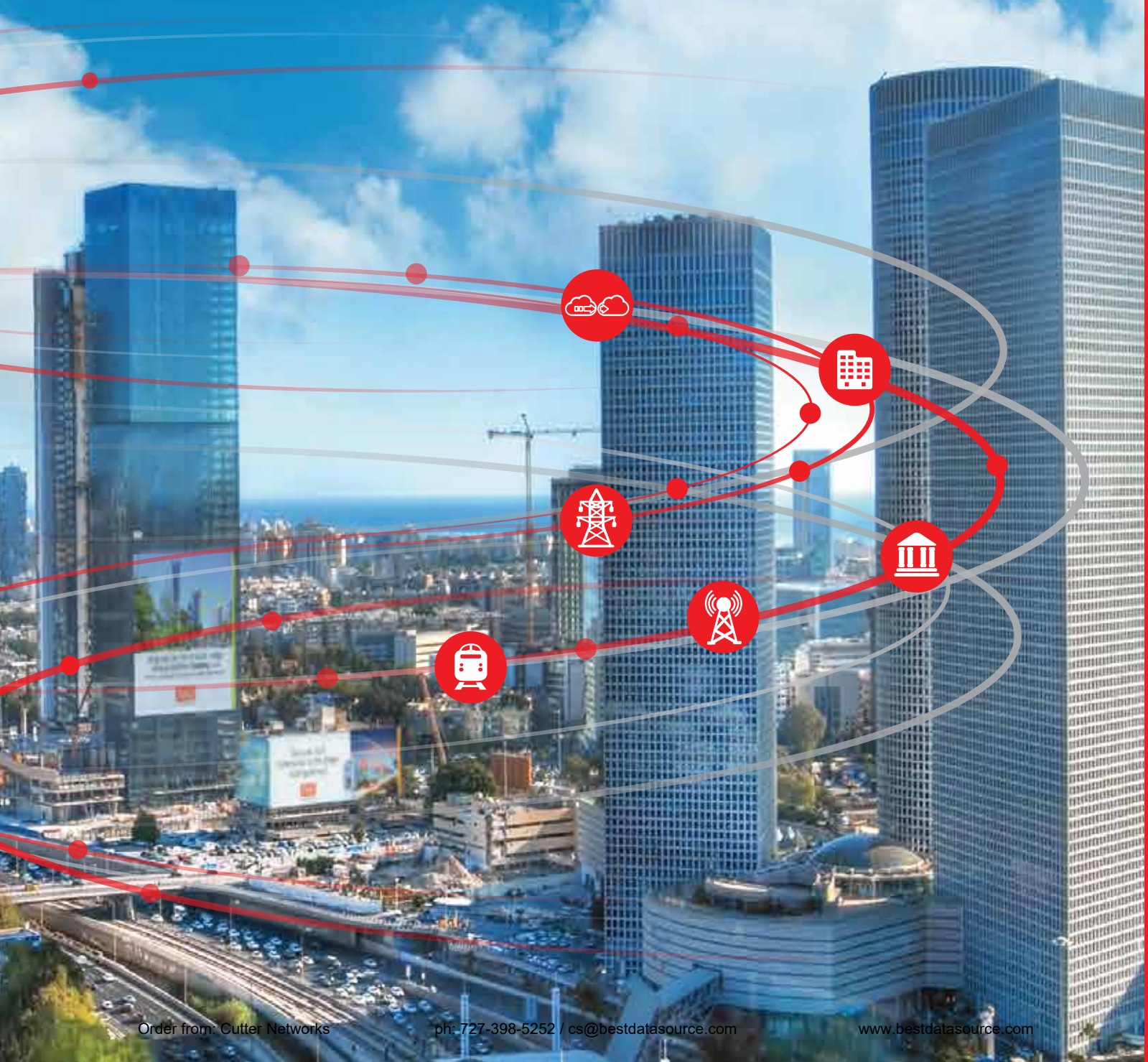


# Service Assured Solutions

2019 Catalog



Your Network's Edge®



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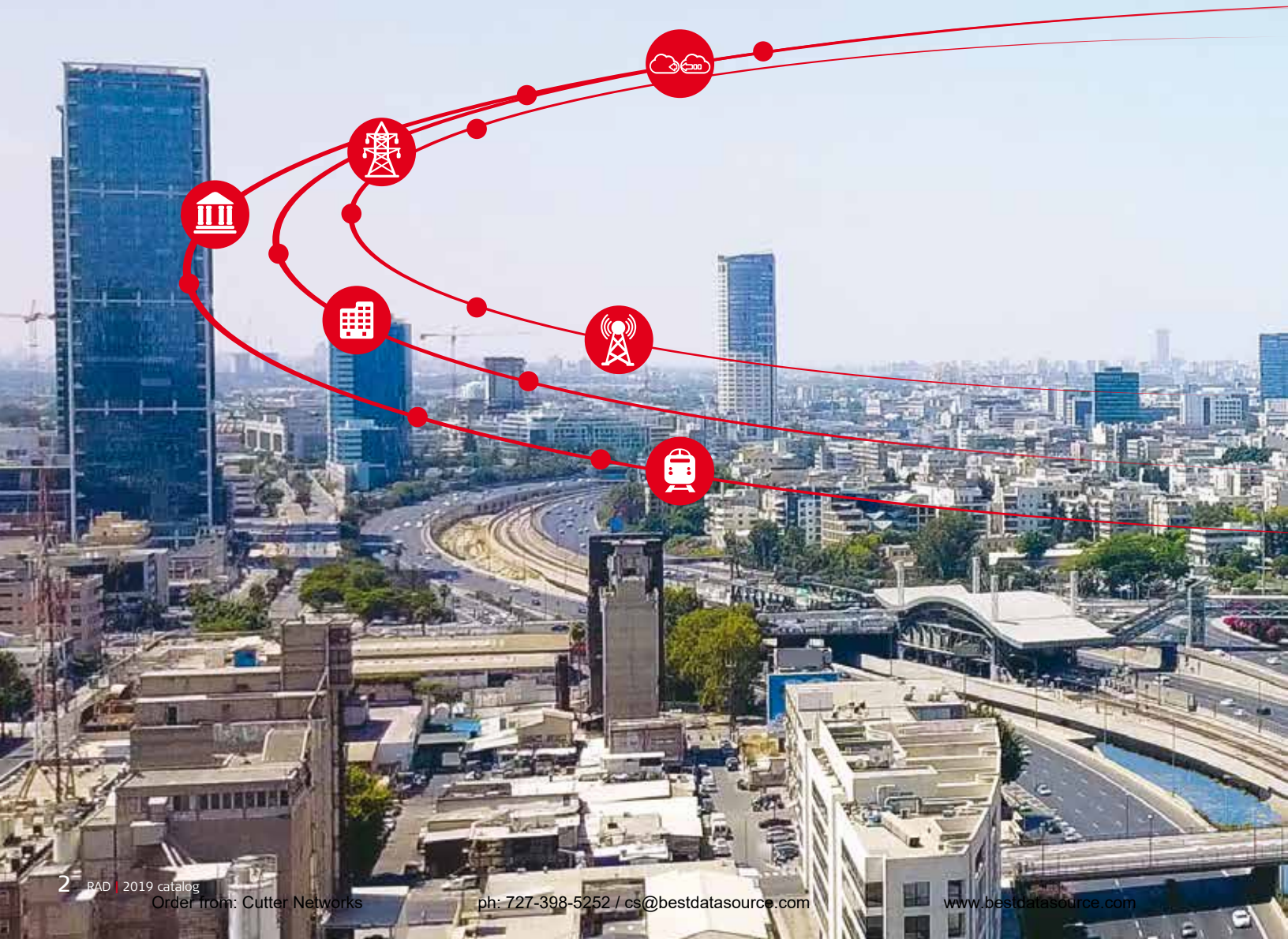


# Evolve Any Service over Any Network

RAD is a global Telecom Access solutions and products vendor. Our customers are top-tier service providers, power utilities, mass transportation systems, and government agencies. By allowing service providers and network operators to decouple service evolution from network evolution, we assist them in migrating at a pace that is right for them. They can leverage existing resources and prolong the use of a large variety of their current legacy interfaces and equipment, as well as maintain network and service performance to guarantee user experience and critical operations.

**We are at the forefront of pioneering technologies, such as:**

- SDN/NFV network edge virtualization
- Secure industrial IoT communications
- Migration to packet
- Timing synchronization for LTE/LTE-A and 5G





## Service Providers

Migrate to NFV/SDN edge virtualization **today** with RAD's Service Assured Access solutions.

## Critical Infrastructure

OT/IT convergence, industrial IoT backhaul and cyber-secure operational WAN with RAD's Service Assured Networking solutions.

With over 37 years of innovation, a significant worldwide presence in over 150 countries and an installed base of more than 16 million network elements, RAD has a proven track record of delivering value and addressing our customers' needs.

RAD is a member of the \$1.35 billion RAD Group of companies, a world leader in telecommunications solutions.





# Leading the Network Edge Virtualization



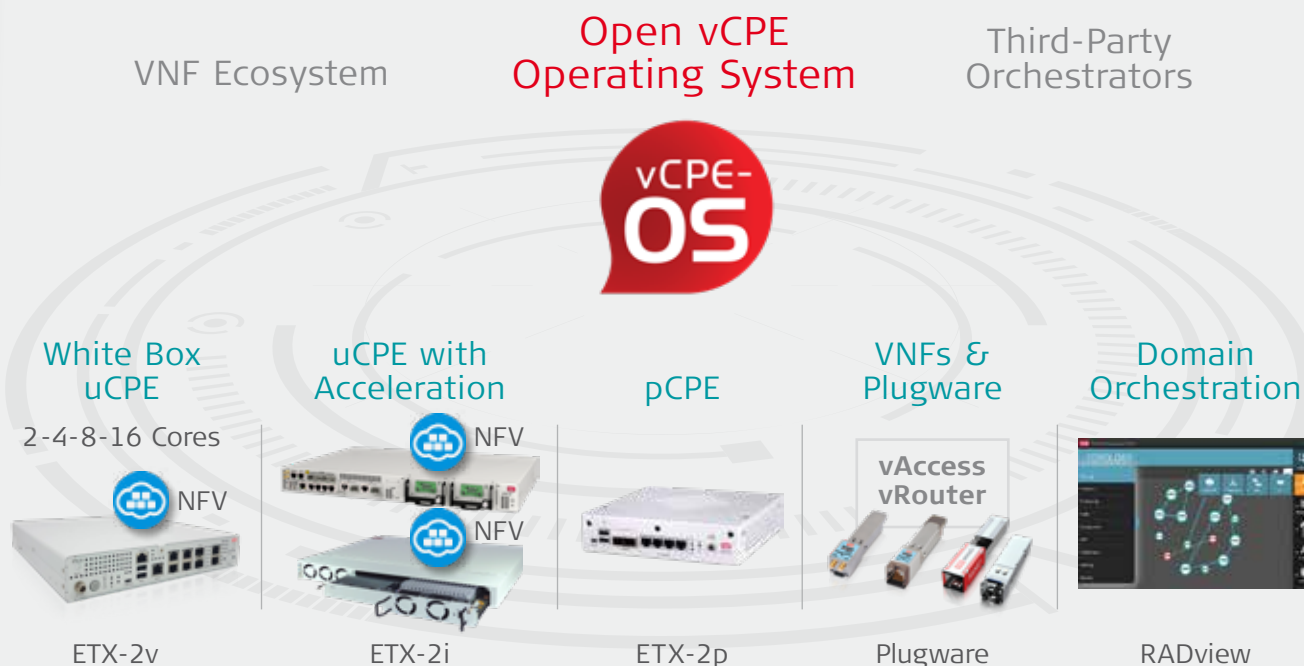
Virtualization  
by RAD

**RAD, the industry pioneer of network edge virtualization**, provides a comprehensive **vCPE Toolbox** offering everything CSPs need to roll out carrier-grade, **service assured** vCPE-based services **today**:

- **Powerful, open vCPE-OS operating system** capable of running on any hardware platform
- **White and gray box** platforms, including Carrier Ethernet NIDs (EADs) and IP routers with pluggable x86 server modules
- **Plugware**, adding a broad spectrum of interfaces, connectivity, conversion and hardware offload/acceleration capabilities to any white box
- **Virtualized network functions (VNFs)**, including vRouter, vFirewall, vSD-WAN, vEncryption, vAccess and more
- **RADview management and domain orchestration** with standard APIs for quick service rollout and easy migration to third-party orchestrators
- **D-NFV Alliance**: pre-tested VNFs and apps

## RAD's Powerful, Carrier-Grade vCPE Toolbox

The Most Comprehensive Network Edge Virtualization Solution!





## vCPE Toolbox: Service Assured Innovation

RAD's vCPE Toolbox provides service delivery and assurance capabilities combined with rich WAN connectivity tools for an extended service footprint including in brownfield infrastructure.



### Operating System

Open, slim and agile, ensures high performance of all vCPE aspects (incl. third-party VNFs)

Already integrated with major brands



### High Availability

Backup and redundancy of network, connections, vCPE system uptime, and NFV infrastructure (NFVI) stability



### Security

Wide range of security measures to allow direct and secure connection to data centers over public networks



### Health

WAN, NFVI and VNF PM, troubleshooting and self healing

Service chain diagnostics

Real-time CPU monitoring



### Automation

Zero-touch provisioning, VNF onboarding and chaining

Maintenance, updates, rollback and tear down



### WAN Connectivity

Ubiquitous service look and feel over any access for unified global deployments of any value-added service, in every end-customer location







## Comprehensive Life-cycle Management

Carrier-grade and life-cycle management tools that predict, assure and monitor the customer experience.





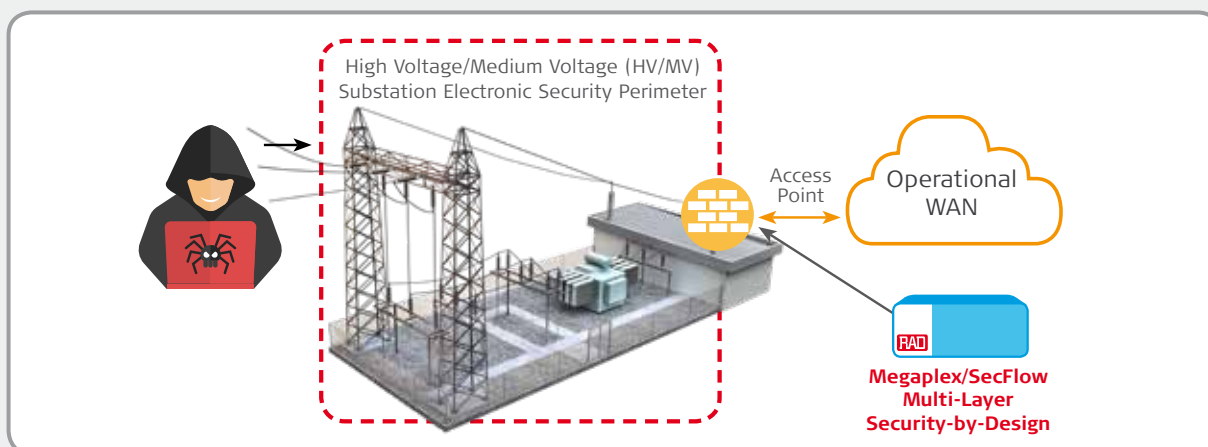
# Cyber Security for Critical Infrastructure



## Boosting NERC-CIP/IEC-27000 Compliance

RAD's SAN solutions are in line with recent North American Electric Reliability Corporation Critical Infrastructure Protection (NERC-CIP) directives and the IEC-27000 International Security Management Standards. RAD will help you boost your cyber security and compliance levels:

- Encryption and integrity for all communications outside ESP
- Application-aware (SCADA-aware) firewall
- Record/monitor all device connections in substations



- Cyber Shield solution protects from attacks on SCADA and management traffic
- Strategically located to securely manage all electronic access to the substation's ESP, and to protect the cyber assets within it from external and internal attacks:
  - Device connection control (DCC) using IEEE 802.1x Network Access Control to ensure authenticated and authorized internal substation connections
  - SCADA-aware security layer, including firewall, intrusion prevention, anomaly detection, and more
  - IEEE 802.1AE (MACsec) and IPsec encryption and data integrity verification to prevent source-spoofing, session hijacking, man-in-the-middle and distributed denial of service (DDoS) attacks
- Boost compliance level with NERC-CIP requirements for bulk electric system (BES) protection
- Layered security approach addresses all vulnerability points including integrity, confidentiality (encryption), authentication, authorization, and auditing
- Access control, user authentication and privilege-level associations for local and remote access using Secure Shell (SSH), TACACS or RADIUS
- Optional: Secure backhaul over public/private cellular for primary/backup traffic

Multiservice Access  
Node with D-NFV



Megaplex-4

Ruggedized SCADA-Aware  
Gateway/Switches and  
Routers



SecFlow®





# Secure Industrial IoT with Edge Computing



RAD offers a comprehensive solution for secure networking for Smart Cities, Connected Industry, Smart Transportation, Smart Energy (generation, transmission and distribution), and more, to allow fast, secure and economical deployment of thousands of new remote IIoT sites with always-on reliability and mission-critical protection.



## Power Utilities

- Smart Grid
- Re-closers
- Load breakers
- RTUs/SCADA
- Secondary substations
- Meter concentrators



## Transportation

- Traffic control
- Info boards
- Kiosks



## Smart Cities

- Smart parking
- Traffic monitoring and control
- Bike sharing
- Smart lighting
- Public safety
- Payment kiosks (PoS)



## Gas Utilities

- Flow meters
- Volume/pressure/level sensors



## Connected Industry

("Smart Factory/ Industrie 4.0/ Society 4.0")

- Production floor monitoring
- Remote PLC control
- Automated quality control



## Water Utilities

- Flow control
- Quality
- Leakage detection
- Pump/valve control
- Meters



# Comprehensive End-to-End Solution

## Key Benefits



### Always-on connectivity

Seamless connectivity over any access with resiliency and redundancy options



### Security

End-to-end IPsec VPN tunnels over private and public networks with firewall and encryption



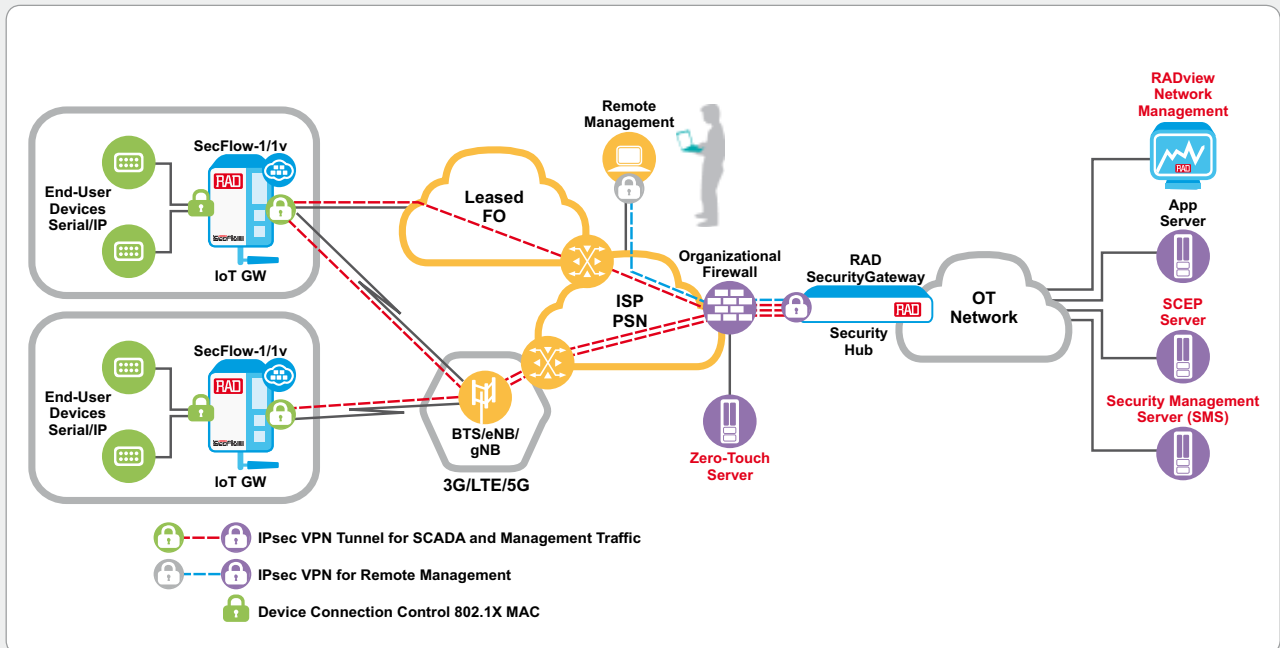
### Computing

Fog/edge application support to minimize latency and maximize efficiency



### Simplified operations

Secure zero-touch configuration for automated installation and provisioning



### SecFlow

Ruggedized SCADA-Aware Gateway/Switches and Routers with Edge Computing



### SecurityGateway

VPN Aggregator, Router and Firewall



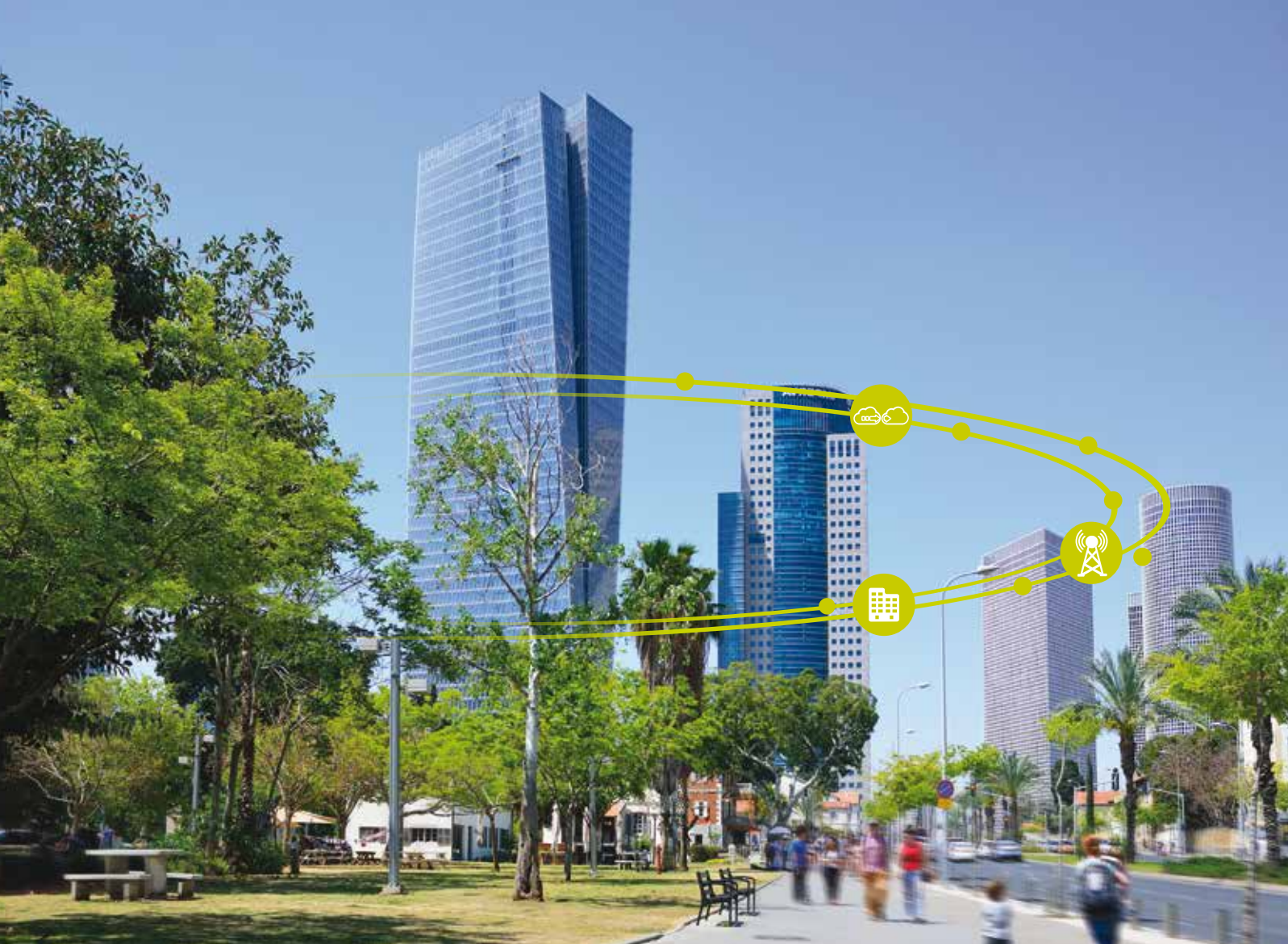
### RADview

Network Management, Firewall Configurator and Security Management (SIEM)



A graphic on a red background featuring the text "RAD Solutions" in white. The text is surrounded by several white curved lines and circular icons. The icons include a power line tower, a cloud with a key, a building, a train, a classical building, and a radio tower. The lines and icons suggest a network or infrastructure theme.

# RAD Solutions



# Service Providers

Migrate to NFV/SDN edge virtualization **today** with RAD's Service Assured Access solutions.

For mobile, business and wholesale service providers, we provide an economical migration path to network edge virtualization via the disaggregation of software and hardware. In addition, our Service Assured Access solutions are designed to deliver a competitive edge with complete visibility of network and service performance for greater operational efficiency, as well as timing synchronization for LTE/LTE-A and future 5G deployments.

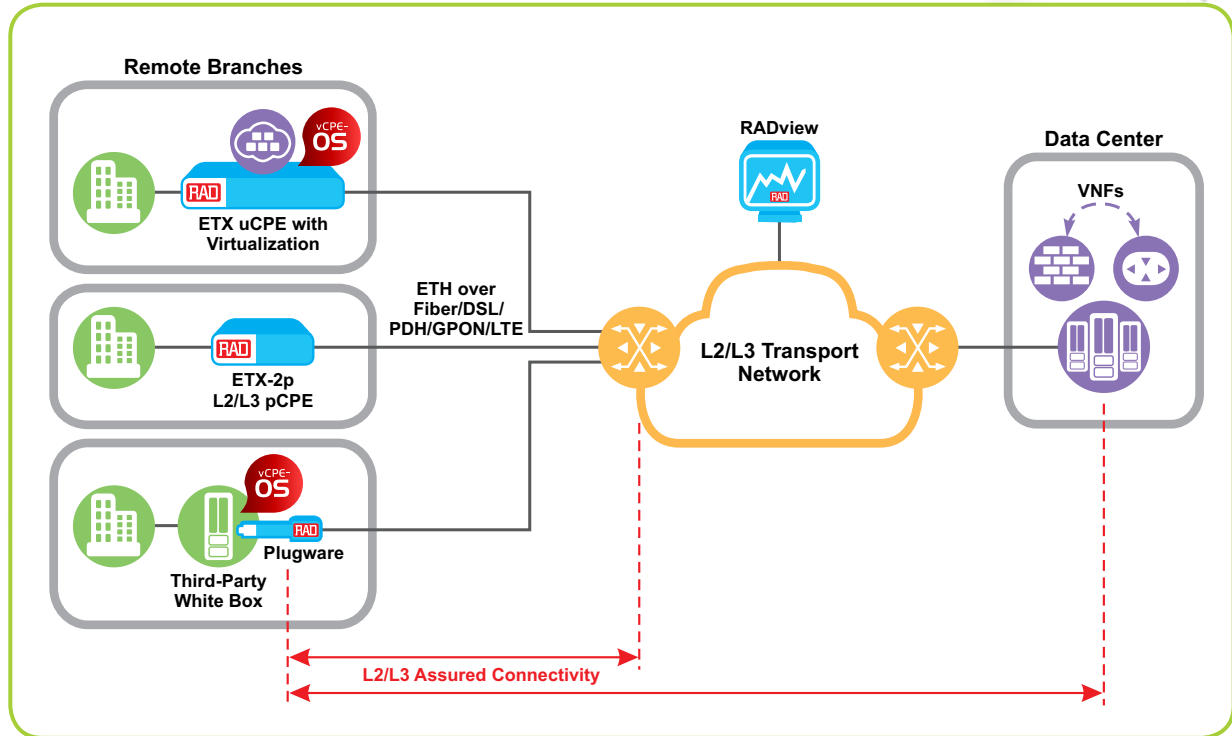
Key SAA solutions include:

- Service-assured vCPE Toolbox offering everything service providers need to roll out carrier-grade vCPE-based business services while maintaining full openness to avoid vendor lock-in
- Market-leading EAD portfolio for MEF 3.0 and IP VPNs, including comprehensive SLA assurance, end-to-end visibility and life-cycle management capabilities over any access
- Seamless migration from TDM to IP, supporting an existing installed base and services while introducing next-gen communications





## vCPE



## Your Benefits:

- Scalable solution allows operators to spin up virtual managed services, from security to routing, SD-WAN to IT services, and much more
- Cost-optimized white box vCPE for business services
- Open, high performance operating system (vCPE-OS) runs on any white box and supports any access with PM, troubleshooting and self-healing capabilities
- Plugware allows assured seamless connectivity over Ethernet fiber/copper, WiFi, xDSL/PDH/GPON, as well as LTE (uplink/backup)
- Integrated and optimized compute resources enable remote deployment of network functions and value-added services; VNF download and service-chain configuration are performed with a powerful and intuitive edge orchestrator
- CPU hardware offload, together with forwarding plane acceleration, allows consistent and predictable wire-speed performance with built-in service assurance, freeing up CPU resources for additional services

## Products Included in this Solution:



**ETX-2i, ETX-2v, ETX-2p**  
vCPE & pCPE Platforms



**Plugware**  
MiNID, MiRICI, MiTOP, MiCLK  
Smart SFPs



**vCPE-OS**  
Open Carrier-Class  
Operating System

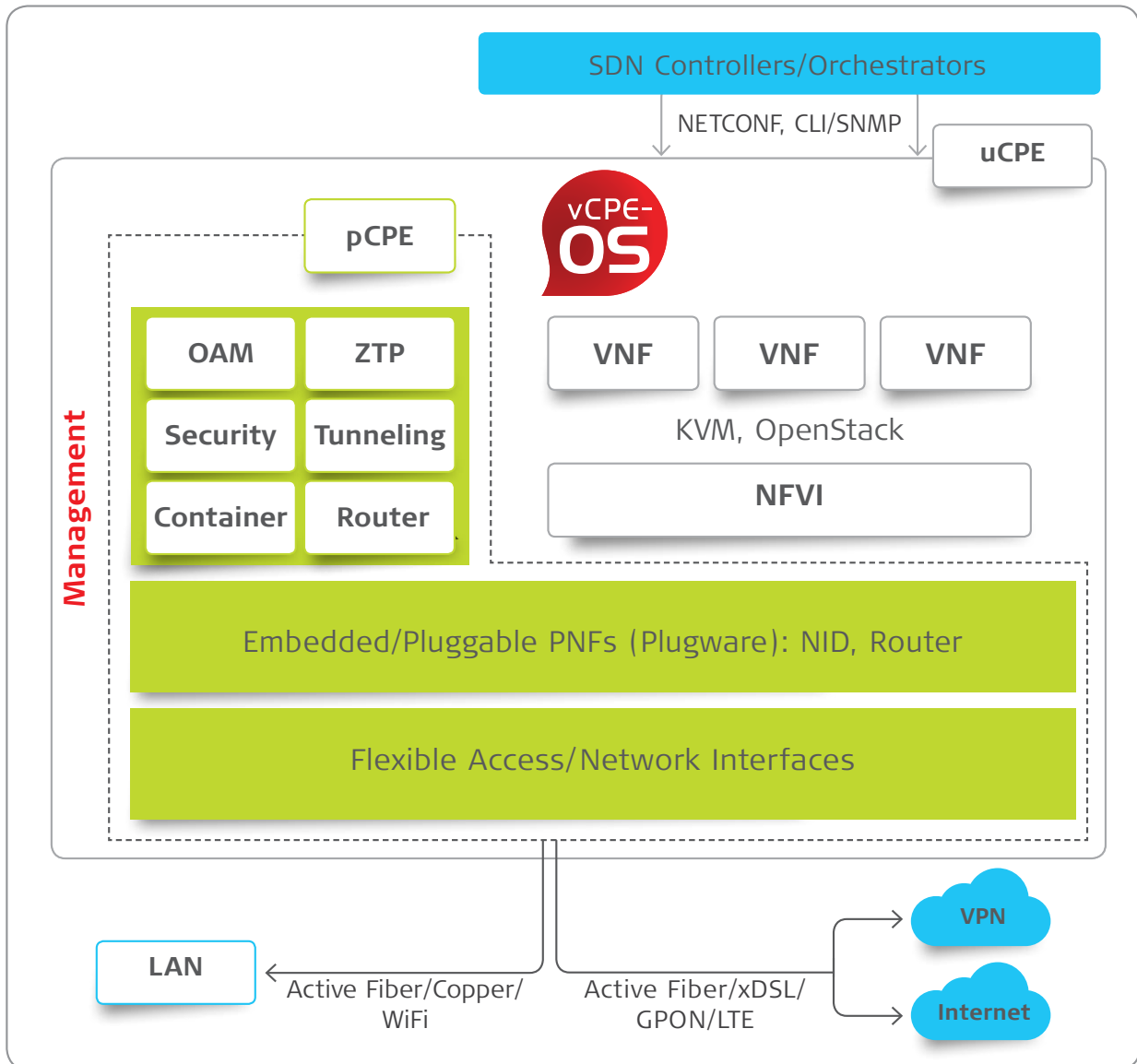


**RADview**  
Management and Domain  
Orchestration





## Common Operating System for pCPE and uCPE

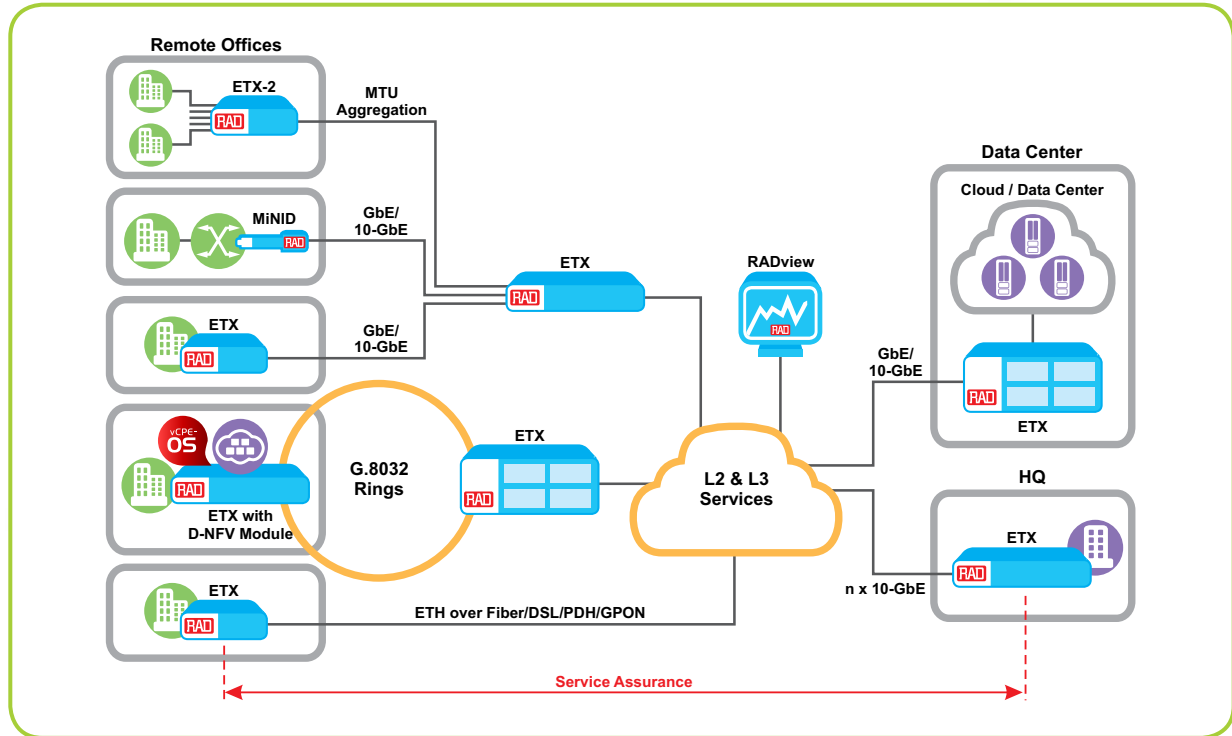


- Open NFV/SDN architecture facilitates integration with network-wide orchestrators and SDN controllers
- Powerful, carrier-class operating system (vCPE-OS), pre-integrated on RAD's vCPE platforms and also available for third-party white box devices





## Carrier Ethernet and IP VPNs



### Your Benefits:

- Easily plan, deploy, provision, and maintain SLA-based business and cloud access services with the same "look and feel" over any access: fiber/copper/TDM/wireless
- Carrier Ethernet demarcation switch up to 100G
- Integrated L3 router functionality
- MEF 3.0-certified with a feature-rich toolkit: RFC-2544/Y.1564 testing, multi-CoS traffic management, fault management, Y.1731/TWAMP performance monitoring
- Instant upgrades to existing equipment with MiNID service assurance booster
- Enhanced service provisioning, visibility and reporting using RADview Service Manager and RADview Performance Monitoring portal
- vCPE functionality at the customer edge for service agility and premium offerings, e.g., SD-WAN and other value-added services

### Products Included in this Solution:



**ETX-2**  
IP and Carrier Ethernet  
Demarcation



**ETX-2i**  
1G/10G/100G EAD with  
vCPE module



**MiNID**  
Miniature Programmable  
Network Interface Device

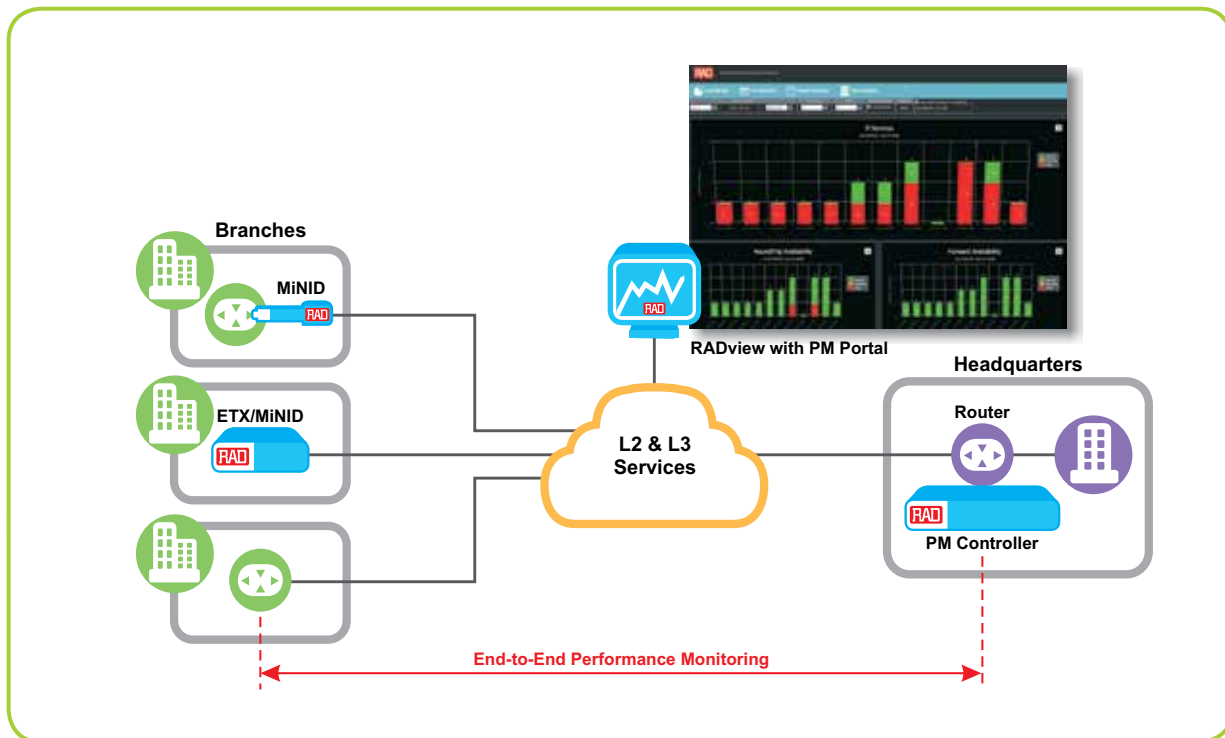


**RADview**  
Management and Domain  
Orchestration





## Performance Monitoring for Business VPNs



### Your Benefits:

- Performance monitoring for L2, L3 VPNs to assure service level agreement (SLA) for businesses
- PM Controller functionality (appliance/VNF) supports Y.1731, TWAMP, ICMP Echo ("ping"), and UDP Echo opposite RAD devices or third-party responders
- RADview PM supports SLA reporting with drill-down capabilities per PM session
- Optional service assurance upgrade with MiNID:
  - Easy plug-and-play installation into existing installed base
  - Unique form factor reduces space and power consumption requirements
- L2 (Y.1731) and L3 (TWAMP) test generation and response
- Service activation testing
- Analysis of micro-bursts affecting QoE
- Deep end-to-end visibility and performance monitoring across heterogeneous networks and equipment types, independent of installed-base capabilities

### Products Included in this Solution:



**ETX-2/ETX-2i**  
IP and Carrier Ethernet Demarcation with D-NFV



**MiNID**  
Miniature Programmable Network Interface Device



**PM Controller**  
Performance Monitoring Generator

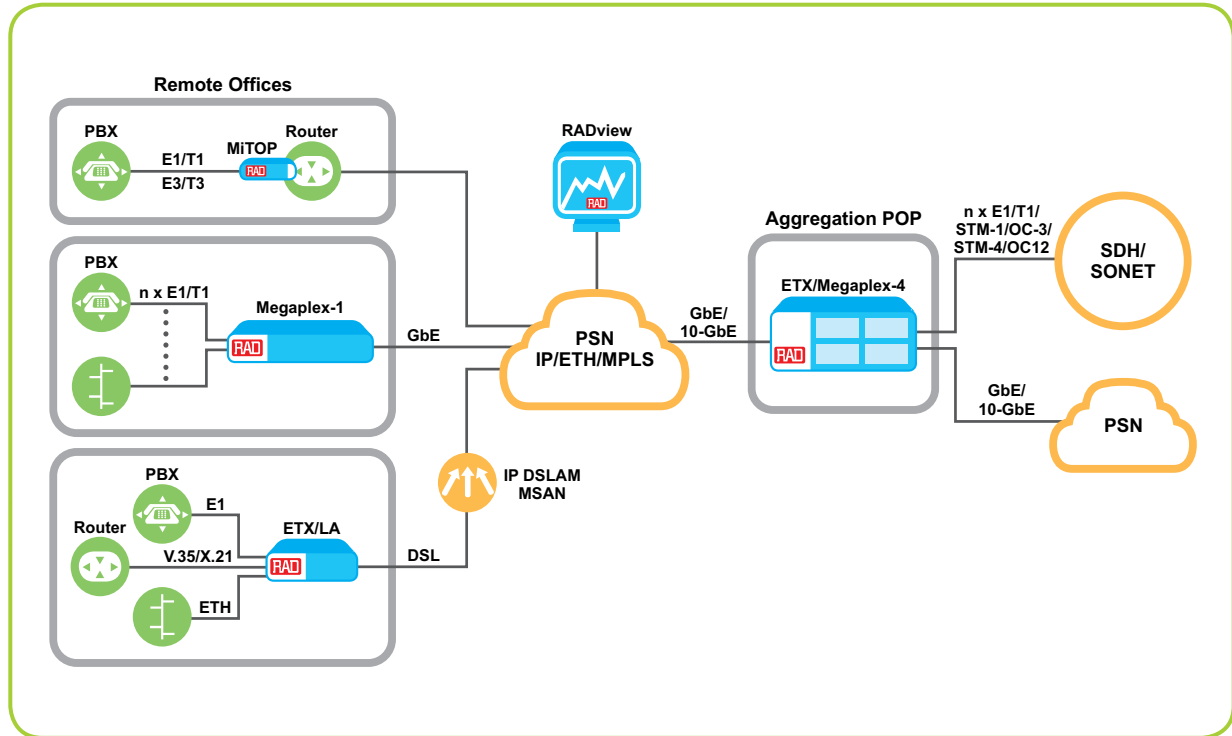


**RADview**  
Management and Domain Orchestration





## TDM Migration



### Your Benefits:

- Maintain legacy TDM services over new packet network to keep revenue flow and customer loyalty
- Enable alternative providers to add leased lines to their service portfolio to attract new customers
- Support heterogenic First Mile footprint requiring CPE support for DSL/EFM, Ethernet, GPON connections, and flexibility in PWE termination options: customer site-to-customer site, customer site-to-POP/network, POP-to-POP
- Allow a single transport network for IP/Ethernet and TDM services to simplify operations and lower TCO

### Products Included in this Solution:



**ETX-2**  
IP and Carrier Ethernet  
Demarcation



**ETX-5**  
Ethernet Service  
Aggregation Platform



**Megaplex-1**  
Multiservice Pseudowire  
Access Gateway



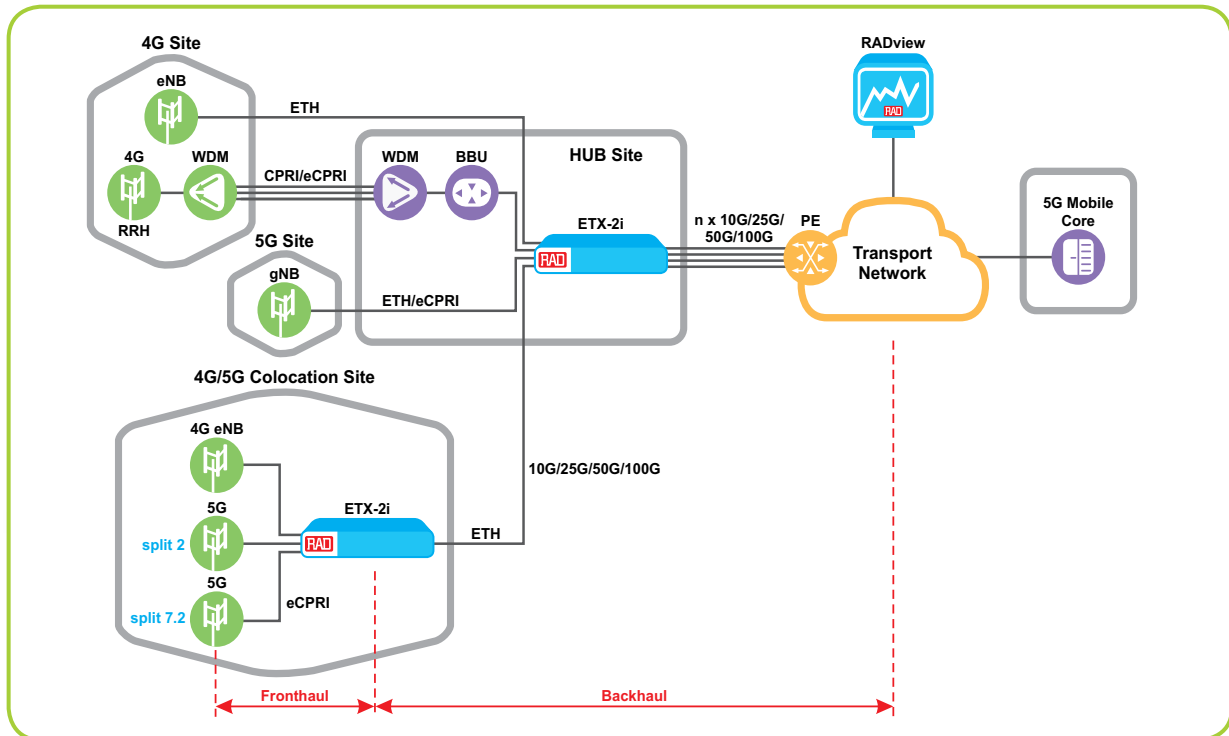
**RADview**  
Management and Domain  
Orchestration







## Mobile xHaul



### Your Benefits:

- Fast roll outs of early 5G deployments with in-field future upgrades to meet new requirements
- Highly efficient 4G/5G aggregation: 10G, 25G, 50G, and 100G, timing synchronization
- CSG for multiple 5G RAN splits and co-located 4G/5G sites
- Fixed-mobile convergence: Co-located mobile and fixed broadband sites
- Multi-CoS Carrier Ethernet/IP backhaul with service management and OAM-based diagnostics
- L2, L3-based fronthaul/backhaul performance monitoring for multiple network slices and for network sharing
- Small form factor to meet space and power supply restrictions

### Products Included in this Solution:



#### ETX-2/ETX-2i

IP and Carrier Ethernet  
Cell Site Gateway up to 100G



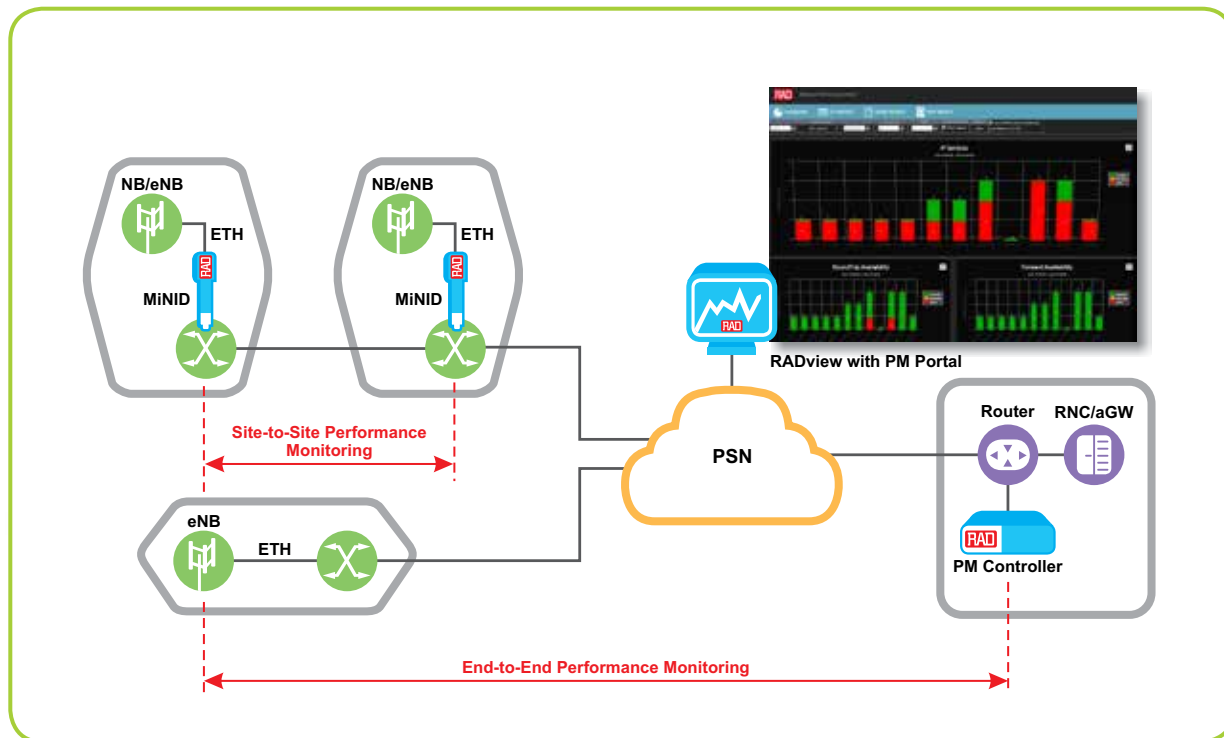
#### RADview

Management and  
Domain Orchestration





## Performance Monitoring for Mobile Networks



### Your Benefits:

- Monitoring and troubleshooting backhaul performance, including LTE X2, S1 traffic path
- Service activation tests (RFC-2544/Y.1564) and continuous performance monitoring
- PM Controller functionality (appliance/VNF) supports Y.1731, TWAMP, ICMP Echo ("ping"), and UDP Echo opposite RAD devices or third-party responders
- High precision one-way measurements opposite any TWAMP responder
- RADview Performance Monitoring portal for SLA reporting
- Enhanced service assurance with MiNID:
  - Easy plug-and-play installation into existing backhaul networks
  - L2/L3 test generation and response capabilities
  - Remote packet capture for deep traffic analysis

### Products Included in this Solution:



**MiNID**  
Miniature Programmable  
Network Interface Device



**PM Controller**  
Performance Monitoring  
Generator

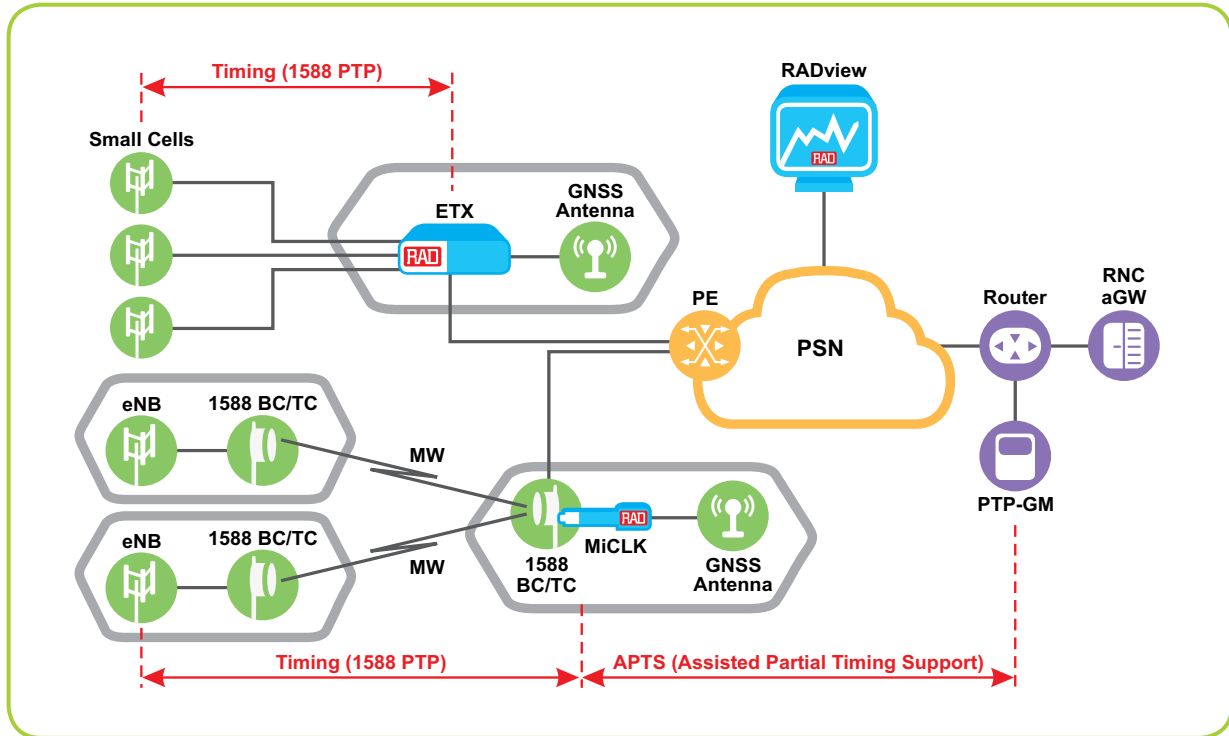


**RADview**  
Management and Domain  
Orchestration





# Timing Synchronization for Mobile Networks



## Your Benefits:

- Addressing stringent timing requirements (frequency/phase) for LTE/LTE-A macro and small cells with a fully featured PTP Grandmaster:
  - ETX-2 in a local POP/hub
  - MiCLK unique SFP plugged into an aggregation switch
- Cost efficiency by bringing PTP Grandmaster closer to the cell site
- Built-in GNSS receiver
- Full network coverage, even in underground and indoor installations
- No need to install GNSS antenna on every cell site; avoid spoofing and jamming
- Fits existing installed base – no need for CapEx investments in retrofitting network with 1588 BC/TC support across the entire path
- Robust GNSS backup – time holdover for 72 hours, using Sync-E or 1588 frequency references from the network (Assisted Partial Timing Support)

## Products Included in this Solution:



**ETX-2**  
IP and Carrier Ethernet  
Demarcation



**MiCLK**  
1588 Grandmaster on  
an SFP



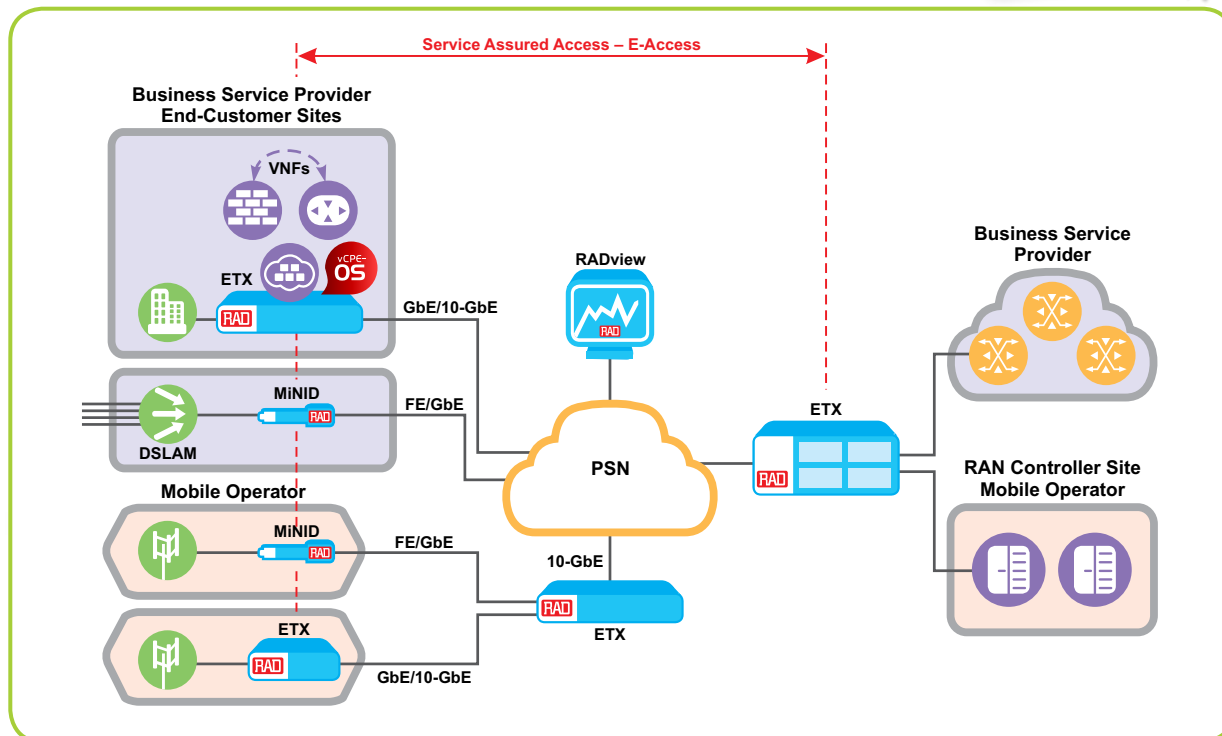
**RADview**  
Management and Domain  
Orchestration







## Wholesale Networking



### Your Benefits:

- Provide wholesale Carrier Ethernet transport services to multiple service providers with complete visibility and controlled service hand-off between multiple networks
- Demarcation for business, mobile and DSLAM backhaul over the same transport network
- Provide SLA-based backhaul all the way to the end-customer site, cell site or POP
- MEF-certified Carrier Ethernet 2.0 E-Access support with single-CoS and/or multiple-CoS EVC/OVC for standards-based carrier-to-carrier connectivity
- Seamless connection between networks with 1-GbE, 10-GbE and 100G E-NNI interfaces with optional redundancy
- Enhance wholesale offering with VNF-based, customer-managed, value-added services

### Products Included in this Solution:



**ETX-2**  
IP and Carrier Ethernet  
Demarcation



**ETX-2i-100G**  
100G EAD with vCPE  
Module



**MiNID**  
Miniature Programmable  
Network Interface Device



**RADview**  
Management and  
Domain Orchestration





# Critical Infrastructure

Industrial IoT with edge computing and cyber-secure operational WAN, using RAD's Service Assured Networking solutions.

RAD provides Service Assured Networking (SAN) solutions that ensure seamless migration to packet switched communication networks and applications. We address all communication needs of the utilities, transportation and government sectors with always-on reliability and mission-critical protection. We offer best-of-breed reliability tools. Our SAN solutions are used for cyber-secure industrial IoT (IIoT) and operational WANs, fog/edge computing, TDM to packet migration, distance teleprotection and distribution automation, as well as Smart/Safe City deployments.

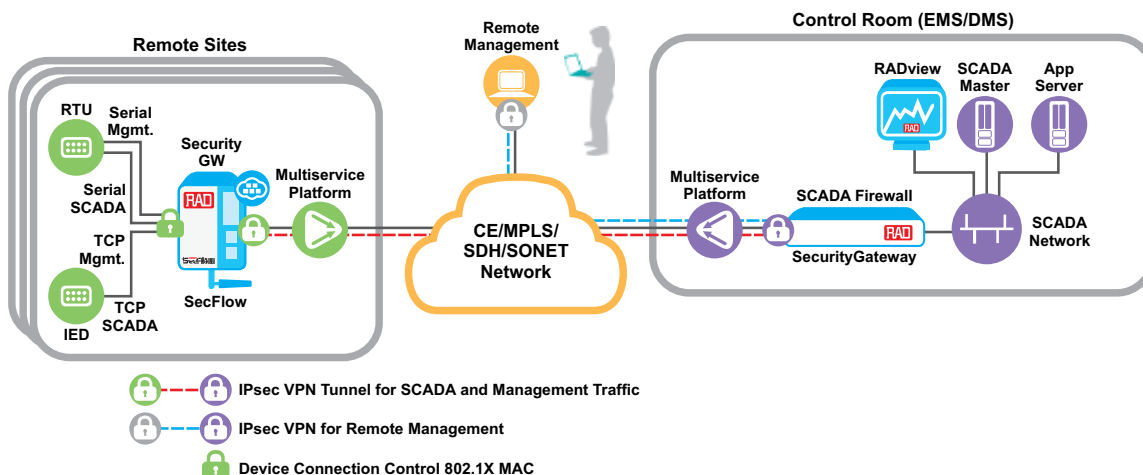
Key SAN solutions include:

- Secure networking for digital transformation to allow fast, secure and economical deployment of thousands of new remote IIoT sites
- Multiservice, packet and PoE-intensive OT WANs, enabling easy migration from TDM to PSNs
- Seamless communications over fiber optics, radio links, 2G/3G/LTE cellular links, and leased lines
- Extensive security suite includes SCADA-aware firewall, intrusion prevention, man-in-the-middle attack prevention, encryption, device connection control, event logger, and anomaly detection

# Cyber Security Solutions



## 1 Cyber Shield Overlay for Operational WAN



### Your Benefits:

- RAD's SecFlow security gateways for remote sites isolate industrial control systems (ICSs)/automation devices from attack vectors on management and SCADA planes:
  - Cyber Shield for **management** traffic (NERC CIP Intermediate System)
  - Cyber Shield for **SCADA** traffic
- Upgrades existing operational technology (OT) networks with Intermediate System for secure remote and local access, SCADA-aware firewall, intrusion prevention system functionality, man-in-the-middle attack prevention, encryption, device connection control, event logger, and anomaly detection
- Fits any OT network architecture and ICS/SCADA device connectivity (serial or TCP)
- The most comprehensive and cost-effective solution on the market simplifies multi-box alternatives
- Works in conjunction with any third-party VPN aggregators

### Products Included in this Solution:



**SecFlow**  
SCADA Secure Switch/Routers with Edge Computing



**SecurityGateway**  
VPN Aggregator, Router and Firewall



**RADview**  
Management and Domain Orchestration







Cyber Security  
by RAD

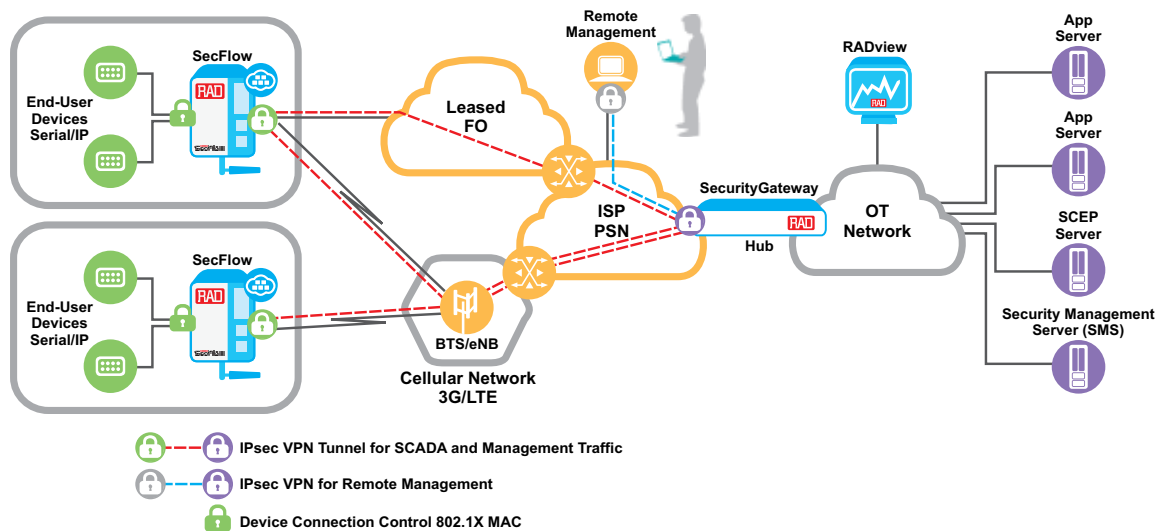
See Page 7



Secure IIoT  
Edge Computing

See Pages 8-9

## 2 Secure Industrial IoT Backhaul



### Your Benefits:

- Ideal for the utilities, transportation and government markets
- RAD's SecFlow security gateways for remote sites isolate industrial control systems (ICSs)/automation devices from attack vectors on management and SCADA planes
- Greenfield communications/security solution for sites connected via

public cellular networks, with Intermediate System for secure remote and local access, SCADA-aware firewall, intrusion prevention system functionality, man-in-the-middle attack prevention, encryption, device connection control, event logger, and anomaly detection

- Fits any ICS/SCADA device connectivity (serial or TCP)
- Automated PKI solution for remote sites with dynamic IP address allocated from cellular APN
- The most comprehensive and cost-effective solution on the market simplifies multi-box alternatives

### Products Included in this Solution:



**SecFlow**  
SCADA Secure Switch/Routers  
with Edge Computing



**SecurityGateway**  
VPN Aggregator, Router and  
Firewall



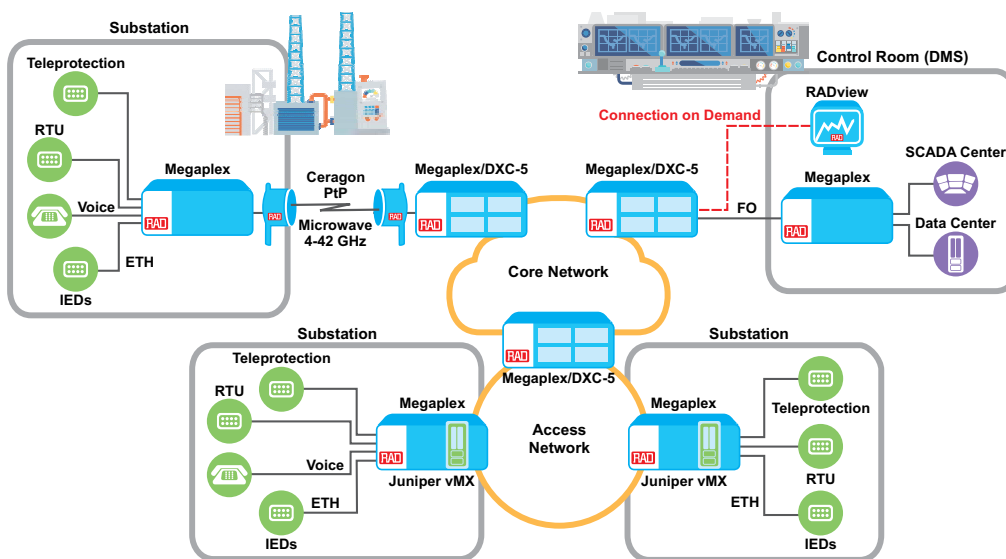
**RADview**  
Management and Domain  
Orchestration



# Power Utility Communications



## 1 Multiservice Operational WAN



### Your Benefits:

- Powerful cross-generation TDM, IP-MPLS and Ethernet capabilities, including TDM DS0 cross connect and SDH/SONET, Gigabit Carrier Ethernet with OAM and assured QoS, TDM pseudowire, Ethernet over NG-PDH/SDH/SONET, IP/MPLS, MPLS-TE, MPLS-TP and OTN/DWDM
- Complete cyber attack prevention suite, including encryption, authentication, authorization, and auditing
- Easily configurable connectivity of all serial automation and Teleprotection devices to either SDH/SONET network or to a packet network
- Supports analog and digital data and voice devices, as well as Ethernet IEDs, with versatile rates from RS-232 up to STM-64/OC-192 or 10 GbE
- Guaranteed smooth migration to PSNs based on hybrid design for reduced latency and better resiliency
- Point-to-point and point-to-multipoint radio connectivity supports high capacity mission-critical traffic over licensed and unlicensed bands

### Products Included in this Solution:



**Megaplex**  
Next-Generation Multiservice Networking Node with Juniper vMX Module



**DXC-5**  
High Capacity Hybrid Cross Connect



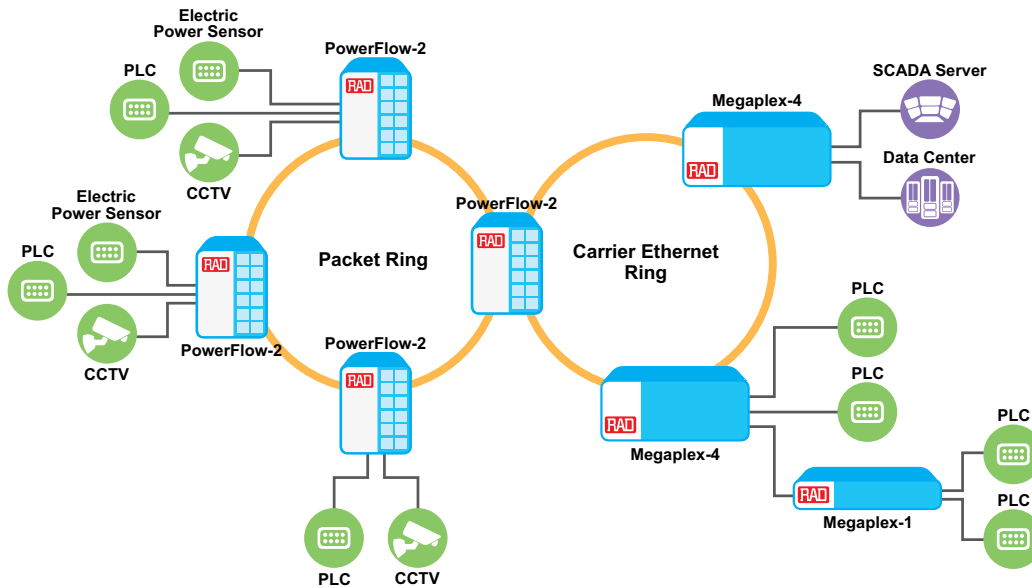
**Ceragon**  
Wireless Transport Platform



**RADview**  
Management and Domain Orchestration



## 2 Packet Operational WAN



### Your Benefits:

- Supports Ethernet-based communications for mission-critical automation traffic within the substation and between SCADA control centers
- Multiple elements on each ring/sub-ring
- Complies with IEC 61850-3 and IEEE 1613 environmental standards
- Legacy communications using pseudowire emulation (PWE) with hitless PWE redundancy
- Optional PoE+
- Ring protection: Standard with G.8032 and proprietary with fast recovery time (< 10ms for PF\_Ring™)
- Supports installation in harsh environments, IEEE 1613 and/or IEC 61850-3 (optional for specific devices)

### Products Included in this Solution:



**Megaplex-4**  
Next-Generation  
Multiservice Networking  
Node



**Megaplex-1**  
Multiservice Pseudowire  
Access Gateway



**PowerFlow**  
Managed Ruggedized  
Ethernet Switch with  
Power over Ethernet

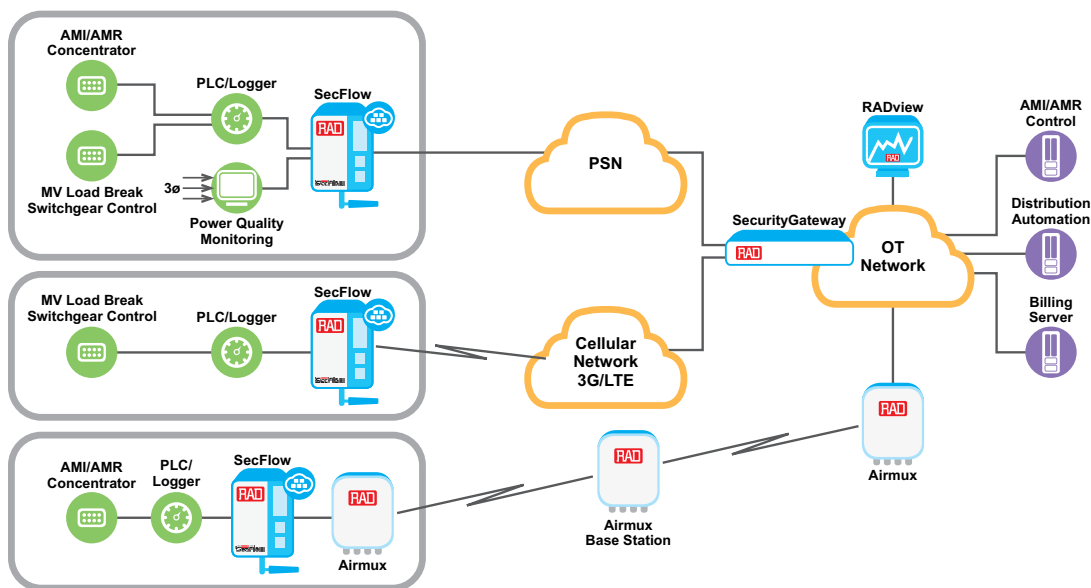


**RADview**  
Management and Domain  
Orchestration





### 3 Industrial IoT Backhaul for Distribution Automation and Smart Metering



#### Your Benefits:

- A comprehensive and secure solution addressing communications to secondary substations, metering and automation network integration, and cyber security
- Virtual environment for user-tailored applications allows customers to add new applications on top of SecFlow devices
- Zero-touch provisioning, enhanced cyber security (stateful firewall, SIEM)
- Seamless communications over fiber optics, radio links, 2G/3G/LTE cellular links, and leased lines from a telecom service provider
- Secure remote access for end-user device management
- Transparent delivery of SCADA protocol conversion and terminal server
- Integrated IPsec encryption with automated PKI support
- Complies with IEC 61850-3 and IEEE 1613 environmental standards for outdoor installations
- Point-to-multipoint radio connectivity supports high capacity mission-critical traffic over licensed and unlicensed sub-6 GHz bands

#### Products Included in this Solution:



**SecFlow**  
Ruggedized SCADA-Aware  
Gateway with  
Edge Computing



**SecurityGateway**  
VPN Aggregator, Router  
and Firewall



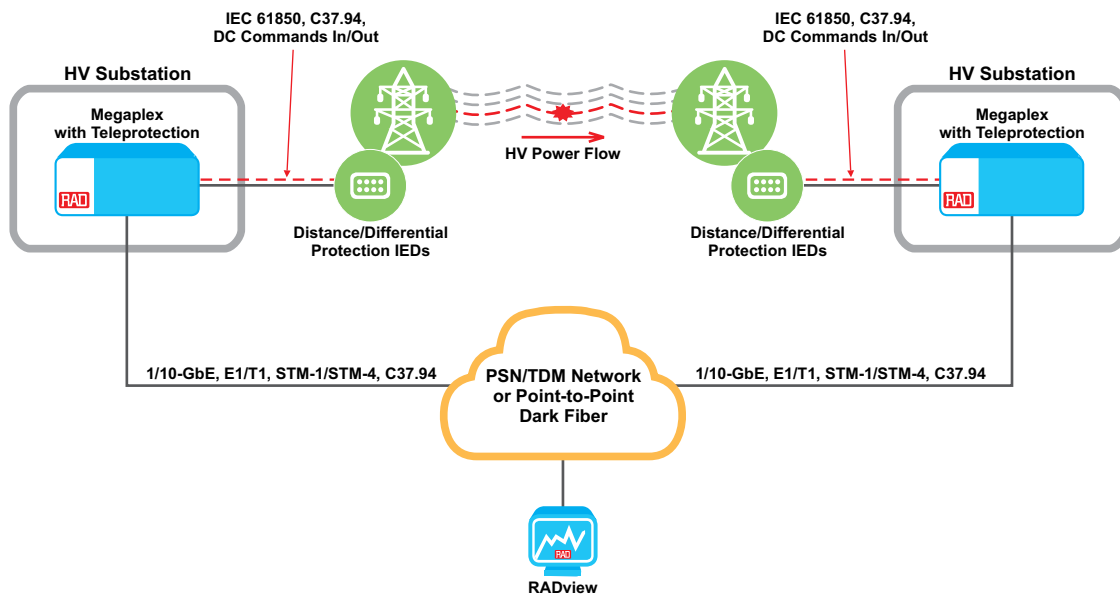
**Airmux**  
Point-to-Point and  
Point-to-Multipoint  
Broadband Wireless Access



**RADview**  
Management and  
Domain Orchestration



#### 4 Distance and Differential Protection Communications



#### Your Benefits:

- Single product supports both distance trip command relays and differential Teleprotection delivery over TDM or IP network
- Wide range of Teleprotection interfaces — serial, G.703 co-directional, E&M, C37.94 — to extend differential Teleprotection
- relay communication over any infrastructure
- Reduce CapEx and OpEx by using a single-box solution for all substation communication services, including voice, data, automation, and Teleprotection signals
- Redundancy hierarchy from the Teleprotection interface up to the communication link ensures 0 (zero) msec hardware protection
- Sub-2 msec end-to-end delay over PSN
- Tested interoperability with most Teleprotection contact relays from leading vendors (such as Alstom, ABB, Siemens, SEL, Schneider)
- Distance protection complies with IEC 60834

#### Products Included in this Solution:



**Megaplex-4**  
Next-Generation Multiservice  
Networking Node



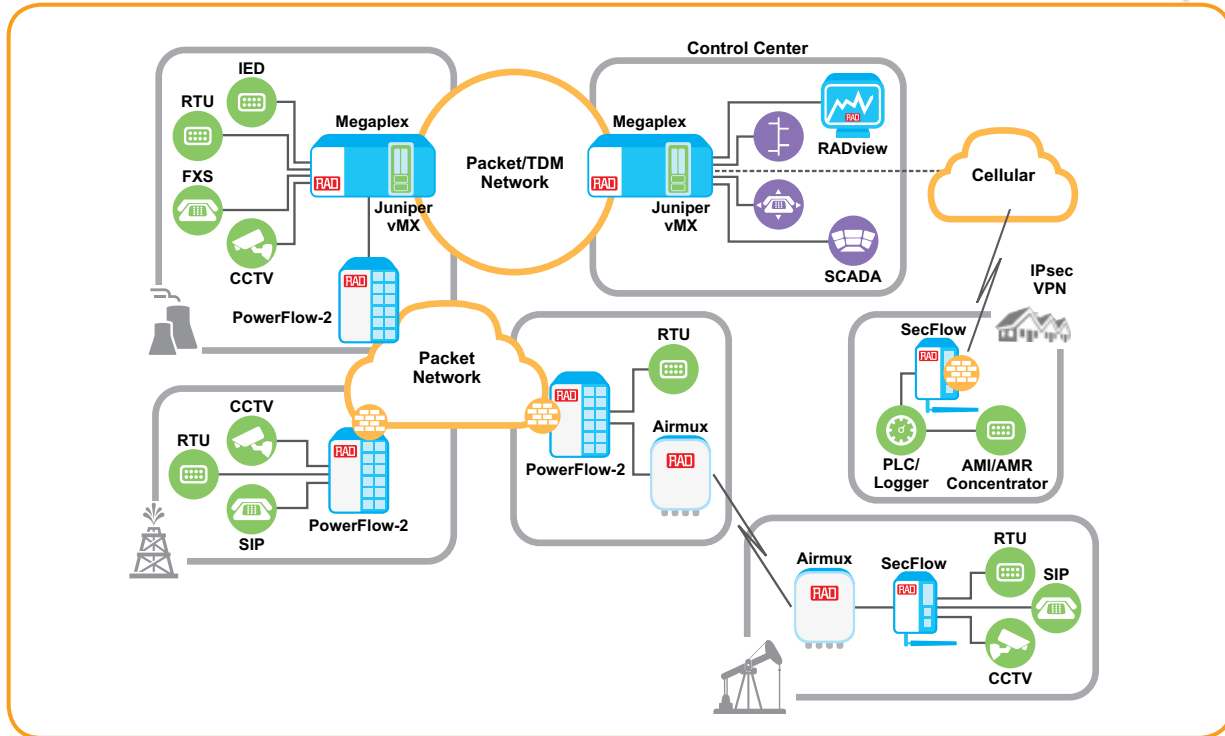
**Megaplex-1**  
Multiservice Pseudowire  
Access Gateway



**RADview**  
Management and Domain  
Orchestration



# Oil and Gas Utility Communications



## Your Benefits:

- Cyber-secure M2M connectivity for compressor stations, storage tanks, LACT and flow meters, cathodic protection, etc.
- Supports all communication needs, including SCADA protocols, voice and new packet services (CCTV, VoIP, etc.)
- Multiservice aggregation for any transport network, including SDH/SONET, IP/MPLS, MPLS-TP, CE and OTN/DWDM
- Complies with environmental standards for outdoor installation in harsh conditions
- Supports any available media and connectivity option, including fiber, radio, 3G/4G cellular links, or leased lines from a local telco
- Distributed SCADA security suite with integrated firewall and encryption
- Point-to-point and point-to-multipoint radio system supports up to 250 Mbps over sub-6 GHz bands, with dedicated bandwidth allocation per site and service reach of up to 120 km (74.5 miles)

## Products Included in this Solution:



**Megaplex**  
Next-Generation Multiservice Networking Node with Juniper vMX Module



**PowerFlow**  
Managed Ruggedized Ethernet Switch with Power over Ethernet



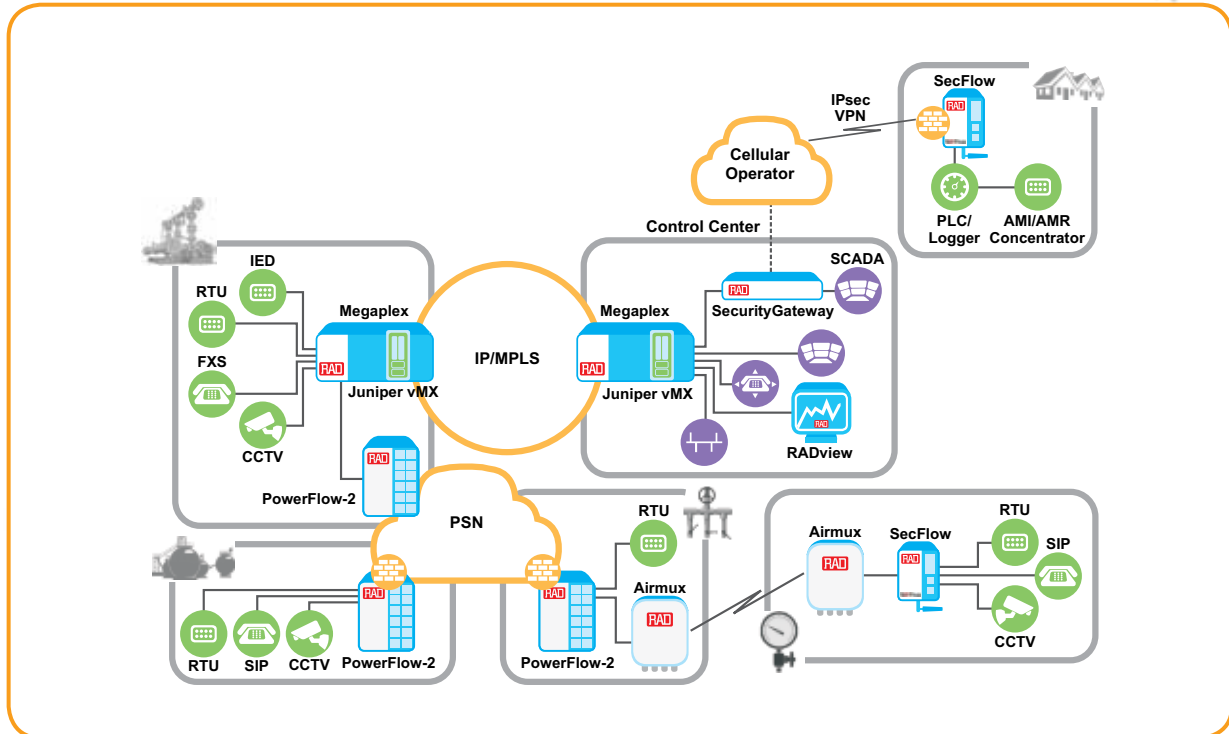
**SecFlow**  
Ruggedized SCADA-Aware Ethernet Switch/Router



**RADview**  
Management and Domain Orchestration



# Water Utility Communications



## Your Benefits:

- Cyber-secure SCADA connectivity for water monitoring and automation devices, sensors, pumps, surface and groundwater availability tracking devices, etc.
- Supports all communication needs, including SCADA protocols, voice and new packet services (CCTV, VoIP, etc.)
- Multiservice aggregation for any transport network, including SDH/SONET, IP/MPLS, MPLS-TP, CE and OTN/DWDM
- Supports any available media and connectivity option, including fiber, radio, 3G/4G cellular links, or leased lines from a local telco
- Distributed SCADA security suite with integrated firewall and encryption
- Point-to-point and point-to-multipoint radio system supports up to 750 Mbps over sub-6 GHz bands, with dedicated bandwidth allocation per site and service reach of up to 120 km (74.5 miles)
- Complies with environmental standards for outdoor installation in harsh conditions

## Products Included in this Solution:



**Megaplex**  
Next-Generation  
Multiservice Networking  
Node



**SecFlow**  
Ruggedized SCADA-Aware  
Ethernet Switch/Router



**Airmux**  
Point-to-Point and  
Point-to-Multipoint  
Broadband Wireless Access



**RADview**  
Management and Domain  
Orchestration





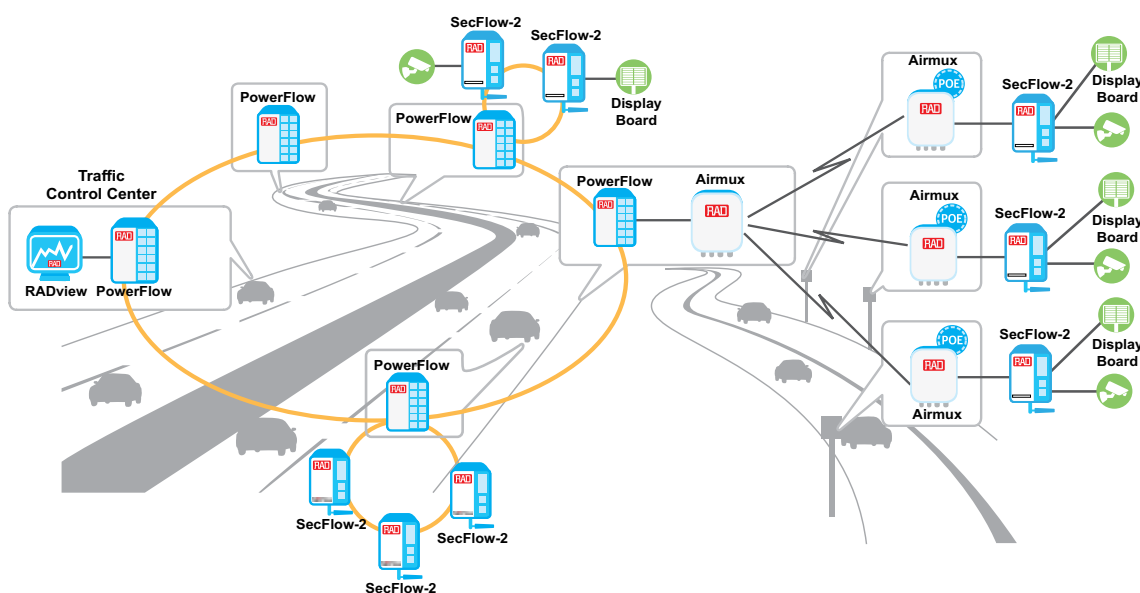


# Highway Communications



Cyber Security  
by RAD

See Page 7



## Your Benefits:

- Backhaul high-definition video feeds, roadside display board and billing station data from remote facilities over fiber, high throughput microwave PtP and PtMP radio links, and 10-GbE rings
- Enable outdoor installations with industrial design and ruggedized enclosures
- Extensive PoE support including PoE++ and Airmux PoE
- 10-GbE carrier-grade Ethernet core rings with traffic management capabilities ensure reliable connectivity with appropriate quality of service for various applications

## Products Included in this Solution:



**PowerFlow**  
Managed Ruggedized  
Ethernet Switch with  
Power over Ethernet



**SecFlow**  
Ruggedized SCADA-Aware  
Ethernet Switch/Router

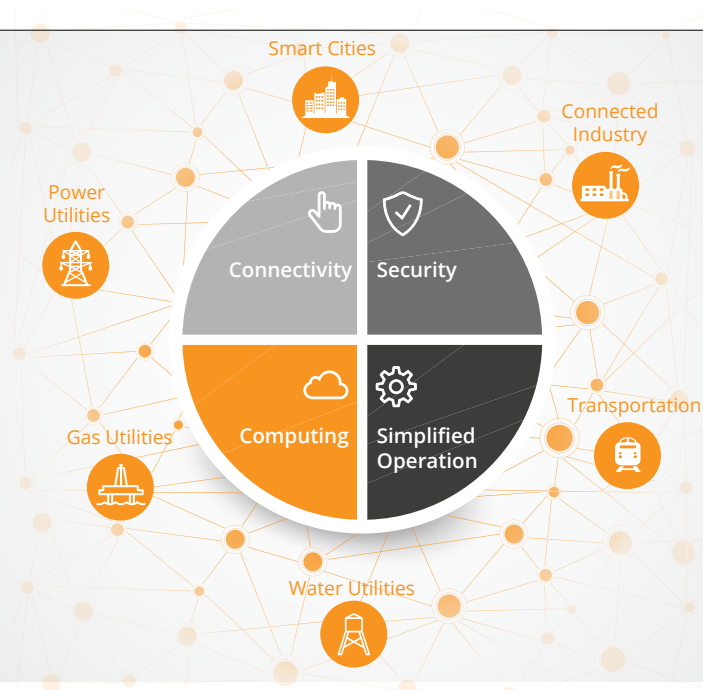


**Airmux**  
Point-to-Point and  
Point-to-Multipoint  
Broadband Wireless Access



**RADview**  
Management and Domain  
Orchestration





# Secure Industrial IoT with Edge Computing by RAD

**RAD offers a comprehensive solution for secure networking** for Smart Cities, Connected Industry, Smart Transportation, Smart Energy (generation, transmission and distribution), and more, to allow fast, secure and economical deployment of thousands of new remote IIoT sites with always-on reliability and mission-critical protection.

## Take Advantage of Edge Computing:

- Customize IIoT gateways for specific IIoT applications
- Reduce number of network devices
- Increase cyber security
- Independent and fast delivery of new, non-networking features



### SecFlow

Ruggedized SCADA-Aware Gateway/  
Switches and Routers



### SecurityGateway

VPN Aggregator, Router and Firewall



### RADview

Network Management, Firewall Configurator  
and Security Management (SIEM)

Visit [www.rad.com](http://www.rad.com) for more information



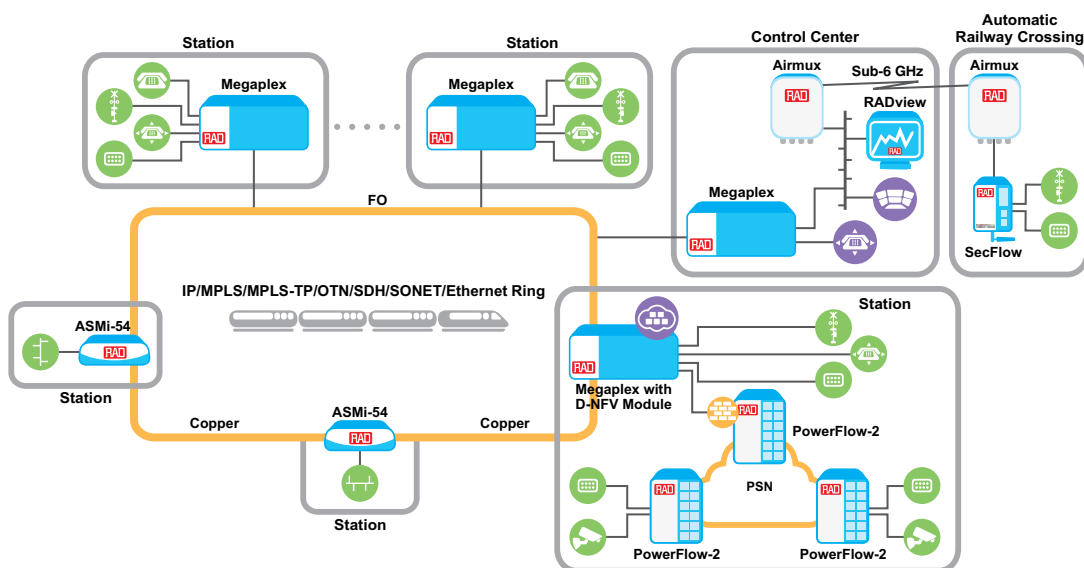
Your Network's Edge®



# Train and Metro Communications



## 1 Operational WAN for Trains and Metros



### Your Benefits:

- Ensure protected connectivity between stations and control room using multidrop and ring topologies
- Ethernet extension over fiber or copper (SHDSL) to enable service reach to remote M2M and video devices
- Support mission-critical railway applications, including automatic train supervision (ATS), centralized traffic control (CTC), SCADA, and multiparty hotlines, as well as passenger information systems (PISs)
- Support legacy TDM and Ethernet traffic delivery over SDH/SONET/IP/MPLS/MPLS-TP/CE/DWDM/OTN and/or carrier-grade fiber optic rings
- Supports analog and digital data and voice devices, as well as Ethernet IEDs, with versatile rates from RS-232 up to STM-64/OC-192 or 10 GbE
- Point-to-point and point-to-multipoint radio connectivity supports high capacity mission-critical traffic over licensed and unlicensed bands

### Products Included in this Solution:



**ASMi-54**  
SHDSL.bis Modems



**Megaplex**  
Next-Generation  
Multiservice Networking  
Node



**PowerFlow**  
Managed Ruggedized  
Ethernet Switch with  
Power over Ethernet

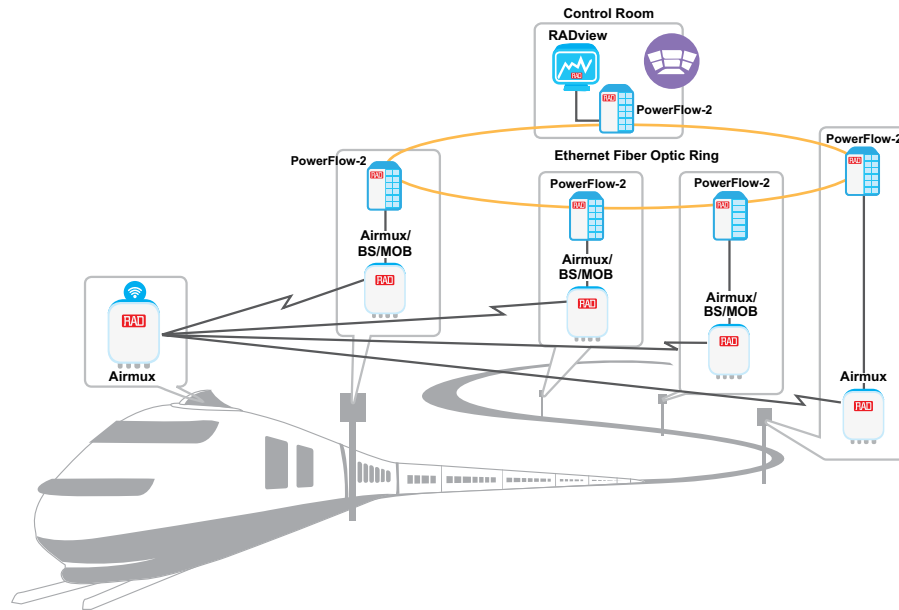


**RADview**  
Management and Domain  
Orchestration





## 2 Wireless Broadband Mobility for Trains and Metros



### Your Benefits:

- Supports bi-directional broadband connectivity for on-board video surveillance, infotainment and WiFi in moving vehicles using easy-to-deploy base stations and Ethernet access switches
- Guaranteed high capacity mobile video and data connectivity for ruggedized mobile units mounted on vehicles, trains and vessels at affordable total cost of ownership (TCO)
- Supports connectivity on moving vehicles at up to 300 km/h (186.4 mph)
- Up to 100 Mbps total throughput
- Seamless handover for real-time video streaming
- Reliable coverage over long distances in various terrains and topologies
- Best reliability and performance in metro and underground deployments
- 10-GbE carrier-grade Ethernet core rings ensure reliable connectivity with appropriate quality of service for various applications

### Products Included in this Solution:



**RADWIN**  
Mobile Wireless Access  
for Transportation  
Communications



**PowerFlow**  
Managed Ruggedized  
Ethernet Switch with  
Power over Ethernet



**RADview**  
Management and Domain  
Orchestration



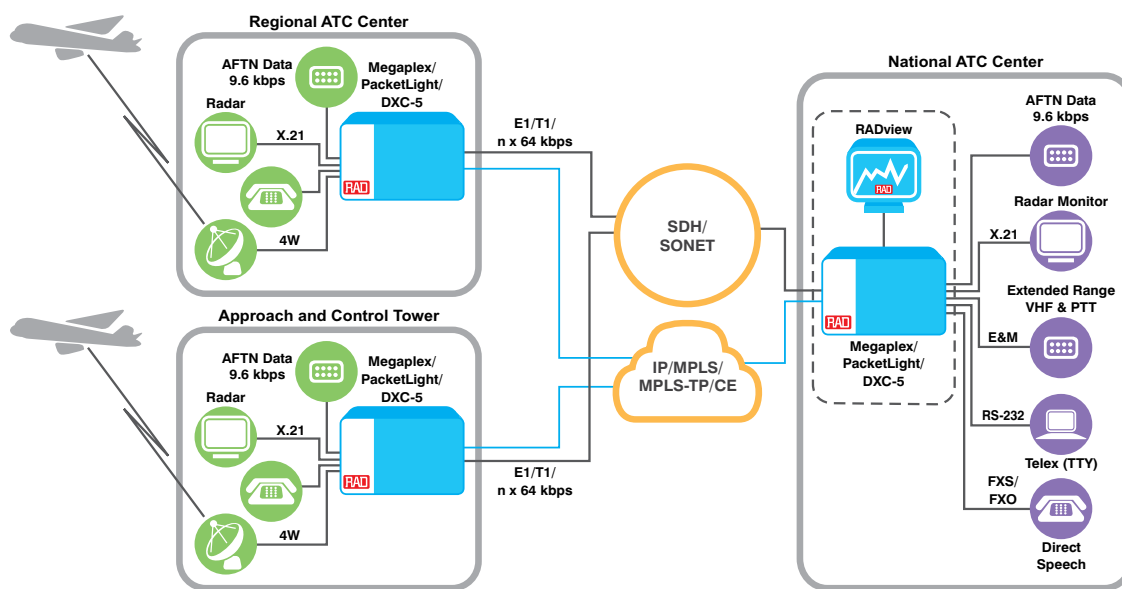




# Air-Traffic Control Communications



## 1 Multiservice Operational WAN for Air-Traffic Control



### Your Benefits:

- Ensure reliable, uninterrupted communications between different traffic control centers with RAD's multiservice connectivity solutions over any transport network, including SDH/SONET, IP/MPLS, MPLS-TP, CE, OTN, DWDM
- Deliver direct speech (DS), Telex (TTY), radar data (RD), extended range VHF (ER), and VHF data link (VDL) traffic, together with other voice, fax and LAN services, using industry-standard interfaces
- Transport traffic over copper, fiber, microwave, or satellite links
- Distributed SCADA security suite with integrated firewall and encryption
- Optimized for subrate leased line transmission and backup to reduce OpEx
- Ruggedized platforms withstand the rigors of field operations
- Support fail-safe operations with ISDN, VSAT and Ethernet backup

### Products Included in this Solution:



**Megaplex**  
Next-Generation  
Multiservice Networking  
Node



**DXC-5**  
High Capacity Hybrid  
Cross Connect



**PacketLight**  
Complete Solutions for  
WDM/OTN and Dark  
Fiber Applications



**RADview**  
Management and  
Domain Orchestration






**Cyber Security  
by RAD**

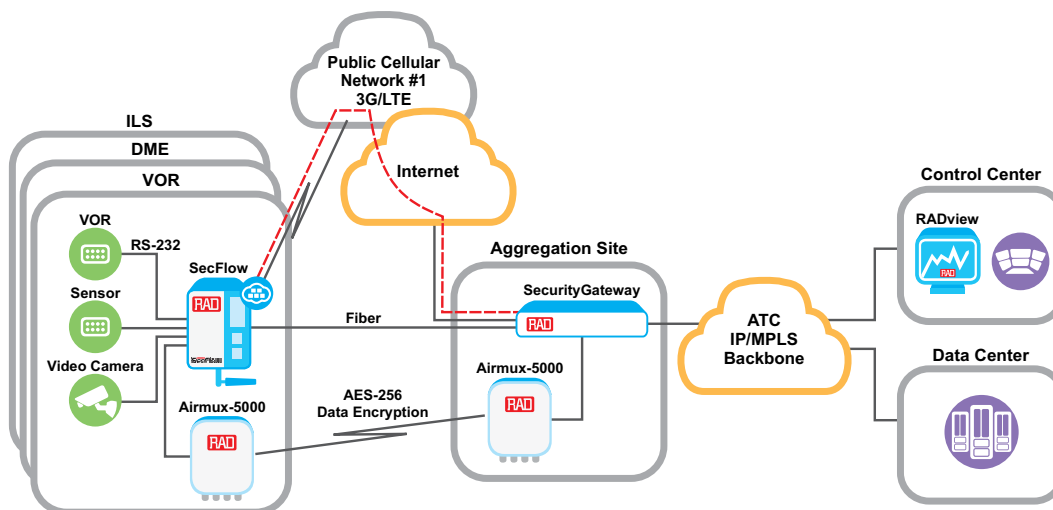
See Page 7



**Secure IIoT  
Edge Computing**

See Pages 8-9

## 2 Industrial IoT Backhaul for Remote Unmanned Sites



### Your Benefits:

- Ensure management and monitoring for unmanned ATC sites (VOR, DME, ILS)
- SCADA capabilities, dry contacts and serial tunneling
- Extensive PoE support for CCTV camera applications
- Zero-touch provisioning, enhanced cyber security (stateful firewall, SIEM)
- Seamless communications over fiber optics, radio links, 2G/3G/LTE cellular links and leased lines
- Integrated IPsec encryption with automated PKI support
- Transport traffic over copper, fiber, microwave, or satellite links
- Point-to-point and point-to-multipoint radio connectivity for high capacity mission-critical traffic over licensed and unlicensed bands
- Secure remote access for end-user device management

### Products Included in this Solution:



**SecFlow**  
Ruggedized SCADA-Aware Gateway with Edge Computing



**SecurityGateway**  
VPN Aggregator, Router and Firewall



**Airmux**  
Point-to-Point and Point-to-Multipoint Broadband Wireless Access



**RADview**  
Management and Domain Orchestration





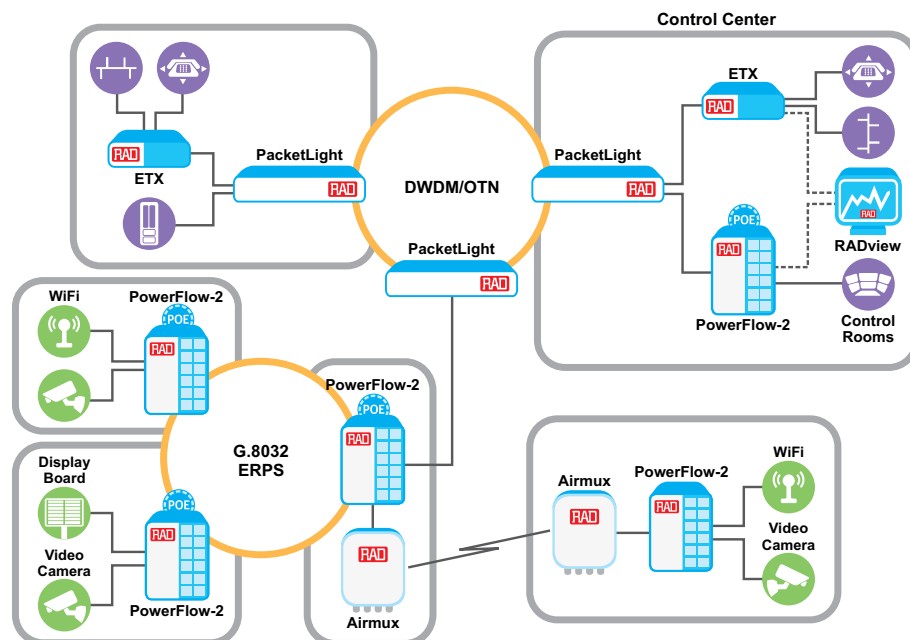
# Smart City Communications



Cyber Security  
by RAD

See Page 7

## 1 Operational WAN for Smart Cities



### Your Benefits:

- Provides a comprehensive solution for all Smart City communications
- Connect security cameras, WiFi access points, display boards, meter concentrators, and other sensors in urban and rural areas over fiber optics and wireless radios
- Central management to provision and control the communications network
- Long-distance fiber optic private network backbone with OTN/DWDM multi-tunneling at rates of up to 100G
- Secure connectivity over public/private networks
- Turnkey deployment solutions
- by RAD for Safe City and security projects, including consulting, communications, video surveillance and analytics systems, cameras, and sensors
- G.8032 Ethernet Ring Protection Switching (ERPS) and PoE support

### Products Included in this Solution:



**PacketLight**  
Complete Solutions for  
WDM/OTN and Dark  
Fiber Applications



**PowerFlow**  
Managed Ruggedized  
Ethernet Switch with  
Power over Ethernet



**Airmux**  
Point-to-Point and  
Point-to-Multipoint  
Broadband Wireless Access

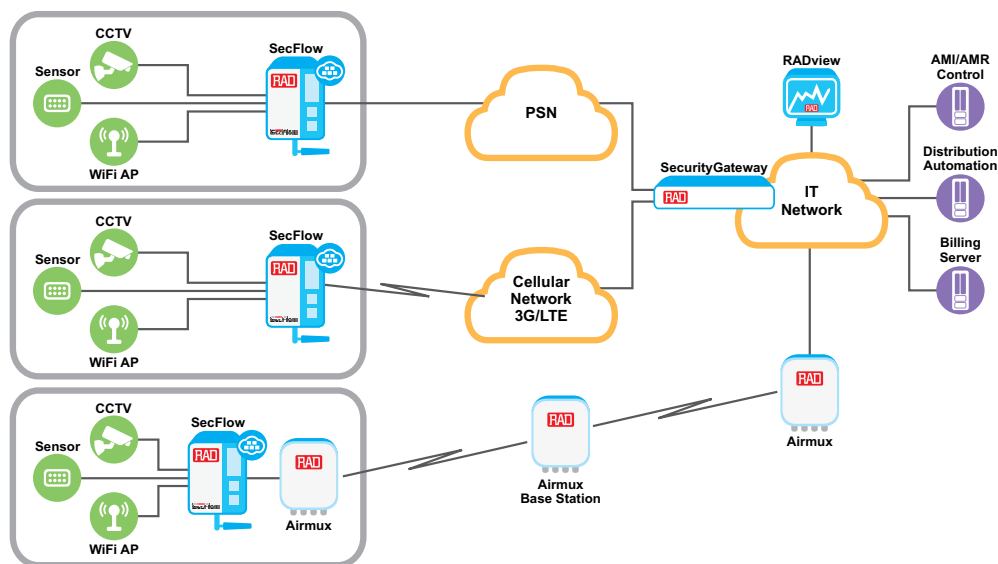


**RADview**  
Management and  
Domain Orchestration





## 2 Industrial IoT Backhaul for Smart Cities



### Your Benefits:

- A comprehensive communications solution for CCTV cameras, WiFi access points, sensors, payment kiosks, etc.
- Ruggedized devices for outdoor installations
- Virtual environment for user-tailored applications allows customers to add new applications on top of SecFlow devices
- Seamless communications over fiber optics, radio links, 2G/3G/LTE cellular links, and leased lines
- Integrated IPsec encryption
- Zero-touch provisioning with enhanced cyber security (stateful firewall, SIEM)
- Secure remote access for end-user device management
- Transparent delivery of legacy traffic from serial-based devices
- M2M protocol gateway
- Point-to-multipoint radio connectivity supports high capacity mission-critical traffic over licensed and unlicensed sub-6 GHz bands

### Products Included in this Solution:



**SecFlow**  
Ruggedized SCADA-Aware  
Gateway with Edge Computing



**SecurityGateway**  
VPN Aggregator, Router  
and Firewall



**Airmux**  
Point-to-Point and  
Point-to-Multipoint  
Broadband Wireless Access



**RADview**  
Management and  
Domain Orchestration





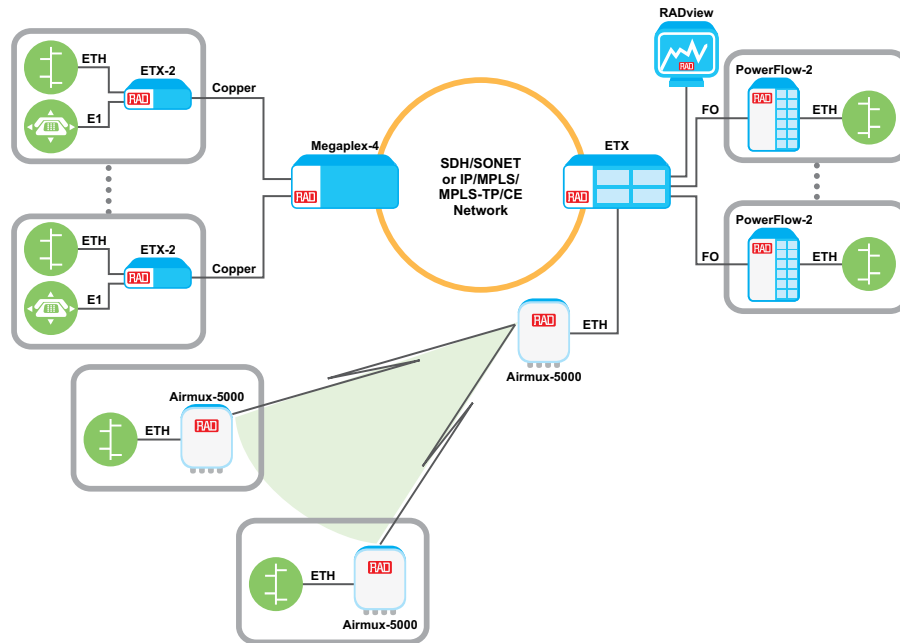


## First Responders and Military Communications



Cyber Security  
by RAD

See Page 7



### Your Benefits:

- Connect a privately owned government/military/public network to remote sites using diverse infrastructure
- Support multiple services, including Ethernet, TDM and low speed data, using the same device
- Utilize existing SDH/SONET network or build a state-of-the-art IP/MPLS, MPLS-TP, CE backbone

### Products Included in this Solution:



**Airmux-5000**  
Point-to-Multipoint  
Broadband Wireless  
Access



**ETX-2/ETX-2i**  
IP and Carrier Ethernet  
Demarcation with D-NFV



**PowerFlow**  
Managed Ruggedized  
Ethernet Switch with  
Power over Ethernet



**RADview**  
Management and Domain  
Orchestration





# RAD Products



# Virtualized Network Functions

## by RAD

RAD's comprehensive vCPE Toolbox includes, among others, a range of virtualized network functions (VNFs) that are pre-tested and integrated in RAD's platforms. Some of these VNFs include the vSD-WAN VNF that applies software-defined networking (SDN) to WAN connections; vRouter, which applies routing and security gateway functionality to WAN connections for IP-based business services; and vEncryption – performing Layer 2 encryption of user traffic for point-to-point and multipoint vCPE-based services.

The vAccess manages RAD's pluggable PNFs and provides carrier-grade capabilities to white boxes. Additional VNFs are available via RAD's D-NFV Alliance (see page 6 for more details).

### vRouter

Virtualized Router Function for IP-Based Business Services



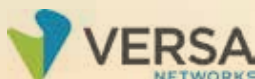
Hot Product

The vRouter is a virtual WAN router for service providers, allowing IP connectivity to the office branch over any IP transport. vRouter is part of RAD's vCPE Toolbox, offering efficient, cost-effective business gateway functionality as part of VPN, cloud and internet access services.

- IPv4/v6 routing
- Multiple routing protocols (OSPF, BGP, etc.)
- DHCP, NAT and NAT Traversal
- VPN support with IPsec tunneling
- IKE/PKI support for authentication
- Secure management with SNMP, CLI and NETCONF

### vSD-WAN

Virtualized Networking Function for SD-WAN-Based Business Services by Versa Networks



Hot Product

The vSD-WAN by Versa Networks is a virtualized network function (VNF) that applies software-defined networking (SDN) to WAN connections. Featuring both networking and security functions in a single software, it is used to connect enterprise branch offices and data centers at a lower cost compared to IP VPNs. vSD-WAN offers multi-tenancy and high availability to optimize cost/performance of end-customer services. It features distributed network service functions to provide the flexibility and elasticity for easy, highly scalable and secure deployments. In addition, self-provision and self-care capabilities transform the customer experience. vSD-WAN is part of RAD's vCPE Toolbox. It can be hosted as a VNF on RAD's vCPE-OS and deployed with any ETX platform, as well as any supporting white box. This allows service providers to expand their managed services portfolio with a simplified and unified architecture.

- Zero-touch provisioning
- Multi-tenant support
- Application awareness, QoS
- Flexible deployment options: bare metal, gray box and VNF
- Advanced routing: VRRP, IPAM, OSPF/BGP/MP-BGP/PBR, segment routing, MPLS L3 VPN and L2 VPN, QoS
- Security capabilities with UTM: stateful firewall, DDoS prevention, malware protection, IPS-IDS, IPsec, antivirus, user and group authentication, URL and file filtering
- Visibility and analytics
- WAN optimization

**vFirewall**

Virtualized Firewall  
Function for IP-Based  
Business Services

Hot Product



The vFirewall is a virtualized network function (VNF) that applies enhanced security and routing functionality to the office branch's WAN connections. Featuring both networking and security functions in a single software, it is used to address all WAN connectivity requirements of a business branch, providing VPN or internet access services. vFirewall is part of RAD's vCPE Toolbox and available with all ETX-2i and ETX-2v platforms, allowing service providers to expand their managed services portfolio with a simplified and unified architecture.

- Stateful packet filtering firewall or pure router
- Intrusion prevention
- DoS attack mitigation
- IPv4/v6 routing
- Static, dynamic, or policy-based routing
- VPN support with IPsec, OpenVPN and NAT
- DHCP, DNS and NAT support

**vEncryption**

Virtualized Network  
Encryption Function for  
vCPE-Based Services by  
Senetas

Hot Product



The vEncryption virtualized network function (VNF) by Senetas is a data encryption software running on RAD's vCPE-OS operating system within the ETX-2i and ETX-2v white box and vCPE platforms, as well as other KVM-based virtualization platforms. It provides extremely tight protection for data transmitted across high speed networks.

The virtualized encryptor operates at the data link layer (Layer 2), masking the payload of received network traffic. The headers are left unencrypted to ensure traffic forwarding through the network remains unchanged. The vEncryption VNF can be used in both point-to-point and multipoint topologies for transport services such as:

- Dark fiber
- CWDM/DWDM
- Layer 2 MPLS (VPLS)
- Carrier Ethernet MEF services – E-LAN, E-Line, E-Tree
- Ethernet pseudowire
- Ethernet Virtual Private Line (EVPL)
- Local Area Networks (LAN)
- Internal server interconnects

**vAccess**  
Pluggable PNF  
Management

Hot Product



Part of RAD's vCPE Toolbox, vAccess is a state-of-the-art virtualized network function (VNF). It provides control and management for RAD's pluggable PNFs, as well as additional data-plane functionalities and service assurance capabilities.

vAccess upgrades any white box to a carrier-grade level with the following functions:

- Packet over TDM (E1/T1/E3/T3)
  - PPP and MLPPP in a vCPE environment
- Control and management of RAD's pluggable devices
- Active measurement and reporting of VNF connectivity, performance and delay/delay variation (PDV):
  - Supports performance monitoring for SLA compliance of the service function chain
  - Detects and reports VNF freeze and performance degradation to ensure fast resolution



## • A

**Airmux-400**

Point-to-Point Broadband  
Wireless Access



RAD's Airmux-400 series of point-to-point broadband wireless radios delivers native Ethernet and TDM services over a single wireless link in various sub-6 GHz frequencies. The various high capacity Airmux-400 radio systems provide aggregated throughput of up to 750 Mbps and a range of up to 120 km (75 miles).

The Airmux-400 incorporates advanced features, such as MIMO and OFDM for optimal performance and unmatched robustness in all environments, making it ideal for:

- Cellular, WiMAX and ISP backhaul
- Broadband access
- Private networks

- **Multi-band operations over 2.3 GHz, 2.4 GHz, 2.5 to 2.7 GHz, 3.5 GHz, and 4.9 to 6 GHz in a single device**
- **5 MHz, 10 MHz, 20 MHz, 40 MHz, or 80 MHz channel bandwidth**
- **TDM over packet integration for TDM service support**
- **Net throughput (aggregated):**
  - Airmux-400H: up to 750 Mbps
  - Airmux-400P: up to 250 Mbps
  - Airmux-400A: up to 350 Mbps
  - Airmux-400SP: up to 25 Mbps
- **OFDM, MIMO and antenna diversity capabilities**
- **Extended range – up to 120 km (75 miles)**
- **Hub-site synchronization (HSS) supports simultaneous transmission from up to 16 co-located Airmux-400 and/or Airmux-5000 units**
- **Ring protection link (RPL) for Ethernet resiliency**
- **Spectral power measurement and RF survey tool – “Spectrum View” – for quick and easy installation**

**Airmux-5000**

Point-to-Multipoint  
Broadband Wireless  
Access



Hot Product

RAD's Airmux-5000 point-to-multipoint broadband wireless radios are the ideal wireless solution for business users demanding high capacity throughput with dedicated traffic bandwidth allocation and service level agreement (SLA) per subscriber. Featuring up to 750 Mbps aggregated sector capacity and a range of up to 40 km (25 miles), a single Airmux-5000 base station supports up to 64 remote subscriber units (SUs) with multi-band operation, making it ideal for:

- Service providers and ISPs, offering IP backhaul and 4G/broadband access for remote, rural and underserved communities
- Private networks requiring high capacity inter-branch connectivity for university campuses, healthcare organizations, government institutions, large enterprises and public establishments
- Security and surveillance applications requiring aggregation and backhaul of traffic from multiple colocated HD cameras
- **Multi-band operations over 2.3 GHz, 2.4 GHz, 2.5 – 2.7 GHz, 3.3 – 3.8 GHz and 4.9 – 6.4 GHz in a single device**
- **Up to 750 Mbps aggregated throughput per sector**
- **Up to 64 remote subscriber units per sector with aggregated throughput of 5, 10, 20, 25, 50, and 100 Mbps**
- **Supports fixed and nomadic applications**
- **Airmux-5000i with beamforming antenna**
- **5 MHz, 10 MHz, 20 MHz, or 40 MHz channel bandwidth**
- **OFDM, MIMO and antenna diversity capabilities**
- **Range up to 40 km (25 miles)**
- **Intra- and inter-site TDD synchronization using hub-site synchronization (HSS) and GPS**
- **Low constant latency – typically 4 to 10 msec in full sector load**

## ASMi-54 Family

### SHDSL.bis Modems



The ASMi-54 line includes the multi-port ASMi-54 advanced SHDSL.bis modem and the cost-effective ASMi-54L SHDSL.bis modem. The devices support point-to-point and hub-and-spoke connectivity as well as drop-and-insert (daisy chain) and ring topologies over copper and fiber.

The managed SHDSL.bis modems extend E1 and mid-band Ethernet services over multipair-bonded copper links. Ensuring reliable performance over poor quality or noisy lines, the devices employ next-generation SHDSL technology and EFM bonding to achieve variable data rates of up to 22.8 Mbps. The ASMi-54 family is ideal for service providers, mobile operators, enterprises, utilities, and transportation companies. The devices feature a compact, half 19-inch enclosure, with optional rail-mountable metal enclosure for deployment in extreme temperature environments.

- Up to four Fast Ethernet ports with an integrated switch; optional one (ASMi-54L) or four (ASMi-54) E1 interfaces
- ITU-T G.991.2, ETSI 101524; TC-PAM 16 or TC-PAM 32
- ASMi-54: up to 22.8 Mbps over 8-wire (4 pairs)
- ASMi-54L: up to 11.4 Mbps over 4-wire (2 pairs), 5.7 Mbps over 2-wire (1 pair), or up to 30 Mbps over 4-wire using RAD's high performance SHDSL technology
- EFM bonding per IEEE 802.3-2005;
- M-Pair bonding for HDLC
- VLAN prioritization, rate limitation per port and Ethernet QoS support; Ethernet OAM per IEEE 802.3-2005 (formerly 802.3ah)
- Managed via SNMP, Telnet and ASCII terminal

## Ceragon FibeAir IP-20

### Wireless Transport Platform



**CERAGON**

Ceragon's wireless transport platform accommodates various needs in different scenarios while maintaining availability and security at the highest standards.

The FibeAir IP-20 platform meets any critical infrastructure wireless transport need, of any scale, in any topology and at any frequency, combined with an advanced security feature set and low-latency performance.

The FibeAir IP-20 comes in all-outdoor, split-mount and all-indoor configurations supporting 6.86 GHz frequency range.

#### FibeAir IP-20C:

- Double wireless backhaul capacity via remote activation of another radio carrier with no site visits required
- Provides the highest radio capacity and spectral efficiency in any condition and any frequency channel size (up to 80/112 MHz)
- Field-proven LoS MIMO 4x4 technology – enabling 1-Gbps radio capacity over a single 30-MHz channel or 2 Gbps over a single 60 MHz

#### FibeAir IP-20E:

- Provides ultra-high radio capacity and spectral efficiency of up to 2.5 Gbps over a 500-MHz channel
- Minimizes your sites' physical footprint with an integrated flat panel antenna

#### FibeAir IP-20S:

- Compact, all-outdoor wireless backhaul node that is optimized for simple installation and operation
- Operates within the entire microwave spectrum (6 – 42 GHz)

## • D/E

**DXC-5**High Capacity Hybrid  
Cross Connect

Hot Product



RAD's DXC-5 enables a seamless migration to next-generation operational networks. It provides multiservice, high capacity core and edge aggregation over TDM, hybrid and all-packet transport. The DXC-5 reduces operational costs by using a single platform for all service requirements. Critical infrastructure network operators choose the DXC-5 as it coexists with legacy cross connects, then seamlessly replaces them when they reach end-of-life status, allowing the addition of new services and bandwidth capacity. DXC-5's transport flexibility ensures that services are matched to the best technology to meet their requirements. By performing service multiplexing over packet and DS1-level TDM switching in the same device, it reduces the transport cost per bit and ensures mission-critical reliability with minimal latency.

- High density Ethernet/SDH/SONET platform available in 2U- and 5U-high form factors
- High capacity: from E1/T1 to STM-64/OC-192, 10 GbE with a variety of connectivity options including Carrier Ethernet and PDH/SDH/SONET
- Non-blocking SDH/SONET switch capabilities
- TDM circuit emulation
- Carrier Ethernet 2.0-certified including Ethernet OAM, QoS
- Sub-50 ms protection: 1:1, 1+1 APS, BLSR, PW, ERPS, LAG
- Synchronization: BITS, Sync-E, ACR

**Egate-100**Gigabit Ethernet over TDM  
Aggregation Gateway

RAD's Egate-100 Gigabit Ethernet over TDM gateway transports Gigabit Ethernet traffic over channelized STM-1/OC-3 or over three DS3 lines. It leverages widely available PDH/SDH/SONET networks to deliver carrier-class Ethernet Private Line (EPL) services at granular rates, from a fractional E1/T1 to bonded n x E1/T1 channels. The Egate-100 supports NG-PDH encapsulation and bonding standards, such as generic framing procedure (GFP), virtual concatenation (VCAT) and link capacity adjustment scheme (LCAS).

The Egate-100 Gigabit Ethernet over TDM gateway is typically deployed in a central location to aggregate Ethernet user traffic received from a large number of remote units, such as RAD's RICi Ethernet demarcation devices, providing a complete access solution from the service provider's central site to the customer premises.

- Supports MLPPP, as well as GFP (G.8040, G.7041/Y.1303), VCAT (G.7043) and LCAS (G.7042) standards
- MEF-certified for EPL services per MEF-9 specifications
- Ethernet OAM per IEEE 802.3-2005 (formerly 802.3ah)
- Four priority queues per VLAN priority (802.1p), DSCP and IP Precedence; traffic policing per flow and per EVC.CoS
- Gigabit Ethernet and STM-1/OC-3 port protection
- Secure Telnet and web applications, SNMPv3 and RADIUS
- NEBS-compliant
- Optimized for IP DSLAMs and WiMAX base station backhaul applications



**ETX-2i**

IP and Carrier Ethernet  
Demarcation with D-NFV

Hot Product



Part of RAD's Service Assured Access solutions, the ETX-2i line of next-generation NID/NTUs offers advanced demarcation for SLA-based, L2 and L3 business services, wholesale services and mobile backhaul. The ETX-2i is MEF Carrier Ethernet 2.0-certified and offers a complete service life-cycle toolset.

The ETX-2i also serves as a Universal CPE (uCPE) Whitebox+, which enhances a pluggable x86 server module with physical network functions (PNFs) to enable superior performance for vCPE applications. It is supported by RADview management and orchestration.

• **ETX-2i: IP and Carrier Ethernet  
Demarcation Device with D-NFV**



Available as a modular demarcation device, the ETX-2i enables operators to deliver the most advanced Carrier Ethernet services, IP VPNs and vCPE functionalities over any network connection. In addition, the ETX-2i combines advanced timing functionalities for LTE/LTE-A.

- Up to eight GbE combo ports
- Integrated wire-speed switch/router
- Modular network interfaces: FE/GbE (combo), E1/T1, T3, VDSL2, or SHDSL
- Flexible synchronization offering Sync-E, IEEE 1588v2 slave, BC and TC for frequency and phase synchronization in mobile networks
- Hot-pluggable x86 D-NFV server module for hosting virtual functions
- NEBS-compliant and environmentally hardened enclosure options
- 3U device with six GbE combo ports and 64 x E1/T1, offering high scale, cost-effective TDM over packet services

• **ETX-2i-B: IP and Carrier Ethernet  
Demarcation Device with D-NFV  
for SMBs**



ETX-2i-B is a demarcation device optimized for remote branches and SMBs over native Ethernet access. It is ideal for carriers, service providers, and wholesale operators requiring advanced Ethernet L2/L3 functionality at customer premises and multi-tenant units (MTUs).

- 1U device with up to 10 GbE ports
- Fan-less 2U device with 10 GbE ports, ideal for cost-effective small-cell aggregation
- Integrated 6-Gbps switch/router
- Pluggable x86 D-NFV server module for hosting virtual functions (1U device)

• **ETX-2i-10G: 10G Carrier Ethernet  
Demarcation/Aggregation Device**



The ETX-2i-10G combines intelligent, high bandwidth demarcation and aggregation capabilities for enterprise headquarters and mobile backhaul operators. As an aggregation solution at the concentration point, a single unit can support numerous services and concurrent OAM sessions.

- 19" unit with up to four 10-GbE and up to 24 GbE ports in various combinations
- Half-19" unit with up to four 10-GbE and up to eight GbE ports in various combinations
- Flexible synchronization offering Sync-E, IEEE 1588v2 slave, BC and TC for frequency and phase synchronization in mobile networks
- ITU-T G.8032 Ethernet Ring Protection Switching
- NEBS-compliant and environmentally hardened enclosure options

## • E

- **ETX-2i-100G: 100 GbE Carrier Ethernet Demarcation Device**

Hot Product



ETX-2i-100G delivers the full suite of Carrier Ethernet demarcation and aggregation capabilities, at 100 GbE rates. ETX-2i-100G addresses the increasing demand for high bandwidth access to data centers, while maintaining MEF CE 2.0 SLAs, service monitoring, flexibility and management.

- **19", 1U with redundant power supply**
- **Three 100-GbE (QSFP28) interfaces and 10 1/10-GbE SFP+ ports**
- **Advanced QoS with hierarchical policing and bandwidth shaping per EVC and EVC.CoS**
- **Accurate and scalable hardware-based OAM and performance monitoring per ITU-T Y.1731 and TWAMP**
- **Y.1564 service activation testing at wire-speed**

## ETX-2i vCPE Applications



The ETX-2i products feature an x86-based D-NFV module for hosting virtual functions (VFs) and applications. The D-NFV module runs on vCPE-OS, which includes standard KVM hypervisor and OpenStack compute node to support third-party applications. RADview Domain Orchestrator enables easy VF download.

Supported applications include:

**SD-WAN**

Software-defined control of WAN connections with secure overlay tunnels for business services

**Router**

Virtual router for hosted public clouds and branch CPE deployments

**Cryptography**

Standard AES 256-bit cipher encryption/decryption of L2-L4 traffic

**Firewall**

Unified threat management for provider-managed SMB services

**Session Border Controller (SBC)**

Manages VoIP signaling and media flows

**Packet Analyzer**

Troubleshooting on demand from the customer edge using a packet sniffer VF

**WAN Optimization**

Eliminates content duplication, handles compression and optimizes latency

**Contact your local RAD distributor for additional/new application information.**



## ETX-2

### Carrier Ethernet Demarcation



Hot Product

The ETX-2 line of Carrier Ethernet NID/NTUs offers demarcation for SLA-based business services, wholesale services and mobile backhaul. The ETX-2 is MEF Carrier Ethernet 2.0-certified for E-Line, E-LAN, E-Tree, and E-Access services, as well as delivering TDM pseudowire over packet networks. Supporting high capacity service provisioning per EVC/EVC.CoS, flexible classification and H-QoS traffic management, it also performs accurate and scalable service testing and performance monitoring. The ETX-2 is supported by RADview management and enables a variety of protection mechanisms. It also offers NEBS-compliant and environmentally hardened enclosure options.

## • ETX-203AX: Carrier Ethernet Demarcation Device



ETX-203AX is ideal for carriers, service providers, and wholesale operators requiring advanced Ethernet functionality at customer premises and multi-tenant units (MTUs).

- Six FE/GbE ports; flexible selection of SFP and copper interfaces
- Optional E1 network port for cost-effective Ethernet over PDH services
- Optional SHDSL network port
- for cost-effective Ethernet over SHDSL service
- Optional LTE modem for management and backup of EVC services over cellular network
- Wide-range AC/DC power supply

## • ETX-203AX-T: Carrier Ethernet Device with LTE/Broadband Connectivity



ETX-203AX-T extends Ethernet VPN services to new, out-of-reach locations allowing rapid site commissioning by using readily available LTE or broadband networks. The ETX-203AX-T enables cost-effective Ethernet VPN services backup using LTE or broadband. Additional cost optimization can be achieved by splitting traffic between a service-assured VPN and best-effort LTE or broadband access.

- Five FE/GbE ports with flexible selection of SFP and copper interfaces
- Optional built-in LTE modem with global service coverage
- Secure EVC tunneling over private IP/LTE networks or over the internet
- Full suite of MEF CE-2.0 capabilities for SLA monitoring, diagnostics and fault detection
- Data and management protection using LTE or broadband
- Integrated wide-range AC/DC power supply

## • ETX-203AM: Universal Carrier Ethernet Demarcation Device



Available as a modular demarcation device, the ETX-203AM enables operators to deliver Carrier Ethernet services and L2 VPNs over any network connection.

- Four FE/GbE user ports
- Modular network interfaces: FE/GbE (combo), E1/T1, T3, VDSL, or SHDSL

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### • ETX-205A: Carrier Ethernet/ Mobile Demarcation Device



The ETX-205A provides advanced Carrier Ethernet demarcation and offers combo interfaces and power supply redundancy. For LTE/LTE-A mobile backhaul, the ETX-205A is installed at cellular tower and controller sites to guarantee differentiated SLAs.

- L2 VPN service demarcation with superior traffic management and monitoring capabilities
- Flexible synchronization offering Sync-E, IEEE 1588v2 slave, BC and TC for frequency and phase synchronization in mobile networks
- Distributed Grandmaster architecture integrating built-in GPS receiver with IEEE 1588v2 Grandmaster functionality for cost-optimized LTE deployments
- E1/T1 pseudowire services per MEF-8, UDP/IP, MPLS static labeling in SAToP and CESoP modes, and with CAS

### • ETX-220A: 10G Carrier Ethernet Demarcation/Aggregation Device



The ETX-220A combines intelligent demarcation and aggregation capabilities to deliver SLA-based Carrier Ethernet services for enterprise and carrier-to-carrier E-Access applications.

- Up to four 10-GbE ports and up to 20 x 1-GbE ports in various combinations
- Flexible synchronization offering Sync-E, IEEE 1588v2 slave, BC and TC for frequency and phase synchronization in mobile networks

### ETX-2p

Physical CPE for Branch Routing and Edge Access to Centralized Virtualization

Hot Product



ETX-2p combines multiservice routing, Ethernet access and centralized virtualization capabilities to provide service-assured WAN communications for distributed branches. Featuring powerful networking capabilities and rich management interfaces, it is an ideal solution for on-net service provider VPNs, off-net public IP and hybrid networks. ETX-2p easily integrates with standards-based SDN controllers, orchestrators and operations/business support systems (OSS/BSS).

- Linux-based, carrier-class pCPE with open management interfaces
- IPv4/IPv6 routing and tunneling for overlay and underlay transport
- Comprehensive management suite, including NETCONF/YANG, CLI, Syslog, and alarms
- On-net and off-net zero-touch provisioning (ZTP)
- Advanced performance monitoring and diagnostics: TWAMP, ICMP Echo, UDP Echo and fault propagation
- Advanced security features include SNMPv3, SSH, SFTP, Access Control, 5-level user authentication, IPsec, X.509, TACACS+, RADIUS
- Ubiquitous service look and feel over any access supported by RAD's plugware

**ETX-2v**

Open vCPE White Box Platform

Hot Product



The ETX-2v includes a line of carrier-grade white boxes installed at the customer premises – either at headquarters or in remote branch sites. The ETX-2V products support a wide range of business customers and user scenarios, from small offices to large sites, using a variety of bandwidth, processing power and LAN/WAN options.

- White box appliances for virtual CPE, SD-WAN and NFV featuring powerful x86 processors
- Hardware-based security featuring a Trusted Platform Module (TPM)
- Flexible SFP/UTP connectivity with optional interfaces including: LTE, WiFi, VDSL, GPON, ETHoPDH, PWE, and more
- Supports a range of x86 CPU technologies (Rangeley, Denverton and XEON-D), with flexible multi-core options
- Various memory (RAM, SSD) size options
- Intel QuickAssist technology – authentication, encryption, etc.
- SRIOV-capable ports to enhance throughput
- Fan-less, low power (~ 7W) options reduce carbon footprint
- Rack-mount and desktop options

## ETX-2v vCPE Applications



The ETX-2v products feature an x86-based platform for hosting virtual functions (VFs) and applications. The D-NFV module runs on vCPE-OS, which includes standard KVM hypervisor and OpenStack compute node to support third-party applications. RADview Domain Orchestrator enables easy VF download.

Supported applications include:

**SD-WAN**

Software-defined control of WAN connections with secure overlay tunnels for business services

**Router**

Virtual router for hosted public clouds and branch CPE deployments

**Cryptography**

Standard AES 256-bit cipher encryption/decryption of L2-L4 traffic

**Firewall**

Unified threat management for provider-managed SMB services

**Session Border Controller (SBC)**

Manages VoIP signaling and media flows

**Packet Analyzer**

Troubleshooting on demand from the customer edge using a packet sniffer VF

**WAN Optimization**

Eliminates content duplication, handles compression and optimizes latency

**Contact your local RAD distributor for additional/new application information.**

## • E/F

**ETX-5**

Ethernet Service  
Aggregation Platform



The ETX-5 is a leading CE 2.0 access aggregation switch, successfully deployed worldwide in many large networks. It delivers aggregated Ethernet and TDM pseudowire traffic from the access network to the PE (provider edge) over 10-GbE links. Part of RAD's Service Assured solutions for service providers and critical infrastructure, the ETX-5 is ideal for first-level aggregation at the POP, E-NNI inter-carrier demarcation and as a pseudowire gateway for seamless migration to packet networks.

For an enhanced user experience, the ETX-5 is supported by the new RADview management and orchestration system, featuring an intuitive UI/UX to simplify configuration and enable zero-touch service provisioning end-to-end. The ETX-5 is Carrier Ethernet 2.0-certified and includes an extensive toolset to deliver and manage SLA-based services.

- **MEF Carrier Ethernet 2.0-certified:**  
E-Line, E-LAN, E-Tree services,  
E-Access; MEF-8;  
MEF-22: mobile backhaul;  
MEF-26: E-NNI
- **Ethernet Ring Protection  
Switching:** ITU-T G.8032v2;  
supports 40-GbE ring over LAG,  
virtual rings
- **Extensive TDM pseudowire  
support:** CESoPSN, SAToP,  
CESoETH (MEF-8), UDP/IP  
encapsulation
- **Ethernet OAM termination and  
grooming;** ITU-T Y.1564 generator/  
responder
- **16 x 10-GbE network/user ports;  
80 x 1-GbE ports; 16 channelized  
STM-1/OC-3 user/network  
ports; four channelized STM-4/  
OC-12 user/network ports with  
redundancy**
- **Fully redundant, modular system  
designed for high availability**
- **Supported by RADview  
Service Manager and RADview  
Performance Monitoring portal**
- **AC or DC power feed redundancy;  
NEBS-compliant industrial-grade  
enclosure withstands extended  
temperature range**

**FCD-155E**

Ethernet over SDH/SONET ADM



The FCD-155E transports Ethernet traffic over SDH or SONET networks, enabling carriers and service providers to provide LAN connectivity and internet access while continuing to support E1, T1, E3, or T3 traffic. Installed at the customer site, or used as an add/drop multiplexer on the SDH/SONET ring, this device improves bandwidth efficiency by supporting Ethernet over SDH/SONET encapsulation and framing to enable IP channel bandwidth configuration in increments up to 100 Mbps wire-speed.

The FCD-155E is widely deployed by carriers and service providers to leverage their optical bandwidth for revenue-generating Ethernet services, while enterprises, utilities and campuses use it to provide LAN services over existing fiber optic infrastructure.

- **Standard next-generation STM-1/  
OC-3 ADM utilizing GFP, VCAT, LCAS**
- **Grooms Ethernet and E1/T1/E3/T3  
traffic over STM-1/OC-3 fiber**
- **Multiservice functionality in the  
same box:**
  - Two or six 10/100BaseT ports
  - Up to 21 x E1/28 x T1 ports, one  
E3/DS3 port
- **SFP-based uplinks**
- **Optional dual power supply  
configuration**
- **Advanced management option  
including DCC and IP tunneling**
- **Available with standard protection  
on the main link**
- **Compact size**

**FCD-IP**

E1/T1 Access Unit with  
Integrated Router



RAD's FCD-IP access unit with integrated router is an E1/T1 or fractional E1/T1 access device that enables service providers to bundle data, voice and IP access services over a single E1 or T1 access line. It supports WAN services such as E1 or T1, Frame Relay with auto-learn and ISDN BRI for data backup. An integrated router supports IP routing and transparent bridging.

The FCD-IP is an ideal solution for small to medium-size companies requiring voice and data connectivity and internet access via low rate TDM lines.

- One or two independent Ethernet ports or an integrated four-port switch (10/100BaseT)
- Data interfaces: V.35, RS-530, V.36/RS-449, V.24, X.21
- Three optional sub-E1/T1 ports or four analog ports (FXS, FXO, E&M) for PBX/phone connectivity
- IP/IPX routing and transparent bridging; OSPF support
- Supports Frame Relay (RFC 1490) and PPP protocols
- Self-healing ring and drop-and-insert capabilities
- Fail-safe sub-E1/T1 ensures uninterrupted service
- Dial backup over PSTN

**IPmux-2L**

TDM Pseudowire Access  
Gateway



The IPmux-2L is a cost-effective TDM pseudowire access gateway, extending TDM, HDLC and LAN traffic over dark fiber, IP, MPLS, or Ethernet. The device provides an ideal solution for circuit emulation and legacy leased line services, as well as for PBX backhaul, PSTN access, TDM trunking over packet transport, and cellular backhaul. Incorporating a multi-standard pseudowire ASIC, it enables transparent delivery of legacy user traffic over next-generation transport with minimal processing delay.

IPmux-2L supports point-to-point and hub-and-spoke network topologies, offering a complete migration solution when combined with other TDM pseudowire CPEs (such as IPmux-24 and IPmux-216) and aggregation gateways supporting TDM pseudowire (such as ETX-5 and Megaplex-4).

- Up to two E1 user ports
- Optional n x 64 serial user data port
- Multi-standard TDM pseudowire ASIC: TDMoIP, CESoPSN, SAToP, CESoETH, HDLCoPSN
- QoS support with four priority queues
- Pseudowire OAM
- High precision clock recovery for 2G/3G cellular traffic over PSN; optional Sync-E support
- Centralized SNMP-based remote management with RADview

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## IPmux-24, IPmux-216

TDM Pseudowire  
Access Gateways



The IPmux-24 and IPmux-216 extend TDM, HDLC and Ethernet services over packet transport using standard pseudowire encapsulation over Fast Ethernet or Gigabit Ethernet access. The devices' compact design, ease of installation, and advanced traffic management capabilities enable carriers to extend their services from legacy backbones over greenfield packet networks, without affecting customer experience or replacing existing end-user equipment. They also allow service providers to add traditional leased line services to their Layer 2 portfolio and permit enterprises to reduce their IT expenses on PSTN connectivity and branch-to-branch communications. In addition, they support cellular operators in migrating their services to economical packet switched backhaul while maintaining the mobile network's stringent synchronization requirements.

- Up to four (IPmux-24), eight or 16 (IPmux-216) E1 or T1 TDM user ports
- Three SFP-based fiber or copper Fast Ethernet or Gigabit Ethernet interfaces
- Multi-standard hardware-based TDM pseudowire: TDMoIP, CESoPSN, SAToP, HDLCoPSN, CESoETH
- ITU-T G.8032 Ethernet Ring Protection Switching (ERPS) for sub-50 ms restoration; Ethernet link and TDM pseudowire redundancy
- Ethernet OAM: IEEE 802.3-2005 (formerly 802.3ah), 802.1ag/ITU-T Y.1731 (CFM)
- High precision clock recovery for 2G/3G cellular traffic over PSN
- QoS per 802.1p, ToS/DSCP, EXP
- MEF-9, MEF-14 certified for EPL, EVPL services

## Juniper MX/vMX

IP/MPLS Edge Router Module  
for Megaplex-4



The full-featured, carrier-grade MS-JNPR card (based on Juniper's vMX) extends more than 20 years of Juniper edge routing expertise to the virtual realm. The vMX virtual router runs the Junos operating system and compiles the programmable Trio chipset microcode for x86 chipsets, which maintains complete feature and operational consistency with physical MX Series 3D Universal Edge Routers.

The vMX provides sophisticated routing services that support business and broadband services, route reflection, and customer premises equipment (CPE) applications. Optional virtualized services for the vMX significantly expand its application range.

RAD also offers the Juniper MX physical appliances for 10G MPLS backbones, if required.

- Full-blown IP/MPLS, MPLS-TP edge router
- VPN support: L2 and L3 VPNs, VPLS, EVPN
- Dual stack IPv4/IPv6 with rich L3 features, including static and dynamic routing and multicast routing
- Advanced Ethernet switching and bridging functionality
- QoS including traffic prioritization, policing and shaping
- High availability (HA) and resiliency
- Based on Junos OS and managed by Junos Space

## LA-210

EFM DSL Network Termination Unit



The LA-210 enables service providers to deliver mid-band Ethernet and high speed Ethernet where fiber is not present, by offering Ethernet access rates of up to 22 Mbps over bonded SHDSL bis copper lines based on standard EFM (Ethernet in the First Mile) technology. Installed at the customer premises, it delivers Ethernet services, such as inter-office LAN connectivity, internet access and virtual private networks (VPNs), as well as legacy TDM service, using pseudowire emulation. The LA-210 features Carrier Ethernet attributes, including Ethernet OAM for proactive SLA monitoring, quality of service (QoS) per Ethernet flow and advanced traffic management capabilities – all starting at the service hand-off points. The LA-210 is certified by the Metro Ethernet Forum to deliver Ethernet Private Line (EPL) and Ethernet Virtual Private Line (EVPL) services per MEF-9 and MEF-14 specifications.

- Mid-band Ethernet access up to 22 Mbps using EFM bonding
- Up to four pairs of EFM bonded SHDSL bis uplink lines
- Up to four Fast Ethernet user ports
- Pseudowire support for E1, V.35 or X.21 traffic
- MEF CE 2.0-certified
- Advanced QoS mechanism per EVC/EVC.CoS
- Ethernet link and service OAM with performance monitoring for end-to-end SLA control
- Multi-standard pseudowire support for legacy services over PSN

## Megaplex-1

Multiservice Pseudowire Access Gateway

Hot Product



RAD's Megaplex-1 is a compact, highly reliable multiservice access node that transports analog and TDM traffic originating from legacy circuit-switched devices over packet switched networks (PSNs). It is specifically designed to address the needs of critical infrastructure network operators who are migrating to next-generation Ethernet, IP or MPLS communications. This includes utilities, transportation operators and government agencies. It enables seamless service migration with a scalable TDM over packet pseudowire engine and comprehensive multiservice support for PDH, high and low speed data, analog voice, and Teleprotection devices.

- Grooming and transmitting analog voice and TDM-based services over packet using standard pseudowire technology
- Wide range of services: E1/T1, FXS/E&M, IEEE C37.94, programmable serial ports and more
- PWE redundancy per tunnel for ultra-fast hitless restoration ensures maximum service uptime
- Bridge functionality with two optical/copper GbE uplinks and up to four FE user interface ports
- 1U 19-inch fan-less enclosure with redundant, wide-range power supply (AC/DC)

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## Megaplex-4

Next-Generation  
Multiservice Access  
Node

Hot Product



### Megaplex-4 Multiservice Modules



RAD's Megaplex-4 is a carrier-class, high capacity multiservice access concentrator for delivering legacy and next-generation services over PDH/SDH/SONET and packet switched transport networks (PSN). Its ability to handle a broad range of Ethernet, data and voice services, as well as a large variety of network technologies, in a single compact managed node, makes it an ideal aggregation solution for carriers and service providers.

The device also provides a perfect fit for large enterprises, utilities and transportation companies who require an efficient way to transport and provision multiple legacy and next-generation services over their high capacity pipes. Megaplex-4 can be used as a central aggregation unit for CPEs carrying TDM and Ethernet services over various access link technologies, e.g., SHDSL and SDH/SONET.

The Megaplex-4 is available with a cable management solution to reduce storage space and handling, and eliminate cable waste.

- **Modular 4U or 2U 19-inch units housing multiple I/O modules**
- **Carrier-class reliability with hardware, service and system redundancy**
- **Hardened and certified for IEEE 1613, including fan-less operation for power utilities and EN 50121-4 for railways**
- **Integrated MPLS switch and IP router**
- **MEF Carrier Ethernet 2.0-certified with traffic management, performance monitoring and Ethernet OAM**
- **Hybrid Ethernet and TDM architecture supporting various services up to STM-4/OC-12 and multi-GbE**
- **Three-tier built-in cyber security, including 802.1x and MACsec**
- **Non-blocking cross connect for a high volume of DS0 channels**
- **Built-in support for distance and differential Teleprotection for power utility applications**
- **Integral xDSL copper modems and fiber multiplexer cards**
- **Voice compression, terminal server, serial multiplexer and Omni voice conferencing modules**
- **Pluggable x86 D-NFV server module for hosting virtual functions and applications**
- **Interoperability with existing TDM equipment (Nokia, Newbridge)**

The Megaplex-4 offers x86 based modules hosting multiple networking and security functions. This helps reduce the number of physical network devices for better reliability and simpler operation. The Megaplex-4 supports tailor-made as well as third-party applications, which can be tested and certified by RAD, offering a future-ready and flexible solution to meet new application needs.

#### Multiservice Modules:

##### IP/MPLS Edge Router

Based on Juniper's successful virtualized MX router series (vMX)

##### SecurityGateway

L3 VPN router with a stateful firewall and an extensive networking feature set

##### CES Processor

Multi-function engine for processing voice compression, serial communications and sub-TS (DS0) cross-connect

##### Ubuntu

Virtualization capabilities enabling the users to install various applications directly over Ubuntu distribution

**Contact your local RAD distributor for additional/new application information.**

**MiCLK**

1588 Grandmaster on an SFP with Built-In GNSS



RAD's MiCLK® is the world's first Grandmaster on an SFP, allowing easy upgrades for existing base stations and backhaul equipment to support IEEE 1588 for LTE/LTE-A. Easily plugged into service routers to simultaneously distribute frequency and time, the patented MiCLK eliminates the need to install GPS/GNSS antennas at every cell site while providing highly accurate timing distribution with full network coverage – even in underground and in-building installations. It is also ideal for 4G small-cell deployments.

The field-proven MiCLK allows service providers to avoid spoofing and jamming risks, and dramatically reduces installation and engineering costs by eliminating the need for additional space or power requirements.

- **Fully-featured standard IEEE 1588 Grandmaster including phase/Time of Day (ToD) to meet stringent LTE Advanced requirements**
- **Built-in GNSS receiver**
- **Robust GNSS backup – time holdover when GNSS reception is lost, using Sync-E or 1588 frequency reference from the network (Assisted Partial Timing Support) to deliver continuous and accurate synchronization to the base station**
- **Miniature pluggable device fits in any standard SFP port**
- **Scalable solution supports up to 64 slaves**
- **Part of RAD's vCPE offering**

**MiNID**

Miniature Programmable Network Interface Device

Hot Product



MiNID® is a field-programmable miniature L2/L3 network interface device (NID), available in a variety of form factors. Part of RAD's vCPE and white box solution portfolio, it enriches the Service Assured Access offering with software-defined functionalities for enhanced demarcation, remote monitoring and fault isolation, as well as remote packet capture and micro-burst measurement capabilities.

MiNID also provides instant upgrades for legacy switches and routers, as well as for vCPE platforms and COTS servers to help service providers, mobile operators and wholesale carriers introduce new services quickly and with better quality of experience (QoE) while increasing operational efficiency and lowering costs. Remotely managed via CLI, web interface and SNMP, it features zero-touch provisioning for fast and simple installation and does not require dedicated training.

- **MiNID SFP**



The MiNID SFP is easily pluggable into SFP ports of switches and routers and eliminates the need for standalone demarcation devices. It delivers substantial OpEx savings by eliminating additional power, space and cabling expenses.

- **Plug-and-play installation**
- **Fits small cells, macro cells, switches, routers, DSLAMs, COTS servers and more**
- **Variety of optical options**
- **LC connectors**
- **Extended temperature range**

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• **MiNID Sleeve**

The MiNID Sleeve is easily pluggable into SFP ports of switches and routers and seamlessly hosts standard FE and GbE SFP modules.

- **Compatible with standard fiber and copper SFPs in a variety of ranges**
- **Reduces inventory by reusing existing SFPs**

• **MiNID Standalone**

The MiNID is also available in a miniature standalone enclosure, with a variety of user and network port options for maximum interface flexibility. Optional bypass-relay functionality ensures fail-safe operation and Power over Ethernet (PoE) support eliminates the need for an additional power supply.

- **Two ports with flexible user or network functionalities**
- **Combo ports automatically select between fiber and copper/RJ-45**
- **Internal bypass relay for copper interfaces offers service continuity in the event of power failure**
- **Bypass PoE enables powering both the MiNID and the end device**

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## **MiRiCi-155**

Smart SFP Gigabit Ethernet over STM-1/OC-3 Converter



RAD's smart SFP MiRiCi-155 connects Gigabit Ethernet LANs over wireline or wireless STM-1 or OC-3 links. The miniature Ethernet over STM-1/OC-3 converter provides TDM connectivity to any Ethernet device with an SFP (small form-factor pluggable) compatible GbE port. Hot-swappable and software-configurable, the intelligent SFP converter is a fully managed device supporting standard GFP encapsulation. It delivers a complete Ethernet over SDH/SONET solution in a finger-sized SFP enclosure and enables a quick rollout of new Ethernet services over legacy TDM infrastructure. The MiRiCi-155 is part of RAD's "System on an SFP" product line.

- **Delivers Gigabit Ethernet traffic over a single STM-1/OC-3 link**
- **Supports standard GFP encapsulation**
- **Hot-insertion SFP-format plug, MSA-compliant**
- **User-configurable**
- **Enhanced management of control, status and monitoring**
- **Out-of-band management through I<sup>2</sup>C**
- **Supports full duplex flow control**
- **Fault propagation from WAN to LAN link**
- **Part of RAD's vCPE offering**



## MiRiCi-E1/T1, MiRiCi-E3/T3, MiRiC-ML/E1,T1

Smart SFP Ethernet to E1/T1 or E3/T3 Remote Bridges



RAD's MiRiCi-E1/T1, MiRiCi-E3/T3 and MiRiC-ML/E1,T1 connect Fast Ethernet or Gigabit Ethernet LANs over framed or unframed E1 or T1 circuits, or over framed T3 links. The smart SFP miniature remote bridges provide TDM connectivity to any Ethernet device with an SFP (small form-factor pluggable) compatible Fast Ethernet or GbE port. Hot-swappable and software-configurable, the intelligent SFPs are fully managed devices supporting standard GFP encapsulation, as well as HDLC and cHDLC. MiRiC-ML supports PPP and ML-PPP, with RAD's vAccess VNF as the virtualized service engine. They deliver a complete Ethernet over PDH solution in finger-sized SFP enclosures and enable a quick rollout of new Ethernet services over legacy TDM infrastructure. The MiRiCi-E1/T1, MiRiCi-E3/T3 and MiRiC-ML are part of RAD's vCPE Toolbox. They provide simple and cost-effective alternatives to external, standalone bridge units or conversion cards for user devices, saving on space, cabling and power consumption, and simplifying management.

- Supports framed and unframed E1/T1, E3/T3
- Supports standard GFP, HDLC-like, and cHDLC encapsulation
- Supports PPP and ML-PPP with vAccess VNF
- Hot-insertion SFP-format plug, MSA-compliant
- User-configurable
- Enhanced management of control, status and monitoring
- Out-of-band management through I<sup>2</sup>C
- Supports full duplex flow control
- Fault propagation from WAN to LAN link
- Software download via TFTP
- Supports Ethernet OAM per 802.3-2005 (formerly 802.3ah)
- Part of RAD's vCPE offering

## MiTOP-E1/T1, MiTOP-E3/T3

Smart SFP-Format TDM Pseudowire Gateways



RAD's MiTOP-E1/T1 and MiTOP-E3/T3 transport framed or unframed E1/T1 or E3/T3 traffic, respectively, over Ethernet, IP and MPLS networks. Featuring multi-standard pseudowire support and Synchronous Ethernet (Sync-E) in a finger-sized enclosure, the smart SFP devices provide an ideal solution for service providers, utility companies and enterprises wishing to ensure highly accurate timing synchronization for their legacy services while migrating to packet switched transport.

Part of RAD's "System on an SFP" portfolio, the MiTOP-E1/T1 and MiTOP-E3/T3 are designed for quick and simple insertion into any Fast Ethernet or Gigabit Ethernet port with an MSA-compatible socket.

- Transmits TDM-based services over Ethernet, IP or MPLS networks
- Standard pseudowire encapsulation: CESoPSN, SAToP
- Single E1/T1 or E3/T3 TDM user port
- Transparent to all signaling protocols
- Hot-insertion SFP-format plug, MSA-compliant
- Selectable clock source
- Basic management of control, status and monitoring
- Supports Synchronous Ethernet (Sync-E)
- Part of RAD's vCPE offering
- Supports fractional E1/T1
- Supports CESoPSN CAS
- Up to eight pseudowire tunnels per E1/T1

## • O/P

### Optimux-106, Optimux-108, Optimux-108L

Fiber Multiplexers for 4 E1/T1  
and Ethernet or Serial Data



The Optimux-106 and Optimux-108 fiber multiplexers deliver TDM and Fast Ethernet or serial data traffic over a fiber optic link, providing a simple, low-cost solution for point-to-point and point-to-multipoint connectivity up to 120 km (75 miles).

The Optimux-108L is an entry-level, power-saving E1 and Ethernet fiber optic multiplexer, enabling a 40% reduction in OpEx related to power consumption of network elements. Typical users include transportation and utility companies, universities and governments, internet service providers (ISPs), and carriers extending data and voice from SDH/SONET networks or backhauling cellular traffic.

- Up to four E1 or T1 ports and a Fast Ethernet user interface; optional V.35 user port (Optimux-106, Optimux-108)
- Full 100 Mbps Ethernet data rate (user)
- Simple plug-and-play installation
- Range extension up to 120 km (75 miles)
- Redundant uplink interfaces and power supplies (Optimux-106, Optimux-108)
- Card versions for the Megaplex-4
- Management via ASCII terminal, web server, Telnet or RADview
- Temperature-hardened enclosures
- Dedicated 10/100BaseT Ethernet management port or dual in-line package (DIP) switches for full or basic management capabilities (Optimux-108L)

### PacketLight

Complete Solutions for  
WDM/OTN and Dark Fiber  
Applications Layer 1 Encryption



PacketLight's product suite offers the flexibility to build a cost-effective, highly efficient optical network infrastructure for CWDM/DWDM, OTN and dark fiber connectivity, while addressing challenges faced by service providers and organizations.

PacketLight solutions are ideal for a variety of vertical markets, such as carriers, ISPs, dark fiber providers, data centers, storage facilities, utility companies (railway and power companies), and financial institutions.

The wide range of PacketLight xWDM and dark fiber solutions includes multi-rate sub-10G CWDM/DWDM platforms, 10G CWDM/DWDM and 100G solutions with built-in OTN options, muxponders, amplification and booster solutions, WSS-based ROADMs, 10 x 1-GbE muxponders, and passive multiplexing solutions.

- Multi-rate transponders, 2 Mbps to 100 Gbps
- Muxponder for high wavelength utilization; scales to 44/96 wavelengths
- Layer-1 encryption for GbE, 10-GbE, 4G FC, 8G FC, and 16G FC
- Long-distance solutions by amplification and DCM
- Performance monitoring
- Supports single or dual fiber
- Low latency connectivity
- Hot-swappable PSU (AC/DC) and fan
- Integrated management
- Compact 1U integrated devices
- Simple to install, maintain and configure
- Cost-effective CPE device
- Integrated OTN layer (with FEC)



## PM Controller

### Performance Monitoring Generator

The PM Controller is a high capacity, central generator for always-on performance monitoring (PM), on-demand testing, diagnostics and troubleshooting of mobile backhaul networks, as well as for premium Carrier Ethernet and IP business services. It uses a wide variety of standard tools to provide deep visibility into network and service performance and to ensure optimal quality of experience in LTE/LTE-A networks, typically characterized by rapid small-cell deployment. Part of RAD's Service Assured Access offering, the PM Controller works opposite routers, switches, mobile base stations, or third-party responders, as well as opposite RAD's ETX and MiNID NIDs. As a non-disruptive add-on, the PM Controller is an ideal solution for existing heterogeneous networks. It enables top-line PM and testing in a dynamic environment regardless of the capabilities of the underlying installed base.

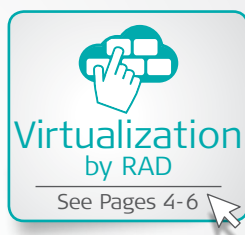
- **PM Controller Standalone Appliance**



- **Four FE/GbE combo ports**
- **Monitors and troubleshoots backhaul performance**
- **Service activation tests (Y.1564) over L2/L3, opposite RAD devices or third-party responders**
- **Continuous connectivity and service performance monitoring sessions using TWAMP, ICMP and UDP Echo**
- **Connects to the RADview Performance Monitoring portal for SLA and quality of experience (VoLTE mean opinion score) reporting with aggregated and drill-down views per PM session**

- **PM Controller Virtual Network Function (VNF)**

RAD's PM Controller is also available as a VNF that can be downloaded to third-party servers and central-site appliances, as well as to the x86 server within RAD's vCPE devices, using the RADview Domain Orchestrator.



#### PMC VNF

The PMC VNF provides central generation of always-on performance monitoring over Layer 3 networks.

**Contact your local RAD distributor for additional/new application information.**

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## • P

**PowerFlow**

Managed Ruggedized Ethernet Switch with Power over Ethernet

Hot Product

RAD's PowerFlow consists of managed and unmanaged industrial-grade Gigabit Ethernet switches, designed to build packet-based, PoE-intensive operational networks for critical infrastructure.

PowerFlow is ideal for OT WANs of power utilities, railways, traffic controllers, and Safe City applications requiring advanced Ethernet functionality and Power over Ethernet (PoE) support.

• **PowerFlow-2:  
Managed Ruggedized Ethernet  
Switches with Multiple Options**



RAD's PowerFlow-2 is a series of industrial-grade, managed Fast Ethernet and Gigabit Ethernet switches, with or without PoE support, that provide stable and reliable Ethernet transmission. Housed in ruggedized DIN rail or wall-mountable enclosures, these switches are specifically designed for harsh environments, such as industrial networking and intelligent transportation systems (ITS), as well as military and utility market applications where environmental conditions exceed commercial product specifications.

- **Compact Ethernet switches with up to 16 x 10/100/1000BaseT ports, and eight x 100/1000BaseFX SFPs ports**
- **Variety of input voltage from 12-48VDC to HVDC of 110/220V DC and support of 110/220V AC**
- **Variety of PoE feeding options including PoE (802.3af), PoE+ (802.3at) and POE++ (60W)**
- **Flexible deployment scenarios using xSTP, ERPS (ITU-T G.8032) and ultra-fast recovery with PF-ring/chain**
- **Certified for EN 50121-4, IEC 61850-3, IEEE 1613 and NEMA TS2**
- **Wide range of operating temperatures from -40°C to 75°C (-40°F to 167°F)**

• **PowerFlow-2-10G:  
Industrial 10G Core Switch  
Demarcation/Aggregation Device**

RAD's PowerFlow-2-10G managed industrial-grade core switches provide a wide variety of reliable mechanisms for mission-critical network communications. These mechanisms include redundant and isolated power supplies, STP/RSTP/MSTP and ITU-T G.8032 Ethernet Ring Protection Switching. The PowerFlow-2-10G is a fan-less unit with IP30 ruggedized metal housing to meet demands of industrial grade and core layer applications.

- **Industrial-grade Ethernet switches equipped with four x 10G SFP+ ports**
- **Variety of input voltage and PoE feeding options including PoE+ with up to 400W per unit**
- **19" unit with up to four 10-GbE and up to 24 GbE ports in various combinations**
- **Supports STP, RSTP, MSTP, ITU-T G.8032v1, G.8032v2 Ethernet Ring Protection Switching (ERPS), and PF-Ring for redundant cabling**
- **NEBS-compliant, environmentally hardened enclosure options**

## RADview

### Network Management and Orchestration

RADview is a modular network management and edge domain orchestration suite for RAD's Service Assured Access and Service Assured Networking solutions. It enables configuration, provisioning, monitoring, and management of networks and services, and includes the following management tools:

- Network element manager
- Performance monitoring portal for ongoing monitoring of Ethernet and IP services
- D-NFV orchestrator for virtual machines and application services at the customer edge
- End-to-end service manager for planning and activation of Carrier Ethernet services
- Service center for managing TDM services

RADview is fully compliant with the ITU-T Telecommunications Management Network (TMN) standards, and features advanced fault, configuration, administration, performance, security (FCAPS) capabilities. Using an SNMP southbound interface, it also includes third-party device monitoring capabilities. RADview's northbound interface enables integration into a third-party umbrella system (OSS).

RADview's security information and event management (SIEM) enables collection of all security events detected in the network. The system collects cyber security events from all RAD gateway devices in the network and displays them visually on customizable dashboards, with configurable dynamic updates and a searchable database.

- Monitors device health, optimizes network operations and minimizes mean time to repair (MTTR)
- Client/server architecture with multi-user support and seamless handover of user privileges
- Zero-touch and auto-discovery capabilities
- Wide range of northbound application programming interfaces (APIs)
- Firewall configurator for remote clusters and devices
- Syslog server with optional manual message filtering
- Interoperable with third-party NMS and leading OSS/umbrella systems
- Multi-platform Java-based solution supporting Windows and Linux
- IBM Tivoli's Netcool®/OMNibus™

### Intuitive, HTML5 UI/UX:



RADview Domain Orchestrator



RADview Performance Monitoring



RADview Service Manager



# R

## • RADview Performance Monitoring



The RADview Performance Monitoring module enables ongoing monitoring of Ethernet and IP service performance by collecting KPI (key performance indicator) data from RAD devices. Part of RAD's Service Assured solutions, it allows service providers and network operators to easily monitor and manage actual network and service performance over time and compare it to service requirements and SLA (service level agreement) guarantees.

The RADview Performance Monitoring module enables immediate detection of service degradation, so that remedial actions are taken to quickly restore guaranteed performance levels. The system retrieves data lost due to connection failures and exports standard CSV ASCII files to OSS or third-party management systems.

- Collects, stores, analyzes and presents KPIs from RAD devices
- In-service bandwidth utilization measurements
- Actual performance metrics based on ITU-T Y.1731:
  - Frame delay (latency)
  - Frame delay variation (jitter)
  - Packet delivery ratio
  - Availability
- TWAMP-based L3 performance monitoring for IP services
- SLA threshold policy management
- Performance dashboard with aggregated and drill-down views
- Monthly and real-time SLA statistics reporting

## • RADview Domain Orchestrator



The RADview Domain Orchestrator manages the physical and virtual resources required for effectively running vCPE services and for delivering service agility at the customer edge. It installs, configures and manages virtual machines on the x86 D-NFV module residing within RAD's customer-edge devices. In addition, it manages the VNF life cycle from on-boarding new VNFs to configuring services, chaining VNFs, deploying service function chains and ongoing monitoring of live services.

Featuring a web client with state-of-the-art user interface (UI), the RADview Domain Orchestrator enables fast and easy service creation and management of value-added applications and provides a holistic view of the vCPE services.

- Configuration and monitoring using OpenStack control node
- Manages application repository with data on vendor, usage and system requirements for each VF
- Downloading and provisioning multiple VFs by the D-NFV module
- x86 inventory management and utilization reporting
- DNFV-OS deployment; ongoing OS and application software updates
- Web client with intuitive UI





#### • RADview Service Manager



The RADview Service Manager module is part of the RADview management suite and provides end-to-end management of MEF-based Carrier Ethernet services for Service Assured Access. An intuitive GUI, "point-and-click" functionality and easy-to-follow wizards facilitate planning, provisioning, monitoring, diagnostics, and SLA assurance, so that network operators can add new service offerings, as well as minimize overall operating costs, reduce provisioning times and maximize the efficiency of the entire network.

- Offline resource optimization and capacity planning simplifies pre-deployment stages
- "Point-and-click" end-to-end service provisioning and OAM settings
- Automatic correlation of network faults with impacted services and customers
- Security management supporting user access profiles and allowing network partitioning
- Graphic representation of network clouds, links, nodes, end-to-end services, and network status indication
- Standard northbound interfaces to third-party OSS systems
- GUI designed for management of very large networks

#### • RADview Service Center



The RADview Service Center path management system enables end-to-end management of RAD's TDM access products, while easy-to-follow wizards facilitate provisioning and monitoring over SDH/SONET and PDH networks. Supported capabilities include automatic path routing, automatic re-routing of protected paths, physical and logical representation of the network links, and more. The system allows network operators to add new service offerings while minimizing overall operating costs, reducing provisioning times and maximizing the efficiency of the entire network.

- "Point-and-click" provisioning from a central workstation for networks of RAD products
- Automatic periodic self-healing of faulty services
- Service security management, supporting user network access profiles and allowing network partitioning
- Service availability report
- Dynamic filter displays service and network link-related alarms
- Windows-based client and Linux-based server

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## • R

**RADWIN****Mobile Wireless Access  
for Transportation  
Communications****RADWIN**

RADWIN's mobile wireless radios for transportation communications ensure continuous high speed wireless connectivity between trains or metros and network control and data centers. They deliver the highest throughput for on-board communications with guaranteed bandwidth to each railway vehicle, even on subways and monorail lines. RADWIN's radios offer bi-directional and asymmetrical train-to-track bandwidth with per-train quality of service (QoS) guarantees. This allows always-on communications between trains and control and operations centers for critical services such as information displays, panic buttons, PTT (push-to-talk), telemetry, ticketing machines, and video streaming. They are fully compliant with railway environmental standards, which are a prerequisite for all equipment installed on railways and metros. RADWIN's field-proven mobile wireless access devices are deployed worldwide, powering applications such as broadband WiFi for passengers, real-time high-definition CCTV, PIS, CBTC and more. Operating in challenging outdoor conditions and in underground tunnels, they deliver unmatched capacity and long-range coverage.

- Coverage range of 11 km (6.8 miles)
- Integrated WiFi access point (802.11b/g/n) for video transmissions
- Built-in GPS for vehicle tracking
- Direct DC power from the vehicle (10 to 36 VDC), power consumption <25W
- Up to 750 Mbps total available throughput from the base station
- Up to 100 Mbps total available throughput for vehicle/vessel subscriber units
- SNMPv3
- AES 128
- IP67 rating for severe outdoor conditions

**RIC-155L****Managed Gigabit Ethernet to  
STM-1/OC-3 Converter**

The RIC-155L delivers Gigabit Ethernet traffic over STM-1/OC-3 or channelized OC-3 links at 155 Mbps access rates. Enabling quality of service (QoS) management for multiple traffic types, as well as monitoring and diagnostics, it is ideal for extending Ethernet connectivity over TDM backbones. Other typical applications include IP DSLAM backhaul, inter-POP connectivity or high bandwidth private line services.

- Two UTP and SFP GbE user ports
- STM-1/OC-3c network ports
- VLAN-aware and VLAN-unaware bridging
- G.7041/Y.1303 GFP encapsulation
- Four QoS levels based on Strict Priority scheduling
- Remote and local, inband and out-of-band management, secure Telnet and web applications, SNMPv3 and RADIUS
- Ethernet jumbo frames supported

**RIC-LC**

Ethernet Converter for Multiple PDH Circuits



RAD's RIC-LC is a Fast Ethernet over E1 converter that provides simple, efficient and cost-effective Ethernet connectivity over up to 16 bonded E1 links. As an Ethernet converter for multiple PDH circuits, the RIC-LC enables service providers to supply high capacity Ethernet services to remote locations over existing TDM infrastructure. Deployed in point-to-point or hub-and-spoke topologies, it operates opposite Ethernet over TDM demarcation devices and aggregators, such as RAD's RICi-16 and Egate-100 as well as opposite third-party gateways that support Ethernet over NG-PDH encapsulation and bonding techniques.

The RIC-LC is an ideal solution for Ethernet Private Line and Ethernet Private LAN services, inter-office connectivity, and IP DSLAM, IP Node B and WiMAX base station backhaul over PDH access networks.

- Up to 16 E1 network interfaces
- Four Fast Ethernet UTP/SFP user ports
- GFP (G.8040), VCAT (G.7043), LCAS (G.7042)
- VLAN-aware and VLAN-unaware bridging; VLAN stacking
- Four QoS levels; SP and WFQ scheduling; CIR (committed information rate) support
- Remote and local, inband and out-of-band management
- Dual in-line package (DIP) switches for activating diagnostic loopback tests
- TDM to Ethernet fault propagation

**RICi-4E1, RICi-4T1, RICi-8E1, RICi-8T1**

Ethernet over Four or Eight E1 or T1 NTUs



RAD's RICi-4E1, RICi-4T1, RICi-8E1 and RICi-8T1 deliver mid-band and Fast Ethernet services over up to eight bonded E1 or T1 circuits. Employing various standard bonding technologies to create a scalable, virtual channel from individual E1 or T1 circuits, these devices improve overall network availability by reducing latency and optimizing line utilization and throughput. RAD's RICi NTUs support a large variety of applications, including transparent inter-LAN connectivity, direct internet access and Ethernet Private Line, as well as IP DSLAM and WiMAX base station backhaul.

The devices are deployed in point-to-point or hub-and-spoke topologies, providing a cost-effective, high performance solution for mid-band and Fast Ethernet services over legacy PDH/SDH/SONET backbones.

- Four or eight E1/T1 ports
- Up to four 10/100BaseT user ports
- Circuit bonding using MLPPP
- Metro Ethernet Forum certified for MEF-9 EPL services
- Four QoS levels according to VLAN priority (802.1p), DSCP, and per-port priority schemes, per application requirements
- Ethernet OAM per 802.1ag and performance monitoring per ITU Y.1731 for end-to-end SLA control
- Secure Telnet and web applications; SNMP and RADIUS



## • R

**RICi-16**

Ethernet over Bonded PDH NTU



The RICi-16 connects Fast Ethernet LANs over multiple bonded PDH links, enabling service providers to extend high capacity Ethernet-based services to remote locations. It is also ideal for backhauling Ethernet traffic from IP Node Bs, IP DSLAMs and WiMAX base stations over copper-based or microwave PDH connections. Employing standard Ethernet over NG-PDH technology, the RICi-16 improves overall network availability by reducing latency and optimizing line utilization and throughput.

The RICi-16 is MEF-certified for Ethernet Private Line and Ethernet Virtual Private Line services. It is equipped with advanced Ethernet SLA capabilities for handling multi-priority traffic, ensuring latency, jitter and packet delivery performance on a per-flow basis. The RICi-16 features a "pay-as-you-grow" license model, allowing the addition of E1/T1 links according to evolving bandwidth requirements.

- Up to 16 E1/T1 ports; two bonded clear channel T3 ports or a single channelized T3 port
- Up to four 10/100BaseT user ports
- Circuit bonding using standard GFP, VCAT and LCAS with multi-VCG support
- Metro Ethernet Forum certified (MEF-9, MEF-14) for EPL, EVPL services
- Hierarchical QoS with configurable Strict Priority and WFQ (weighted fair queuing) scheduling, EVC shaping
- Color-sensitive P-bit re-marking
- Ethernet OAM per 802.3-2005 (formerly 802.3ah), 802.1ag and performance monitoring per ITU Y.1731 for end-to-end SLA control
- Secure Telnet and web applications; SNMPv3 and RADIUS

**RICi-E1, RICi-T1, RICi-E3, RICi-T3**

Fast Ethernet over E1/T1 or E3/T3 NTUs



The RICi-E1, RICi-T1, RICi-E3 and RICi-T3 are network termination units (NTUs) connecting Fast Ethernet over framed or unframed E1/T1 or E3/T3 circuits.

The devices are deployed in point-to-point or hub-and-spoke topologies, working opposite RAD's RICi-16 and Egate-100 Ethernet over TDM gateways. This enables carriers and service providers to extend their customer reach and utilize legacy PDH infrastructure in delivering new Ethernet services. Typical applications include Ethernet access, backhauling network management traffic and connecting inter-office or enterprise LAN segments.

- 10/100BaseT user port
- Single E1, T1, E3, or T3 network port
- PDH to Ethernet fault propagation and TDM loop detection
- Interoperable with third-party devices:
  - RICi-E1/T1 supports standard GFP (ITU-T G.8040) and HDLC
  - RICi-E3/T3 supports X.86 (LAPS)
- QoS priority queues
- Plug-and-play functionality using DHCP client
- Remote diagnostic tools on TDM and Ethernet ports
- Managed via SNMP, web server or Telnet



## ROC-19/19L

### Outdoor Cabinets



ROC-19/19L is a self-contained outdoor cabinet for housing a single 19"-wide RAD unit and a cabling system for various telecom services. Constructed for outdoor use, the enclosure is powered from a DC power source and is ideal for service providers that require efficient environmental isolation for their equipment.

The ruggedized IP56 (ROC-19) and IP66 (ROC-19L) NEMA-4-rated construction includes a rain hood, offering full shielding and protection against dust, rain and ice. Efficient ventilation is assured by an intake fan with replaceable air filters (ROC-19) or passive convection (ROC-19L). Secure, efficient maintenance and access are offered by a 2-point (ROC-19L) or 3-point (ROC-19) door locking mechanism, as well as an integrated fiber cable splicer/guide system, intrusion detection and over-current protection.

- Outdoor cabinet for one 19"-wide RAD unit, with integrated fiber splicer and guides
- IP56-66 NEMA-4-rated metal enclosure
- 24 VDC or 48 VDC powered
- Effective grounding and over-current protection
- 2- or 3-point door locking
- Intake fan with replaceable filters, or passive cooling
- Wall or pole mounting options

## SecFlow-1

### Ruggedized SCADA-Aware Gateway

Hot Product



The compact SecFlow-1 is a ruggedized multiservice gateway, featuring built-in security mechanisms designed for applications controlling mission-critical operations. It is ideal for industrial IoT backhaul, enabling fast, secure and economical deployment of new IoT sites. Allowing secure connectivity over wireless or fiber networks – either public (e.g., cellular) or private, it connects all types of industrial devices, including RTUs, smart meter aggregation devices, IoT base stations or concentrators, CCTV cameras, point-of-sale devices, WiFi base stations, and more.

SecFlow-1 is also used for operational WANs, providing reliable and secure Layer 3 communications for power utilities, water and gas utilities, public safety and homeland security agencies, as well as intelligent transportation operators.

- Multiservice support: Fast Ethernet/GbE, serial RS-232/485
- Connectivity to remote and isolated sites using a dual SIM cellular modem for 2G/3G/HSPA+/HSDPA/LTE uplink supporting flexible connectivity methods such as encrypted L3 DMVPN, IPsec VPN, NAT
- Advanced Ethernet and IP feature-set
- Cyber security suite: IPsec encryption with automated PKI, ACL, stateful firewall
- Serial protocol handling with transparent tunneling/protocol conversion/terminal server
- feature-set for IEC 60870-5-101, IEC 60870-5-104, Modbus RTU to Modbus TCP, and DNP3.0 RTU to TCP
- Complies with IEC 61850-3 and IEEE 1613
- Form factor and functionalities address various installation needs for small stations and data collection sites
- Fault management and reporting, bulk software upgrade, and database management using RADview
- Web interface
- Zero-touch provisioning
- IPsec VPN redundancy

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## SecFlow-1v

Ruggedized Multiservice Gateway

Hot Product



The compact SecFlow-1v is a ruggedized multiservice gateway, featuring built-in security mechanisms designed for applications controlling mission-critical operations. It is ideal for industrial IoT backhaul, enabling fast, secure and economical deployment of new IoT sites. Allowing secure connectivity over wireless or fiber networks – either public (e.g., cellular) or private, it connects all types of industrial devices, including RTUs, smart meter aggregation devices, IoT base stations or concentrators, CCTV cameras, point-of-sale devices, WiFi base stations, and more. RADview's security information and event management (SIEM) enables collection of all security events detected in the network. The system collects events from SecFlow devices and displays them visually on customizable dashboards.

SecFlow-1v provides reliable and secure Layer 3 communications for power utilities, water and gas utilities, public safety and homeland security agencies, as well as intelligent transportation operators.

- **Hosting of third-party software using Linux LXD container technology**
- **Multiservice support: GbE copper and fiber, serial RS-232/485, Power over Ethernet (PoE)**
- **Connectivity to remote and isolated sites using a dual SIM**
- **Single or dual cellular modem for a 2G/3G/HSPA+/HSDPA/LTE uplink**
- **WiFi connectivity as access point**
- **Dynamic routing with OSPF, BGP, VRF and secure VPN using IPsec, DMVPN and NAT for flexible connectivity**
- **Cyber security suite: 802.1X, IPsec encryption with automated PKI, stateful firewall**
- **Serial protocol handling with transparent tunneling/protocol conversion/terminal server for IEC 60870-5-101, IEC 60870-5-104, Modbus RTU to Modbus TCP, and DNP3.0 RTU to TCP**
- **Complies with IEC 61850-3 and IEEE 1613**
- **Zero-touch provisioning, firewall configuration, fault management and reporting, bulk software upgrade, and database management using RADview**

## SecFlow-2

Ruggedized SCADA-Aware Ethernet Switch/Router



The compact SecFlow-2 is a ruggedized Ethernet switch/router with built-in security mechanisms designed for applications controlling mission-critical operations. It is ideal for industrial IoT backhaul, enabling fast, secure and economical deployment of new IoT sites. Allowing secure connectivity over wireless or fiber networks – either public (e.g., cellular) or private, it connects all types of industrial devices, including RTUs, smart meter aggregation devices, IoT base stations or concentrators, CCTV cameras, point-of-sale devices, WiFi base stations, and more.

SecFlow-2 is also used for operational WANs, providing reliable secure Layer 2 and Layer 3 communications for power utilities, water and gas utilities, public safety and homeland security agencies, as well as intelligent transportation operators.

- **Multiservice support: Fast Ethernet/GbE, serial RS-232/485, Power over Ethernet (PoE)**
- **Connectivity to remote and isolated sites using a dual SIM cellular modem for 2G/3G/HSPA+/HSDPA/LTE uplink supporting flexible connectivity methods such as encrypted L3 DMVPN, IPsec VPN, L2 VPN, NAT**
- **Advanced Ethernet and IP feature-set**
- **Cyber security suite: 802.1X, IPsec encryption with automated PKI, ACL, stateful firewall**
- **Serial protocol handling with transparent tunneling/protocol conversion/terminal server feature-set for IEC 60870-5-101, IEC 60870-5-104, Modbus RTU to Modbus TCP, and DNP3.0 RTU to TCP**
- **Complies with IEC 61850-3 and IEEE 1613**
- **Form factor and functionalities address various installation needs for small stations and data collection sites**
- **Fault management and reporting, bulk software upgrade, and database management using RADview**

## SecurityGateway

VPN Aggregator, Router and Firewall

Hot Product



SecurityGateway is a major building block of RAD's industrial IoT solution, serving as a state-of-the-art VPN aggregation appliance. In the fast growing market of IIoT and the need for secure communications, SecurityGateway provides a small form-factor yet powerful and cost-effective solution for aggregating traffic from multiple remote IIoT sites.

SecurityGateway aggregates multiple VPNs from remote SecFlow devices and addresses industrial IoT applications, for example:

- Distributed automation in secondary substations
- Smart meter concentration
- Water resources management
- Smart retail

Typically located behind the organizational firewall, SecurityGateway may also serve as a WAN gateway, depending on customer needs. RADview's security information and event management (SIEM) enables collection of all security events detected in the network. The system collects events from SecFlow devices and displays them visually on customizable dashboards.

- **Compact 19" 1U VPN aggregation device supporting L2/L3 VPNs**
- **Optional high availability**
- **Feature-rich, dual stack IPv4/IPv6, including static and dynamic routing and NAT**
- **Stateful firewall, IKE1 and IKE2, automated PKI (X.509) with integrated DNS resolver**
- **Supports flexible connectivity methods such as encrypted IPsec VPN, OpenVPN and L2TP**
- **User authentication using RADIUS**
- **L2 functionality**
- **User-friendly, easy-to-use web-based GUI**
- **Fault management and reporting using RADview**

## SFP/XFP/SFP+ Transceivers

Small Form-Factor Pluggable Transceivers



RAD's SFP/XFP/SFP+ small form-factor pluggable transceivers are hot-swappable, input/output transceiver units converting optical and electrical media. Providing a wide range of detachable interfaces to multimode/single-mode optic fibers and UTP/coaxial electrical cables, RAD's miniature transceiver units enable significant savings in system maintenance and upgrade costs, as well as facilitate efficient design of host devices and flexible network planning.

It is strongly recommended to order RAD devices with original RAD SFP/XFP/SFP+ transceivers installed, to ensure that the entire assembled unit has undergone comprehensive functional quality tests. RAD cannot guarantee full compliance to product specifications for units using non-RAD SFP/XFP/SFP+ pluggable transceivers.

### Optical SFPs

- **MSA (multi-source agreement) compliant**
- **Built-in DDM (digital diagnostic monitoring) function**
- **64- to 1016-byte frames, including VLAN-tagged frames**
- **LOS (loss of signal) fault propagation**
- **Flow control mechanism**

### Smart SFPs

- **GPON OLT in an SFP**
- **VDSL2 SFP**

## • V

**vCPE-OS**

Open Carrier-Class  
Operating System  
for Network Edge  
Virtualization

Hot Product



Part of RAD's vCPE Toolbox, the Linux-based, carrier-class vCPE-OS runs on any white box server and is pre-loaded in RAD's virtual CPE (vCPE) platforms. It combines powerful networking capabilities with virtualization for hosting and accelerating SD-WAN and any other value-added virtual network function (VNF) applications from any vendor.

- **Slim, high performance operating system for optimized vCPE**
- **Open solution, compatible with any VNF (networking, security and IT), orchestrator and SDN controller**
- **Any access with advanced transport/networking capabilities: LTE, WiFi, Carrier Ethernet, xDSL, PON, and TDM**
- **High availability: performance monitoring, troubleshooting and self healing – TWAMP, ICMP Echo, UDP Echo**
- **Any hardware: RAD's white box, gray box platforms, third-party servers, and RAD's pluggable PNFs**
- **Comprehensive management and security suite**
  - NETCONF/YANG, CLI, Syslog, alarms, and more
  - SNMPv3, SSH, SFTP, Access Control, TACAS+, RADIUS
  - Zero-touch and call-home provisioning

## vCPE-OS Virtualization Applications



The vCPE-OS includes standard KVM hypervisor and OpenStack compute node to support third-party applications. RADview Domain Orchestrator enables easy virtualized function download.

Supported applications include:

**SD-WAN**

Software-defined control of WAN connections with secure overlay tunnels for business services

**Router**

Virtual router for hosted public clouds and branch CPE deployments

**Cryptography**

Standard AES 256-bit cipher encryption/decryption of L2-L4 traffic

**Firewall**

Unified threat management for provider-managed SMB services

**Session Border Controller (SBC)**

Manages VoIP signaling and media flows

**Packet Analyzer**

Troubleshooting on demand from the customer edge using a packet sniffer VF

**WAN Optimization**

Eliminates content duplication, handles compression and optimizes latency

**Contact your local RAD distributor for additional/new application information.**



# | RAD Services

The graphic features the RAD Services logo and title in white on a dark gray background. To the right, a series of red curved lines with circular nodes connects several white icons: a cloud with a download arrow, a power line tower, a building, a train, a classical building, a radio tower, and a globe.



## RADcare Global Services

### Peace of Mind, Where and When You Need It

RAD's Service Assured Access (SAA) and Service Assured Networking (SAN) solutions are all about enabling service providers and network operators to deliver the best possible service experience and seamlessly migrate to next-generation networks – all while increasing operational efficiency and reducing TCO.

Complementing these offerings are RADcare Global Services, a great resource developed specifically to help our customers receive the full benefits of our solutions with real-time service guidance, planning and preventive maintenance.

RADcare Global Services provide expert consulting and troubleshooting assistance, online tools, regular training programs, and various equipment coverage options – all designed to enable seamless installations and faster service rollouts. Moreover, our RADcare programs help service providers to meet their SLAs and avoid penalties, while private network operators can rely on full support for their mission-critical applications.

These vital services are available from authorized RAD Partners and backed by a highly dedicated and professional team of regional technical assistance centers, together with project management staff and international training professionals.



# RADcare Global Services



- Project Assured
- Guidance throughout design and rollout
- High- and low-level network design
- Support service migration and network upgrades
- On-site services



- Strict SLA commitments on response, service restore and resolution times
- 24x7 support, priority handling and escalation procedures
- RADcare Online portal for software updates and upgrades
- Optional multi-year blanket coverage



- Training-on-demand
- Regional sales, pre-sales and technical seminars
- RAD certification



- Project coordination
- Single point of contact
- Periodic meetings and progress reports
- Project-specific documentation

## Partner Benefits

- Strict service level agreements (SLAs): receive response, restore service and resolve issues within a known and guaranteed time frame
- Move to the head of the queue with priority handling by RAD support centers and round-the-clock access to RAD's experts
- Free access to RADcare Online, including regular software updates and patches, online/remote configuration assistance and RAD's FAQ knowledge base

## Customer Benefits

- Ensure optimal quality of experience for your customers by maintaining a high quality network
- Meet your SLAs and avoid penalties by minimizing service outages and enabling fast recovery
- Plan ahead to limit your spending on support and eliminate hardware repair costs related to old equipment
- Shorten time to market (TTM): rely on RADcare to support your operations so you can turn up new services faster



## RADcare Professional Services

RADcare Professional Services encompass all relevant aspects of the pre-installation design and rollout stages to get the new network up and running as quickly and as seamlessly as possible while providing additional vital benefits.

RADcare Professional Services include the following valuable elements:  
Planning • Staging • Site Survey • Equipment and Management Installation  
• Acceptance Testing and Commissioning • Resident Engineer



## RADcare Project Assured Service

Enjoy full Project Assured service led by certified RAD engineers who are committed to your project's success from start to finish. RAD offers different Project Assured packages which include:

- High-level design (HLD): thorough review of the physical topology, required hardware and software, and network management
- Low-level design (LLD): a definitive reference for system and network implementation, including detailed configuration instructions for devices, network management system and interfaces
- Configuration and testing performed by RAD experts to ensure ideal turn-up time
- Full documentation of your system's installation requirements for easier maintenance and future changes
- Commissioning design and execution so that the entire network can be certified before sign-off



## RADcare Project Management

RAD's professional Project Management staff ensures that your project will have a timely and smooth implementation from the planning stage through completion.

- A single point of contact (Project Manager) within RAD supervises all logistical, technical and commercial aspects of the implementation of all network solutions under your contract
- Periodic status meetings
- Detailed project plan procedures and documentation, regular progress reports, and management of all project aspects



## RADcare Training Center

RAD's training programs are designed to keep your team up-to-date with the latest RAD solutions.

- Technical seminars, web-based training and project-based training: a variety of on-site and remote interactive training options to ensure your engineers master your RAD equipment
- Course materials include a carefully balanced mix of lecture, demonstration and hands-on experience
- Topics include theory, configuration and troubleshooting



## **RADadvantage** *Partners Program*



# Welcome to the RADadvantage Partners Program

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Commitment. Trust. Respect. Partnership. These are just some of the values that comprise the essence of RADadvantage, RAD's channel partner program. Ultimately, the success of a partnership is measured by the benefits that are enjoyed by all parties:

the vendor, its partners, and their respective end-users. That's why RAD places immense importance on its network of channel partners and invests significantly in partner enablement, engagement and support.

## Shared Interests and Commitments

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RAD and its channel partners embrace a set of fundamental guiding principles:

- Delivering the highest quality products, solutions and services that create loyal end-users
- Maximizing customer satisfaction
- Conducting business in an atmosphere of trust and mutual respect
- Resolving problems with candor and good judgment
- Cooperating to win new business and improve existing opportunities

## RADadvantage Program Highlights

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The RADadvantage Partners Program is designed to incrementally reward partners based on achievements in annual revenues, service level accreditation and commitment. Designated partnership levels are reviewed and adjusted annually.

**RADadvantage Partners enjoy benefits such as:**

- Industry-leading margins
- Joint business development efforts
- Online and face-to-face sales and technical training programs
- Discounted demo gear
- Support for co-branded marketing activities
- Official acknowledgement of Partner relationship





# Welcome to RADacademy



RADacademy equips RAD Partners with the knowledge they need in order to sell, demonstrate, install, and support RAD's solutions for service providers and critical infrastructure.

## »Our Goals

- Present the unique value of our solutions, using the latest presentations and sales tools
- Deliver the know-how to configure, install and support our solutions
- Ensure that knowledge transfers from RAD to Partners globally, on a quick and consistent basis

## »Sales Training and Certification

This program is based on face-to-face training for new Partners/new personnel, followed by ongoing WBT. Solution Partners must attend the majority of the relevant WBT sessions.

## »Technical Training and Certification

This program begins with the annual regional technical seminars, where RAD's trainers introduce the latest features and functions. Some WBT sessions serve this purpose as well.

## »Web Based Training (WBT)

RADacademy's WBT is a popular, long-running program of weekly update WBT classes for RAD Partners, covering everything from product updates to the latest technology developments. During these live sessions, the participants are encouraged to ask questions and engage with our subject matter experts. There is also access to RAD's WBT archive where previous sessions are available for viewing.

## »End-User Project-Based Training

One of the main ingredients for a successful installation is the transfer of knowledge to the user.

RAD offers direct training to end-users, arranged via RAD Partners, on-site or at RAD headquarters. Our trainers' expertise will ensure that the implementation of RAD's solutions will be as smooth as possible.

In addition to classroom training (either on-site or at a RAD office), we also offer training via WBT.

» For more information, please contact [training@rad.com](mailto:training@rad.com)



[www.rad.com](http://www.rad.com)

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Your Network's Edge®

## RAD Group

RAD is the anchor of the \$1.35 billion RAD Group of companies, a world leader in communications solutions. A unique business philosophy distinguishes the RAD Group, which has incubated hundreds of Israeli start-ups since its inception. Each company in the RAD Group operates autonomously under a common strategic umbrella. This decentralized approach maximizes the advantages inherent in small business units, such as flexibility, entrepreneurial spirit and management focus. The companies coordinate strategy, sales channels and R&D efforts. Four RAD Group companies are currently traded on the Nasdaq Stock Market in the US, while the others are privately held by the group's founders and various venture capital firms.

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