The bridge to possible

Converged SDN Transport for 5G

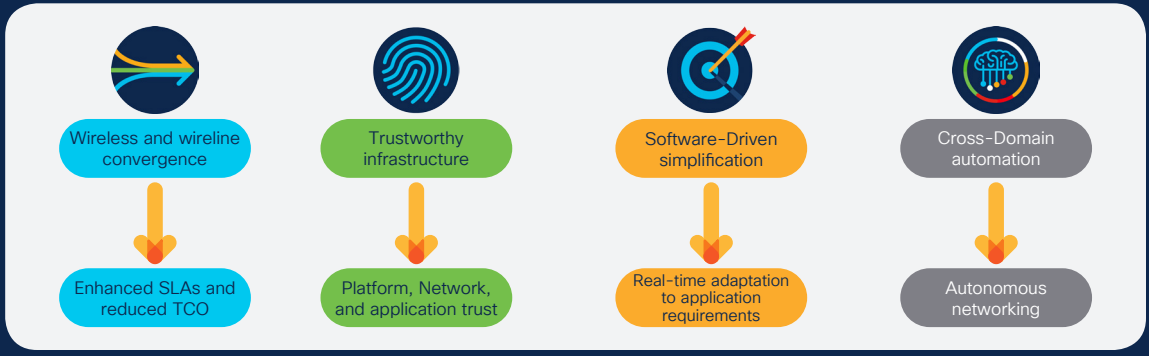
The challenge

Service providers are facing declining or flat service margins due to cost pressures from increasing traffic demands and flat Average Revenue Per User (ARPU). Supporting 5G services requires networks to meet the stringent service requirements of 1-ms latency and 1-Gbps bandwidth per user and to provide this support for billions of connected devices with an expanding threat surface.

The solution

Deliver 5G services by leveraging Cisco® service provider solutions to generate new revenue streams for your business. Cisco offers a holistic solution, including xHaul transport, 5G packet core, and security, all under an automation umbrella that provides deep visibility and control for service assurance. Cisco is also driving industry initiatives to help open up the Radio Access Network (RAN) to allow service providers the flexibility to build the best network for their needs. The Converged SDN Transport solution is in the center of the 5G transformation and delivers the following capabilities outlined in Figure 1.

Figure 1. Converged SDN Transport capabilities and benefits



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Benefits

Grow revenue

- New 5G enterprise services

Reduce cost

- 62% Total Cost of Ownership (TCO) savings with network convergence
- 400% capacity increases
- 36% savings in upfront costs

Enhance customer experience

- 78% faster time to service
- 55% reduction in mean time to repair

Mitigate risk

- Trustworthy platforms with hardware root of trust

The bridge to possible

What if you can converge all your fixed and mobile services into a single, secure, fully automated network that can adapt in real time to application requirements and stringent SLAs?

The 5G architectural transitions

The Cisco technology platforms allow you to deliver on the stringent 5G requirements and the key 5G architectural changes defined by the Third-Generation Partnership Project (3GPP). Those architectural changes require an evolution from unified Multiprotocol Label Switching (MPLS) toward Segment Routing (SR) and Border Gateway Protocol Virtual Private Network (BGP VPN) technologies with end-to-end IP. This enables wireline and wireless network convergence, enhanced Service-Level Agreements (SLAs), resource-efficient soft network slicing, less than 50 ms of protection against failures, scalable Traffic Engineering (TE), and a simplified protocol stack that eliminates protocols like the Label Distribution Protocol (LDP) and the Resource Reservation Protocol (RSVP) TE.

1. Cloud RAN

Moving from a distributed RAN to a cloud RAN can reduce OpEx overhead at cell sites, increase resource efficiency, and reduce overall RAN CapEx spending. Cloud RAN also delivers service agility and spectral efficiency gains. The Converged SDN Transport for 5G architecture can deliver on the tight time-error budgets and low-latency needs of cloud RAN for the transport network with a simplified network topology and advanced traffic controls.

2. Mobile edge compute and virtualization

As services are located between centralized and market-based data centers, operators need an efficient technology tool to integrate the Wide Area Network (WAN) and those data center locations. Using SR and BGP-based VPNs will ensure that application latency, quality of service, and bandwidth requirements are met. SR MPLS and SRv6 can enable seamless service chaining for virtual network functions.

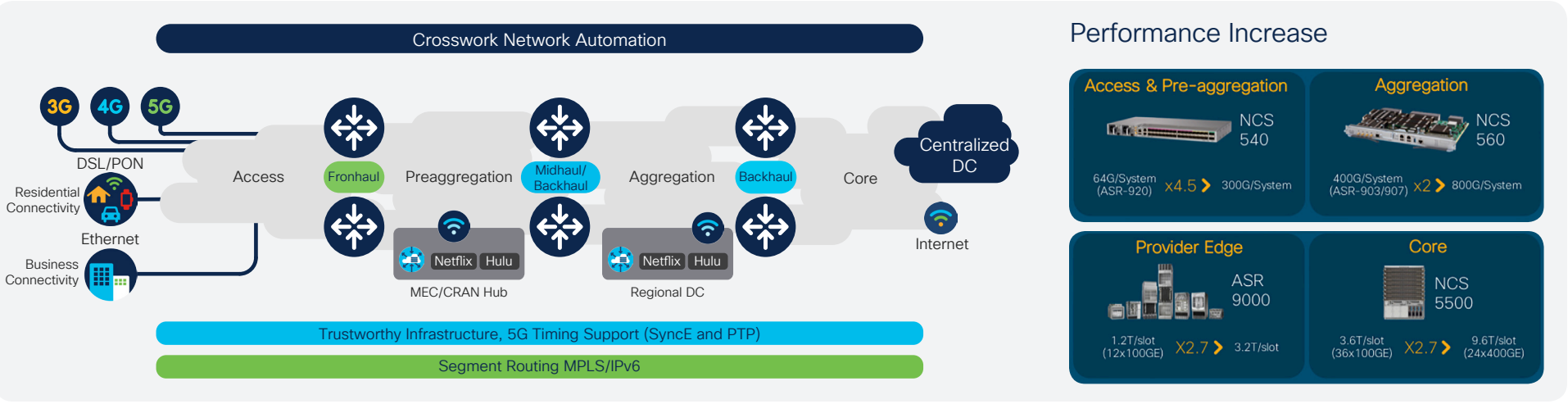
3. Cloud-native Control and User Plane Separation (CUPS)

A cloud-native packet core and distributed SDN architecture enable CUPS, allowing operators to scale control and user planes separately, as needs dictate. This eliminates complex management and enables operators to partition the network and position functions and services exactly where needed. This can enable latency-sensitive services and content caching to move closer to end users to ensure the client experience.

4. Network slicing

Network slicing is the ability to build what looks like discrete end-to-end networks for different 5G services or customers. Segment routing Flexible Algorithm (Flex- Algo) and a cross-domain, multivendor services orchestrator enable soft slicing, while maximizing resource efficiency. Flex-Algo provides per-user, per-application traffic steering with routing isolation to meet any required SLA and end-user slice visibility.

Figure 2. Converged SDN Transport for 5G solution overview.



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Converged SDN Transport for 5G solution pillars

To meet the requirements of 5G networks, the Cisco Converged SDN Transport solution is based on the five pillars illustrated in Figure 3.

Figure 3. Five pillars of Converged SDN Transport



Network convergence – Convergence in access networking with one infrastructure to handle wireless and wireline services, protocol convergence with SR and EVPN, and optical and IP layer convergence with Routed Optical Networking all offer simplification by reducing complexity and allow service providers to save money by operating a single network and reduce the number of moving parts.

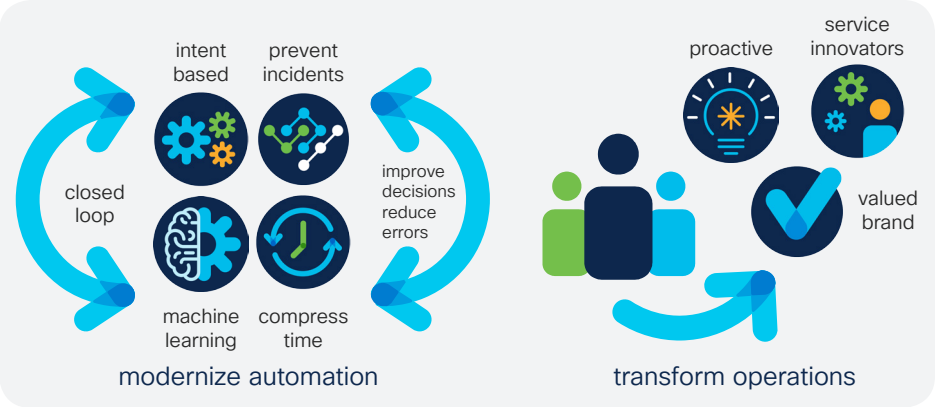
Trustworthy infrastructure – Cisco products are designed from their foundation with security in mind. Beginning at the component level to ensure there has been no tampering builds a foundation to deliver platform trust, network trust, and application trust. These trustworthy systems have a unique chip called the Trust Anchor Module (TAM) built to securely store cryptographic keys in hardware, enabling capabilities like secure boot. The ability to verify and report on the integrity of the network infrastructure allows service providers to provide the critical infrastructure required for 5G applications.

Mass-Scale, 5G-Ready portfolio – To support the demands of a 5G service, the transport network must be application/service aware, have integrated automation tools that quickly ingest telemetry data and act upon it, and have fronthaul-, midhaul-, and backhaul-specific features to maximize performance. Cisco has a full portfolio of routers and automation software to support your 5G service.

Software-Driven simplification – Converged SDN Transport for 5G permits programmability at every level. It can effectively scale service automation and orchestration by leveraging software Application Programming Interfaces (APIs) and standard data models with associated tools such as YANG, XML, and JSON-related SDKs. The infrastructure also supports real-time monitoring and assurance of the physical and logical network through telemetry.

Cross-Domain automation – Cisco provides a suite of automation products for orchestration and automation within the Cisco Crosswork™ suite. For example, the Crosswork Situation Manager derives proactive insights based on Artificial Intelligence and Machine Learning (AI/ML) algorithms and can significantly reduce event noise by up to 99 percent. To achieve the scale required by 5G, networks need to be automated to deliver service agility with optimized operational costs, like setting up, modifying, or removing a 5G network slice in minutes or seconds.

Figure 4. Cisco's intent-based automation for proactive remediation



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“Cisco NCS routing technology powered by automation software running traffic over dark fiber offers us an ideal blend of innovative technology to support our LTE advanced and 5G network.”

- Greg O’Connor
Vice President of Network Core and Access, Sprint

5G solution components

5G-Ready routers

With the **Cisco Network Convergence System (NCS) 500, 5500, and 5700 Series Routers**, and the **Cisco ASR 9000 Series Aggregation Services Routers**, Cisco has a comprehensive 5G routing portfolio designed to address indoor and outdoor cell site, aggregation, edge, and core applications for converged mobile and wireline networks. The portfolio features industry-leading low TCO, using space and power-efficient platforms, leading innovation with capabilities like segment routing, and offering the highest density in the market today.

As the mobile industry and consortia continue to standardize requirements for D-RAN and C-RAN Low-Level Splits (LLSs) and High-Level Splits (HLSs) under option 2, option 7, and option 8, it is clear that the transport network is critical. To support these options, the fronthaul, midhaul, and backhaul networks must support strict timing synchronization and an allocation of time-error budget beyond the current 3GPP requirements. Mobile operators will use multiple timing sources like GNSS or a transport network-based timing solution like Synchronous Ethernet (SynchE) with Precision Timing Protocol (PTP) to help ensure phase synchronization. Cisco transport products are developed with these standards in mind and help operators build a 5G-capable xHaul network by incorporating:

- Class B and Class C T-BC Boundary Clock Noise Generation performance according to G.8273.2
- G.8275.1 (Full on-path PTP support profile) with layer 2 Multicast encapsulation
- G.8275.2 (Partial on-path PTP support profile) with layer 3 Unicast encapsulation (IPv4 and IPv6)
- External timing ports to allow separate connections to diverse GNSS receivers as Primary Reference Time Clocks (PRTCs)
- Internal GNSS receiver support in equipment (if appropriate based upon location)
- Synchronous Ethernet (G.8262) and Ethernet Synchronization Message Channel (ESMC) support (G.8264) with a pathway to the new (currently draft) enhanced Synchronous Ethernet (eSynchE)

The bridge to possible

The flexible consumption model

Purchase network capacity as needed in a cost-efficient manner.

Benefits

- **Reduce upfront capital**
- **Protect investments** – Licenses are transferrable to next-generation hardware
- **Simplify operations** with bundled automation for Cisco EPNM, WAE, and NSO
- **Use capital efficiently** with network-wide license pooling

5G automation suite

The Cisco automation suite consists of **Cisco Network Service Orchestrator** for end-to-end service orchestration; **Cisco Crosswork Optimization Engine** as an SDN controller for dynamic path optimization for constraints like latency and bandwidth; **Cisco WAN Automation Engine (WAE)** capacity planning and failure analysis for IP and optical; **Cisco Evolved Programmable Network Manager (EPNM)** for device lifecycle management; and **Cisco Crosswork Situation Manager** for service assurance based on AI/ML technologies.

5G security solutions

Comprehensive 5G security technologies provide threat mitigation across end-user devices, air interfaces, RAN, xHaul, the data center, and packet core. Starting with in-box hardware and software security, Cisco 5G trustworthy routers have a **TAM** chip to store all sensitive, cryptographic data encrypted to protect against exploits. **Cisco Stealthwatch®** is leveraged for enhanced visibility and threat detection, **Cisco Umbrella™** for DNS protection, **Cisco Firepower®** for DDoS protection and next-generation firewall capabilities, **Cisco Identity Services Engine (ISE)** for segmentation and isolation, and **Cisco Advanced Malware Protection (AMP)** for malware protection. Cisco security products harness the power of **Talos®** threat intelligence, which blocks around 20 billion attacks daily.

5G mobility solution

Cisco Ultra Cloud Core is a Kubernetes-based solution that provides a common execution environment for Cisco's container-based 5G applications. The platform is hardened, resilient, carrier grade, and purpose built to meet the high-security and high-availability requirements of service provider networks. Using the Cisco Ultra Cloud Core, Cisco 5G applications are enabled with:

- Advanced analytics and advanced infrastructure health checks
- Simplified and low-risk methods to introduce new 5G services, new configurations, and upgrades
- Automated deployment and automated testing as part of a CICD workflow
- Consistent technology and software components across all Cisco 5G applications

Service providers who use the Cisco Ultra Cloud Core can benefit with faster time to market for new services, easier and automated deployments and upgrades, and overall lower operational costs.

To start building a Converged SDN Transport for your 5G network, go to www.cisco.com/go/5g.

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