Carrier-Grade Ethernet Expansion Solutions

As you expand fiber to the FTTX, is your backbone ready?
Telco Systems products allow you to offer premium services without a premium price. This will allow you to skip WDM and go right to 100GE – available and ready now!

Introduction

Many businesses and service providers are migrating from 1GE/10GE to 100GE networks as they attempt to avoid the obstacles presented by heavy bandwidth demand, while leveraging the benefits that 100GE networking has to offer. The requirement for more bandwidth has become a constant battle. As internet usage continues to increase with the popularity of data and streaming services, so does the demand for more bandwidth. From connecting remote communities to education (homework, e-learning, campus networks), finance (online banking, stock trading, bill pay), and business purposes (company intranets, remote workers), to social media (Facebook, Instagram, Twitter, Snapchat), political (campaigns and outreach) and personal purposes, data requirements continue to rise – quicker than service providers can react.

In support of these activities, service providers are being driven to enhance their network backbone capacities in their business Ethernet, mobile backhaul, cloud networking, and SDN & NFV network applications.

The challenge with today's 1GE or 10GE Metro Ethernet Access Networks is: how do you upgrade your current network as fast and efficient as possible, without incurring a large amount of OPEX or CAPEX?

Identifying the challenges

Today's 1GE networks and 1GE rings use xWDM or LAG, so they're not going to be sufficient to handle the increased demand and will prove to be too expensive and too complex to manage.

- Access network Bandwidth increasing
  - Broadband video
  - Expanding access network footprint
  - 5G Mobile Backhaul is coming
- Existing Nx 1G or 10G core network is saturated
- Need solution that will scale for future without breaking the bank.

Today's Typical Approach:

- Add more capacity by adding additional 1GE or 10GE parallel core network links over new fiber
- Implement or turn up additional WDM wave lengths
- Add new or additional type 2 links
- Problem With Today's Business as Usual Approach
  - Inefficient use of bandwidth
  - Adds operations complexity by adding more boxes and physical links
  - Makes network traffic engineering difficult
  - Reduces network resiliency
  - Difficult to scale for future growth
  - Costly, resource intensive to deploy and manage

Questions:

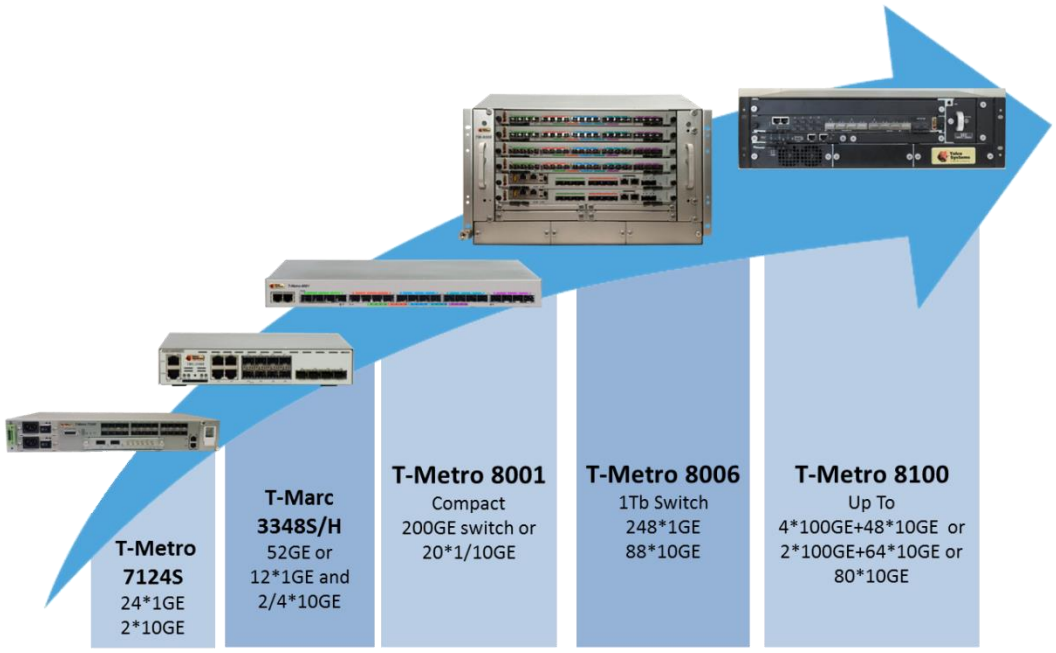
- Are you looking to replace existing legacy aggregation/transport equipment for better bandwidth scale and resiliency?
- Do you want carrier-grade Ethernet solution, with L2 to the local sites?
- Do you want to scale to Nx 10GE at L2 with site and node resiliency?
- Are you thinking about deploying a cost effective Packet Optical Transport (OADM/DWDM) 100GE solution for areas with limited fiber?

Telco Systems' Solution

- Deploy single high bandwidth Nx10GE and or 100GE single fiber or wavelength interconnect solution
- Remove or eliminate need for cost and complexity of WDM in the network
- Virtual traffic engineering of bandwidth
- Increase network resiliency while reducing network complexity
- Deploy cost effective, scalable, multi-services core network solution designed specifically for the needs of small carriers
- Future-proof solution: upgrading to 100GE will future-proof your network for years to come.
- This requires little to no integration effort, transparently addressing interop & resiliency requirements without the need for massive OPEX or CAPEX.

Carrier-Grade Ethernet Expansion Solutions

Telco Systems Aggregation, Transport and Core Products



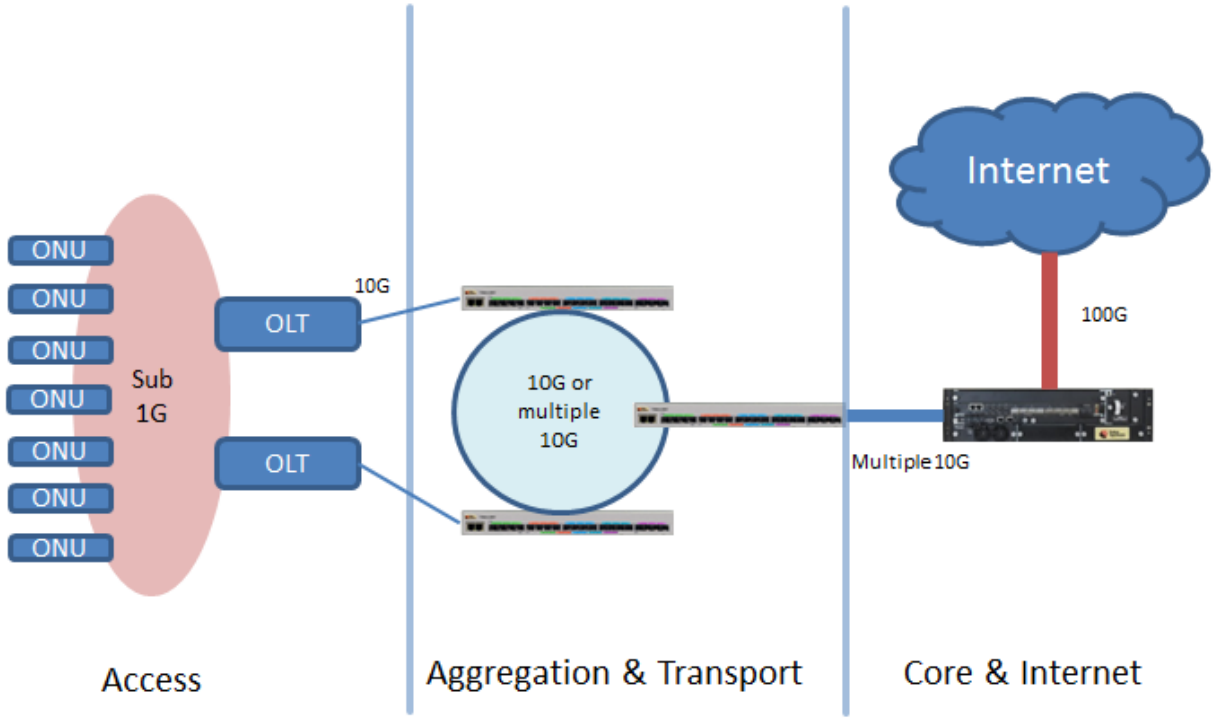
Products Benefits

- **Scalability** Good port densities on all products to meet location-based needs and available footprint. Ready for growth when needed or required.
- **Any Service Any Port** Run MPLS on ring links for dynamic ring resiliency while presenting L2 to access / edge devices
- **MPLS/VPLS** Allows for a resilient transport network that is transparent to the "client" network
- **MC-LAG** The client uses LACP, but is not aware it is in a LAG group with two server devices (TM-8001's). This reduces the need for protocol interoperability
- Deploy single high bandwidth Nx10GE and or 100GE single fiber or wavelength interconnect solution
- Remove or eliminate need for cost and complexity of WDM in the network
- Virtual traffic engineering of bandwidth
- Increase network resiliency while reducing network complexity
- Deploy cost effective, scalable, multi-services core network solution designed specifically for the needs of small carriers

Edge Genie NMS

- Offers comprehensive network management solution, Point and Click service provisioning - simplifying deployment of MPLS
- Provisioning of new services
- Adding new devices to the ring
- Allows for ease of monitoring and OAM

End to End Network - it's really multiple networks



Different Networks, different requirements. Each Network can't be treated the same.

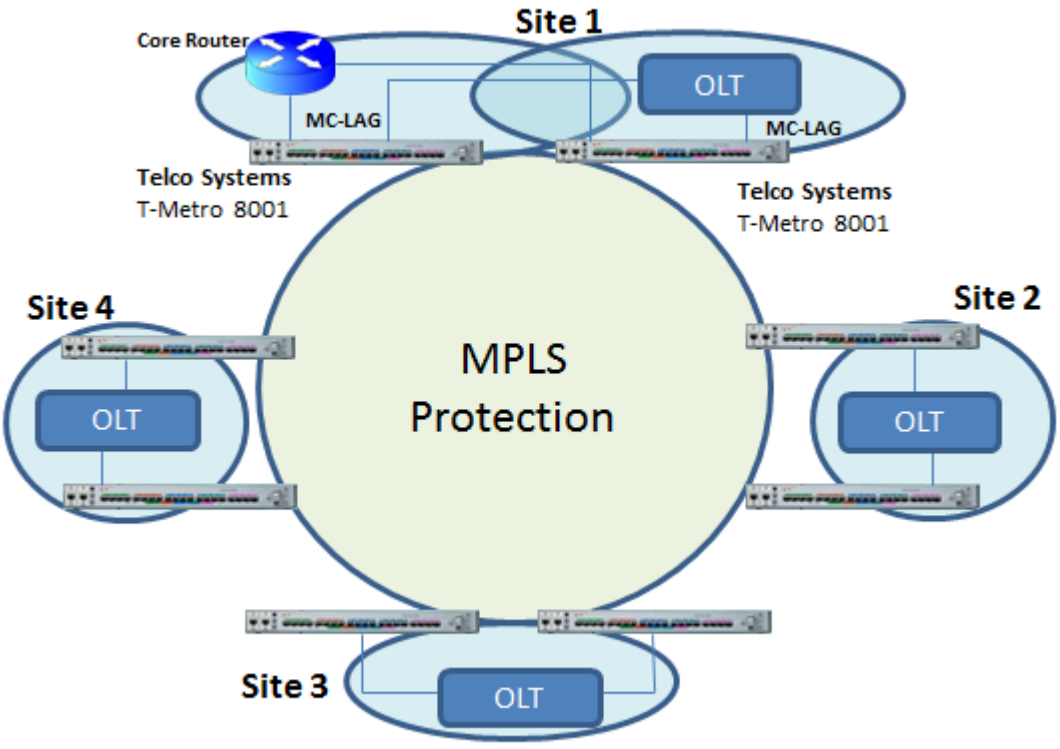
- **Access Network:** Normally sub 1G connections to subscribers, lower speed interfaces. Higher density of connections. Access platforms specialize in Access speeds and protocols
- **Aggregation & Transport:** Normally 10G or multiple 10G, higher speed interfaces
  Transport platforms specialize in resiliency and traffic engineering
- **Core & Internet:** Dense 10G or even 100G, highest speed interfaces
  Core & Internet Platforms specialize in service processing and upstream connections

MEF/MPLS Resiliency Solution for Protection Solution – Transparent Resiliency

A "mix or match" solution utilizing different platforms at different sites to the right size and cost the customers needs.

With this, customers can have resilient transport network that allows for a large amount of flexibility.

- Telco Systems BiNOX OS allows for a wide range of capabilities that POTS solutions do not have.
- MC-LAG is superior to chassis based solutions that utilize cross-card LAG by allowing for true device redundancy. Which provides a more reliable network with added redundancy.
- This solution is agnostic to the 3rd party client devices and allows for a wide range of 3rd party devices to serve as clients.
  - Platforms currently able to provide this solution:
    - T-Marc 3308, T-Marc 3312, T-Marc 3348, T-Metro 8001 and T-Metro 8100



Notes:

- **MC-LAG will be used for client protection**
- **MPLS Core is segmented from the rest of the network.**
- **All incoming services are tagged and placed in many-to-one Transport Protected LSP Trunks**

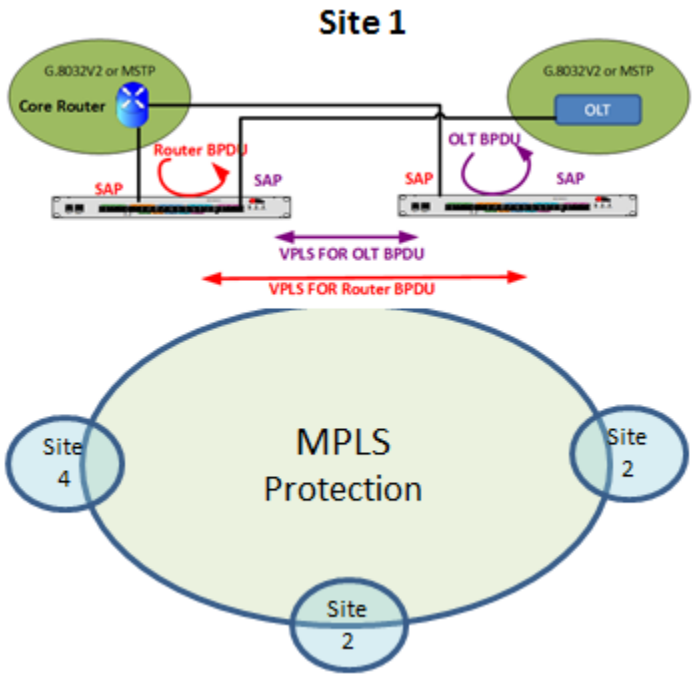
Non MC-Lag Solution

In some cases MC-LAG is not the preferred method of local protection. Telco Systems has implemented a solution for this situation also.

- We can provision a VPLS service between the Telco Systems local site devices to transparently transport the client's protection BPDU's to create a ring
- This solution can be applied at each local site isolating different vendor ring protocols in the network by transparently passing BPDU's between that vendors devices
- The client device could be using xSTP, G.8032v2 or some other mechanism for resiliency. If a link goes down the client's mechanism will switch traffic the other direction.
-

In this solution, the Telco Systems MPLS/VPLS network is still transparent to the local device and protocol integration is not required.

- This solution has been successfully implemented in live customer networks
- This solution is agnostic to the 3rd party client devices, allowing for a wide range of 3rd party devices to serve as clients
- Customers can have resilient transport network that allows for a large amount of flexibility



Notes:

- **MC-LAG MPLS Core is segmented from the rest of the network.**
- **All incoming services are tagged and placed in many-to-one Transport Protected LSP Trunks**
- **Client devices can uses xSTP, G.8032 or other mechanism for local resiliency**