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An Executive Brief on Routed Optical Networking

Introduction

Faced with rising costs and flattening revenues, communication service providers (CSPs) are exploring new approaches to improve their operational efficiency and halt the declining profitability equation. They are looking for a solution that offers investment protection for the massive growth of IP services without requiring linear cost increases in capital expenditures (CapEx) and operating expenditures (OpEx) to implement and manage these investments.

CSPs are trying to keep up with the rapidly evolving offerings of today's content and application providers. They need to create a more elastic infrastructure to meet the increasing demands of 5G, Internet of Things (IoT), and cloud-based applications.

To be successful, CSPs will need to eliminate siloed operations and buying decisions to integrate multiple network layers and eliminate redundant functionality to streamline management, upgrades, and service launches to simplify network operations. These challenges exist because most networks are layered and siloed into separate technologies and adding a service can now add cost at each layer. Redundant protection at those layers also results in poor network utilization and additional complexity.

The Cisco Routed Optical Networking solution addresses the operational and physical aspects of the network. Today, operational costs make up almost 80% of network costs. The high-cost pain points lie in the complexity of managing multiple layers, the power and space constraints, and lifecycle management. Services today run over routers, optical transport network (OTN) switches, optical transponders, and reconfigurable optical add-drop multiplexers (ROADMs) on a traditionally multi-layered architecture managed by different departments.

In the past, IP and optical integration, or IPoWDM, suffered from density tradeoffs and different technological advancement cycles. Organizational boundaries slowed the potential to leverage advances in automation. With this present mode of operation, it is difficult to properly optimize any network.

There is a transformational architecture causing significant economic disruption in electronics today and leading communication service providers (CSPs) to consider its adoption when compared to their present operating mode. Network processing units (NPUs) in routers can now scale from 10s to 100s of Terabits, and 400G optics are reduced in size and power, thus providing an opportunity to design and architect the network in very different ways than before. 2.4Tbps coherent pluggable optics are also coming to the market.

Perhaps most important is the five-year 57% OpEx savings from simplifying network management. Even better, total cost of ownership (TCO) for IP aggregation in mobile backhaul applications show savings of up to 50% in CapEx and 70% in OpEx.

Rethink your network

The Cisco vision for this new solution is to leverage the fundamental lifecycle changes happening in routers and optics and utilize those technologies in a different architecture. These technological advancements result in massive scalability in the Cisco 8000, NCS 5000, and NCS 500 routers, smaller footprint and higher functioning 400G ZR/ZR+ coherent optics, simpler DWDM line systems, telemetry software, and automation, all leading to a new network paradigm. Software advances in IP, optical, and hierarchical controllers assist in developing automation functions.

That new network is an architecture where all services are router to router. This is also called "routed optical networking." It will enable operators to maintain their growth and protect their investment over the next 10-15 years. Early models (ACG TCO) have proven more than 45% (see Figure 1) OpEx savings to date.

The routed optical networking solution works by converging IP and private-line services (TDM, OTN, fiber channel, and ethernet over SONET) onto a single internet protocol/multiprotocol label switching (IP/MPLS) network where all switching is done at Layer 3. Leveraging standarized protocols such as circuit style segment routing (CS-SR), routed optical networking provides the added insurance that the existing network can continue to deliver high revenue and value services for the provider, one wavelength at a time. Flexible management models are enabled through a single network layer for

"Progress is impossible without change, and those who cannot change their minds cannot change anything."
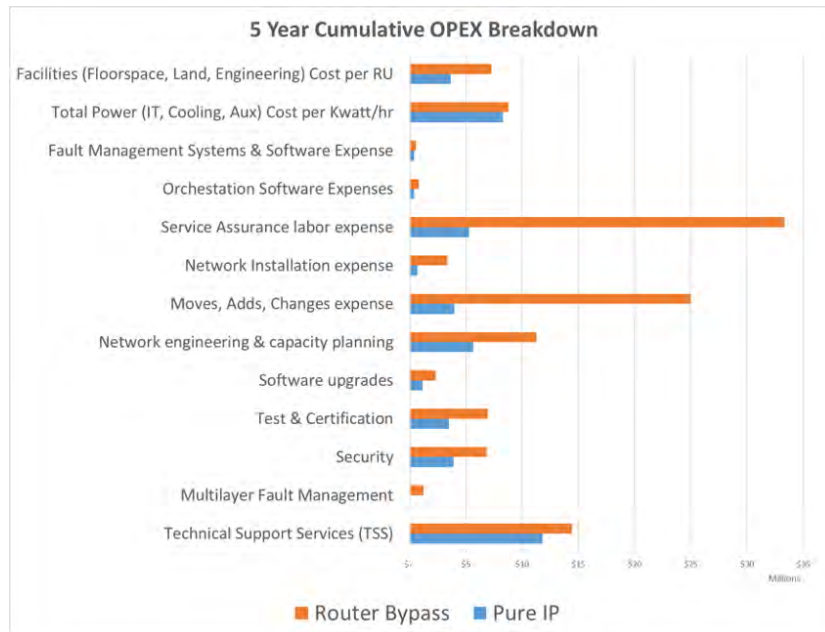
George Bernard Shaw

Figure 1. Five-year cumulative OpEx of IP transport to router bypass (Source: ACG Research 2020)
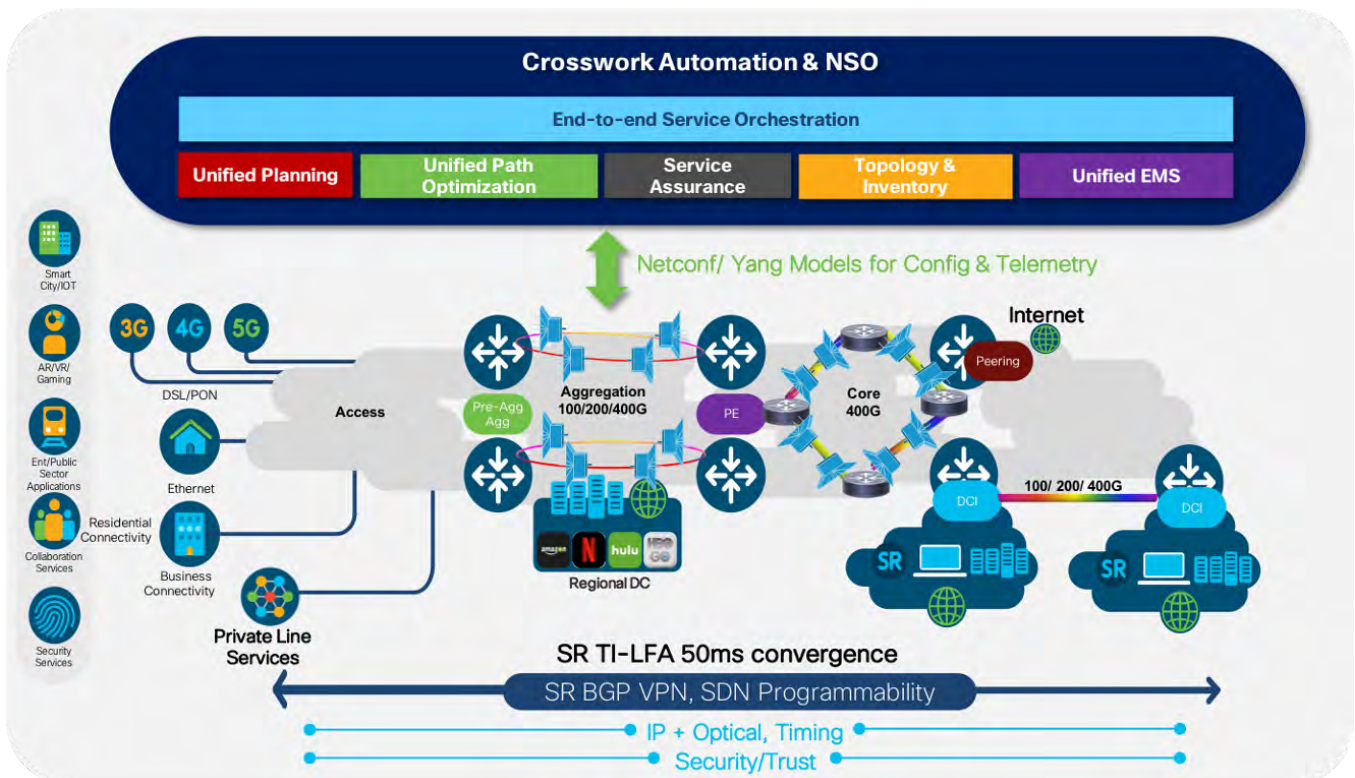

Figure 2. Routed optical networking architecture

model-driven programmability that provides automated turnup and provisioning for simpler network management. This simplified architecture enables open data models and standard APIs, allowing a provider to focus on automation initiatives for a simpler network topology (see Figure 2).

With the Bright coherent pluggable optic, the NCS 1010 Open Line System and private line emulation (PLE) are now supported, so providers can easily extend and expand their current ROADM networks with the next 400G wavelength

> "Cisco is fully committed to the Routed Optical Networking architecture. This is a strategic investment today across our routing, optical, management, and automation platforms."

Jonathan Davidson

Executive Vice President and General Manager, Cisco Networking

they deploy without removing any portion of the network. This seamless growth method to a routed optical network provides added insurance that the network in place can be leveraged, yet move the provider with ease into the new architecture wavelength by wavelength.

The benefits of the routed optical networking architecture result in simplified planning, design, activation, troubleshooting, and management. Reducing devices in the network enhances resiliency and availability, while it also optimizes wavelength and the embedded fiber capacity. In short, it simplifies all aspects of network maintenance.

Cisco and our Customer Experience (CX) team have also created multiple modeling tools with the Routed Optical Networking Architecture Transformation Advisory Service – consisting of a planning service, a solution validation service, and CX support services. For instance, one modeling effort took an operator's five-year growth plan and increased the traffic at a compound annual growth rate (CAGR) beyond their estimates, then extended it to a 15-year lifecycle. In this example, the converged architecture proved to be a significantly lower TCO investment. These modeling tools can take any complex network design and run it quickly without waiting weeks or months for results.

Conclusion

With the routed optical networking solution, sustainability is top of mind. With increased capacity and scalability, the reduced footprint and power for a lower carbon impact are significant. Network modeling of the solution shows up to 45% power reduction and up to 70% real estate savings. The modularity and programmability of IOS XR minimizes intervention during setup and operation, reducing offsite operations. Thus, there are fewer truck rolls and fewer maintenance windows. New packaging of optics and other platforms use less materials and have shifted to recyclable material to achieve customer carbon dioxide (CO_2) emission goals.

The economics of networking are changing thanks to a new generation of massively scalable routers and 400G optics, enabling the collapsing of layers that will result in simpler topologies and a lower cost per bit for both greenfield and brownfield networks.

Ultimately, this network optimization will provide efficient network utilization and accelerated time to service. Cisco is leading the way with this disruptive and transformational architecture designed to simplify the network and lower the TCO.

Learn more

Visit Cisco Routed Optical Networking for more information.