Utility Wide Area Networks of Today & Tomorrow

Today's Reality!

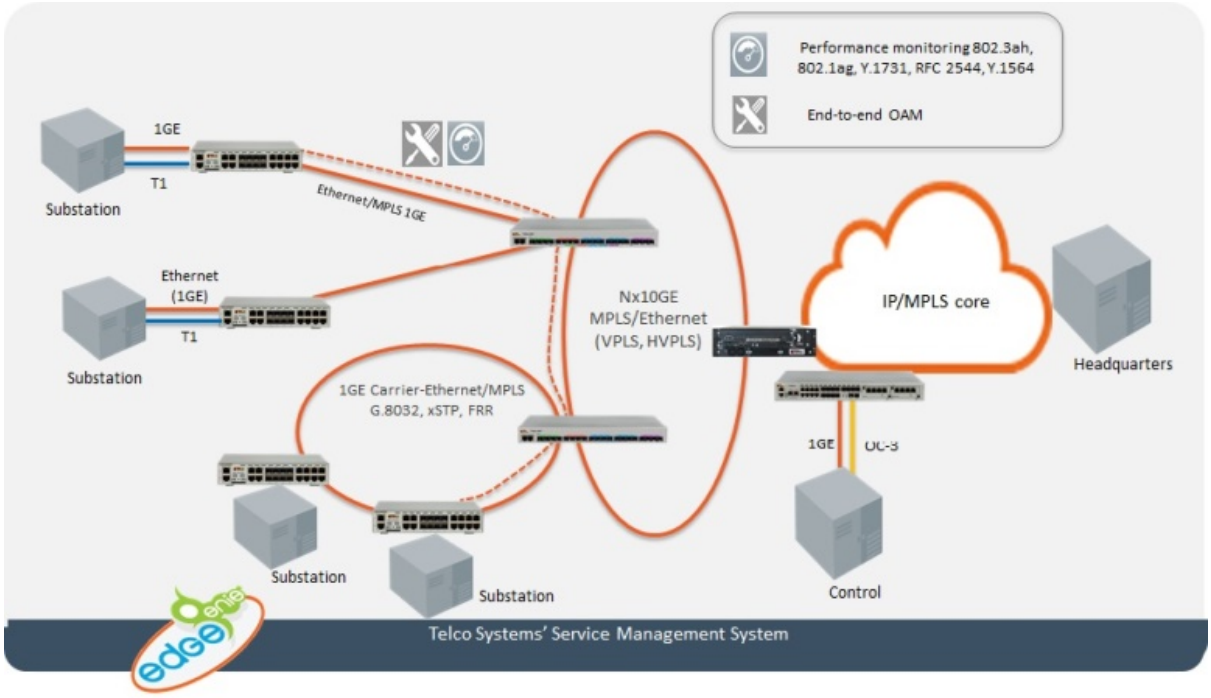
There comes a time when all utilities need to make a decision to upgrade their WAN networks from current legacy TDM and SONET based technologies to Carrier Ethernet or MPLS. Bandwidth requirements and networking complexity for substation data connectivity continue to increase. Legacy TDM and SONET based solutions are inadequate to meet the cost and network flexibility requirements needed for the future. Many TDM and SONET vendor platforms have reached end-of-life status and are difficult and costly to source and support.

Newer technologies such as Carrier Ethernet and MPLS are feature rich and can offer many advantages including lowering costs, higher bandwidths, better network utilization, and ability to flatten networks and eliminate overlays. These technologies also include a rich set of operations, maintenance and service assurance tools.

Many of the past concerns about moving to packet based networks were related to resiliency, availability and delay. Today, these concerns have been addressed by packet ring protection standards, service assurance tools, and other mechanisms that make packet networks capable of providing the levels of service previously provided by TDM and SONET.

With all this being said, Operators are facing the choice to either replace everything at once, which can be time-consuming and costly, or to upgrade over time while maintaining some of the older legacy equipment. In most cases during this transition both technologies will coexist for some time.

In this Telco Systems Whitepaper, we will discuss today's technologies and explore the advantages and benefits of evolving to a packet based WAN network. When considering upgrading a legacy network, Carrier Ethernet and MPLS are the technologies that should come to mind. There is no right or wrong answer when making a decision. It's whichever fits the needs. The nice thing about making this decision today is that Carrier Ethernet and MPLS are mature technologies with robust standards for services definitions coming from the MEF (Metro Ethernet Forum).



Benefits of Carrier Ethernet and MPLS

A key benefit of using Carrier Ethernet and or MPLS is the ability of these technologies to provide consistent, cost-efficient, high-performance, end-to-end connectivity with a robust set of options for data transport service types, operations maintenance and service assurance tools. Network consolidation technologies like MPLS, VPLS, and Circuit Emulation (CES) when implemented closer to the substation, allows for the traffic convergence from most any substation platform application over a single WAN transport protocol. This maximizes network flexibility, scalability and reduces operations and capital expenses.

Carrier Ethernet Operations and Maintenance Tools

OA&M or OAM stands for operations, administration, and maintenance. It is a general term used to describe the processes, activities, tools, standards, etc. involved with operating, administering, managing and maintaining any system. It is more commonly used in the context of computer networks or computer hardware.

Service OAM (SOAM) provides the service assurance over a converged network that service providers are looking for in an Ethernet network. Service assurance provides the detection, resiliency, and monitoring capabilities that are needed for service availability, increased service velocity, allowing auto-provisioning of equipment, and making end-to-end deployment easy through connectivity fault management and link-level protection.

Network Standards

- **Ethernet in the First Mile** (IEEE 802.3ah) - Defines mechanisms for monitoring and troubleshooting Ethernet access links. Specifically, it defines tools for discovery, remote failure indication, remote and local loopbacks, and performance monitoring.
- **Connectivity fault management** (IEEE 802.1ag) - Defines standardized continuity checks, loopbacks, and link trace for fault management capabilities in enterprise and carrier networks. This standard also partitions the network into 8 hierarchical administrative domains.
- **Fault management and performance monitoring** (ITU-T Y.1731) – In addition to Connectivity fault management, this standard defines performance monitoring (PM) measurements such as frame loss ratio, frame delay, and frame delay variation to assist with SLA assurance and capacity planning. For fault management, the standard defines continuity checks, loopbacks, link trace and alarm suppression (AIS, RDI) for effective fault detection, verification, isolation and notification in carrier networks.
- **Link layer discovery** (IEEE 802.1ab) - Defines discovery for all PEs supporting a common service instance and/or discovery for all devices (PE and P) common to a single network domain.
- **Ethernet Linear protection switching** (ITU G.8031) - Provides sub-50ms path protection switching to Ethernet trunks.
- **Ethernet Ring Protection Switching** (ITU-T G.8032) – Provides sub-50ms protection and recovery switching for an Ethernet network in a ring topology.
- The **RFC 2544** standard, established by the IETF standards body, is the de-facto methodology outlining tests required to measure and prove performance criteria for carrier Ethernet networks. The standard provides an out-of-service benchmarking methodology for evaluating the performance of network devices using back-to-back, frame loss, and latency throughput tests, with each test validating a specific part of an SLA. The methodology defines the frame size, test duration and number of test iterations. Once completed, these tests will provide performance metrics of the Ethernet network under test.
- **ITU-T Y.1564** defines an out-of-service test methodology to assess the proper configuration and performance of an Ethernet service prior to customer notification and delivery. The test methodology applies to point-to-point and point-to-multipoint connectivity in the Ethernet layer and to the network portions that provide, or contribute to, the provisioning of such services. This recommendation does not

define Ethernet network architectures or services, but rather defines a methodology to test Ethernet-based services at the service activation stage.

- **Active Measurement Protocols** offer a method for measuring one-way metrics between network devices. Two-Way Active Measurement Protocol (TWAMP) specified in RFC 5357, adds the ability two-way or round-trip measurement capabilities
- **MEF 8** - CESoETH "tunnels" TDM traffic through a Carrier Ethernet network. The packet network "emulates" a circuit-switched network, re-creating the TDM circuit and its timing Invisible to TDM source and destination equipment runs on a standard Ethernet Line Service (E-Line). T1, DS3, OC3, and OC12 TDM CES circuit types are all supported today.

Benefits of MPLS

MPLS stands for "Multi-Protocol Label Switching" packet-switching VPN technology. When MPLS VPN is used, incoming data packets are assigned a "label" by a "label edge router (LER)". Such labeled packets are forwarded along a "label switch path (LSP)". Along with an LSP, each "label switch router (LSR)" forwards a packet based solely on the instructions in the label. At each hop, the LSR strips the existing label and applies a new label that tells the next hop how to forward the packet. Finally, the LER at the destination system removes the label and delivers the packet to the destined address.

When multiple networks and services - business, residential, wireless - over a single infrastructure, are consolidated, the size and complexity of the network increase dramatically. In a single service network, services and customers are identified by VLAN. When multiple customers are running the same VLAN, tagging and prioritizing the service at any point in the network becomes impossible. It is at this point that we need the tools to give the ability to tag the service and the customer from the demarcation to the core.

Network consolidation: Technologies like MPLS, VPLS, and HQoS when implemented closer to the service access point can enable different types of service such as legacy TDM applications, video and other packet-based services to utilize the same transport protocol and infrastructure.

End-to-end service assurance: MPLS allows very granular identification of the individual services and along with advanced per flow per service CoS, policing and performance monitoring capabilities allows each individual service to be identified and assured throughout the network. The result is the ability to define and meet the performance characteristics required for each service and ensuring secure separation of the services.

Increased scalability: Since MPLS supports over a million labels which can be reused across the network (as opposed the 4000 VLANs in a Layer 2 Ethernet network), an MPLS network scales easily to support an almost unlimited number of customers and services.

Lower CAPEX and OPEX: Deploying L3 VPNs is an expensive and complex solution. Each supporting device needs to maintain routing tables, creating a full mesh of a routing cloud. Using L2VPNs supported by VPLS and HVPLS from the demarcation to the core, on the other hand, reduces the amount of resources required in the core routing equipment and places them in the access where they are simpler and more cost effective.

Optimize network resources: By implementing intelligence in the access network, core network resources, where per-port costs are very high, can be optimized to support significantly more services and create a more deterministic network. If traffic management and routing decisions can be made within the access network, some traffic may not need to traverse the core network at all. Requiring all traffic to pass through the core is analogous to traveling from Boston to New York by way of San Francisco – a waste of resources, energy and time!

How Can Telco Systems Help you?

Telco Systems has been a leading provider of network transport and access solutions to service providers and public utilities for over 40 years.

Telco Systems offers a robust, cost effective, portfolio of Carrier Ethernet, MPLS, and SDN\NFV market leading solutions that can meet most any utility network WAN requirement.

Our widely-deployed, industry-leading T-Marc and T-Metro solutions are designed specifically to address any network topology while meeting the stringent SLA's of our customers with flexible deployment options:

- Flexible transport protocol options: Carrier Ethernet, MPLS or IP
- Integrated legacy TDM support - Seamlessly interconnect legacy TDM components over a packet network
- Network Resiliency - Sub 50ms options include LAG, dual homing, G.8031(path), G.8032(ring) & MPLS FRR
- Deterministic service performance enabled by our flow & service classification, traffic policing capabilities
- Full-Service OAM, SOAM: 802.3ah 802.1ag, Y,1731, CCM, Alarms, LinkTrace, Loopbacks, Dying Gasp
- Layer 2 and Layer 3 Performance Monitoring - Standards-based Y.1731, TWAMP
- Service activation testing based on RFC 2544 & Y.1564 with built in traffic generator and reflector
- Security: Multi-level passwords, Radius, TACACS+, SSHv2, SNMPv3, ACL, Secured FTP
- Scalable bandwidth support: 10/100BTx up to 100Gig
- All services types – E-LINE, E-LAN, E-TREE, E-Access
- Temp Hardened and Weatherized Enclosure options for outdoor cabinet, pole or building mounts

Our Edge Genie web-based network management system simplifies the provisioning of transport services and allows in-depth monitoring of the services along with test, troubleshooting and reporting capabilities.

As substation and utility platform functions become virtualized, our NFVTime solutions provide both hardware and operating system solutions for hosting most any virtualized application.

Telco Systems is ready to help your move to the Next Generation Grid Network with a reliable, easy to manage, multi-protocol network that is ready to support your legacy service and delivering the performance required for your Smart Grid.