White paper
Cisco public

The bridge to possible

A Network Designed to Thrive in the Future of Work

Contents

Catalysts for change

Over two decades, the internet has added $13 trillion to equity market capitalizations globally[1]. In the same period, operating communications networks that provide internet services has grown exponentially more difficult and costly. Profitability is a constant struggle made worse by the operational complexity with legacy architectures. Typically, it costs $5 in OpEx for every $1 spent in CapEx[2] and with traffic growing at over 35 percent CAGR (mostly due to video)[3], this cost imbalance will only worsen. The costs of building and running a traditional network seem to punish any success because they're reaching the limits of scale.

In early 2020, the world changed in the blink of an eye. Physical contact was replaced with web conferencing, and distance learning became the fallback for children from kindergarten through college. Internet traffic spiked by 25–45 percent in various regions across the globe[4]. The internet bent but did not break. Communication Service Providers (CSPs) were the heroes that maintained the connectivity for critical services to function. Eighteen months later, a new normal for the future of work has emerged based on a hybrid environment.

As offices slowly reopen, employees expect a more flexible environment where the term "work" refers more to what they are doing as opposed to where it's performed. CSPs again will be challenged with this shift as many of their networks were built based on profiles and assumptions which are no longer optimal.

The current complexity of traditional network architectures is deeply rooted in history. Long ago, voice traffic was carried on copper lines over strictly voice networks. At higher speeds, the economics inverted, and voice traffic was carried over data networks using Voice over Internet Protocol (VoIP). While transport technology shifted, operational architectures did not. A tradition of using separate networks with multi-layered architectures for each discreet service has grown unproductively redundant, complex, and expensive to operate.

Even as CSPs have adopted end-to-end IP transport networks, higher speeds, larger scale, and disjointed architectures challenge the economic viability of the network infrastructure.

In the wake of the pandemic, analysts have estimated that the world accelerated digitization rates by seven times[5]. In the US, 75 percent of companies are accelerating technology transformation[6]. Globally, 88 percent of enterprises have encouraged employees to work remotely[7]. A hybrid model for in person and remote environments will require a dynamic network to adjust to application performance needs, security, and continued growth in traffic volumes. The hybrid model will be overly complex for CSPs as applications transit mobile and fixed environments, and more devices coming online will require constant traffic prioritization to guarantee the customer experience. Additionally, the shift from traditional perimeter-based security to Zero Trust adds another level of complexity to the network infrastructure and operations. The hybrid nature of work and community means that CSPs will need to expand the reach of their networks to bring high-speed connectivity to underserved and unconnected areas to help people living in those places participate in digital economies and communities.

Fortunately, the cost structures of IP and optical technology have dramatically evolved. Advancements in silicon have dramatically lowered IP routing costs per bit and innovation in optics allows high-speed coherent interfaces to plug directly into routers without need for dedicated Wavelength Division Multiplexing (WDM) line cards. The convergence of IP and optical infrastructure into Routed Optical Networking is now possible and wise. These innovations reduce redundancy of equipment and layers in the network. 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.

[1] ARK Investment Management LLC, 2020 based on data sourced from World Federation of Exchanges, "H1 2020 Market Highlights", Aug 2020, https://www.world-exchanges.org/news/articles/h1-2020-market-highlights
[2] Assembled by averaging various Tier 1 CSPs public records of spend across the globe (2018). Ratios ranged from as low 4x to as high as 7x. Web-scale companies by contrast can report ratios as little as 2x to 3x.
[3] Cisco AIR 2020
[4] Data pulled from peering traffic points around the globe.
[5] How COVID 19 Has Pushed Companies Over The Technology Tipping Point, McKinsey Survey, Oct 2020
[6] Fortune 500 CEO survey: How are America's biggest companies dealing with the coronavirus pandemic? 14 May 2020. Link: https://fortune.com/2020/05/14/fortune-500-ceo-survey-coronavirus-pandemic-predictions/
[7] Gartner HR Survey Reveals 88% of Organizations Have Encouraged or Required Employees to Work From Home Due to Coronavirus. 19 March 2020. Link: https://www.gartner.com/en/newsroom/press-releases/2020-03-19-gartner-hr-survey-reveals-88--of-organizations-have-e

Keeping up with the new normal

Why are these innovations and advancements important? With the proliferation of technologies like AI, ML, and IoT as the key enabler to telemedicine, smart farming, and smart energy, the network is critical to delivering these services whether through 5G and/or Wi-Fi 6. As 5G deployments accelerate, CSP networks need to be flexible to shift with variable market demands and service awareness to prioritize traffic flows throughout the network. The most innovative companies have begun transforming their network to handle these diverse demands and performance requirements, while some are just now recognizing the need for evolution.

In a 2019 report, IDC categorized CSPs into five groups based on their current and planned processes around network operations and automation: Ad Hoc, Manual, Adopter, Developer, and Pioneer[8]. In late 2020 and early 2021, IDC updated their initial study to research the impact of COVID-19 on this group of CSPs[9].

With their updated research, IDC found that most of the CSPs initially classified as Pioneers felt exceptionally prepared for the bandwidth demands generated by COVID whereas those classified as Ad Hoc felt unprepared. Pre-pandemic, Pioneers were embracing virtualization and automation by moving data to the cloud, Virtual Desktop Infrastructure (VDI), remote access, collaboration, and mobile connectivity. The Pioneers were better able to handle the change and distribution of traffic as people participated in more video conferences and consumed more streaming video due to being home.

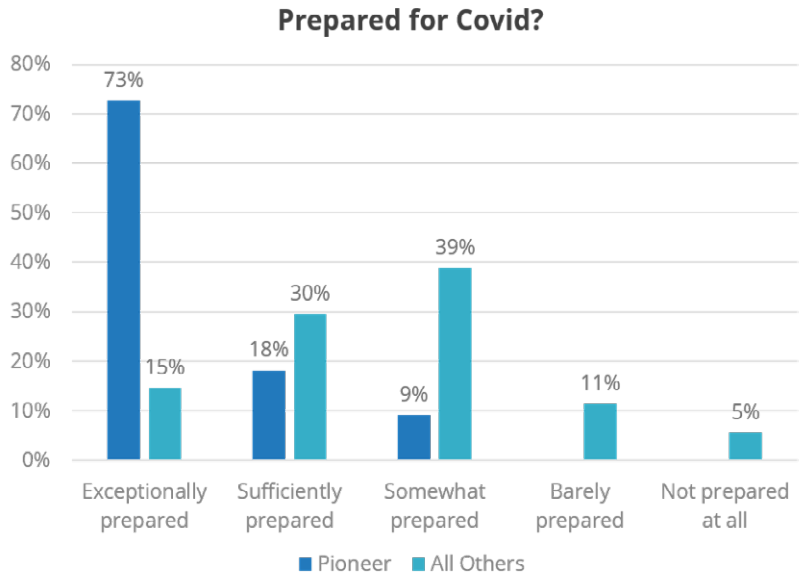

Figure 1. How prepared were CSPs for COVID?

Source: IDC 2021 Research: The State of Service Provider Digitization, Cisco Knowledge Network Service Provider Webinar Series

During the pandemic, Ad Hoc, Manual, and Adopter CSPs were challenged by:

- Low digitization and automation meant managing the network remotely was very difficult. VPNs, proper access, proper user authentications, troubleshooting with limited tools, and bandwidth (home access) were all major hurdles.

[8] 2019 Report: IDC White Paper, Sponsored by Cisco, Improving Service Provider Business Performance Through Digital Transformation, Doc. #US44781119, May 2019

[9] 2021 Report: IDC White Paper, Sponsored by Cisco, Service Provider Business Performance Improvement Through Digital Transformation: Changing Priorities in 2021, Doc. #US47842721, June 2021

- Spending time, money, and resources just staying afloat rather than moving forward with new service offerings, network expansions, and upgrades.
- Short term vs long term vision and planning. With a long-term view, the Pioneers accepted a shorter-term risk of increased costs that has come to reward them in the form of leading the market out into recovery and driving new service offerings to capture market share.

According to IDC's updated research, Pioneers were better able to realize business outcome improvements such as employee productivity and revenue growth as compared with Ad Hoc.

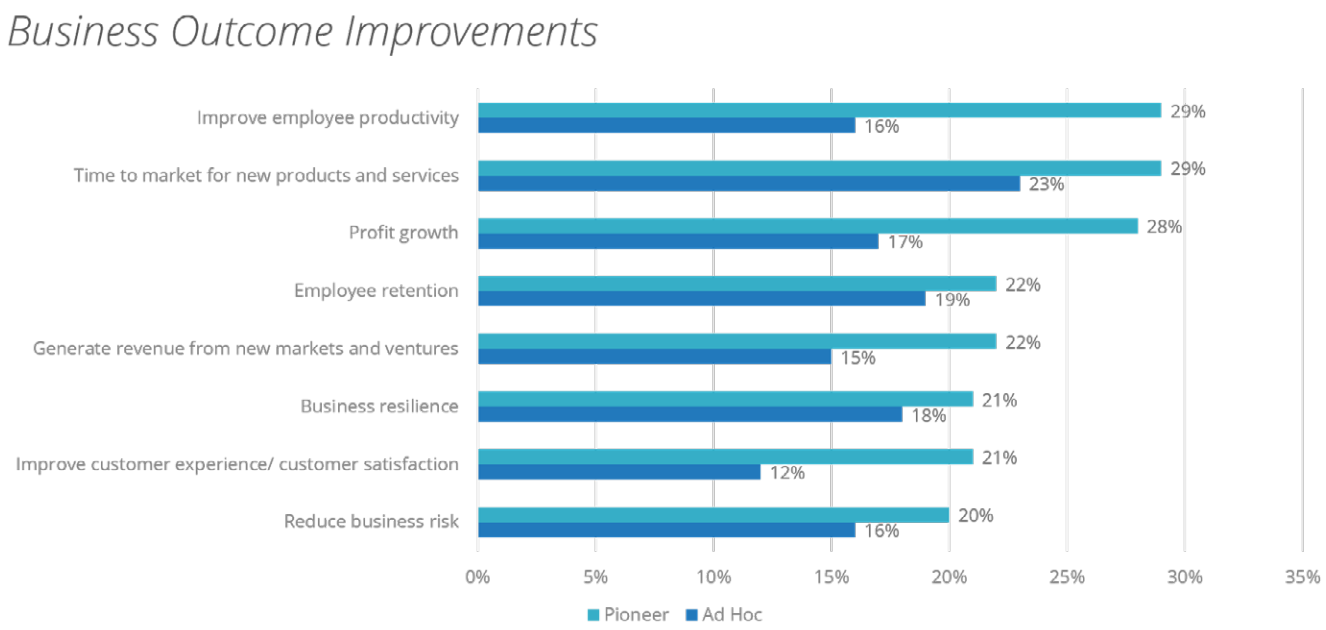

Figure 2. How Pioneers compared to Ad Hoc

Source: IDC 2021 Research: The State of Service Provider Digitization, Cisco Knowledge Network Service Provider Webinar Series

With very high automation maturity, Pioneers were able to innovate faster, grow business by adding new customers and services, and increase revenues. Ad Hoc CSPs were paralyzed; having only the ability to focus on preserving business continuity. CSPs can make minor adjustments to margins by just optimizing CapEx and OpEx, but they cannot grow revenue or their company that way.

Advanced features and technologies such as Segment Routing (SR MPLS and SRv6), circuit emulation, and Ethernet Virtual Private Networking (EVPN) equip CSPs with end-to-end traffic control capabilities to deliver unique network experiences. As a result, they can build a myriad of network slices with specific end-to-end Service Level Agreements (SLAs) to support the evolving needs of content, application, and mobile providers, as well as expanded support for video traffic used in telemedicine and other critical services. With network experiences custom fit to performance needs, CSPs can open new revenue streams.

The Pioneers and Deployers are ready to support the 5G service evolution, and they were able to plan and deploy new service offerings during one of the most hectic events ever to impact CSP networks. They've positioned themselves as market leaders for emerging services and will enjoy double-digit capitalization rates while the remaining providers are playing catch up.

How do we get there?

How are the Pioneers and Deployers making this transition work for them? They're using the principles of a unified converged SDN transport network. The principal pillars for the Cisco Converged SDN Transport network are:

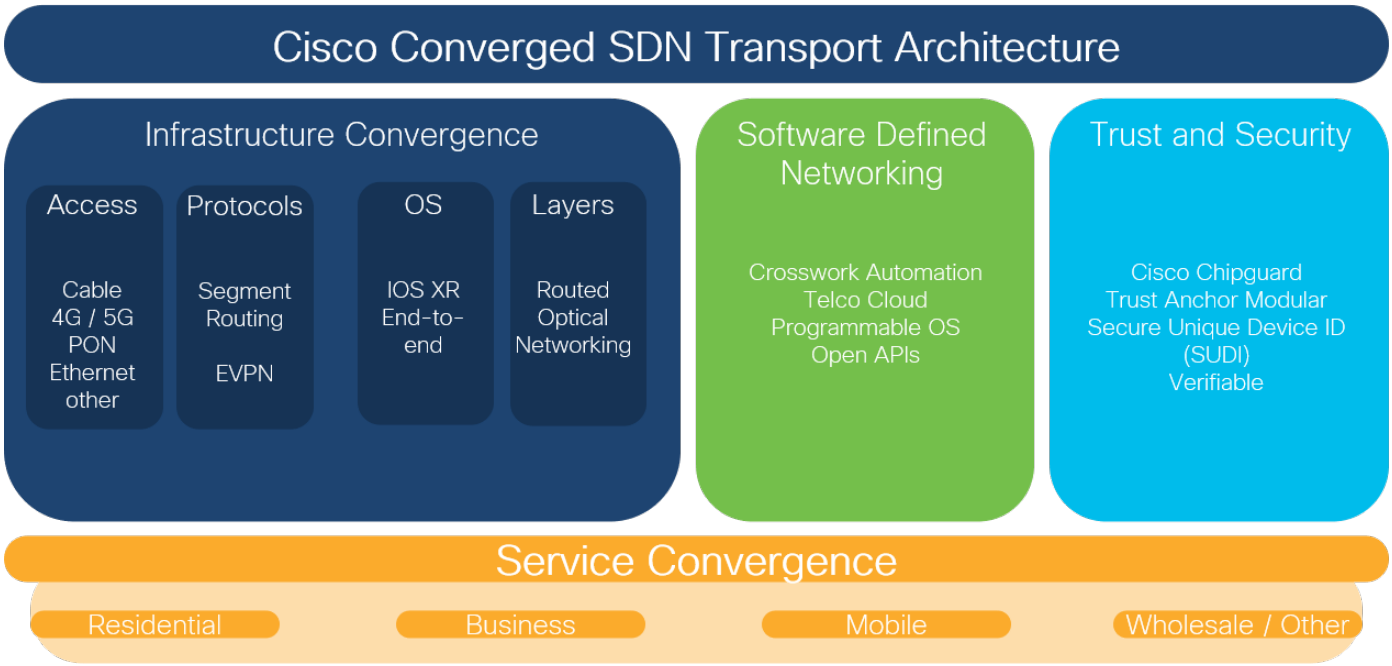

Figure 3. Cisco Converged SDN Transport architecture pillars

1. **Access Convergence**: The architecture flexibly converges different access methods (e.g. ethernet, cable, 4G/5G, etc.) using various access platforms onto a common IP backbone. This enables support for a wide variety of last-mile connectivity options to share the economies of a unified network architecture.
2. **Protocol Convergence**: Converge protocols and services to SR and EVPN. This reduces the effort in design and testing for new functions and interoperability to lower time-to-market for new services. Unique features such as 50ms failover, bandwidth reservation, two-way path creation, and Time-Division Multiplexing (TDM) service emulations are supported with real-time programmability, which are essential to delivering traditional optical line services over an IP network.
3. **Network Operating System (NOS) Convergence**: IOS XR provides consistent, advanced, end-to-end telemetry and unified management and operations across the network from access to the core.
4. **Service Convergence**: To meet SLAs, separate networks were common for various services such as business, residential, mobile, and wholesale. These services can converge on a single network to reduce inefficiencies of operating separate parallel networks and enable the possibility of crossover services and unified experiences.
5. **Network Layer (IP and Optical) Convergence**: This is the most difficult level of convergence but promises the biggest impact on future profitability and operational viability. It involves a multi-phased journey that begins with integrating pluggable optics into the routers to reduce/remove optical transponders for more efficient operation of the IP and optical network layers. The Routed Optical Networking solution advances the journey using a hop-by-hop connection over point-to-point WDM links which potentially allows removal of the Optical Transport Network (OTN) layer.

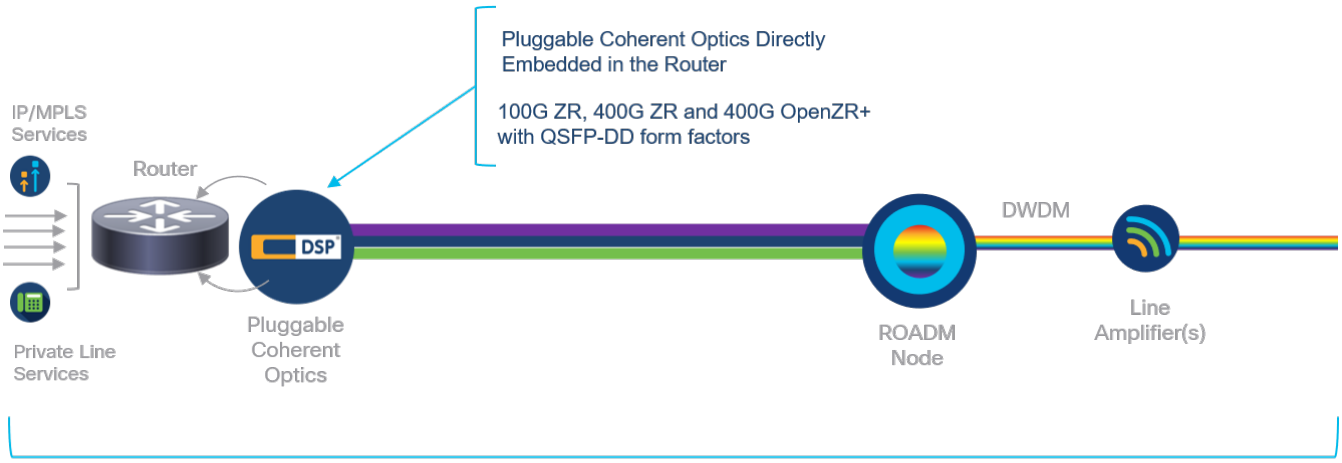

Figure 4. IP and optical layer convergence

Furthermore, automation tools can be integrated into all areas of the IP network and consume real-time telemetry data. This data can be further processed to provide actionable intelligence or network status back to operations teams. This way, operations can reduce service impacting configuration errors and reduce the instance rate of unexpected traffic flow impacts that might result from implemented changes. Additionally, this data can be used within the automation tools to improve network resilience and streamline service activations. Using Segment Routing Path Computation Elements (SR PCE) and EVPN orchestration, operations teams can implement policies that consume the data and provide fixed responses to changes in the network in real time, reducing the need for human interaction and ensuring maximum utilization of fiber assets to improve ROI.

By being proactive in preparing their networks, Pioneers and Deployers have come out ahead during one of the most significant periods of traffic growth anyone could have imagined. With this preparation these two CSP segments can now realize the following business benefits:

- Reduced operational complexity of their networks
- Increasing revenues with a network focused on service and application performance
- Improved time to market for new services
- Optimized utilization of network resources
- Increased network resilience
- Decreased OpEx and CapEx

Conclusion

Under the enormous traffic strain generated by the pandemic, the internet bent but didn't break. It enabled the world to adjust to a new future of work based on hybrid environments. As these hybrid work environments take hold and the pace of digitization continues to accelerate, CSPs will be increasingly challenged to balance business continuity and the customer experience with launching new services and revenue streams. We're at a unique inflection point where innovations and advancements in technology are finally aligned to allow us to make evolutionary changes to networking and connectivity. The status quo and ad hoc have been acceptable in the paradigm of "good enough" networking, but CSPs are finally able to leap forward and be pioneers in the Internet for the Future.

Take a closer look at Cisco's Converged SDN Transport architecture and decide for yourself.