Converged SDN Transport: Changing the Economics for Communication Networks

Value statement

Cisco® Converged SDN Transport is a simplified, trustworthy, programmable network architecture that changes the economics of networks to deliver connected experiences at massive scale.

Overview

Over the past 20 years, the internet has scaled to address an insatiable desire for bandwidth to support streaming services, online gaming, cloud-based business applications, and low-latency critical services for healthcare and financial institutions. However, during the COVID-19 pandemic, this general appreciation for the internet became a critical dependence as the collective global community transitioned to remote connectivity for work, shopping, education, and healthcare. Under massive strain from this new demand, Communication Service Providers (CSPs) proved their ability to provide connectivity that could withstand unprecedented growth.

The bridge to possible

Benefits

The Converged SDN Transport architecture uses advanced technology and solutions to help service providers design and migrate to a network that scales to meet stringent bandwidth and performance demands.

Implementing this design may allow service providers to realize the following business benefits:

- Reduced operational complexity for network management
- Increased revenue with a service-centric network
- Improved time to market for new services
- Optimized utilization of fiber capacity
- Decreased costs

While connectivity didn't break, network weaknesses were exposed under this extraordinary demand. Years of adding new technology in support of emerging services on top of existing technologies and services has resulted in a complex topology that's difficult to manage. To scale quickly with demand, CSPs had to add new infrastructure rapidly and without the ability to plan or test the potential impacts. As a result, more complexity was added into the existing network management structure, increasing the potential for errors and failures.

Now we're witnessing the emergence of a hybrid work environment. Beyond just phenomenal growth, traffic is now originating and terminating all over the network as people work from home/office/vacation/out of country/outer space, so there's less predictability than when most of the traffic was only going to the core of the network. As this hybrid model becomes the new norm and more bandwidth intensive applications come online, using a Converged Software-Defined Network Transport (Converged SDN Transport) framework can help CSPs reduce the overall complexity of their network and operations. It also provides the controls into their network to satisfy the stringent performance needs of today's advanced service offerings and whatever tomorrow brings.

The need to scale networks quickly but reduce complexity and costs

During the early stages of the pandemic, the average internet traffic was up 21 percent at major peering points, and busy-hour traffic spikes hit 2.5 times their normal traffic levels.[1] With hybrid work solidly in place and more collaboration applications coming online, CSPs must satisfy consumer demand for latency-sensitive streaming content or cloud-hosted services from all network types: mobile, residential, and business networks. This demand increases the need for optimized traffic flows to eliminate congestion for high-priority traffic, and providers must consider a new strategy to minimize costs while maintaining high levels of service.

As CSPs work to integrate new infrastructure and capacity, now is the time to simplify network operations by reducing the number of moving parts with a flatter design. Reduce the complexity of managing multiple networks for different access types (mobile, business, and residential) by standardizing on one network for all services and use automation to build granular controls in support of dynamic traffic patterns to use all available capacity rather than overbuild with idle capacity.

A Converged SDN Transport architecture allows you to:

- Evolve from unified Multiprotocol Label Switching (MPLS) toward more neutral protocol options like segment routing and Ethernet Virtual Private Networking (EVPN) with an end-to-end IP design
- Converge wireline and wireless network elements for resource-efficient software-defined network slicing with scalable traffic engineering, a simplified protocol stack, and the ability to offer low-latency failover rerouting
- Converge optics and routing with 100G/200G/400G coherent optics directly in the router, helping to reduce Total Cost to Operate (TCO) with Cisco's Routed Optical Networking solution

References:

[1]. Cisco Internal Report on Covid-19 Impacts on Internet Traffic (March 2020, published in April)

Key capabilities

Use convergence to drive out complexity and cost

With the quantum leap in capacity and density available in new routing systems, CSPs can build a single network that will support a convergence of services on a unified infrastructure. Operating one end-to-end IP network allows CSPs to reduce the number of physical devices needed, simplify their protocol stack with segment routing and EVPN, and reduce operational complexity with a more efficient network design.

Convergence drives the need for more flexibility as the network must accommodate a wide range of requirements driven by new services that don't have the same performance requirements. With the uptake of telco cloud services, the network must be able to support high-demand, high-performance services that are delivered from distributed locations closer to the end users. This creates a strong dependency on the logical systems that will help bind the transport infrastructure and any distributed edge sites as end-to-end services must be built in a seamless fashion with resiliency to minimize the blast radius from outages. With traditional network architectures, scaling to meet these demands created complex layers of new hardware and software mixed with older versions and required an augment of the IP layer and then a corresponding augment of the supporting optical layer.

Fortunately, the cost structures of IP and optical technology have dramatically evolved. Advancements in silicon have significantly lowered IP routing costs per bit and innovation in optics allows high-speed coherent interfaces to plug directly into routers without the need for dedicated Wavelength Division Multiplexing (WDM) line cards. The convergence of IP and optical infrastructure into routed optical networking is now possible and practical These innovations reduce the redundancy of equipment and layers in the network and bring the buying cycles for both layers together, minimizing CapEx spending and network maintenance times. The converged transport network is slimmed and simplified for more agile and efficient operations, driving up to 46 percent TCO savings over current operating methods.

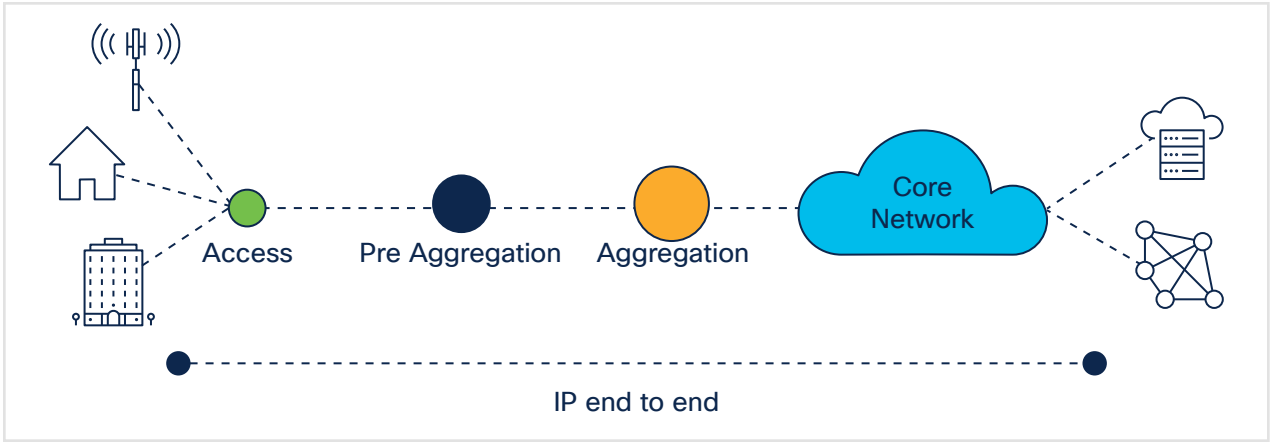


Figure 1. A single IP-based network simplifies management operations and improves network flexibility in support of dynamic traffic needs

The move to a converged architecture combined with a cloud-based service delivery approach helps CSPs decrease time-to-market timelines and create “hybrid” service offerings that can leverage any type of access technology (PON, FTTH, COAX , 4G/5G, Wi-Fi, etc.). In existing networks, these hybrid services would require engineering teams to stitch together new technologies serving specific purposes to deliver new services alongside existing ones. Over time, all these different technologies made networks challenging to manage as interoperability issues and troubleshooting complexity arose, and it prohibited innovation as design and testing cycles scaled linearly with complexity.

To meet the unique Service Level Agreement (SLA) performance standards for different service offerings, CSPs need end-to-end granular control to route traffic into different performance slices. This requires routers and network intelligence that identifies the end-user application wherever it resides and computes the proper network transport path to ensure performance. Segment routing acts as the foundation by providing the ability to label traffic packets by the performance needs of the service and offer varied Quality of Service (QoS) on any path segments. Segment routing dynamically routes traffic based upon service SLA requirements and uses computation elements to provide automatic rerouting to maintain performance during congestion, maintenance, or outage events.

Likewise, EVPN provides an optimal user experience by using SLA-based forwarding to minimize latency and maximize bandwidth. It extends from the data center to the metro/access level bridging the WAN, further simplifying the networking stack. From a management and operations perspective, EVPN not only speeds up service recovery and restoration, but also reduces day-to-day configuration and operations overhead, allowing CSPs to fast track the provisioning and delivery of L2 and L3 VPN services.

Eliminate operational silos and unnecessary network equipment with routed optical networking

Routed optical networking is a solution under the Converged SDN Transport architecture that delivers improved operational efficiencies and simplicity. The solution works by merging IP and private line services onto a single layer where all the switching is done at Layer 3. Routers are connected with standardized 100G, or 400G ZR/ZR+ coherent pluggable optics.

With a single service layer based on IP, flexible management tools can leverage telemetry and model-driven programmability to streamline lifecycle operations. This simplified architecture integrates open data models and standard APIs, enabling a provider to focus on automation initiatives for a simpler topology.

Existing networks rely on IP and optical network layers that are commonly operated in siloes. Despite several attempts to implement multilayer optimization solutions, CSPs are still grappling with OpEx increases and inefficient use of CapEx. But the situation is changing rapidly as functions traditionally delivered in separate chassis-based transponder solutions can now be delivered in a pluggable form factor. As coherent optics technology becomes available in pluggable form factors supporting up to 400G over long distance (400G ZR/ZR+), CSPs can consider architectural shifts to collapse layers and reduce operational complexity. Eventually the IP and optical networks could be combined into a single, simple layer.

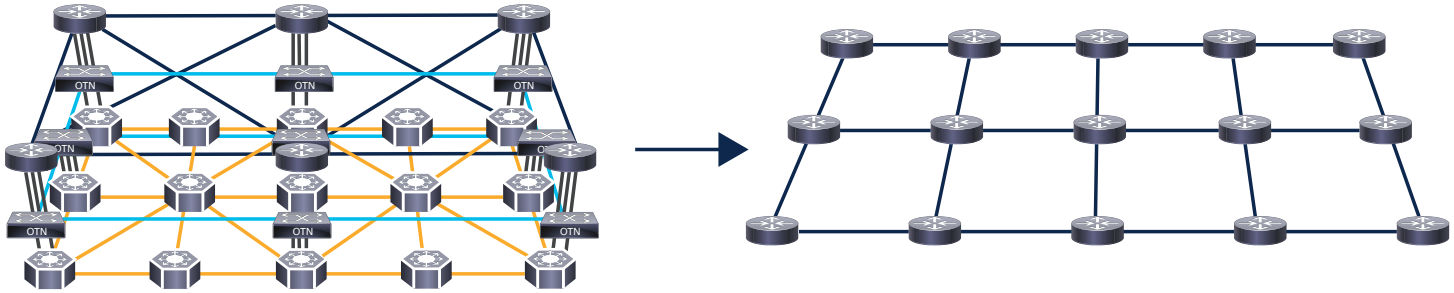
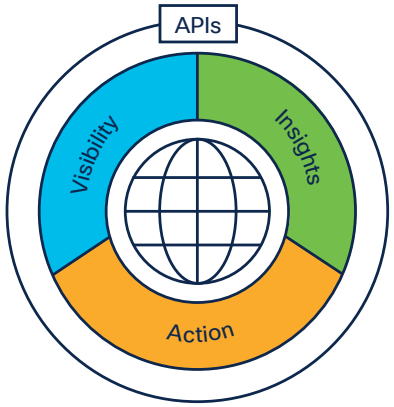


Figure 2. Converging IP and optical into a single control plane

Implementing a routed optical network requires a phased approach to facilitate an existing networks' evolution to start tactically rolling out digital coherent optics that can directly plug into routers to save on transponders. Later, operators can migrate legacy TDM and wavelength services to a full-IP infrastructure with Private Line Emulation (PLE) solutions, resulting in less of a need for OTN layer. Finally, operators can fully collapse IP and optical networks by entirely removing ROADMs and have routers connected router by router over point-to-point simplified WDM links. This overall simplification reduces the number of moving parts, removes management complexity, and serves to drive costs out of the network.

Maintain control and improve response times with automation

Migrating to a simplified, converged framework enables CSPs to improve operations by integrating automation tools into their network that can support scaling for traffic growth. With an end-to-end IP network, telemetry data can be consumed from anywhere, allowing the automation to detect and respond to congestion or other network events before they become a major issue. Automation must go beyond network element and service provisioning to address service assurance. This has become a top priority for CSPs, and Cisco has made significant strides in delivering the key capabilities to align with the changes occurring at the network infrastructure level. With the Crosswork suite of automation solutions, operators get dynamic network visibility and control of events and triggers to proactively mitigate issues that can impact critical services and ensure that client expectations are satisfied.



Visibility: Provide consolidated views on state and operations for both human and machine consumption

- Audit
- Topology
- Discovery
- Inventory
- Instrumentation (SW and HW)
- Telemetry and events

Insights: Operational Intelligence on health and trending of services underlying resources

- Network health
- Service health
- Traffic analysis
- Fault analysis/correction

Action: Plan, design, test and implement changes with both on-prem and cloud tools

- Network planning
- Service design
- Assurance
- Workflow, Operators and Controllers

Figure 3. Bring visibility, insights, and action together to deliver closed-loop automation

Using automation to help manage your network architecture has inherent operational cost benefits:

- Discovery and detailed visualization of topologies
- Automatic rerouting to multiple alternate paths during outage events offers improved network resiliency
- Historical and current LSP utilization, related policies, changes, and events
- Use advanced segment routing traffic engineering to build network slices for differentiated service levels to clients and facilitate new revenue streams
- Network maintenance is simplified because nodes can be programmed in or out of service without disrupting traffic
- Cloud-based test environments allow engineers to stress-test new infrastructure nodes or software and configuration designs before deployments

Gain flexibility with modernized software

To keep up with today's more flexible networks, network infrastructure operating systems need to modernize as well. The improved operational structure of Cisco IOS® XR creates a modern operating system that is designed to help engineers by:

- Providing a single operating system paradigm across the network: edge, aggregation, and core
- Reducing OpEx with custom loads of Cisco IOS XR based on the features you need
- Using a Linux design for easier provisioning and deployment
- Improving operational efficiencies with management API integration to provide near real-time, actionable telemetry data
- Allowing for automation to drive smoother implementations and remote configuration updates

Having a single operating system reduces the management complexity for a team of engineers and improves the operational efficiency of the network. With Cisco IOS XR, you can load and operate only the features you need for a specific use case, whether it's a full version load on a multipetabit core router or a scaled-back version that runs on a multigigabit access router.

With Cisco IOS XR, service providers build powerful automation into their network that takes advantage of the reporting tools and structure they already have in place. By integrating open APIs that access the software stack at all levels, Cisco IOS XR provides the custom access that service providers need to efficiently build and operate a network. For example, with the service layer APIs integrated into Cisco IOS XR, service providers use the same controller agent and telemetry data collection tools that have been used in the past. By combining these service layer APIs with the Open Forwarding Abstraction (OFA) API, engineers can make near real-time changes to network routes.

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The Cisco Advantage

Our networking services help you outline a strategy to achieve your desired business outcomes. We help you navigate evolving technology and digital transformations, prepare your business for emerging trends, and address risks and compliance. Using our expertise, tools, and methodologies, you can improve efficiency and build an agile network for the future. At Cisco, we continuously work to innovate our communication network platforms so CSPs can build personalized networks that meet the needs of their users.

Learn more

Take a few minutes to discover more about the Converged SDN Transport solution, and if you'd like to know more about the routing or software products mentioned above, please visit the service provider solutions page.

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