit, which serves as the hub of the LAN. The hub can be implemented in two ways:

- Simple Ethernet hub, which detects the transmitting node and transparently distributes its signal to all the other nodes. A hub supports only half-duplex communication (the same as in a bus topology).

- Ethernet switch: the switch includes more sophisticated circuits that enable both half-duplex and full-duplex operation and prevent collisions.

In a star topology, the LAN cables are usually made of two twisted pairs (one transmit pair and one receive pair). The standard connector type is RJ-45, and its pin assignment has also been standardized. However, because of the need to use separate transmit and receive pairs, two types of port pin assignments have developed: station ports and hub ports (the difference is interchanging of the transmit and receive pins in the connector). This permits to interconnect connectors of different types by a cable wired pin-to-pin (straight cable).

A fixed assignment of pin functions in the connectors requires using a crossed cable (a cable wired to interconnect the transmit pair at one end to the receive pair at the other end) to interconnect ports of same type. To avoid the need for using two types of cables (straight and crossed), special methods have been developed to enable automatic detection of pairs by the Ethernet interface, thus enabling the interface to select the correct connection irrespective of the type of cable.

Interfaces operating on twisted pairs are designated in accordance with data rate: 10BASE-T (10 Mbps), 100BASE-TX (100 Mbps, where X is the number of pairs) and 1000BASE-T (1000 Mbps, which always uses 2 twisted pairs).

100 Mbps fiber optic interfaces are identified as 100BASE-FX (where X is the number of fibers, and 1000 Mbps fiber optic interfaces carry a label that indicates the operating wavelength range (SX for short wavelength, etc.).

Interfaces that support multiple rates are identified as 10/100BASET, 10/100/1000BASET, etc.

Ethernet Communication Protocol

Today, Ethernet is used as a generic term for a LAN transmission technology that uses Carrier Sense and Multiple Access with Collision Detection (CSMA/CD) to enable the transmission of short bursts of data (called *frames*) between two or more stations (*nodes*).

All the users have permanent access to the full bandwidth of the transmission medium but can only use it for short times, by transmitting short data bursts. Each data burst has a fixed structure, called a frame. The frame structure is explained below. The connection point of each user to the transmission media is called a node. For identification purposes, each LAN node has its own unique number, called MAC address.

Media Access Method

Media access is performed by means of the carrier sense, multiple access protocol (CSMA) with collision detection (CD), defined by IEEE Standard 802.3. The protocol defines three basic steps:

- A node that wants to transmit checks that the LAN is free. If another node is already transmitting, the node waits until the LAN is free.

- When the LAN is free, the node starts transmission and sends its frame. Each node has equal access rights, therefore the first node that starts transmitting is the one that seizes the LAN.

- When two nodes start transmitting at the same instant, a collision occurs. In this case, the transmitting nodes will continue to transmit for some time, in

order to ensure that all transmitting nodes detected the collision (this is called "jamming"). After the jamming period, all transmitting nodes stop the transmission and wait for a random period of time before trying again.

The delay times are a function of collision numbers and random time delay, therefore there is a good chance that an additional collision between these nodes will be avoided, and the nodes will be able to transmit their messages.

The basic procedure described above has been developed for half-duplex communication, because it declares a collision whenever data is received during a local transmission. However, when using 2 twisted pairs, separate pairs can be used for the transmit and receive directions, to permit each node to simultaneously transmit and receive (full-duplex operation). Another approach to achieve full-duplex operation involves using advanced signaling methods, and is commonly used for operation at the higher data rates, for example, for GbE).

As mentioned above, modern Ethernet interfaces are often capable of operation at the two basic rates, 10 Mbps and 100 Mbps, or even at three rates (10/100/1000 Mbps). Therefore, the rate and operating mode (half-duplex or full-duplex) are user-configurable options.

When connecting equipment from different vendors to a common LAN, several operating modes are possible, depending on the specific characteristics of the equipment interconnected by means of the LAN . These modes are listed below, in ascending order of capabilities:

- Half-duplex operation at 10 Mbps.

- Full-duplex operation at 10 Mbps.

- Half-duplex operation at 100 Mbps.

- Full-duplex operation at 100 Mbps.

- Half-duplex operation at 1000 Mbps.

- Full-duplex operation at 1000 Mbps.

To ensure interoperability (which practically means to select the highest transport capability supported by all the equipment connected to the LAN), two approaches can be used: manual configuration of each equipment interface, or automatic negotiation (auto-negotiation) in accordance with IEEE Standard 802.3.

The auto-negotiation procedure enables automatic selection of the operating mode on a LAN, and also enables equipment connecting to an operating LAN to automatically adopt the LAN operating mode (if it is capable of supporting that mode).

When auto-negotiation is enabled on all the nodes attached (or trying to attach) to a LAN, the process is always successful. However, even if the nodes on an operating LAN are manually configured for operation in a fixed mode, a late-comer node with auto-negotiation capability can still resolve the LAN operating rate, thereby enabling it to adopt the LAN rate. An auto-negotiating node that cannot detect the operating mode (half or full duplex) will default to half-duplex. Therefore, as a practical configuration rule, do not enable the full-duplex mode without enabling auto-negotiation, except when all the nodes have been manually configured for the desired operating mode (which may of course be full duplex).

Basic Ethernet Frame Structure

The frame transmitted by each node contains routing, management and error correction information. For Ethernet LANs, the characteristics of frames are defined by IEEE Standard 802.3.

Basic frame lengths can vary from 72 to 1526 bytes and have the typical structure shown in *Figure C-11*.

- **Preamble**. Each frame starts with a preamble of seven bytes. The preamble is used as a synchronizing sequence for the interface circuits, and helps bit decoding.

- **Start-Frame Delimiter (SFD)** field – consists of one byte. The SFD field indicates where the useful information starts.

- **Medium-Access (MAC) Destination Address (DA)** field – consists of six bytes. The MAC DA field carries the address of the destination node.

- **Medium-Access (MAC) Source Address (SA)** field – consists of six bytes. The MAC SA field carries the address of the source node.

Note	*In conventional notation MAC addresses are represented as 6 pairs of hexadecimal digits, separated by dashes, for example, 08-10-39-03-2F-C3.*

- **Length/Type** field – consists of two bytes that indicate the number of bytes contained in the logical link control (LLC) data field. In most Ethernet protocol versions, this field contains a constant indicating the protocol type (in this case, this field is designated **EtherType**).

- **MAC Client Data** field. The MAC client data field can contain 0 to 1500 bytes of user-supplied data.

- **Padding** field. The optional padding field contains dummy data, that is used to increase the length of short frames to at least 64 bytes.

- **Frame Check Sequence (FCS)** field – contains four check bytes generated by a cyclic redundancy check (CRC) code. The FCS field is used to detect errors in the data carried in the frame.

72 to 1526 Bytes							
Preamble (7 Bytes)	SFD (1 Byte)	MAC Destination Address (6 Bytes)	MAC Source Address (6 Bytes)	Length/Type (2 Bytes)	MAC Client Data (0 to 1500 Bytes)	Padding Bytes	Frame Check Sequence (4 Bytes)

Start Frame Delimiter
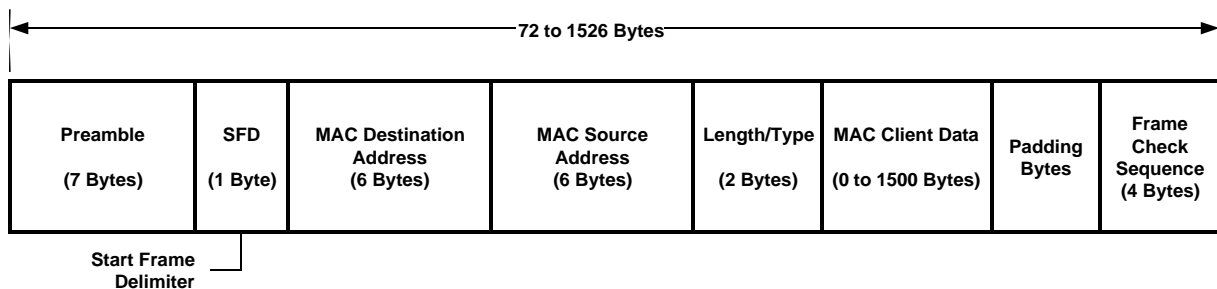
Figure C-11. Basic Ethernet Frame Structure

Bridging

Communication between Nodes on Same LAN

A MAC address is unique and identifies a single physical port. Therefore, two Ethernet nodes attached to the same LAN exchange frame directly, by specifying the desired MAC destination address, together with the source MAC address.

The node that identifies its MAC address in the destination field can send a response by copying the frame source address to the destination address field.

Communication between Nodes on Different LANs

To enable nodes on different LANs to communicate, it is necessary to transfer frames between the two LANs. The device used for this purpose is called *MAC bridge*, or just *bridge*. Two types of bridges are used:

- Local bridges, which have Ethernet ports attached to the two LANs. The bridge control mechanism learns the nodes attached to each LAN by reading the source MAC addresses of the frames generated by the nodes. When the destination address of a frame is not on the LAN from which it was received, the bridge transfers it to the other LAN.

- Remote bridges, which are used in pairs. A basic remote bridge has one LAN port and one WAN port. The WAN port communicates through a link with the WAN port of the remote bridge connected to the desired remote LAN. In this case, the traffic addressed to destinations not located on the local LAN is transferred through the WAN link to the remote bridge.

Using Virtual Bridged LANs

VLAN can be used to provide separation between traffic from different sources sharing the same physical transmission facilities, and provide information on the relative priority the user assigns to each frame. The characteristics and use of virtual LANs (VLANs) and of the MAC bridges capable of handling tagged frames are defined in IEEE Standard 802.1Q.

VLANs are made possible by a slight modification to the Ethernet frame structure shown in *Figure C-11.* The structure of an Ethernet frame with VLAN support is shown in *Figure C-12* (for simplicity, the preamble and SFD fields are not shown).

0	4	8	12	16	20	24	28	31

Destination MAC Address (DA)		
Destination MAC Address (DA)	Source MAC Address (SA)	
Source MAC Address (SA)		
Tag Protocol Identifier (8100)	PRI	0 VLAN ID
EtherType (IP = 0800)	Ethernet Payload (42 to 1500 Bytes)	
Ethernet Payload ...		
CRC		
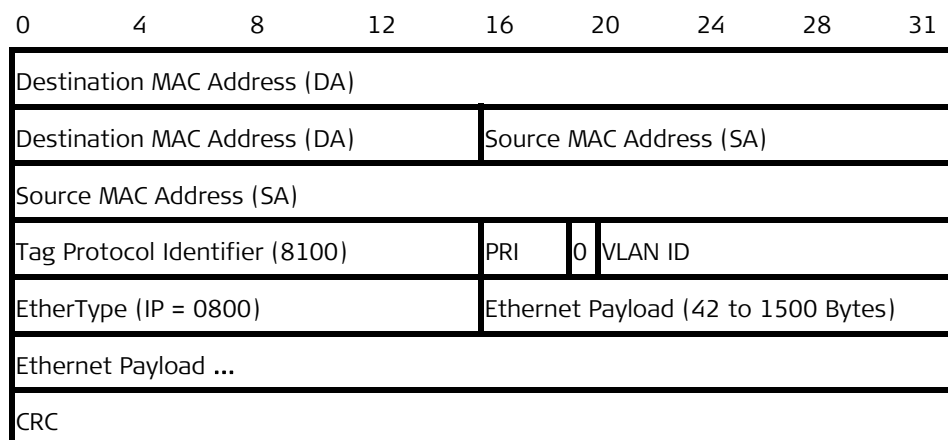
Figure C-12. Structure of Ethernet Frame with VLAN Support

Ethernet frames with VLAN support include a tag header immediately after the source MAC address (therefore, such frames are also referred to as *tagged frames*).

The tag header comprises 4 bytes:

- Two bytes for the tag protocol identifier. For Ethernet-encoded tags in accordance with IEEE802.1Q, these bytes carry the equivalent of 8100.

- Priority (PRI) specified by the user (3 bits: 7 is the highest priority and 0 is the lowest priority).

- One bit for the canonical format indicator (always 0 as shown in *Figure C-12*).

- VLAN ID (12 bits), used to indicate the VLAN to which the frame belongs.

Ethernet Transport over SDH/SONET Networks

Ethernet payloads (10 Mbps or 100 Mbps) can be carried over SDH/SONET using several encapsulation protocols. FCD-155 supports two encapsulation protocols:

- Link Access Protocol – SDH (LAPS) in accordance with ITU-T Rec. X.86

- Generic Framing Procedure (GFP) in the framed mode, in accordance with ITU-T Rec. G.7041. With GFP, it is possible to increase the bandwidth utilization efficiency using the GFP multiplexing method.

LAPS Encapsulation

With LAPS, each Ethernet frame is encapsulated in the frame structure shown in *Figure C-13*. The LAPS frame is delineated by flags, followed by HDLC information (address and control), and by a LAPS service access point identifier (SAPI). The Ethernet frame is followed by a LAPS frame checksum (FCS), for error detection.

Flag	HDLC Address	HDLC Control	LAPS SAPI	Ethernet Frame	LAPS FCS	Flag
(1 byte)	(1 byte)	(1 byte)	(2 bytes(	(64 to 1500 bytes)	(4 bytes)	(1 byte)
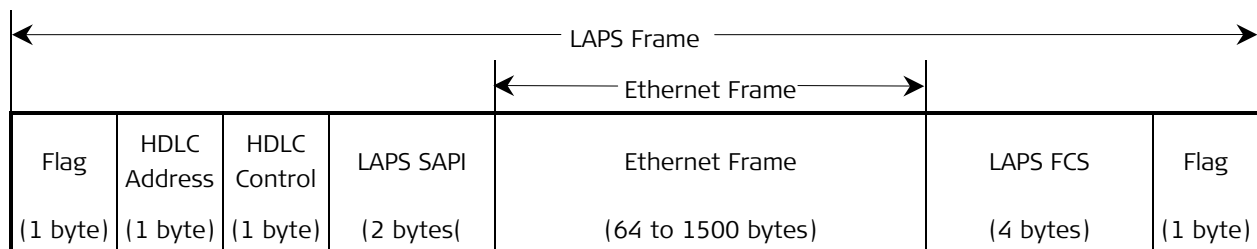
Figure C-13. LAPS Encapsulation Format

GFP Encapsulation

The GFP encapsulation method uses the basic frame structure of *Figure C-14*.

Core Header	Payload Header	Ethernet Frame
(4 bytes)	(4 bytes)	(1500 bytes)
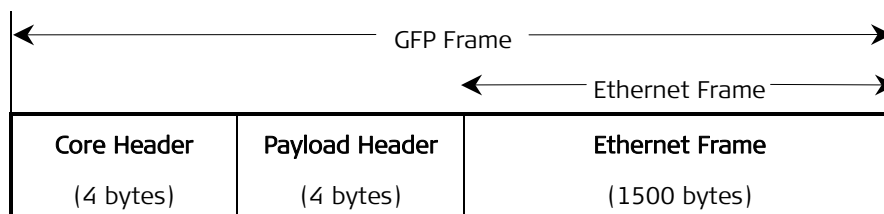
Figure C-14. Basic GFP Encapsulation Format

Figure C-15 shows the detailed structure of the basic GFP frame. The frame includes the following fields:

PLI	Payload length indicator
cHEC	Core header CRC (calculated using ITU-T CRC-16 polynomial)
Payload Area	Carries a framed PDU
Payload Header	Header used for client PDU management
pFCS	Optional payload FCS (calculated using ITU-T CRC-32 polynomial)
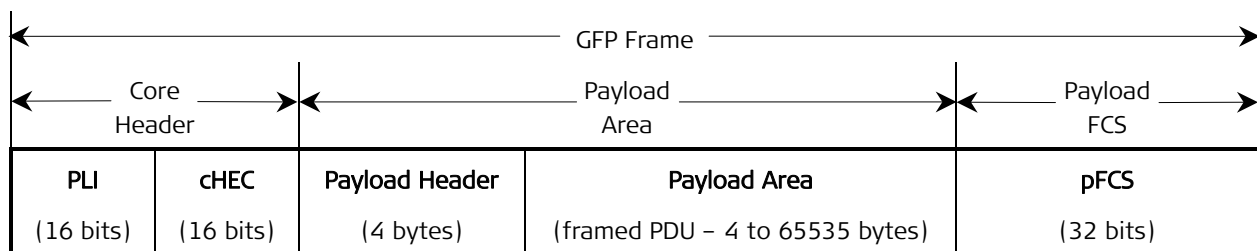
Figure C-15. Detailed Structure of Basic GFP Frame

All the GFP OAM&P functions are handled by the GFP core header.

The payload header supports the payload-specific adaptation functions, which depend on the client application (for FCD-155, the client application is Ethernet). The payload header also supports multiplexing (using extension headers), and any application-dependent link management functions (using dedicated client management frames)

Protection against errors (on a per frame basis) is provided by the optional payload frame checksum (FCS) field.

Idle frames are used for asynchronous rate adaptation.

GFP Protocol Stack

The encapsulation process can be described by means of a GFP protocol stack, illustrated in *Figure C-16*:
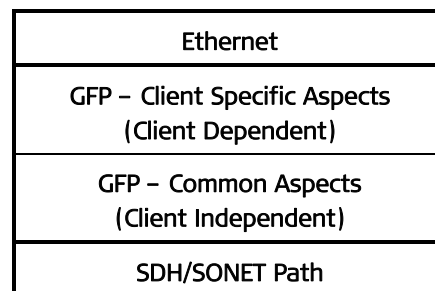
Figure C-16. GFP Protocol Stack

- The top layer is the client application, in this case Ethernet. For the FCD-155, the Ethernet switch provides up to four independent application streams (one stream per virtual group).

- The link layer is divided into two sections:

  - GFP common aspects section: performs adaptation to the physical layer.

  - GFP client-specific aspects section: handles the frames received from the client application, and presents them in a standardized format to the GFP common aspects section.

- The physical layer is provided by the SDH or SONET path.

GFP Multiplexing

In the FCD-155, the Ethernet switch provides up to four independent data streams. Each stream may be mapped to a different VC or SPE (or to a user-defined virtually concatenated group of VCs or SPEs), however in this case bandwidth may be wasted, because this approach always occupies the full SDH/SONET bandwidth, irrespective of the actual traffic load generated by the client application, which in general varies randomly with time.

To take advantage of the statistical distribution of traffic, multiplexing can be used. GFP provides support for multiplexing, using two approaches (see *Figure C-17*):

- Frame multiplexing in accordance with the frame type, using the PTI (payload type identifier) field:

  - Client data frames have priority over client management frames

  - Client management frames have priority over idle frames.

- Client multiplexing, implemented by adding extension headers. For this purpose, the extension header includes a customer, or channel, identifier (CID). The CID enables discriminating among various data sources using the same transmission path.
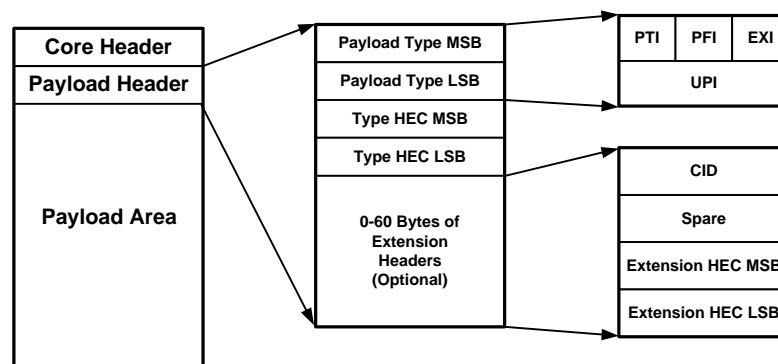
Figure C-17. Support for GFP Multiplexing at the GFP Frame Level

To take advantage of the GFP client multiplexing capability, the user can configure:

- The virtual groups to be multiplexed

- The fraction of physical layer bandwidth to be guaranteed to each virtual group, in 12.5% steps

- The VCs/SPEs to carry the multiplexed groups, and the specific mapping.

With GFP multiplexing, the bandwidth available to each virtual group is never less that the specified minimum. However, if the instantaneous traffic carried by a virtual group does not fully utilizes the reserved bandwidth, any unused bandwidth is made available to the other virtual groups. This ensures the best possible utilization of the available bandwidth, without degrading the quality of service.

C.10   IP Environment

This section describes the IP environment, to provide background information for configuring the parameters that control the routing of management traffic.

The information presented in this section refers to Version 4 of the IP protocol (IP4), currently the most widely used protocol version. IP4 is the only protocol version supported by FCD-155 units and RADview-PC stations.

Introduction to IP

IP means "Internet Protocol". The term *IP protocol* is often used to indicate a standardized set of rules and procedures that enable data exchange through a packet-switched network.

Accordingly, the term *Internet* indicates the set of networks that use the IP protocol and are interconnected in a way that, at least in principle, permits any entity on one network to communicate with any entity on another network.

Note   *The term "suite of IP protocols" is also often used, in recognition of the fact that the operation of the Internet is actually defined by many related protocols.*

IP Networks, IP Hosts and IP Ports

Any entity that can communicate using the IP protocol is called an *IP host*. The connection point between an IP host and an IP network is called *IP port*.

An *IP network* forms when a number of IP ports can communicate directly (peer to peer) using the IP protocol, without any intermediaries.

An IP host can have any number of IP ports. Moreover, the ports may be located on different IP networks.

IP Addresses

To enable IP communication between two IP hosts, it is necessary to find a route between their IP ports. For this purpose, each IP port is assigned an IP address. The only purpose of an IP address is to permit unambiguous identification of an IP port. Therefore, each IP port must be assigned a distinct and unique IP address.

The IP protocol does not require the IP port to be related in an unambiguous way to a physical (communication) port. This has two main implications:

- Since the IP port is actually a connection to an IP network, any number of IP ports can share a given physical port.

- An IP port may be reached through several physical ports.

Note   *By convention, the scope of IP addresses has been extended in two ways:*
- *To permit identification of IP networks*
- *To permit simultaneous addressing of all the ports connected to a IP network (this operation is called broadcasting).*

IP Packet Structure

The information exchanged through IP networks is organized in packets. The structure of an IP packet, as specified by IP protocol Version 4, is as follows (the numbers are byte numbers):

0	4	8	12	16	20	24	28	31
IP Version (4)	IP Header Length	IP Type of Service (IP TOS)		Total IP Packet Length (total number of octets in header + payload)				
Fragment Identification (16 bits)				Flags (3 bits)	Fragment Offset (13 bits)			
(These fields are used for IP packet fragmentation)								
Time to Live (Range: 0 to 255; when 0, packet is discarded)		Number of Upper-Layer Protocol Carried in Payload (IGMP = 2) (UDP = 17)		IP Header Checksum				
Source IP Address								
Destination IP Address								
Options (when used)						Padding (as required)		
Payload (maximum bytes: 65535 – "header length")								

IP Address Structure

An IP address is a 32-bit number, represented as four 8-bit bytes. Each byte represents a decimal number in the range of 0 through 255.

The address is written in decimal format, with the bytes separated by decimal points, e.g., 164.90.70.47. This format is called *dotted quad notation*.

An IP address is logically divided into two main portions:

- Network portion

- Host portion.

Network Portion

In general, the network portion is assigned by the Internet Assigned Numbers Authority (IANA), and its main purpose is to identify a specific IP network.

There are five IP address classes: A, B, C, D, and E. However, only the A, B and C classes are used for IP addressing. Consult your network manager with respect to the class of IP addresses used on your network.

The network portion of an IP address can be one, two, or three bytes long, in accordance with the IP address class.

This arrangement is illustrated below:

IP Address

Byte 1	Byte 2	Byte 3	Byte 4

Class A

Network Portion	Host Portion

Class B

Network Portion	Host Portion

Class C

Network Portion	Host Portion
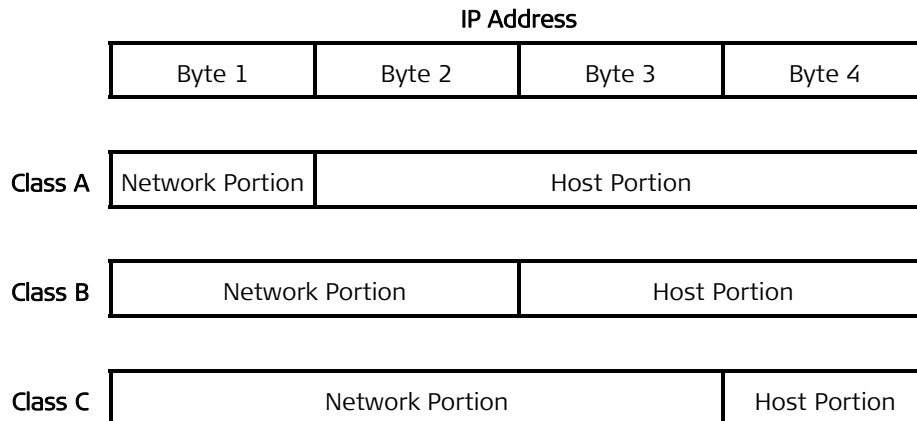
The class of each IP address can be determined from its leftmost byte, in accordance with the following chart:

Address Class	First Byte	Address Range
Class A	0 through 127	0.H.H.H through 127.H.H.H
Class B	128 through 191	128.N.H.H through 191.N.H.H
Class C	192 through 223	192.N.N.H through 223.N.N.H

where:

N – indicates bytes that are part of the network portion
H – indicates bytes that are part of the host portion.

Host Portion

In general, the host portion is used to identify an individual host connected to an IP network.

After obtaining an IP network address, the using organization is free to assign host identifiers in accordance with its specific needs.

Note

The following host identifiers have special meanings, and must not be assigned to an actual host:

- *The "all-zeros" host identifier is interpreted as a network identifier.*
- *The "all-ones" host identifier is interpreted as a broadcast address. Therefore, a message with an "all-ones" host identifier is accepted by all the hosts in the network.*

Subnetting

Given the scarcity of IP network addresses, for organizations operating several relatively small, physically separated, IP networks, e.g., several departmental networks, it is advantageous to enable several physical networks to share a common IP network address. *Small* in this context means that the number of IP ports connected to each of these networks is small relative to the host address space for the corresponding IP address class.

The approach taken to enable the sharing of an IP network address by two or more networks is called *subnetting*, which means *use of subnets*. The subnetting is relevant only within the using organization, and therefore can be freely selected to meet its specific needs.

To enable subnetting, the meaning of the bits in the host portion of the IP address is further sub-divided into two portions:

- **Subnet number**. For example, subnet numbers can be used to identify departmental subnets. The subnet number follows the network identifier.

- **Host number** – the last bits of the IP address.

This subdivision is illustrated below:

Net Number	Subnet Number	Host Number

For example, when the subnet includes 16 IP hosts, only the last four bits need to be reserved for the host number. For an organization which obtained one global Class C network address, this means that four bits are available to identify subnets. Therefore, this organization can implement 16 IP subnets, each comprising up to 16 hosts (except for two subnets that are limited to 15 hosts).

Subnet Masks

Subnet masks are used to indicate the division of the IP address bits between the net and subnet portion and the host portion.

The mask is a 32-bit word that includes "*ones*" in the positions used for net and subnet identification, followed by "*zeros*" up to the end of the IP address.

For example, the default subnet mask for any Class C address (i.e., all the eight bits in the host address space are used for hosts in the same net) is 255.255.255.000.

However, if the same address is used in a subnet comprising up to 16 hosts and for which the host numbers range is 00 to 15, the subnet mask changes as follows:

IP Address (Dotted-Quad)	192	70	55	13
IP Address (Binary)	1011 1111	0100 0110	0011 0111	0000 0111
Subnet Mask (Binary)	1111 1111	1111 1111	1111 1111	1111 0000
Subnet Mask (Dotted-Quad)	255	255	255	240

In most applications, the binary subnet mask is built as a contiguous string of "*ones*", followed by a number of "*zeros*" (the number of "*zeros*" is selected as needed, to complete the number of subnet mask bits to 32). Therefore, when this conventional approach is used, the subnet mask can also be specified simply by stating the number of "*ones*" in the mask. For example, the subnet mask shown above is specified by stating that it comprises 28 bits.

IP Routing Principles

The exchange of information between IP hosts is made in packets using the structure specified by the IP protocol. As explained in the *IP Packet Structure* section above, IP frames carry, within their header, the IP addresses of the destination and source hosts.

In accordance with the IP protocol, an IP host checks the addresses of all the received frames, and accepts only frames carrying its own IP address as the destination. The source address is then used to enable the destination to respond to the source.

An IP host will also respond to broadcasts (frames whose destination host identifier is "*all-ones*").

Note   *IP hosts support additional protocols within the IP suite, e.g., protocols used for connectivity checking, maintenance, etc. Therefore, IP hosts will accept additional types of messages, which are beyond the scope of this description.*

When checking the destination address of an IP frame, an IP host starts by checking the network identifier. If the network identifier is different, the host will immediately reject the frame. Therefore, IP hosts can communicate only if they have the same network identifier.

For example, this means that when a management station managing the FCD-155 is connected directly, through a LAN, to the FCD-155 Ethernet management port, the network identifier part of the IP address assigned to the FCD-155 Ethernet port must be identical to the network identifier of the management station.

To enable hosts located on different IP networks to communicate, IP routers are needed. The routers monitor the flowing traffic and identify the IP addresses of the local hosts connected to them, and then communicate this information to the other routers which are "known" to it using special protocols. Therefore, a router can determine to which other router to send a packet with a foreign IP address.

The user can increase the routing efficiency by specifying a default gateway to handle IP traffic to other networks (this is always an IP router). When a default gateway address is specified, packets with IP destinations located on other networks are sent to the default gateway for processing: the router serving as default gateway then sends them to their destination.

The default gateway must always be in the same IP subnet as the port sending traffic to the gateway.

Note   *As an alternative, static IP routing may also be used. To define a static route, the user must specify the next hop, that is, IP address of the next port to which IP packets are to be forwarded.*

Tools for Checking IP Connectivity

The IP protocol is referred to as an unreliable connectionless packet delivery protocol, because each packet transmitted by an IP host travels on its own through the network until it eventually reaches its destination. To ensure reliable delivery, higher layer protocols are used, for example, the widely-used TCP protocol.

However, using higher layer protocols cannot provide an answer to the need to check that it is indeed possible to reach the desired IP destination address, because configuration errors or a network fault, for example, temporary congestion or failure of critical communication links, may still prevent the establishment of an IP connection. Therefore, it is often necessary to check for IP connectivity.

The IP protocol suite includes a special protocol, the Internet Control Message Protocol (ICMP), that enables IP hosts connected to the Internet to report a wide range of errors and provide information about the conditions that caused the errors. Support for this protocol is mandatory on every IP host.

ICMP includes a dedicated connectivity test procedure, implemented by means of two types of ICMP messages: *echo request* and *echo reply*. This procedure is often referred to as *ping*ing: the host wanting to check IP connectivity to a destination sends one or more *ping* (echo request) messages, and the destination returns an echo reply message for each request. By comparing the number of *pings* sent to the number received and the time needed for each reply to reach the *ping* source, the source host can obtain useful information regarding the transmission conditions.

C.11   SNMP Environment

The SNMP management functions of the FCD-155 are provided by an internal SNMP agent.

The SNMP management communication uses the User Datagram Protocol (UDP), a connectionless-mode transport protocol, part of the suite of protocols of the Internet Protocol (IP). This section covers the information related to the SNMP environment.

Note

> *Telnet management uses the TCP protocol over IP for management communication. After a Telnet session is started, the management interface is similar to that used for the supervision terminal.*

SNMP Principles

The SNMP management protocol is an asynchronous command/response polling protocol: all the management traffic is initiated by the SNMP-based network management station (except for trap messages), which addresses the managed entities in its management domain. Only the addressed managed entity answers the polling of the management station.

The managed entities include a function called an "SNMP agent", which is responsible for interpretation and handling of the management station requests to the managed entity, and the generation of properly-formatted responses to the management station.

SNMP Operations

The SNMP protocol includes four types of operations:

getRequest   Command for retrieving specific management information from the managed entity. The managed entity responds with a **getResponse** message.

getNextRequest   Command for retrieving sequentially specific management information from the managed entity. The managed entity responds with a **getResponse** message.

setRequest   Command for manipulating specific management information within the managed entity. The managed entity responds with a **setResponse** message.

trap   Management message carrying unsolicited information on extraordinary events (e.g., alarms) reported by the managed entity.

Management Information Base

The management information base (MIB) includes a collection of *managed objects*. A managed object is defined as a parameter that can be managed, such as a performance statistics value.

The MIB includes the definitions of relevant managed objects. Various MIBs can be defined for various management purposes, types of equipment, etc.

An object's definition includes the range of values and the "access" rights:

Read-only   Object value can be read, but cannot be set.

Read-write   Object value can be read or set.

Write-only   Object value can be set, but cannot be read.

Not accessible Object value cannot be read, nor set.

MIB Structure

The MIB has an inverted tree-like structure, with each definition of a managed object forming one leaf, located at the end of a branch of that tree. Each "leaf" in the MIB is reached by a unique path, therefore by numbering the branching points, starting with the top, each leaf can be uniquely defined by a sequence of numbers. The formal description of the managed objects and the MIB structure is provided in a special standardized format, called Abstract Syntax Notation 1 (ASN.1).

Since the general collection of MIBs can also be organized in a similar structure, under the supervision of the Internet Activities Board (IAB), any parameter included in a MIB that is recognized by the IAB is uniquely defined.

To provide the flexibility necessary in a global structure, MIBs are classified in various classes (branches), one of them being the experimental branch, and

another the group of private (enterprise-specific) branch. Under the private enterprise-specific branch of MIBs, each enterprise (manufacturer) can be assigned a number, which is its enterprise number. The assigned number designates the top of an enterprise-specific sub-tree of non-standard MIBs. Within this context, RAD has been assigned the enterprise number **164**. Therefore, enterprise MIBs published by RAD can be found under **1.3.6.1.4.1.164**.

MIBs of general interest are published by the IAB in the form of a Request for Comment (RFC) document. In addition, MIBs are also often assigned informal names that reflect their primary purpose. Enterprise-specific MIBs are published and distributed by their originator, which is responsible for their contents.

Enterprise-specific MIBs supported by RAD equipment, including the FCD-155, are available in ASN.1 format from the your nearest authorized RAD business partner.

Management Domains Under SNMP

SNMP enables, in principle, each management station that knows the MIBs supported by a device to perform all the management operations available on that device. However, this is not desirable in practical situations, so it is necessary to provide a means to delimit management domains.

SNMP Communities

To enable the delimitation of management domains, SNMP uses "communities". Each community is identified by a name, which is a case-sensitive alphanumeric string defined by the user.

Any SNMP entity (this term includes both managed entities and management stations) can be assigned by its user community names.

Access Restriction Using SNMP Communities

In general, SNMP agents support two types of access rights:

- **Read-only**: the SNMP agent accepts and processes only SNMP *getRequest* and *getNextRequest* commands from management stations which have the same read-only community name.

- **Read-write:** the SNMP agent accepts and processes all the *SNMP* commands received from a management station with the same write community name.

For each SNMP entity it is possible to define a list of the communities which are authorized to communicate with it, and the access rights associated with each community (this is the SNMP community name table of the entity).

For example, the SNMP community name table of the FCD-155 SNMP agent can include three community names.

In accordance with the SNMP protocol, the SNMP community of the originating entity is sent in each message.

When an SNMP message is received by the addressed entity, first it checks the originator's community: if the community name of the message originator differs from the community name specified for that type of message in the agent, the

message it discarded (SNMP agents of managed entities report this event by means of an authentication failure trap).

FCD-155 Communities

The SNMP agent of the FCD-155 is programmed to recognize the following community types:

Read   SNMP community that has read-only authorization, i.e., the SNMP agent will accept only *getRequest* and *getNextRequest* commands from management stations using that community.

Write   SNMP community that has read-write authorization, i.e., the SNMP agent will also accept *setRequest* commands from management stations using that community.

Trap   SNMP community which the SNMP agent will send within trap messages.

SNMP Traps

The FCD-155 SNMP agent supports the MIB-II authentication trap, and in addition generates enterprise-specific traps for each alarm message.

Traps are also sent to notify the management station of the following events:

- Resetting (warm start trap)

- Change in status of the management link (up or down)

- Authentication failure (use of wrong community).

Index of Main Activities

Customer Response Form

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Thank you for your assistance!

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Publication Number: 180-200-05/08

Please grade the manual according to the following factors:

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