12A2-1 (Invited)

Title: Verizon Optical Network – Strategic Vision

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Abstract:
Through network introduction of emerging optical technologies Verizon continuously enhances our end-to-end optical network. Spanning across Access, Metro and Long Haul domains, leading edge deployments include: xPON, ROADMs, WSSs, GMPLS, and $40G^{+}$ wavelength support.

Introduction:
Continuous advances in optical components and systems are being disclosed on an almost daily basis, promising to reduce costs, gain efficiencies and support advanced features and services.

Verizon is focused on transforming its network to meet emerging bandwidth requirements and applications. Use of next generation optical components, sub-systems and control plane enabled network elements is key to meeting such requirements. With strong emphasis on standards based interfaces.

Our vision is to build a fully automated end-to-end all optical network capable of supporting advanced services for Residential, Enterprise, Government, and Wholesale applications. Support for IP and TDM traffic must be done efficiently and transparently. To achieve this, advanced optical technologies such as Next Generation (NG) PON, ROADMs, WSSs, 40G/100G line rates, and others must meet the challenge of driving down network costs while being easy to deploy for rapid network scaling.

Presentation:
Presentation will cover how strategic vision and target architectures are being realized in overall network deployments.

In the ULH domain, supporting Global and National backbone network demands, a photonic optical mesh network is a fundamental necessity. These DWDM based networks must be capable of supporting multiple Tb/s of traffic, 100^{+} wavelengths, optical reaches with out regeneration often exceeding 3,000 Km for national and 12,000 Km for submarine applications, and scaling of client interfaces from 10G to 40G and beyond (e.g. 100^{+}G).

Reconfigurable Optical Add Drop Multiplexers (ROADMs), equipped with Wavelength Selective Switches (WSS), tunable optics, multi-rate client ports, and SONET ADM on a “blade” or “wavelength” have allowed for efficient system installation and network scaling. The combined impact of these optical component advancements has reduced build costs by over 50%, when compared to previous methods. Hybrid packet and TDM fabrics will further reduce network costs and allow for better integration and convergence of traditional network boundaries.

SONET mesh enabled with GMPLS Optical Control Plane will support the Metro/Core and ULH domains offering advanced new services and network protection/restoration scenarios. Service activation will take minutes for fractional and full rate GigE and OCn

services to be provisioned, and network faults will remain transparent but offer improved network robustness as routing alternatives will increase.

OTN G.709 promises better management of services across domains, and improves the ability to offer higher rate transparent services to our largest Enterprise, Government, and Wholesale customers.

Deployment of PON technology in the access domain has extended the last leg of the optical network to the mass market residential and small business customers on a massive scale. Evolving from B-PON to G-PON is already underway, and advancements will continue as the components evolve to support NG PON systems such as 10G, WDM, and hybrid PON.

Handling the growing expansion of fiber terminations and connections has created an opportunity for mechanizing the 'tried and true' manual optical patch cord and patch panel method of operation. MEMS, Beam Steering and Robotic switches are now available or nearing availability to automate fiber terminations and connections. Several critical factors still need to be addressed for large scale acceptance to occur. Depending upon the application, issues include: cost per connection, scalability of device, connection performance, and stability of connection during power failures. Moving to these devices will allow for: automated provisioning, better performance monitoring, centralized testing, physical layer network grooming, and additional fault/restoration techniques.

Conclusion:
As new services and applications drive the need for ever increasing transport capacity in the optical network, continuous scaling must occur by rapidly integrating new technology that support standards based interfaces. The transport network must also transition from an OSS (operational support system) controlled network to a dynamic control plane enabled network. A self aware network capable of recognizing topology, capacity, and elements to establish service routes, bandwidth allocations, and protection schemes to meet rigorous yet changing customer demands. In doing so, the end-to-end optical network must remain: accessible, predictable, scalable, reliable and survivable.

Adherence to open standards, with cooperation through the system vendor development cycles to reach common interpretation and implementation of industry standards will help improve time to market of new technology and enhance the customer experience.

About the author:

William C. Uliasz received his B.S.E.E. degree from Northeastern University, Boston, MA in 1987. He has held various technical assignments focused on the access and transport network during his 19 years at Verizon. He is responsible for setting the target architecture for Verizon Telecom a Director in the Verizon Technology Organization (VTO).