

4 Choosing the Right Packet Network

Some power utilities are operating self-owned networks, while others lease some or all network services from a carrier or service provider. The preference for either approach tends to vary between regions according to regulatory, financial, cultural, and technological factors. According to Pike Research, the share of public wired technologies in utility networks “will decline, as traditional leased lines are replaced by newer and, in many cases, private, networking technologies. Private copper is projected to show a CAGR decline of nearly 18.2%, largely due to the use of new technologies (both wired and wireless), particularly with respect to SA and DA applications...fiber optic communications are projected to grow at about 7.9% on a CAGR basis, driven largely by utilities requiring higher substation bandwidth for applications including video surveillance systems at critical infrastructure points.”⁴

Whether self-operated or leased from a carrier, a utility communications network must include the functionalities described above and, in the case of the latter, include performance guarantees in the form of an SLA (Service Level Agreement) purchased from the provider.

When migrating to next-gen networks, utility network operators need to choose which technology to employ, with available packet-based options including carrier-grade Ethernet, IP, vanilla MPLS (Multi-Protocol Label Switching), MPLS-TE, and the newest variant – MPLS-TP. In addition, they can consider utilizing the new generation of Circuit Switching (CS) based on OTNs (Optical Transport Networks). Like SDH/SONET, OTNs can be used as the physical layer for reliably transporting legacy and Ethernet or IP traffic over fiber optic connections at rates from 50 Mbps up to over 100 Gbps.

Each of the packet-based networks listed above can fulfill the basic aim of reliably transporting information from place to place, but have quite different characteristics:

IP is usually discussed in the context of the user information interface, but in some cases, it can be used as a transport network. The IP suite does not define lower layers, and thus must run over Ethernet, OTN, SDH/SONET (PoS – Packet over SDH/SONET), etc. Similarly, IP does not provide standard OAM or APS mechanisms, rather leveraging its native routing protocols. However, these are not always rapid enough to meet stringent availability requirements. IP has a strong security component called IPsec, which can provide authentication, integrity, and confidentiality mechanisms, but at a relatively high operational cost.

⁴ Smart Grid Networking and Communications Report, 2012, Pike Research - A Part of Navigant Consulting

- Service continuity for legacy applications and equipment, even after core networks are replaced to Ethernet/IP/MPLS
- Circuit emulation solutions without compromising service quality or latency levels
- Ensure deterministic QoS for NGN services and advanced grid applications over packet transport using multi-priority traffic management, end-to-end OAM and diagnostics, and performance monitoring
- Multi-standard timing over packet synchronization, including 1588 Grandmaster functionality in the same communications device
- Multi-level redundancy options for Five Nines resiliency
- Future-proof solutions streamlined for Smart Grid communications and IEC61850 architecture, including reliable, low-latency Ethernet services between sites with real-time messaging, such as GOOSE/GSSE
- Help protect critical infrastructure and IP-based SCADA systems from malicious cyber attacks with cyber security and authentication protocols, such as SSH, SSL, SNMPv3, and RADIUS

Among the various options offered to utility network operators, RAD's hybrid solutions enable the use of a single device to migrate non-critical services to the new packet environment, while protection and other vital traffic is kept over the legacy SDH/SONET network for the duration of the transition period with a roll back option, thus allowing a phased transition without increasing the capital investment or operating costs involved in the process.

Conclusion

The move towards Smart Grids and next-generation networks in utility communications is already under way, requiring utilities to give special attention to their critical applications. Robust clock accuracy, QoS assurance, resiliency, and on-going performance monitoring are "must have" elements in any next-generation network being considered by utility network operators.

To meet specific utility needs and challenges, a typical smart utility communications network should include the following elements/capabilities:

- Support for legacy services and traffic

- Traffic management and hard/hierarchical QoS
- Synchronization
- Security

Utilities around the world are discovering that Ethernet has been engineered and standardized with exactly such qualities to become carrier-grade, and are now thus capable of meeting the exacting requirements of critical utility applications. While several packet-based networking options are available, a comparison between them outlines their respective strong and weak points. A combination of carrier-grade Ethernet in the access/aggregation with an MPLS core may, in many cases, satisfy these requirements while addressing the needs of various functions within the utility organization.

Utilities may operate on different schedules with regards to the move to smart communications, however they all share the need to lower migration costs and make it as efficient as possible. RAD Data Communications helps them achieve exactly that with a wide selection of utility-grade solutions, from multi-functional devices, providing the highest performance while optimizing the number of network elements to be deployed, to hybrid TDM/Packet solutions, which allow utility operators the freedom to choose the migration path that best suits their needs and budgets.

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