Why an IP/MPLS Network Makes Sense for Smart Grids

by Fai Lam - Tuesday, January 29, 2013


A foundation for the future

An end-to-end IP/Multiprotocol Label Switching (MPLS) communications network helps power utilities balance today’s business requirements with tomorrow’s goals. IP/MPLS has become the technology of choice for power utilities’ transmission and subtransmission communications networks. Now, power utilities embarking on new smart grid projects are looking to the benefits of IP/MPLS for deployment into their distribution and field area networks (FANs).

It used to be that electricity flowed in one direction — from large-scale generation plants through transmission lines into distribution lines and out to consumers. Distribution operators needed only minimal communications coverage in most of their low- and medium-voltage service territories. However, smart grid projects such as grid modernization, substation automation, distribution automation, and advanced metering infrastructure put new demands on the communications network — today and in the future.

With smart grid applications, power utilities have new requirements to support 2-way communications and information management. In addition, they must support non-traditional micro-generation elements that could unbalance the electrical load. That means control and monitoring must reach throughout the wider transmission and distribution networks as well as to new renewable energy sources. And, while communications networks must be expanded and enhanced, costs must be contained.

Deploying IP/MPLS into transmission, subtransmission, distribution, and FANs, gives a power utility a single physical infrastructure for all their operational and corporate communications needs. This allows them to:

- Increase operational efficiency to control costs without compromising power quality, functionality or reliability.
- Support existing mission-critical time division multiplexing (TDM) services while introducing new IP and Ethernet applications and smart grid services.
- Scale to increase services and grow the number of users, devices, applications and capacity.
- Improve network and operational system security to comply with new regulations and protect critical infrastructure.
- Increase network resiliency and availability while enabling advanced quality of service (QoS) to prioritize mission-critical applications over other traffic.
- Provide reliable transmission over different transport technologies including microwave and optical.

Convergence contains costs

As power utilities face growing challenges, including increased demands for reliable energy and new
smart grid applications, they can’t afford to continue deploying separate communications networks for each application.

Running IP-based smart grid applications over traditional Synchronous Digital Hierarchy (SDH) or Synchronous Optical Network (SONET) networks can quickly exhaust bandwidth and make operations more complex. In addition, power utilities need the ability to add applications and services without increasing the operational costs associated with equipment, maintenance and network administration.

An end-to-end IP/MPLS network helps power utilities reduce capital and operating expenditures (CAPEX/OPEX) without jeopardizing safety, security or reliability. The flattened and simplified network provides end-to-end service consistency, QoS, and operations, administration and maintenance (OAM). It also eliminates the complexity that is created when deploying, integrating, and maintaining multiple technologies in different parts of a multi-tiered end-to-end network.

Power utilities gain greater ability to contain both CAPEX and OPEX through:

- Granularity in bandwidth, scaling options, and statistical multiplexing that minimize the CAPEX required to deploy and to scale an IP/MPLS infrastructure.
- Simplified network management that helps to reduce OPEX.
- Supporting multiple applications and services with the same IP/MPLS network routers and switches that reduce CAPEX and OPEX.
- New devices and applications that improve operational and workflow efficiency.

Figure 1. A single network with a flatter architecture helps power utilities contain costs.

**Support for existing and new services**

Power utilities need a communications architecture that seamlessly supports traditional communications for existing applications and new IP and Ethernet communications for the smart grid. In technology terms, they need to combine the flexibility and scalability of IP with the predictability and reliability of TDM.

IP/MPLS gives power utilities the right combination of capabilities. MPLS adds the deterministic performance advantages of a circuit-based network to an IP network. It also enables network convergence, virtualization and resiliency. With IP/MPLS, power utilities can integrate new applications and run existing applications side by side on a common network.

IP and Ethernet are key communications protocols for the smart grid infrastructure. Ethernet provides the cost-effective, high bandwidth physical interfaces and communications medium. IP technology serves as a bridge between applications and the underlying communications medium. This allows power utilities to immediately deploy new IP-based smart grid applications, such as:
- IP-based supervisory control and data acquisition (SCADA)
- IEC 61850-based substation systems
- Synchrophasor systems
- Video surveillance systems
- Distribution automation
- Advanced metering infrastructure
- Voice over IP (VoIP), IP mobile radio, Wi-Fi® mobility, physical substation security and corporate LAN access

A single, converged network enables power utilities to migrate applications currently supported with TDM services to more efficient IP and Ethernet-based implementations. It also allows them to use a single IP/MPLS network and services management platform to introduce, operate, and troubleshoot new technologies and services.

Using a single network and services management platform simplifies network configuration and troubleshooting, and enables proactive awareness to help minimize service downtime.

**Built-in security features**

With the increasing risk of cyber attacks and other security threats, many governments are augmenting regulatory and security requirements. An IP/MPLS network provides a number of mechanisms to protect critical infrastructures:

- Access control lists, filters and authentication of signaling messages prevent session hijacking, spoofing, denial of service attacks and other malicious network behavior.
- SNMPv3 confidentiality and integrity features and Secure Shell (SSH) encryption provide strong password security.
- An integrated stateful firewall helps stop unexpected and unwanted traffic from entering the network.
- Network address translation (NAT) protects and hides private addressing space from external entities.
- Group encryption protects sensitive data during transit and ensures data integrity and privacy.
- Intrusion detection system (IDS) and intrusion protection system (IPS) capabilities detect and protect against network and traffic anomalies.

**A smart grid needs a smarter network**

Implementing a smart grid means different things to each power utility. However, the need to extend reach and performance to optimize real-time applications that drive smarter energy management and usage is common to all power utilities.

When selecting an IP/MPLS network solution, power utilities should look for a service-aware solution that:

- Minimizes CAPEX and OPEX.
● Offers at least the same level of reliability, QoS, and security as that of traditional utility communications networks. In a mission-critical environment, no compromise is acceptable.
● Supports multiple technologies to concurrently run existing TDM-based applications with a smooth migration path to IP and Ethernet services.
● Scales to accommodate changing requirements and a growing number of applications and services.
● Enables smooth integration of all mission-critical operations and corporate traffic requirements.
● Allows smart grid applications and services to be implemented in a rapid and cost-effective manner.
● Provides access and information to consumers so they can make informed energy consumption decisions.

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