



## Executive Summary

ECI is augmenting its metro-optimized packet transport platform, the Neptune product line, with support for segment routing and Path Computation Element (PCE) functionality.

Since its inception, the Neptune portfolio has focused on the diverse needs and attributes of the metro transport market. To achieve this ECI has developed Elastic MPLS for its Neptune portfolio. Elastic MPLS provides flexible support for MPLS-TP, IP/MPLS and Carrier Ethernet with stitching between domains running different protocols. ECI is also committed to helping service providers develop open, disaggregated, flexible and programmable networks. Neptune software currently supports open interfaces and advanced data modeling with REST APIs, NETCONF and YANG.

ECI is augmenting its Elastic MPLS functionality and the Muse Software Suite to support segment routing, PCE and Path Computation Element Protocol (PCEP). Segment routing can simplify the network by eliminating LDP and RSVP-TE protocols. Programmability and best-path determination can be improved with centralized network visibility and path computation. Segment routing with external PCE also enables compute resources to evolve independently from the data plane.

ECI is committed to multi-vendor interoperability. ECI is participating in the 2018 European Advanced Networking Test Center (EANTC) multivendor showcase as part of the 2018 MPLS+SDN+NFV World Congress in April. ECI expects to deliver segment routing to customers in mid-2018.

### Key Findings

- ECI’s Neptune platform is optimized for metro packet transport.
- Elastic MPLS functionality on Neptune supports IP/MPLS, MPLS-TP and Ethernet, enabling customers to flexibly mix and match between these technologies.
- ECI’s Elastic MPLS does not require network homogeneity as it is smart enough to interwork between different network transport protocols and networking domains to create a seamless networking experience for service providers.
- Neptune supports open, programmable networking providing multivendor interoperability with REST APIs, NETCONF and YANG data modeling, as demonstrated at by its multi-year participation in EANTC.
- ECI is augmenting Elastic MPLS and the Muse Software Suite to include support for segment routing, PCE and PCEP.
- ECI anticipates new software availability in mid-2018.

## DEPLOYING IN THE METRO

The metro network is a diverse on-ramp for residential, enterprise and wireless services. A mix of Ethernet, IP and TDM services converge in the metro on a unified IP/MPLS network for transport to the IP Core.

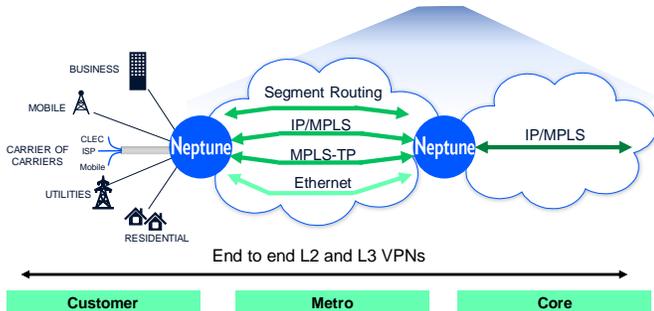


Figure 1: Metro Network Transport

With the evolution to fiber-deep architectures for 5G mobile services, multi-system operator (MSO) cable network evolutions with DOCSIS 3.1 and converged cable access platform and next-generation fiber-to-the-X networks with XGS-PON and NG-PON2, bandwidth growth continues unabated. IP traffic is expected to achieve 24% CAGR through 2021<sup>1</sup>. Global cloud IP traffic is forecasted to increase even faster at 30% CAGR through 2020<sup>2</sup>. ACG's optical port tracker estimates that the number of 100G+ coherent DWDM ports deployed in 2017 exceeded 360,000 units or a 42% increase versus 2016<sup>3</sup>.

## NEPTUNE OPTIMIZED FOR METRO TRANSPORT

ECI launched the Neptune product line in 2012 to provide a cost-effective, high-capacity, feature-rich, diverse-functionality portfolio for traffic aggregation with deterministic and resilient quality-of-service (QoS) delivery to the IP core. ECI consciously focused on optimizing price-performance for the metro transport market. As an example, if the product supported over a million routes as required for an Internet peering router, it would be cost burdened with excess memory. However, if the product was designed with the limited traffic management capabilities of an enterprise Ethernet switch, service providers would be dissatisfied with inadequate traffic classification and QoS performance. Thus, the design attributes of the Neptune

portfolio were specifically targeted to provide optimal performance, flexibility and cost with high resiliency for the metro transport function.



Figure 2: Neptune Portfolio

## SOFTWARE AND IP/MPLS PROTOCOLS

Given its metro location and the diversity in service provider networks and organizations, ECI designed Elastic MPLS to flexibly support IP/MPLS, MPLS-TP and Ethernet based networks.

ECI's Elastic MPLS does not require network homogeneity. With support for stitching and interworking, parts of the network can be deployed with MPLS-TP while other parts are deployed with IP/MPLS. Elastic MPLS is smart enough to interwork between the two domains and sets of protocols, creating a seamless networking experience for service providers navigating both worlds.

Elastic MPLS provides support for a rich IP/MPLS stack and service offerings. The product includes support for BGP, ISIS, OSPF as well as LDP for MPLS label distribution. IP/MPLS OAM functions include BFD, VCCV, Ping, Trace-Route and pseudo-wire ping (PW-Ping). Configurable IP/MPLS services include Layer 3 VPNs via RFC 2547bis/RFC4364, Layer 2 multipoint VPNs via VPLS/H-VPLS and Layer 2 point-to-point VPNs via MPLS pseudo-wires. Additional OAM support is provided via two-way active measurement protocol (TWAMP), enabling IP level test traffic to be generated by a sender node and reflected by a reflector node for round-trip performance measurement.

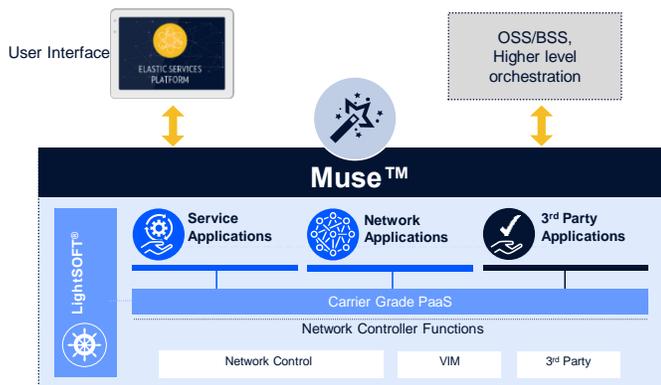
For service providers migrating from a SONET/SDH/OTN transport perspective, they may embrace a more static and connection-oriented approach to circuit creation

<sup>1</sup> 2017 Cisco Visual Networking Index.

<sup>2</sup> 2016 Cisco Global Cloud Index.

<sup>3</sup> Q4-2017 ACG Research Optical Network Report.

and data transport. MPLS-TP lends itself well to such an approach, with ECIs LightSOFT® network management system (an integral part of the Muse™ software suite) providing centralized control/configuration.



**Figure 3: Muse Software Suite**

### **NATIVE ETHERNET SUPPORT**

In addition to support for MPLS-TP and IP/MPLS, Neptune also supports comprehensive Carrier Ethernet functionality and service delivery and is MEF Carrier Ethernet 2.0 certified. Carrier Ethernet services are delivered either as native Ethernet or in concert with MPLS. Ethernet service functions include extensive OAM and performance management with Ethernet link OAM via 802.3ah, connectivity fault management (CFM) with 802.1ag, and CFM performance management with Y.1731. In addition, active throughput and service level agreement testing is supported via RFC2544 and Y.1564.

### **TRANSPORT SDN**

As networks change and workloads become virtualized and shift to public and private data centers, network designs and architectures are also evolving beyond traditional MPLS-TP and IP/MPLS solutions. Enterprises and service providers are embracing the concept of network function virtualization (NFV) and software defined networking (SDN), including Transport-SDN. One of the original design tenants of SDN was the clear separation of the data plane from the control plane, thus enabling each to evolve independently. Open application programming interfaces (APIs) are being used to abstract the underlying data plane, and data modeling is being utilized to create a unified network topology for visibility and hierarchical control.

### **ENTER SEGMENT ROUTING AND PCE**

As service providers migrate IP/MPLS and MPLS-TP networks toward SDN, two powerful approaches have emerged: utilization of segment routing to reduce control plane protocol complexity and external path computation for increased scale and enhanced best-path calculations. With segment routing, LDP and RSVP-TE can be eliminated from the network. Instead of utilizing RSVP-TE to distribute labels for traffic engineered paths, segment routing assigns segment routing identifiers (SIDs) to nodes and links that are then advertised into the domain by the interior gateway protocol. The source node at entry to the network can then express a path through the network from source to destination utilizing a stack of SIDs (segment list). Only the source or headend node is required to maintain flow-state information. Intermediate nodes only need to utilize the outermost label to forward the packet to the appropriate link/node.

By relocating path computation out of the routers and centralizing PCE per domain or hierarchically across multiple domains, service providers can enable PCE to scale compute resources independently from the underlying network elements. A centralized PCE with broad networking telemetry and a unified topology view has the appropriate intelligence to determine the optimal traffic-engineered or policy-constrained path through the network. A PCE can be stateful or stateless. With a stateful implementation, the PCE maintains a synchronized view of existing label switched paths. The PCE can then utilize its unified state information to determine the optimal initial path through the network along with calculating future path re-optimizations to maximize networking efficiency and performance. Industry-leading SDN controllers with PCE functionality bring together real-time network link utilization, performance data and flow policy/intent to construct the best path. Segment routing identifiers (SIDs or labels) can be communicated between the PCE and client network elements, like Neptune, via the Path Computation Element Protocol (PCEP), which has been around for some for years but has undergone a recent renaissance given extensions to the protocol by the Internet Engineering Task Force.

## NEPTUNE SEGMENT ROUTING

ECI is in the process of integrating segment routing and path computation element protocol into Neptune portfolio software. This source-based routing approach will support both internal and external PCE for optimal path routing. With existing Neptune software support for REST APIs, BGP-LS, NETCONF and YANG modeling, the Neptune product line is already well prepared for the move toward Transport-SDN with external control. SDN control and external PCEP can be delivered with the ECI Muse™ Software Suite or any compatible third-party controller. ECI plans to make this software update available in mid-2018.

## EANTC PARTICIPATION AND INTEROPERABILITY

ECI understands that service provider networks are multi-vendor environments and has been an active participant in the EANTC for many years. EANTC is well known for its extensive multi-vendor interoperability testing. ECI is providing multiple Neptune elements with updated software to EANTC's 2018 interoperability test lab for segment routing and PCE interoperability testing. Public results of the testing should be available in April 2018 in conjunction with the 2018 MPLS+SDN+NFV World Congress in Paris.

## CONCLUSION

ECI's Neptune product line is focused on providing price-performance optimized transport and service delivery for the metro market. With support for IP/MPLS, MPLS-TP and native Ethernet services, the product supports diverse networks and organizations. With open interfaces and data modeling, Neptune is helping service providers migrate toward more open and programmable networks. The inclusion of segment routing, PCE and PCEP will further aid service providers in reducing networking complexity while improving performance in the migration toward Transport-SDN.



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