

Accelerate Next-Generation Network Architectures

Why breakthroughs in connectivity are key to technological evolution

More demands mean more bandwidth

The Internet has changed how people share experiences. In the past, people used static pictures and words to describe an event. Today, we share our experiences in real time around the globe through Internet-enabled platforms with live streaming social media services. Additionally, the growing prevalence of Internet of Things (IoT) devices is driving increases in bandwidth and mobile consumption to manage those devices. The addition of immersive experiences such as virtual reality will further increase bandwidth consumption. With mobile network technology like 5G and Wi-Fi 6 launching to support the growth in connectivity demands, service providers will have a difficult time balancing costs and network performance.

Contents

- Confront the revolution
- Improve the technology to keep up
- Maintain control with automation
- Gain flexibility with modernized software
- Innovate to move forward
- Learn more

Confront the revolution

Humans are social creatures, and in the past, people formed communities with other people in close proximity, such as at schools, neighborhoods, or offices. Over the past three decades, technology innovations have expanded communities to include connections with people around the globe. The term fourth industrial revolution is used to describe the exponential changes to the way we live and interact because of the adoption of cyber-physical systems and the implementation of smart technologies that allow IoT devices and machines to make decisions autonomously.¹ This revolution has used communication networks to bridge distances to connect people, machines, and systems. It extends the sense of community beyond previous limits. With the distance barrier removed, the demand for bandwidth has grown exponentially.

Cisco estimates that by 2022, total mobile device connections will exceed the total connections of traditional computers and that bandwidth demands will increase to 396 exabytes per month.² To keep up, service providers are investing capital to augment network capacity. However, the capacity increases are being exhausted more quickly than before. More capital is required, which is potentially straining budgets. Service providers can't continue this exercise of spend-build-exhaust without also introducing operational complexity and increasing operating expenses (OpEx). To remain profitable, service providers need infrastructure elements that can provide bandwidth and operational efficiencies at such vast scale that adding bandwidth capacity has only a minimal impact. With an improved cost structure, service providers could then focus on operational structures and automation tools that can manage the bandwidth moving through the network. These changes would reduce operational complexities and unlock potential new revenue streams.

Cisco can help service providers meet this cost structure change with several new products and services:

- Cisco 8000 Router Series family, which can scale from 10 Tbps up to 259 Tbps.
- Cisco Silicon One chip, which is the first routing chip that breaks the 10 Tbps barrier.
- Crosswork Suite of automation tools, which provide a cloud-based network system qualification and test environment to accelerate deployment timeframes. It also offers automation of network traffic re-routing to improve mean-time-to-repair (MTTR) and insights that help monitor the integrity of your network infrastructure.
- IOS XR7 network operating system (OS), which is a single OS that service providers can deploy throughout their infrastructure to simplify operations.

Improve the technology to keep up

The networking industry has been clamoring for routing performance breakthroughs to support growth into the terabit network level. Cisco has risen to the challenge by holistically evaluating silicon, optics, software, and systems and launching a router that can anchor networks for a decade or more. Cisco is writing a new chapter in routing evolution with the introduction of the Cisco 8000 Series Routing platform.

With the Cisco 8000 Series Routers, service providers can minimize capital expenditures (CapEx) for infrastructure. The routers also give them the ability to scale their network capacity for a decade or more without investing in a new routing platform. The 8000 Series Router units have line-card ports that are capable of 100G or 400G connections and support capacities from 10 Tb/s up to 259 Tb/s. With a flexible-consumption licensing model from Cisco, adding or removing significant capacity becomes a programming function rather than a major project with a significant impact in cost and time. Capacity changes move from

a CapEx event to a predictable OpEx, which gives service providers greater control over their infrastructure budgets. They also maintain the flexibility to meet rapid demand fluctuations.

The new Cisco Silicon One chip in the 8000 Series Routers is the first true routing silicon chip to break the 10 Tb/s barrier. It provides high scalability, deep buffers, advanced telemetry, and carrier-class programmability. The chip offers a full complement of routing features that cloud and service providers need in a single, 1-rack unit (RU) device. When Silicon One is used as part of the rack-mountable modular chassis, the system can achieve a massive 259 Tb/s. This performance makes the 8000 Series routers the catalyst for a cost structure change in the service provider space.

Service providers that use the Cisco 8000 Series and Cisco Silicon One can alter their network cost structure and shift to focusing on new network topologies. Conventional communication network designs require tedious and expensive planning to operate and maintain. However, modern networks can scale seemingly on-demand and use telemetry data and automation to manage capacity flow through the network. The Cisco 8000 Series Routers with the Cisco Silicon One chip allow service providers to scale up or out because they support larger per box performance measurements, which makes it possible to reduce the number of devices that need to be in the system. Using the Crosswork Suite of tools with the 8000 Series Routers, you can build more accurate route exhaustion rate forecasts for improved budgeting and network cost control.

Maintain control with automation

With this improved budgeting, service providers can focus on integrating automation tools into their network and improving their operational structures to support traffic growth. When a 10G route is down, the network probably has enough capacity on alternate routes to keep traffic flowing with minimal delays. However, when a 100G or 400G route drops, the network could be at

a catastrophic standstill without the proper safeguards in place to quickly manage the capacity transition to alternate routes. Operational teams need to have resiliencies planned and programmed into the network. Including tools such as Cisco Crosswork Optimization Engine is critical for automating the alternate route diversity needed to ensure complete network operation during outages.

Many service providers are interested in new network topology designs that consist of smaller, high-performance nodes woven into a network fabric architecture. This distributed architecture offers inherent scalability, resiliency, and operational simplicity. It takes advantage of modularity and standardized elements that can be orchestrated with automation into an easily managed system. The system can take advantage of telemetry data to compile network health reports that give engineers actionable intelligence at a single glance. Engineers can build automation into the network that can detect congestion or other network events before they happen. It can then automatically take action to reroute traffic or alter the traffic flow based on service level agreement (SLA) parameters.

The automation and flexible properties of this distributed architecture also have inherent operational cost benefits:

- Automatic alternate path routing during outage events offers improved network resiliency.
- Congestion management offers threshold controls to shift loads during peak usage times.
- Segment routing techniques can provide 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.

Using the automation tools in the Cisco Crosswork Suite can help speed innovation and improve customer experiences and operations. Service providers can now

plan, implement, operate, and optimize the network to help gain mass awareness, augmented intelligence, and proactive control. Using the Crosswork Suite helps service provider engineers move from a reaction-based workflow to a planning-oriented workflow that lets them control service implementations. This change improves network stability, the customer experience, and helps reduce OpEx. It also makes new revenue streams based on high-performance SLAs feasible.

Gain flexibility with modernized software

To keep up with today's more flexible networks, Cisco has improved the operational structure of IOS XR7 (XR7), the newest release of the Cisco network operating system. At Cisco, we believe that a modern operating system should be simple, powerful, and trustworthy. As a modern OS, XR7 is designed to help engineers by:

- Providing a single OS paradigm across the network: edge, aggregation, and core
- Reducing OpEx with custom loads of XR7 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
- Validating trust within the network so service providers can work to operate a secure environment

XR7 works across access, edge, aggregation, and core hardware environments. Having a single OS reduces the management complexity for a team of engineers. With IOS XR7, you can load and operate only the features you need for a specific use case, whether it's for access, edge, aggregation, or core. Network engineers can better manage the costs and complexity of their network and operators benefit from using only one OS environment. The OS image on a device can be anything

Learn more

To learn more about the Cisco 8000 Series Routers, please visit the [8000 Series product page](#).

To learn more about the new release of Cisco IOS XR7, please visit the [IOS XR7 page](#).

For more information on the Cisco automation tools available, please visit the [Crosswork suite page](#).

from a full OS version load on a multipetabit core router to a scaled-back OS version that runs on a multigigabit access router. Having a single world-class OS that operates in all environments can improve the operational efficiency of the network.

With XR7, service providers can 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 can access the software stack at all levels, XR7 provides the custom access service providers need to efficiently build and operate a network. For example, with the service layer APIs integrated into XR7, service providers can 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, service provider engineers can make near real-time changes to the network routes.

IOS XR7 software includes an extensive boot process that is designed around a hardware trust anchor. This process begins before the CPU is allowed to boot and offers significant protections against compromises to the hardware or firmware. The XR7 secure boot process establishes a chain of trust that begins when the hardware anchor implements self-measurement, followed by measurement and signature verification of the CPU microloader. It then verifies the signature of the bootloader and the OS kernel. The trust validation continues during run time as well to provide a constant check of the infrastructure and operating system.

Innovate to move forward

At Cisco, we continuously work to innovate our communication network platforms so service providers can build personalized networks that meet the needs of their users. The innovations launched with the Cisco 8000 Series Routers, Cisco Silicon One chip, and IOS XR7 represent our efforts to deliver the next generation of network infrastructure. Combining these elements with the Crosswork Suite of automation tools delivers a network solution that can support the needs of service providers during the transition into the fourth industrial revolution.

1. [Marr, Bernard. The 4th Industrial Revolution is here—Are you Ready? Forbes.](#)
2. [Cisco Visual Networking Index, Forecast, and Trends 2017-2022.](#)