UNLEASH THE CLOUD + 5G + AI ERA

Navigate the Five Big Technology Shifts that Will Make or Break Your 5G Success

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EXECUTIVE SUMMARY

5G promises new experiences for consumers and enterprises, and transformational economics for service providers. However, new 5G Radio technologies alone are not enough to drive real service provider business transformation. 5G is the sum of many more building blocks that are closely intertwined with and dependent on a broader technology evolution towards cloud and artificial intelligence (AI) as well.

It is only when you bring these technologies together that you can provide diverse network and edge services over the same infrastructure, automate them, and assure the experience end to end. It's only by combining Cloud + 5G + AI that you can truly transform your business.

Getting there will require very different capabilities than most service providers have in place today. You'll need to evolve your network and business to accommodate five key technology shifts:

1. From boxes to virtualized, cloud-native infrastructure

2. From centralized to distributed architectures

3. From static to dynamic, demand-driven capacity

4. From manual to open, automated operations

5. From bolt-on to connected security

Juniper is helping service providers navigate this journey. We provide all the building blocks needed to create new value and compete in the coming decade. We can help you reimagine your architecture, operations, and service experience to unlock the full power and potential of 5G.

Is Your Business Ready for 5G Transformation?

News reports will tell you "5G is coming." Service providers know 5G is already here. One hundred live networks as of early 2020 and hundreds of operators actively investing, with $1 trillion in cumulative 5G infrastructure capital expenditures (CAPEX) projected through 2025.
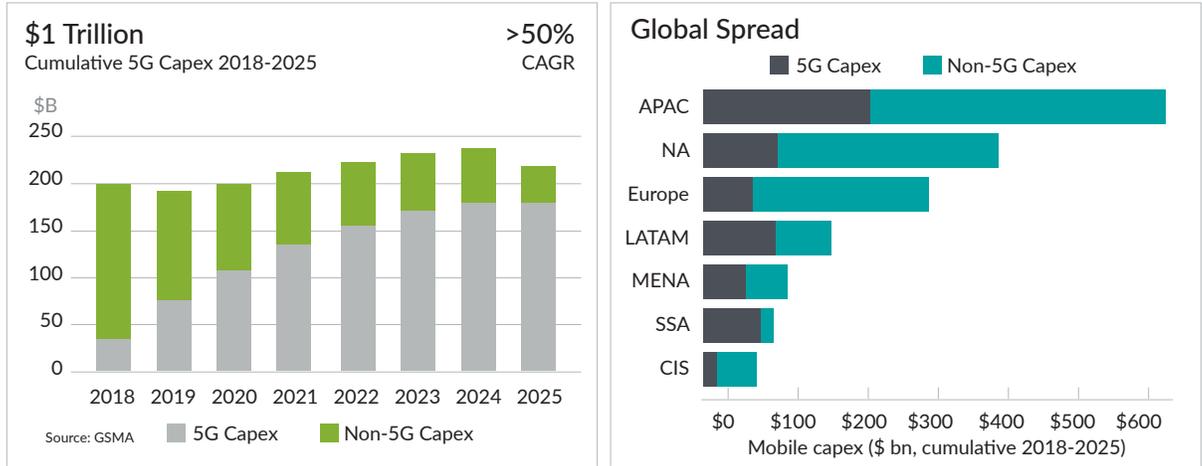
There is sound strategy behind these investments, and it goes well beyond providing faster wireless speeds. Network service providers may fuel our digital world, but they've often been cut out of the value chain for digital services. "Over-the-top" (OTT) application providers capture most of the subscriber attention and wallet-share. Meanwhile, the data traffic traversing service provider networks explodes, costs steadily climb, and revenues remain stubbornly flat. Until now.

5G can turn the status quo on its head, giving you the ability to launch hundreds of new services, each tailored to the perfect user experience and most suitable business model. It can position application intelligence closer to users to help deliver tactile digital experiences that no OTT player can duplicate.

But, there's a big caveat at the core of the 5G story: creating this value will take more than just 5G Radio. To truly reimagine your business, you'll need to combine 5G with the move to:

- **Cloud:** Many fundamental aspects of 5G architecture—telco cloud, distributed edge computing, and virtualized/containerized network functions—depend on a "cloudified" infrastructure. New 5G Radio won't help you dynamically position resources wherever they're needed or automatically scale capacity with demand. Only cloudifying your network can give you that agility.

- **Artificial intelligence (AI):** The combination of 5G and cloud offers a quantum leap in scale, performance, and agility, but adds enormous complexity to network operations. There's no way to handle multiple clouds and hundreds of network slices, or to quickly respond to traffic changes, using the slow, error-prone manual processes of the past. 5G or cloud cannot be realized without automation. Eventually, all automation must be AI-driven to proactively observe what's happening in the network, recognize when intervention is needed, and automatically take action.

Unleash the Cloud + 5G + AI Era

Bringing cloud and AI technologies together with 5G is the key to enabling service provider business transformation. The kind of transformation that helps them create new web-scale value by not just building next-generation networks but changing business models and operational models as well. And, that helps them unlock new revenue-generating services, make operational economics viable, differentiate the customer experience, compete with agility, and safeguard the business.

Achieving all this, however, requires multiple technology building blocks beyond 5G New Radio or 5G New Core. You also need X-haul, distributed edge clouds, Software Defined Networking (SDN), network slicing, segment routing, NFVI stack with associated VNF/CNFs, security, automated management and orchestration, pervasive analytics, automation, and more. Every part of the network must be ready for Cloud + 5G + AI. Juniper provides all these building blocks through our own portfolio or our strategic partners.
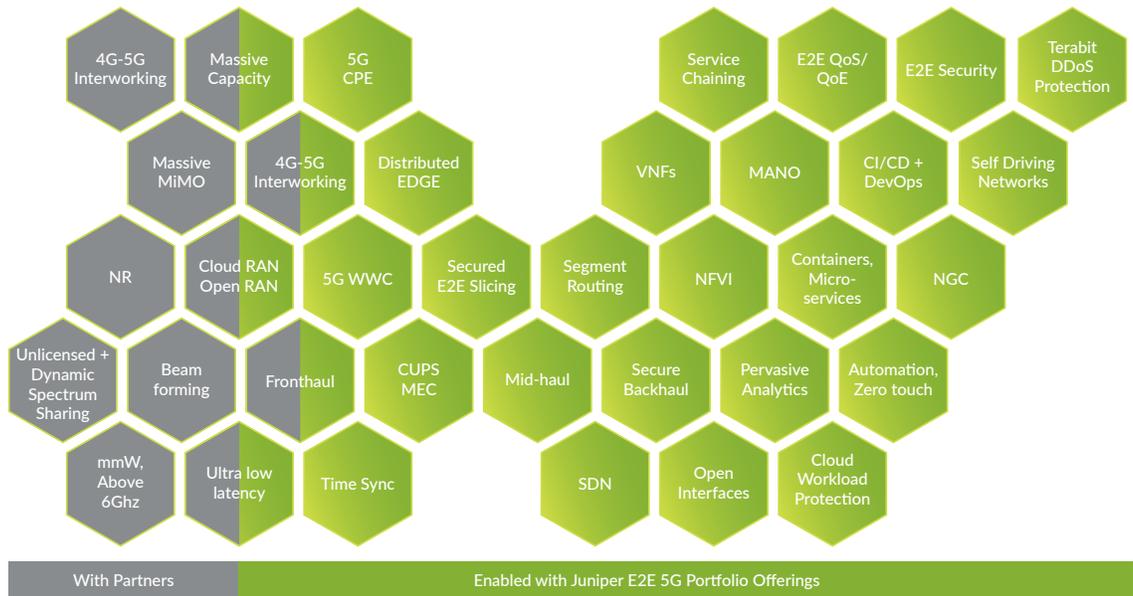
This journey will be different for every service provider—but it will most definitely be a journey. Every part of the network will be transformed, be it radio access, IP transport, packet core, operations or security.

In addition to adding high-performance nodes at all layers, you'll need to replace many physical boxes with virtualized, cloud-native network functions. You'll need to support cloud-native architectures, introduce distributed edge clouds, and support control-user plane separation (CUPS) as new points of service delivery. You'll need to move from static capacity to demand-driven capacity that scales elastically. You'll need to stitch the pieces together with tailored network slices that deliver multiple services over the same infrastructure. Your security posture will need to be baked into and connected across all touchpoints of the network. And, operations will have to be totally automated with intent-driven, closed-loop workflows based on AI and Machine Learning (ML).

These are big transitions. Juniper is helping service providers successfully navigate them across five fundamental shifts. We can help you introduce all the technology building blocks, in a practical way, in tune with your unique journey to Cloud + 5G + AI.

Shift 1: From Boxes to Virtualized, Cloud-Native Infrastructure

Dedicated, purpose-built hardware has been the foundation of previous-generation networks. But, with the need for greater agility, control, and elasticity, there are many scenarios where virtualized functions based on cloud-native architecture make more sense.

That's why many packet core, transport, and radio access network (RAN) functions are being disaggregated and virtualized. By running these functions on off-the-shelf servers, like any other data center application, you can realize the same kind of advantages as the hyperscale cloud companies: elastic scalability, lower total costs, and agility to launch new services or update networks quickly in response to changing demands.

How Juniper Can Help
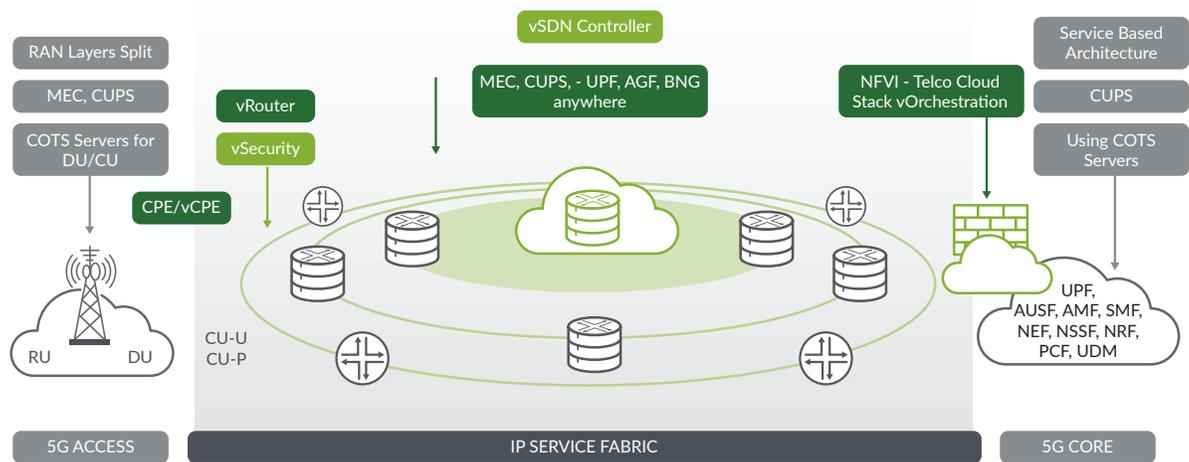
To help you transform your architecture, Juniper provides the **entire NFVI stack**, including overlay, underlay, and orchestration, as a carrier-grade underline telco cloud solution. Unlike other vendors' approaches, this platform is **horizontal and open**. You can use whichever VNFs and third-party applications you prefer without being locked into one vendor's vertical stack. Our solution is also **truly cloud-native**, supporting Kubernetes, containers, and microservices.

With full, **3GPP-compliant support for CUPS**, you can deliver services from anywhere. This flexibility will be essential to delivering new user experiences (immersive 4K and 8K video, mixed reality), as well as new enterprise services like industrial automation, which require **ultra-low latencies delivered under strict SLAs**.

We can help you virtualize more of your network to gain **unprecedented scalability, agility, and cost-efficiencies**. Juniper offers one of the industry's broadest portfolios of virtualized solutions: routers, security appliances, customer premises equipment (CPEs), SDN, and vBNG. All have **full feature parity** with their physical counterparts. And, we're quickly extending this portfolio beyond virtualization to containerized, cloud-native solutions such as the industry's first containerized firewall.

Juniper Cloud Leadership

- 50+ Live Telco Cloud Deployments
- 50+ Pre-Integrated VNFs
- #1 Deployed SDN Controller with Contrail
- Industry-Leading Service Provider Data Center Fabric with QFX
- Industry's First Containerized Firewall with cSRX
- 3GPP-Compliant CUPS UP

## Shift 2: From Centralized to Distributed Architectures

The 5G capabilities that unleash new low-latency services and multi-sided business models all depend on one big innovation: a shift to distributed architectures that bring content and applications closer to end-users.

Distributed edge clouds are effectively tens to hundreds of mini-data centers deployed in the metro-aggregation layer of the IP transport network. As a result, they make the transport network more important than ever. Located either on-premises or off-premises (in service provider locations that are the network equivalent of "beachfront real estate"), they have emerged as a platform for innovation and monetization. They offer an opportunity to deliver new kinds of services in collaboration with OTT competitors, giving service providers the chance to re-insert themselves into the value chain.

With distributed edge clouds, the lines that have long separated access, packet core, and transport layers have blurred. The edge is now home to RAN functions that enable new Cloud RAN and Open RAN architectures, as well as virtualized core functions such as the user plane, which is getting distributed to the edge.

How Juniper Can Help

Each service provider will follow its own edge cloud strategy. But, no matter which kind of edge nodes you plan to build, how many, or where, Juniper can help you create a production-grade distributed edge cloud solution that is monetizable today.
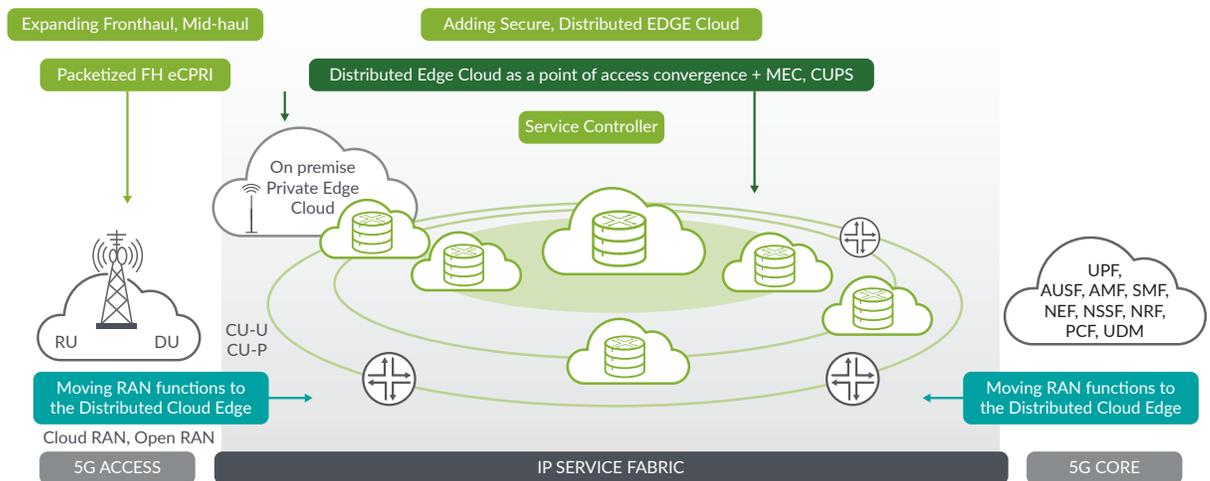
Juniper offers a **distributed universal edge cloud solution**, extensible to a full suite of orchestration, automation, security, and analytics. Distributing cloud services out to the edge means you'll need to build data center-like capabilities in places that never hosted them before, such as Regional Offices, Central Offices (COs) or point-of-presence (POP) locations. We're making the transition easier with a **lean, small footprint** edge cloud solution that fits in space- and power-constrained locations. You also have the **flexibility for hybrid deployments**, with the option to use centralized controllers and hardware-assisted CUPS. You can deploy the right edge capabilities on-demand, in the way that makes the most sense for your business.

We also offer **flexible fronthaul and mid-haul (X-Haul) options** to enable any radio architecture, from Classic RAN to emerging models like Cloud RAN and Open RAN. We're adding **packetized fronthaul with eCPRI support** to handle extreme 5G baseband requirements and enable open, multivendor radio networks. And, we can help you accommodate the spike in east-west traffic you can expect from converging Metro-IP and edge with our **lean edge underlay**, which is purpose-built for distributed architectures.

Juniper can help you build private edge clouds as part of private 5G/LTE networks to support new Cloud + 5G + AI applications. Or, we can help you monetize **new low-latency IoT, 5G consumer and enterprise use cases** from a hosted edge cloud. With our **partnership in Stackpath**, we can even offer "Managed edge cloud as a Service" with ready-to-monetize services such as content delivery network (CDN), that eliminate the need to worry about building the edge first and monetizing it later.

For converged service providers, we also enable 5G wired and wireless convergence (5G WWC). By co-locating the BNG with the edge data center, we can help deliver seamless hybrid access experiences that differentiate from mobile-only offers, while reducing total cost of ownership.

## Shift 3: From Static Capacity to Dynamic, Demand-Driven IP Service Fabric

New 5G experiences will not only generate an explosion in traffic, but also change the traffic patterns in known and unknown ways. Yesterday's capacity planning models—making big upfront investments to build out for peak utilization—just won't work anymore.

You'll need an IP service fabric that can deliver massive capacity, with the ability to scale as and where needed, on-demand. You'll need to make the IP service fabric sliceable in order to ensure the right experience for each application. And, if you're going to deliver ultra-reliable low-latency experiences like industrial automation, you'll need to adhere to stringent 5G time synchronization requirements. At the same time, you can't compromise carrier-grade reliability or security to get there.

How Juniper Can Help

Juniper is investing in new innovations throughout our portfolio to make this shift possible. We can help you build a more intelligent, agile, and responsive IP service fabric.
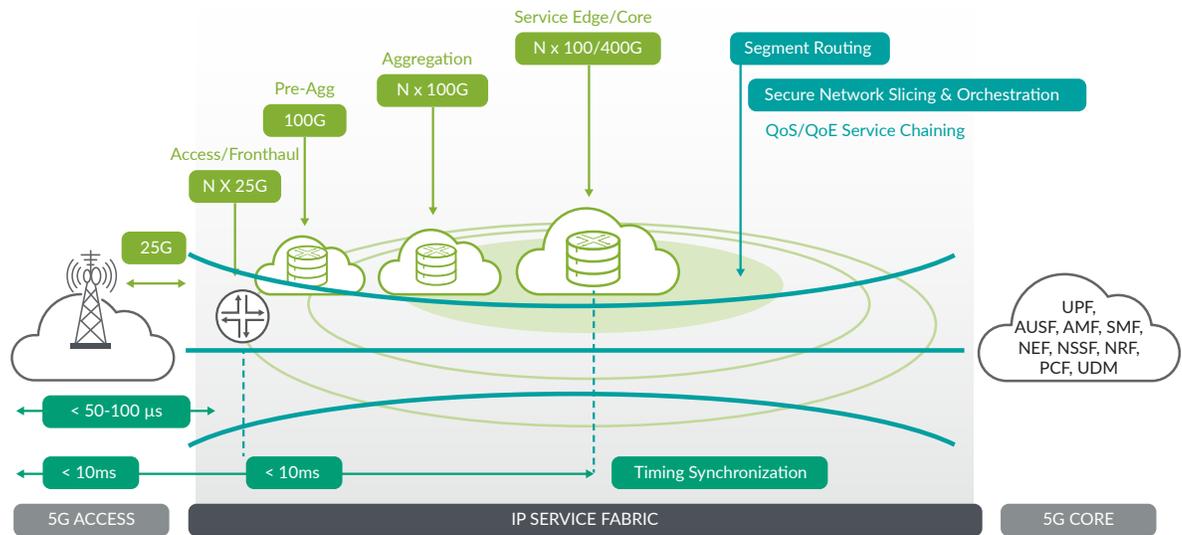
Juniper is enabling **massive boosts in capacity** across access, aggregation, and core networks. We offer new platforms to move from 10-Gigabit Ethernet interfaces to 25 GbE in the access/pre-aggregation plane and 100 GbE in aggregation. We're delivering **industry's first 400-GbE-capable core** with **native MACsec** encryption. We're also setting the bar for the industry in enabling the **most stringent and hybrid timing requirements**. That includes Class C boundary clocks, compliance with TSN Profile A standards, front-haul networks with 150-µs latencies, and round-trip times less than 10 milliseconds to enable ultra-reliable low-latency services.

Our network slicing framework enables **application-aware routing end-to-end**—from the transport network to the data center and the NFVI—with the ability to use any orchestrator for **seamlessly stitching radio, transport, and core slices**. Our slicing framework also integrates segment routing simpler operations and assured service experience. And, it includes integrated security to protect customer data end to end without compromising performance.

Juniper Leads the Way in Dynamic IP Service Fabric for 5G

- Industry's First 400-GbE Platforms with Native MACsec Encryption
- Industry Benchmark in Stringent and Hybrid Timing Requirements
- 100x Node Scalability
- Seamless Network Slicing with Integrated Segment Routing

Shift 4: From Closed, Manual Systems to Open, Automated Operations

Cloud and 5G mean a huge increase in the scale and complexity of service provider networks. You'll be accommodating 10x as many endpoints, 5x as many nodes and sprawling multi-cloud environments across the network. With that growth, you can expect 25x more incidents than you're dealing with today.

There's no way to handle that scale and complexity if you're still using the error-prone manual processes and closed, vendor-specific tools of the past. While automation and openness might have been "nice-to-have" capabilities before, they're "must-haves" for the cloud and 5G future. And keep in mind, openness and automation are not just about operating the network or fixing issues. These capabilities are essential to deliver the right service experience, and to evolve the network and business to modern DevOps ways of working.

How Juniper Can Help
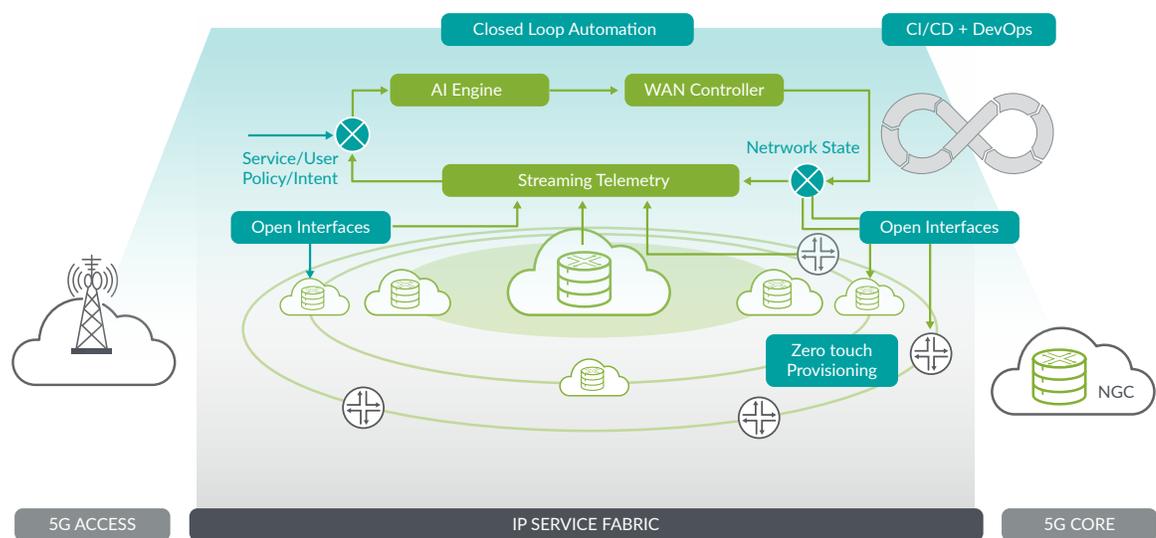
Juniper offers a **cross-domain automation portfolio**, encompassing the entire lifecycle network automation, from planning and design to implementation and operation. In addition, all Juniper routers, switches and security devices run on a common OS, providing a "**One Junos experience**" that service provider operations teams tell us is markedly different from any other vendor.

Our technology stack is built from the ground up to be open and extensible—not just programmable. **Open APIs and interfaces** allow the system to sense data from across the multi-vendor, multi-cloud environment. We enable **continuous closed-loop automation** by streaming real-time telemetry data to a state-of-the-art ML engine. By observing the network in real time, this AI-driven system can translate high-level policy into automated action— including closed-loop validation that business intent was executed correctly.

With fewer protocols and stateful components to worry about, you can also simplify and unify operations. Juniper (through **Anuta partnership**) also offers an easy-to-use graphical user interface with visual workflow builders that take operational simplicity to another level.

Finally, when your network can automatically translate high-level intent into network changes, it becomes much easier to enable **DevOps ways of working and CI/CD pipelines**. Now, you can design, provision, assure, and continually modify services more quickly and easily, at a much lower cost. And, you can draw on Juniper resources— EngNet, NRE Labs, professional services, DIY toolkits—to **customize automation** for every part of your network.

## Shift 5: From Bolted-On Security to Connected Security

New 5G innovations—distributed edge computing, network slicing, massive new IoT installations—will greatly expand the potential threat surface you need to protect. You can expect to see threats increasing in volume, frequency, and sophistication.

You should also expect to need security in more places. New vRAN architectures, new interfaces for edge computing and CUPS, distributed and virtualized network functions, interfaces with public clouds and roaming networks—you'll need to secure them all. Try to do it with today's siloed security systems and bolted-on manual processes, and you'll quickly get overwhelmed. To capitalize on the Cloud + 5G + AI era, you'll need security that's automated and integrated into every part of your network.

How Juniper Can Help

Some vendors are still stuck in the past models, attempting to secure new services by locking down external touchpoints. Juniper employs a revolutionary Connected Security approach that uses the entire network and ecosystem to create a threat-aware infrastructure. This approach secures all users, applications, and infrastructure at all connection points. It dynamically adapts to changing conditions to enforce security policies consistently throughout the network.
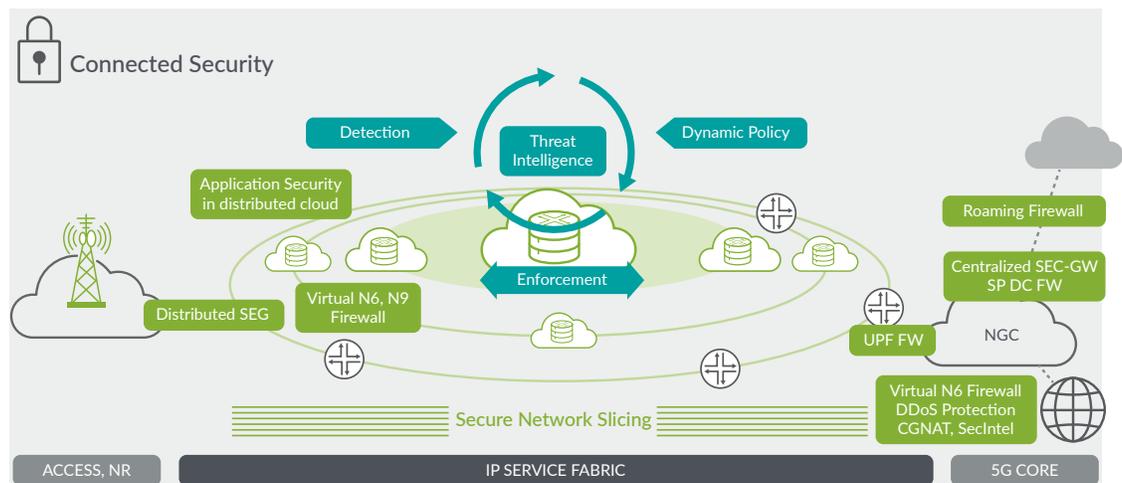
Juniper **embeds security at the system, service, and network level,** including both hardware and software, to provide comprehensive protection for 5G environments. That includes **all the point solutions needed** to secure exposed touchpoints: 5G core interfaces to roaming networks, interfaces to public cloud with carrier-grade NAT, DDoS protection, ongoing threat intelligence via Juniper SecIntel. And, it extends across data center and UPF firewalls, as well as centralized and distributed security gateways and virtual interfaces from the edge cloud. It's this **pervasive Connected Security model** that resonates with service providers worldwide and makes third-party security leaders like NSS Labs recommend Juniper.

With security embedded throughout your infrastructure, you can **simplify, unify, and streamline security operations.** And, since Juniper solutions are designed for a more complex, cloud-connected world, you can **scale and distribute security easily,** driving down **operational economics.**

Finally, Juniper Connected Security empowers you to create and monetize new services with confidence, applying **continuous threat detection and enforcement** to protect users, data, and endpoints. You can use centralized, adaptive policy to secure not just traffic but applications—including at the distributed edge, automatically **extending security across all network slices.** These capabilities allow you to deliver a more secure, assured service experience, without a performance penalty.

NSS Labs Awards Juniper "Recommended" Rating for Data Center Security

- NSS Labs DCSG 2019 Security Value Map Comparative Report

Monetize the Cloud + 5G + AI Era
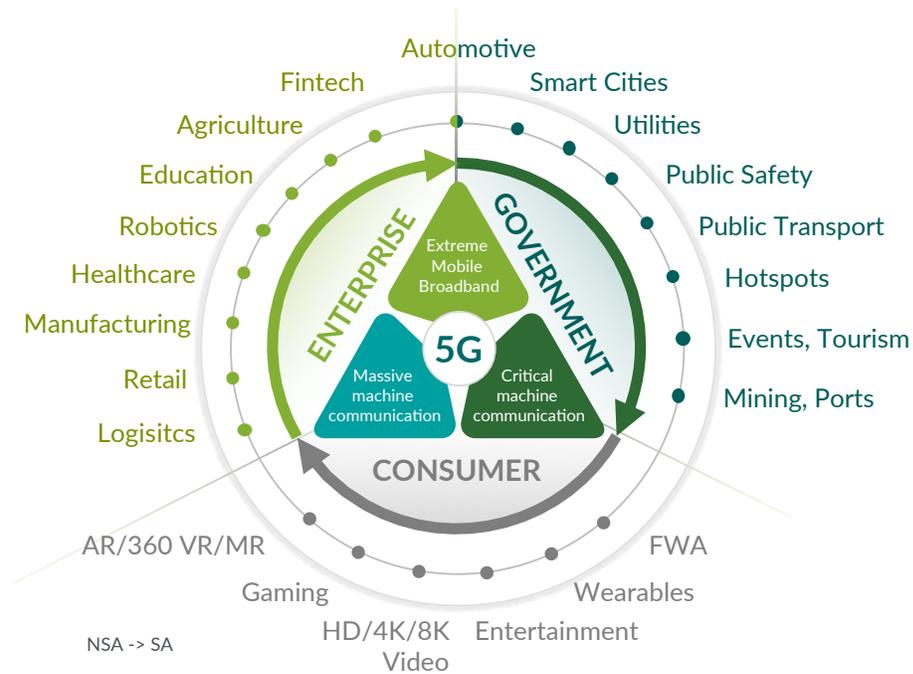
The Cloud + 5G + AI Era opens up new opportunities for service providers in three main segments: consumer, enterprise, and government. Juniper can help you address all these opportunities, and monetize your network in new ways with **Cloud + 5G + AI solutions**.

With a full suite of next-generation capabilities, you can enable services such as:

- **Premium Enterprise Broadband Services**: Offer high-bandwidth, highly reliable enterprise application access with rigorous SLAs.

- **Cloud-delivered Secure Managed Services**: Offer enhanced services such as SD-WAN, SD-LAN, and Wi-Fi to help customers move towards an "AI-driven Enterprise" with wired and wireless service assurance.

- **Private 5G Networks**: Offer ultra-low-latency performance optimized for specific industries and vertical applications (ports, mining, energy exploration) by building private edge clouds.

- **Industrial Automation**: Offer on-premises private edge services using any low latency access. Support 5-10-millisecond round-trip latency, low jitter and "six 9s" reliability that auto-coordinated robots on a factory production line require.

- **Mixed Reality Applications**: Use Juniper off-premises edge cloud and secure network slicing to enable the ~50-millisecond latency required for multi-user 3D manipulation. These capabilities have huge potential in use cases such as construction, interior design, cloud gaming, next-generation social networking, and more.

- **CDN as a Service**: Work with **Juniper and our partner, Stackpath**, to build-and-monetize the edge cloud, starting with CDN services, as a first step.

## Unleash Cloud + 5G + AI to Reimagine Your Business

Building Cloud + 5G + AI networks involves more than adding faster speeds and feeds. It requires navigating multiple technology and architecture options. It is about helping service providers transform their business, not just networks by enabling a generational shift in **Architecture, Economics and Service Experience.**

Juniper can help you make the most of it. We provide the end-to-end building blocks to help you transform your business. Our Cloud + 5G + AI solutions provide:

- The most **Open, Agile Network Architecture** that helps you worry less about your technology choices and focus more on launching new services.
- An **On-demand Economics** model that improves your bottom line.
- A **Secure and Assured Service Experience** that helps you delight customers.

Let us help you accelerate your transformation across five core solution pillars:

- **Cloud-first platforms**: Bring the openness and agility of cloud to your network with Juniper Contrail telco cloud NFVI stack, VNFs, virtualized MX, security, CPE devices, SDN functions as well as underlay and overlay for the service provider IT data center.
- **Distributed edge cloud**: Unleash new edge capabilities with Juniper universal edge cloud solution, Stackpath partnership, lean edge metro underlay, CUPS, and private on-premises edge solutions.
- **Massively scalable IP service fabric with network slicing**: Deliver dynamic new 5G experiences and use cases with Juniper extensive X-haul portfolio, secure network slicing, segment routing as well as low-latency and hybrid timing solutions.
- **Automated operations**: Simplify network operations and improve service experience with our automation portfolio, which includes Northstar, Healthbot, our **Anuta partnership**, One Junos, and DevOps methodologies.
- **Connected Security**: Protect your business with embedded security that extends across our entire portfolio and safeguards your users, applications and infrastructure.
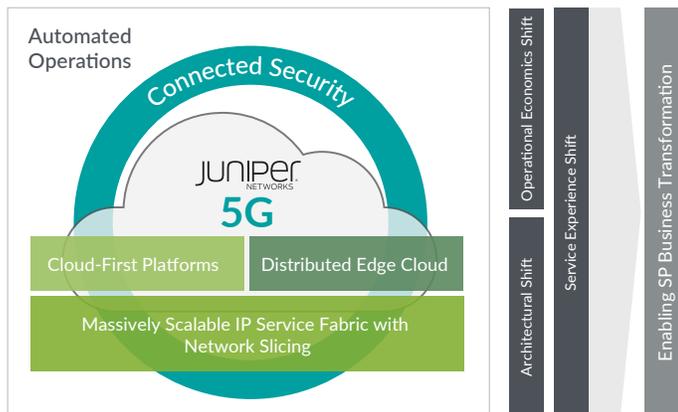
Start Your Transformation

To learn more, visit: **www.juniper.net/us/en/solutions/5g-networking/**.

Juniper: The First Choice in Service Provider Networks

- **49 of the top 50** Service Providers trust Juniper
- Deployed in **9 of the Top 10** Cloud Provider Networks
- **>40% of the Forbes 1000 Enterprises** work with Juniper
- Extensive experience in Cloud + 5G + AI solutions

About Juniper Networks

Juniper Networks brings simplicity to networking with products, solutions, and services that connect the world. Through engineering innovation, we remove the constraints and complexities of networking in the cloud era to solve the toughest challenges our customers and partners face daily. At Juniper Networks, we believe that the network is a resource for sharing knowledge and human advancement that changes the world. We are committed to imagining groundbreaking ways to deliver automated, scalable, and secure networks to move at the speed of business.

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