

The Enterprise WAN Buyer's Guide

# Simplifying Enterprise Network Architecture to Succeed in the Cloud Era.



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# **Enterprise** Challenges

# Enterprise Challenges



While the benefits of cloudification are well understood, enterprise IT organizations are challenged on many fronts to bring those benefits to fruition.



Top-of-mind issues include meeting the network and application services KPIs at the lowest cost point.



In short, enterprises need to do more with less without compromising services.

## Customer Needs

### IT Service Availability

When surveyed, Juniper's enterprise CIO customers say IT service availability is the one key priority keeping them awake at night.

With many applications running in different modes (on-premises, cloud, or hybrid), networks are challenged more than ever with seamless roll-out and simple, effective manageability. These are critical as they get rolled into service availability and MTTR (mean time to resolution) as a measurable performance indicator.

### Security

Cloudification heightens the need for security, which must be integrated seamlessly across distributed enterprise domains. A service edge must be secure: zero-trust is the preferred posture, and security must not interfere with the performance needs of distributed applications and services.

### Automation

With ever-shrinking IT budgets, IT teams need to deliver more with less while maintaining availability. Driving operational simplicity and lowering costs means minimizing operational errors. This is driving IT teams to automation.

### Agility

IT teams within enterprise organizations are under constant pressure to deliver services on time. But users do have choices, like software as a service, or hosting applications in the public cloud. While agility becomes an imperative, cloud adoption is inevitable, especially with benefits like CapEx reduction, on-demand horizontal scale, and utility pricing that's based on consumption.

## Design Considerations

**Cost, complexity, and application availability can be deeply impacted by key performance indicator (KPI) considerations highlighted in the following:**

### Fragmented Orchestration and Tools

While there is a tight coupling between networks and applications, the reality is that they're siloed by the fragmentation of tools used for orchestration and operations. This adds friction to the adoption of virtualized services, and causes day-to-day operational challenges in maintaining service performance.

### Hybrid Applications and Hybrid Cloud Connectivity

As applications span multiple clouds (on-premise, private, public, or a combination), connectivity challenges can be amplified.

Most often, large enterprises have applications leveraging hybrid cloud models and connectivity. This could be for any number of reasons, including custom or legacy applications that are too cumbersome or costly to effectively make the cloud migrations or applications housing sensitive or regulated data.





# **Enterprise**

## Trends and Drivers

# Enterprise Trends and Drivers

1

The evolution of enterprise software architectures driving the digital transformation of businesses.

2

The cloudification of IT network functions, enterprise infrastructure, and applications across multi-cloud implementations.

3

Increased demands upon the network.

## Software Evolution



### Software Architectural Evolution

PaaS, containers, micro-services, and serverless architectures.

### Cloud-Based Services

OTT infrastructure: Identity, firewalls, application development controllers, or unified communications as a service.

## Cloud Adoption



### Agility

Hybrid cloud and any-to-any cloud migration.

### CSPs Support Hybrid Cloud

Private cloud support by Microsoft Azure, Amazon Web Services, and Google Cloud Platform.

## Demands on Network



### WAN Bandwidth Growth

Driven by remote workforce, big data, the Cloud, and IoT.

### High Availability

Reliable, resilient, and fault tolerant networks.

### Simplify Services Delivery

Transform and automate service level agreements (SLAs) into network attributes.

# Enterprise Software Architecture

The evolution of enterprise technology architecture has passed through three phases, each one promising a new level of agility, scale, performance, cost efficiency, and ease of manageability.

1

## Infrastructure as a Service (IaaS) and Platform as a Service (PaaS):

The first steps towards cloudification of enterprise applications.

2

## Containers and Microservices:

Enabling deaggregation of software to run each logical function/module independently, where microservices leverage container technology to enable a multi-cloud solution.

3

## Serverless with Edge Compute:

Stateless enterprise software that executes on demand without the need to explicitly configure server resources, a key driver being Edge Compute and IoT.

## Cloudification

The evolution of software architecture has fueled the growth of applications and services across multiple clouds, and a consequent distribution of the network, data center, and application infrastructure. Enterprises have embraced these technology advancements to realize the benefits that cloud has to offer.

Cloudification drives new business models such as over the top (OTT) services, and places new demands on service orchestration and delivery. This is disrupting the traditional ways of working across each of the IT planes mentioned above.

However, there remain significant challenges in layering applications over a distributed network and/or infrastructure plane(s). This can be simplified with tight SLAs offering service assurance.

### Here's a quick snapshot of the benefits:

A

Simplified WAN model using SD-WAN and virtual routers.

B

WAN optimization, ADC (application delivery controllers), and virtual firewalls.

C

Simplified "as a service" offerings for unified communications (UCaaS) and disaster recovery (DRaaS).





# **Key Enterprise** Network Investment Considerations



# Key Enterprise Network Investment Considerations

**Cloudification places new demands on the network architecture. When we think of Salesforce, Office 365, or any custom public/private cloud-based service, network reachability may not cross your mind.**

Underlying networks are expected to just work – always be available and scale seamlessly with cloud services.

- Cloudification blurs the notion of a physical enterprise boundary. Network-level security becomes a key part of a defense-in-depth strategy, with the ability to tie the overlay network to virtualized services. This ensures seamless security and connectivity regardless of workload locations.
- While cloudification generally optimizes capital expenditure, operating expenditure can exponentially grow with the scale of the enterprise, the network, and the number of virtualized services employed. So, network visibility and automation play a crucial role.

**At Juniper, we are on a journey to realize the vision of a predictive and adaptive autonomous network:**

- Automation frameworks infused with telemetry, analytics, and machine learning.
- High-level intent is to provide input for the network to self-discover, self-monitor, self-configure, and self-heal.



## Autonomous Network

### Network

#### CLI: Human-Driven Automation

- Standards-based interfaces
- Standards-based data model
- Intent-driven network operations

### Controllers

#### Controllers and Bots: Machine-Driven

- Actionable real-time telemetry
- Closed loop automation
- Humans make decisions where machines cannot

### AI/ML

#### Machine Learning-Driven Controllers: Autonomous

- Machine learning-driven
- Integrated with historical and real-time network telemetry
- Human's design and tune machine learning

Autonomous network success depends on the performance of predictive algorithms, which depend on the data models (correlation engines). The fidelity of such data models is directly proportional to the amount of data collected (telemetry) from the network over time.

# Mapping Needs to Solutions

A good approach to a sound architecture is to start with high-level objectives captured in the KPIs for network and application services. The ability to map business needs to corresponding technology that addresses these is key to developing a sound approach.

Customer Need	Technology Solution
<ul style="list-style-type: none"><li>• Optimized site-to-site connectivity with assurance</li><li>• Better SLAs</li><li>• Service agility</li><li>• In-transit data security</li></ul>	<ul style="list-style-type: none"><li>• Cost-optimized MX platforms</li><li>• Security with SRX and vSRX</li><li>• Network optimized</li><li>• Over internet with MX and IPsec (SPC3)</li><li>• MPLS-enabled networking and Paragon Pathfinder service mapping</li><li>• Connected Security</li></ul>
<ul style="list-style-type: none"><li>• Service and application aware SD-WAN solution</li></ul>	<ul style="list-style-type: none"><li>• Session Smart SD-WAN™</li></ul>
<ul style="list-style-type: none"><li>• Better customer experience and security for the internet</li></ul>	<ul style="list-style-type: none"><li>• Paragon Automation Suite, Anuta ATOM</li><li>• EPE solution with Paragon Pathfinder controller</li><li>• DDoS protection</li></ul>
<ul style="list-style-type: none"><li>• Connectivity between private data centers and public clouds</li></ul>	<ul style="list-style-type: none"><li>• EVPN for all workloads</li><li>• In-transit data security</li></ul>
<ul style="list-style-type: none"><li>• Optimized DCI network to manage large east-west traffic</li></ul>	<ul style="list-style-type: none"><li>• EVPN DCI for different workloads</li><li>• Segment routing</li></ul>

## Guiding Principles for the Architecture Design

- 1 The KPIs are translated to the SLAs.
- 2 These SLAs are further categorized into tiers.
- 3 Tag each of the application services with the appropriate SLA tier.
- 4 Factor in the number of sites, employees, and the type of application (for example, SaaS, public or private/on-premises cloud-hosted app).
- 5 Consider planning and design, including network underlay/overlay, network capacity, QoS, redundancy/availability as per the above needs.
- 6 Review operations and management requirements, including network and application visibility for utilization, failure conditions, and auto-healing.

Each of the application SLA tiers can be mapped to the specific network characteristics, which defines the declarative intent for the application service. This intent can then be applied in an automated way to the underlying network and the related resource(s) leveraging the product architecture.

# Juniper Experience-First Networking

**Enterprise cloudification is here and running a scalable, highly available, multi-cloud network isn't easy. For large enterprises and private WAN MPLS infrastructures, it's about delivering a smooth, agile, and well-orchestrated experience to the end user, as applications move into a hybrid cloud environment including public and private clouds, and traditional data centers.**

Problems like network congestion, latency, brownouts, and long lead times to activate new services all degrade end-user experience, sending customers searching for greener pastures from another provider. According to one study, 60% of network problems are discovered first by end users or not reported at all. And 95% of customers who have had a bad service experience don't even bother to complain; they simply walk away.

Current operational models, built on manual processes and antiquated tools, can barely keep up with the growing complexity, scale, and performance requirements of the applications they're delivering. Current tools and processes break down. The customer experience suffers, along with the business. To survive and thrive in tomorrow's multi-cloud services landscape, an operational approach and the tools to support it are needed to be laser-focused on one thing: consistently delivering excellent customer experiences.

It's called "Experience-First Networking." And with our new Paragon Automation solutions, Juniper Networks can help you deliver a smooth deployment solution for your private WAN MPLS solutions.



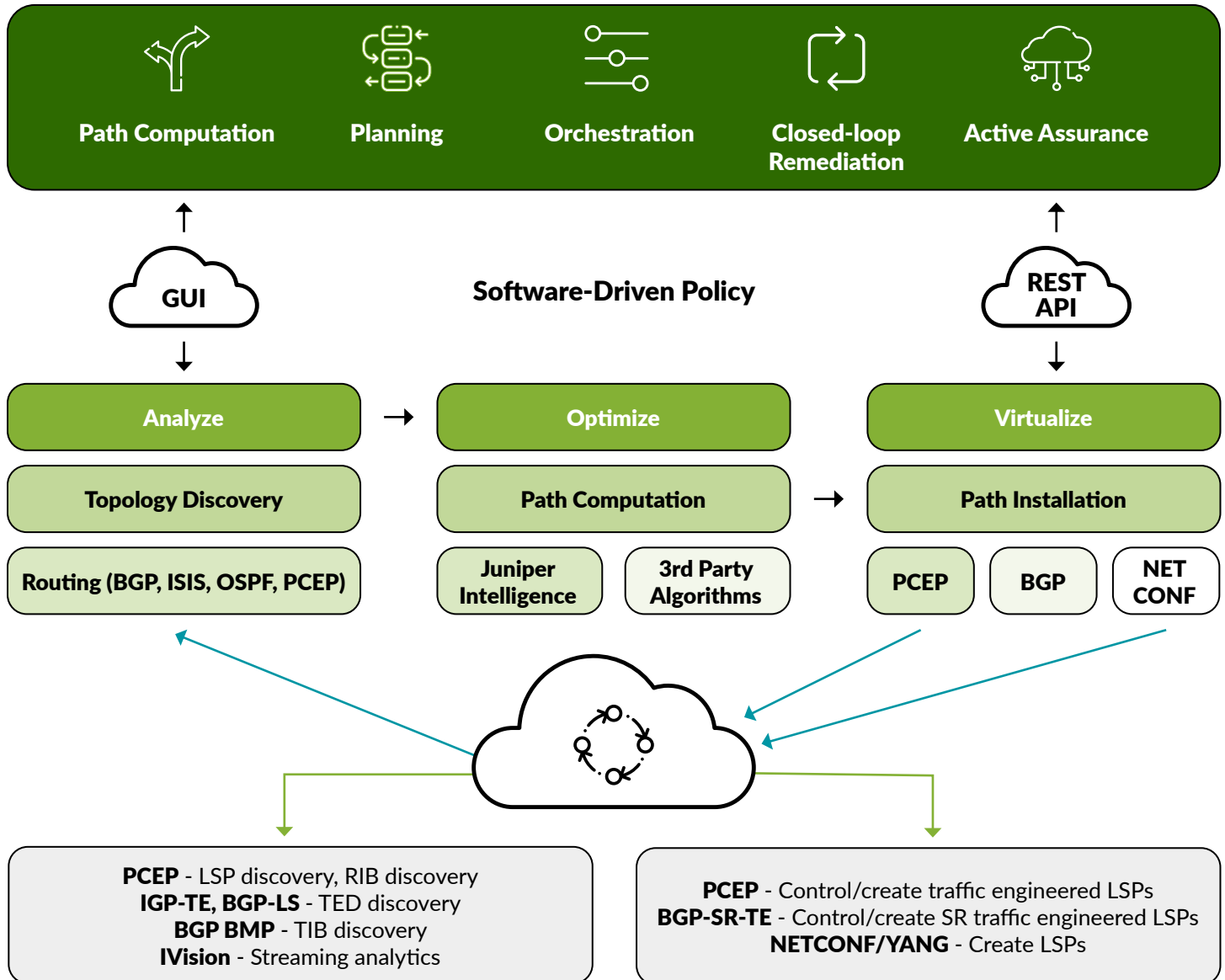
## Automation

Below are some of the solution components that enable excellent customer experiences.

- Programmability is essential in building adaptive, network-aware applications where the starting point is programmability using standard, low-level APIs to provide granular controls over network devices, all the way down to the chip level.
- Automation requires deep network visibility: the MX platform with Junos and custom silicon provides that visibility.
- Junos also provides industry-standard interfaces like RESTCONF, NETCONF/Yang, gRPC, and Junos Telemetry Interface (JTI) that enable automation software to retrieve that rich telemetry from external controllers.
- Machine learning (ML) solutions use this rich telemetry and allow for the creation of sensors, rules, and playbooks for automated network monitoring.
- Network maintenance activities such as adding sites and services, are all orchestrated by the controllers.
- Automated assurance tests at every step of the deployment to verify the health of the network in addition to continued assurance post-deployment.
- WAN provisioning tools discover a deployed topology, optimize with path computation elements, and deploy new paths if necessary.
- Network planning tools allow you to deploy greenfield and brownfield solutions seamlessly with the ability to retrieve a deployed topology and run what-if scenarios.

# Orchestration & Control

The following diagram shows these components working in concert, with policy driving an intelligent infrastructure that includes path computation engines as well as traditional routing protocols. The solution ensures high performance, granular traffic engineering, high availability, and security. This is all programmable or can be driven by GUI or CLI, as well as higher-layer orchestration.



## Telemetry

The traditional model for monitoring the health of a network is based on a so-called “pull” model, using SNMP and CLI to periodically poll network elements. But this is limited in scale and resource intensive. Instead, streaming telemetry natively from the data plane eliminates the need for polling by asynchronously delivering telemetry data to downstream collectors.

A key building block is automation equipped with real-time insight into all aspects of the network state, including device-level, and service-level data. Telemetry is the enabler for “closing the loop” and providing detailed instrumentation back to automation systems.

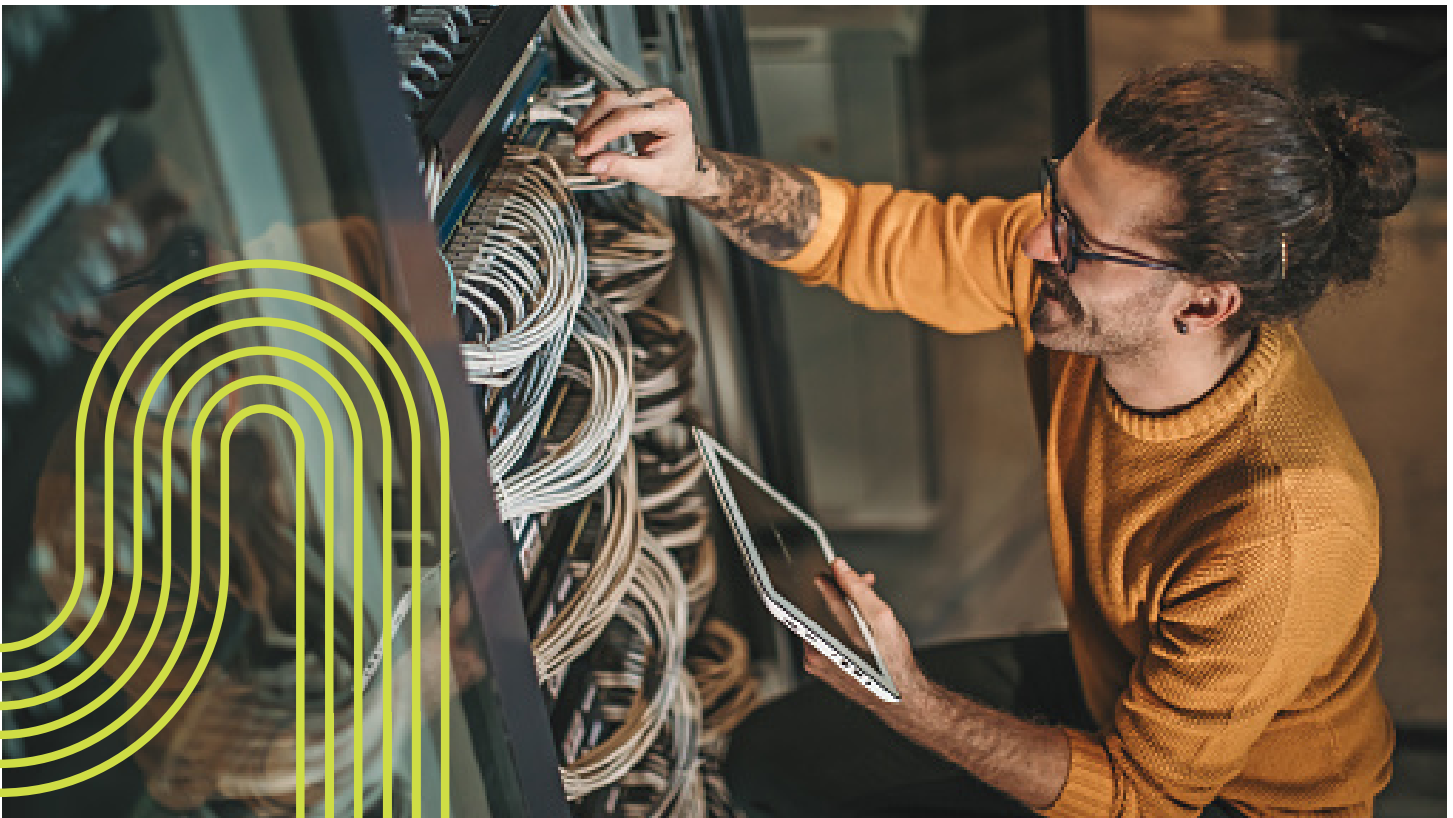


## Deep Networking Insights - Correlation Engine

Traditionally, customers deploy domain-level EMSs (enterprise management systems) to manage specific portions or services within the network. In the event of a failure, the task of extracting, correlating, and understanding data from multiple systems to understand the root cause can be overwhelming. Juniper implements decision-making logic within the system and the controller to interpret the state of the network (via telemetry) and make changes to the network based on the configuration.

## Declarative Intent

As networks become more complex, operational costs to manage them typically grow. Today, network administrators must be technically prescriptive for successful network interaction. Everyday tasks are quite often technical and require highly skilled staff. Declarative intent is a fundamental shift towards having networks accept “guidance” from network administrators in the form of “intent.” Intent becomes more aligned with the business than with the technology.





# Product Architecture

# Product Architecture

**Juniper Networks Enterprise WAN solutions can be viewed as an aggregation services point of presence (PoP) at the enterprise edge. The solution is built upon Juniper Networks® MX Series Universal Routing Platforms as the large and medium site enterprise WAN routers or Session Smart™ Routers (SSR) if an SD-WAN solution is deployed.**

## MX Series Universal Routing Platform

A robust portfolio of SDN-enabled routing platforms that provide industry-leading system capacity, density, security, and performance with unparalleled longevity. MX Series Universal Routing Platforms are the key to digital transformation for service providers, cloud operators, and enterprises in the cloud era. The MX addresses enterprise WAN solutions.

The MX enterprise WAN solution offers the following benefits to large enterprises seeking to use private MPLS or hybrid overlay networks designed with WAN aggregation:

- Improved operational efficiency
- Reduced operational expense
- Flexibility and value for investment
- Security
- Cloud-grade reliability
- Deep network insights

Common MX products for the enterprise include MX 204 and MX 10003 universal routing platforms. For sophisticated peering, MX can be driven by the Contrail PeerBot, which automates the process of network peering – managing multiple border gateway protocol (BGP) routing and complex policies.

## SRX Series Services Gateways

SRX series services gateways protect the network edge, data center, and cloud applications with Juniper next-generation physical, virtual, and containerized firewalls. A common enterprise solution is the SRX300, a next-generation firewall that connects and secures midsized, distributed enterprise branch offices. It consolidates security, SD-WAN, routing, switching, and WAN connectivity in a convenient 1U form factor.

Virtualized solutions include vSRX virtual firewalls and cSRX container firewalls.

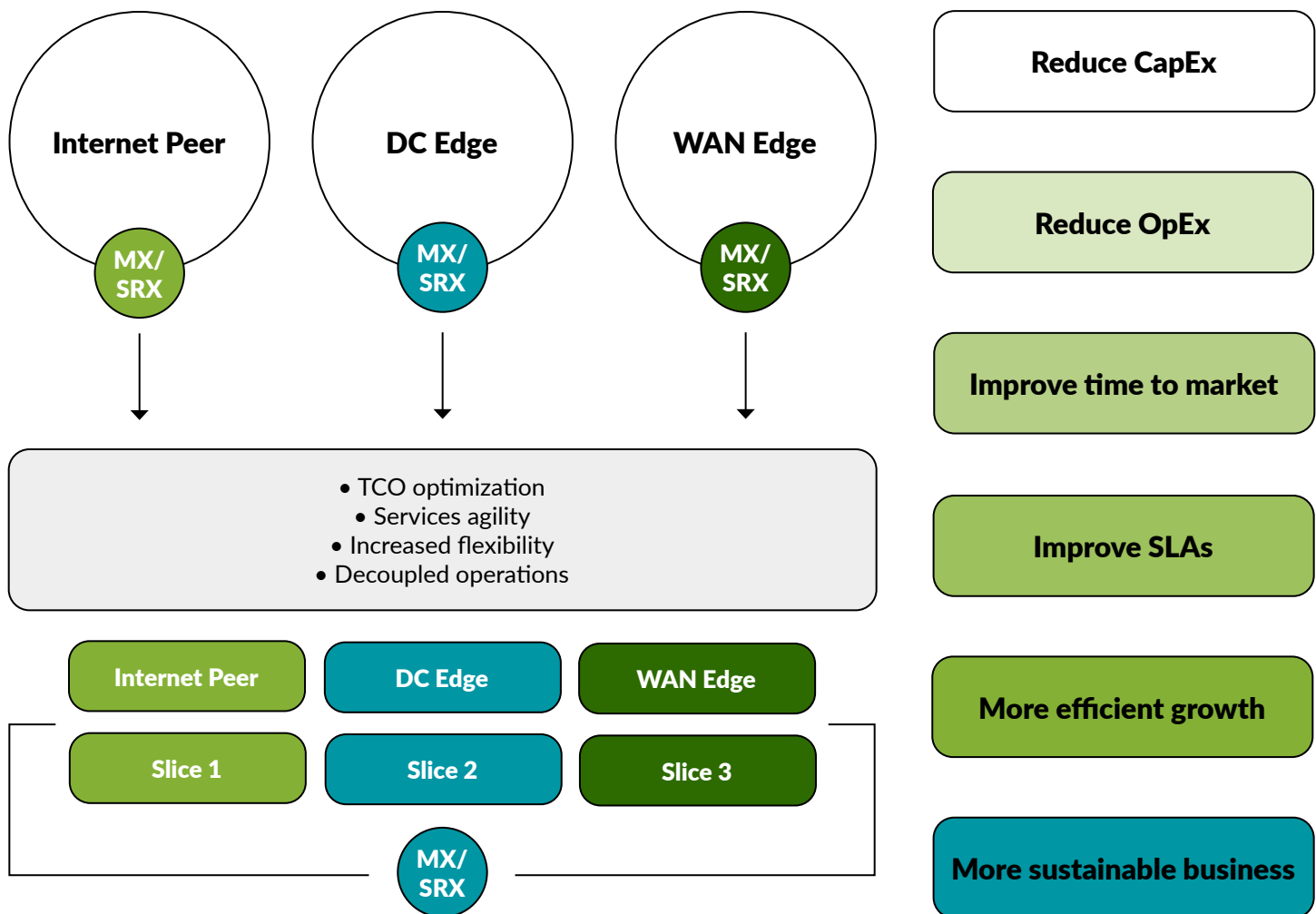
vSRX firewalls provide uncompromised flexibility, effectiveness, and performance in AWS, Microsoft Azure, Google Cloud, IBM Cloud, and Oracle Cloud environments.

cSRX container firewalls offer advanced security services to improve the visibility and secure applications running in containers and microservices.





# Product Architecture



## Versatile Scalable Transport

The most important architectural enhancement to improve network simplicity and service agility is the agility of the routing platform to support multiple use cases, with deep network visibility to enable automated solutions and an automation suite that enables the flexibility. The MX platform is agile, flexible with programmable custom silicon and software (Junos), and ready to accommodate tomorrow's technology today.

MX series routers all run on a single version of Juniper Networks Junos® operating system, which provides a common set of commands as well as robust and proven automation capabilities for configuration, operations, and event management. Junos also supports a rich feature set of proven as well as new technologies that give customers the ability to fully utilize network bandwidth.

Segment routing (SR) simplifies the transport layer by eliminating the need for running MPLS-TE protocols. Additionally, with the help of a controller, SR allows each service to determine its own path through the network (using label stack) as per its SLA requirements, without maintaining any state in the network.



# Product Architecture

## Other Technologies

Some other key software technologies are discussed in more detail in the following sections.

**Note:** You can look up more information on all these products using [Juniper Pathfinder](#).

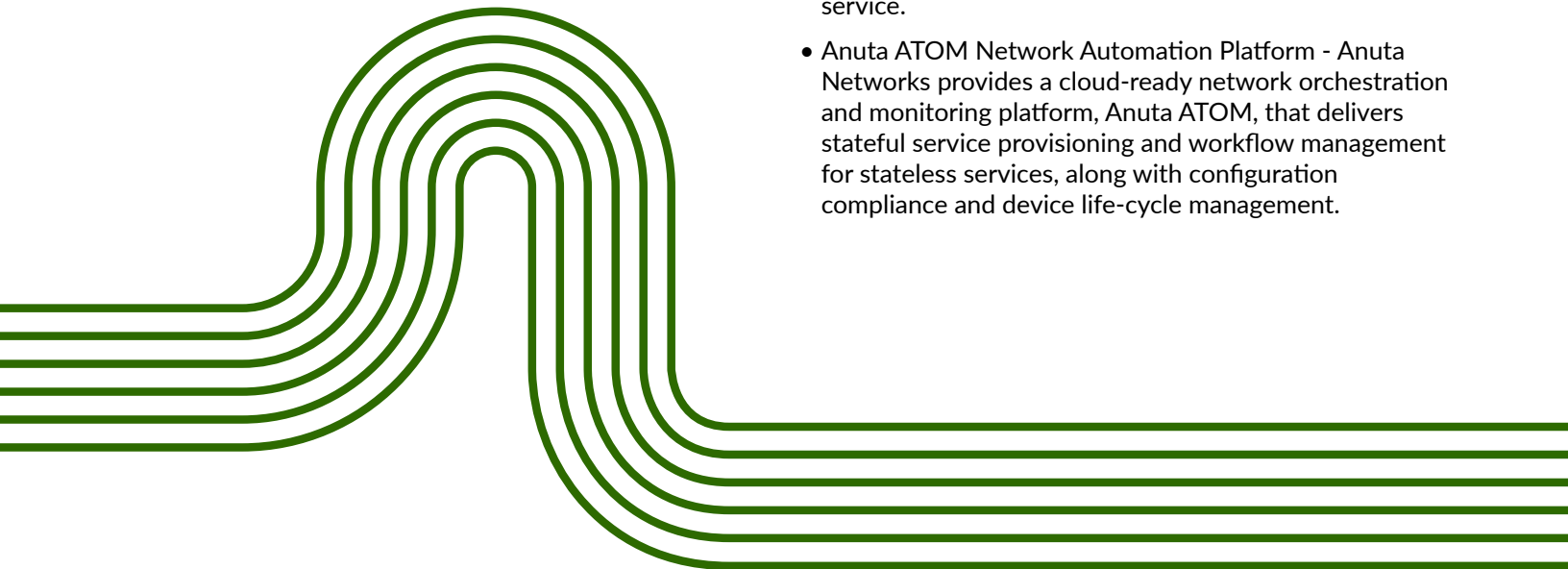
## Paragon

Juniper Paragon Automation is a modular portfolio of cloud-native software applications that deliver closed-loop automation for the MX platform in the most demanding multi-cloud environments. These solutions translate business intent into real-world performance across the lifecycle of a network and services.

They eliminate manual tasks and processes, empowering operations teams to work more quickly, efficiently, and accurately. They also protect customers and business by measuring real service quality on the data plane, assuring that users have a consistent, high-quality experience throughout the life of their service.

- Paragon Pathfinder determines the optimal path for an application based on monitored network operating parameters and encodes that path as a label stack on the service routers. De-aggregating the control plane and the transport provides flexibility in translating higher level application or infrastructure plane services intent to the desired network slice. This provides the desired SLA for the service independent of other services on the same network.

- Paragon Insights (formerly HealthBot) is a cloud-native, network health and diagnostic solution that provides operational intelligence across all service provider, cloud, and enterprise network domains, from network access to servers in the data center. Enables highly customized policies and playbooks through a functional drag-and-drop web interface; intelligently automates diagnostic workflows, and sustains overall performance goals.
- Paragon Planner (formerly NorthStar Planner) is a cloud-native modelling tool you can use for offline visualization and detailed architectural planning of your production network. It enables you to forecast the impact of network changes such as latency, additional traffic, shifts in traffic flows, and new capacity or services. Network operators can simulate the effects of these changes and other traffic scenarios in Paragon Planner without affecting the production network.
- Paragon Active Assurance is a programmable, active test and monitoring solution for physical, hybrid, and virtual networks. Unlike passive monitoring approaches, Paragon Active Assurance uses active, synthetic traffic to verify application and service performance at the time-of-service delivery and throughout the life of the service.
- Anuta ATOM Network Automation Platform - Anuta Networks provides a cloud-ready network orchestration and monitoring platform, Anuta ATOM, that delivers stateful service provisioning and workflow management for stateless services, along with configuration compliance and device life-cycle management.



# Product Architecture

## Software Defined Wide Area Networking (SD-WAN) with Session Smart™ Routing (SSR)

SD-WAN is an automated, programmatic approach to managing enterprise network connectivity and circuit costs. It extends software-defined networking (SDN) into an application that businesses can use to quickly create a smart hybrid WAN.

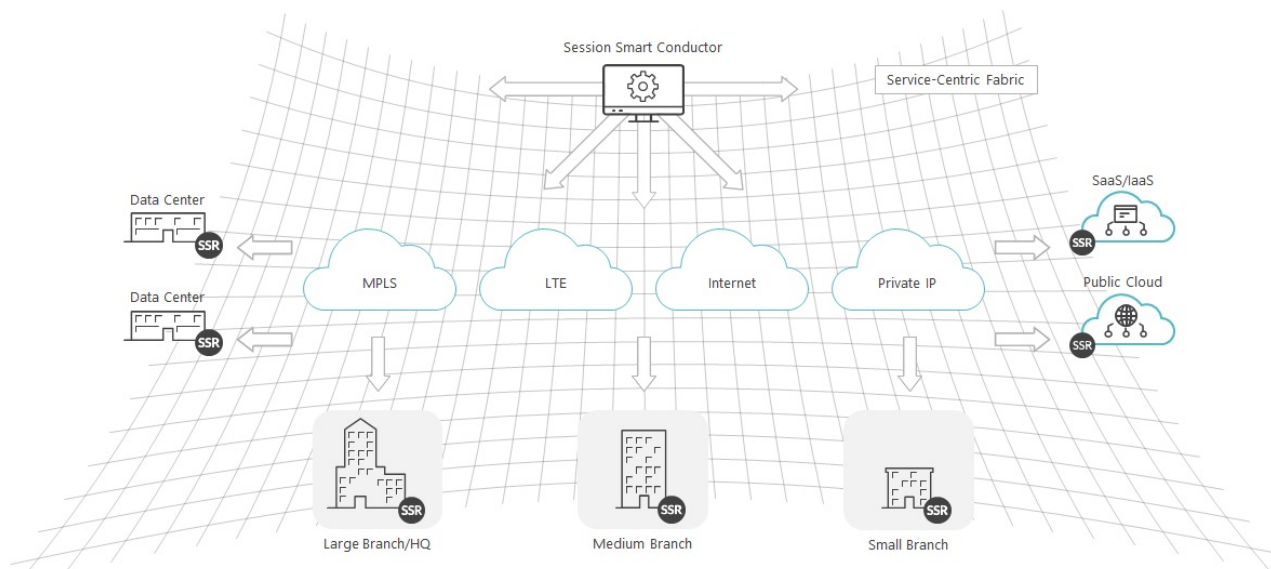
Consisting of business-grade IP VPN, broadband internet, and wireless services, SD-WAN provides the following benefits to enterprises:

- Lower WAN OpEx, CapEx, and overall total cost of ownership.
- Provide greater business agility and responsiveness to keep pace with IT innovations.
- Support multiple, secure, high-performance connections, providing redundancy.
- Improve performance by enabling load sharing across connections and adjusting traffic flows based on network conditions.
- Support the automated provisioning of, and changes to, premium network services such as VPNs, firewalls, security, WAN optimization, and application delivery control.
- Support zero touch provisioning (ZTP).
- Improve network security by encrypting WAN traffic and segmenting the network to minimize damage if breaches occur.

SD-WAN complements any existing private WAN infrastructure but creating an overlay when an underlying private WAN network is detected. The SD-WAN overlay is agnostic to the type of the underlying private WAN network and can include the internet, MPLS, layer 2 switching, or layer 3 routing.

Juniper SSR powers SD-WAN, a flexible services edge, and an L3NID for visibility and control. SSR ensures strong data security and provides per service, per session payload encryption without the overhead of tunneling. SSR optimizes performance, resiliency, and service quality with application and policy-based multipath routing. By routing and policing traffic at the edge, you avoid hair-pinning and latency.

SSR includes a service-centric control plane to improve scalability. You can easily scale policies across thousands of customer sites. Managed by the Session Smart™ conductor, individual Session Smart™ Routers (SSRs) create a service-centric fabric for campuses, branches, data centers, and cloud resources across the distributed enterprise.



# Product Architecture

Juniper Session Smart™ products include layer 3 network interface device (NID), Flexible Services Edge (FSE), and SD-WAN:



The L3NID provides a new standard for WAN management, providing deep visibility, real-time monitoring, and actionable analytics.



The Flexible Services Edge delivers a high-capacity edge router with full-featured traffic engineering and service level agreements more commonly seen in the largest distributed enterprises or even service providers.



The SD-WAN forwards traffic based on administratively defined policies and real-time network conditions, automatically selecting the best path for the right application at the right time for ultimate performance, resiliency, and service quality.

The following table shows the key features and benefits of Juniper Session Smart SD-WAN, which includes all the functionality of the L3NID and the Flexible Services Edge.

Feature	Benefits
Application-aware routing	Supports demanding application-level SLAs. Stateful failover for priority applications.
Zero trust network	Intrinsically high security: sessions are only allowed based on explicit business policies.
Tunnel-free architecture	Efficient WAN performance as it eliminates protocol overhead and provides granular control and visibility.
Session aware data plane	Selects the right path, for the right application, at the right time for ultimate service quality and resiliency.
Unified Communications	Seamless support for managed voice and video.
Runs as a single network element	Minimizes host CPU and RAM requirements; reduces costs; increases head-end router densities.



# Summary

# Summary

Modern enterprise WANs simplify and secure your network architecture from the branch to the cloud. The multi-cloud world has arrived, bringing with it a fundamental shift in the traffic patterns and security posture of your network. These shifts add complexity to your WAN, making management even more difficult.

For anyone building a WAN backbone today, consider:

- 1 A Future-Proofed Outcome**
  - IT function cloudification for cost reduction
  - Edge compute for latency-sensitive applications as well as for cost reduction
  - Network-level security for a multi-cloud environment
  - Streaming telemetry for in-depth network analytics and detailed instrumentation
- 2 Service Assurance**
  - Meeting the needs of the business user applications and the network KPIs
  - Simplifying management tasks through intent-based protocols
- 3 Automation**
  - To reduce operational errors and complexity
  - To enable adaptive, network-aware applications
- 4 An Open, End-to-End Approach**
  - Juniper products provide top-to-bottom and end-to-end solutions to meet all network needs

Whether you manage your company's WAN or use WAN services, it's time to rethink your approach to network architecture and connectivity. You need a solution that's secure, scalable, and doesn't increase network complexity.

That solution is with Juniper Experience-First Networking.

Take the first step





**Corporate and Sales Headquarters**  
Juniper Networks, Inc.  
1133 Innovation Way  
Sunnyvale, CA 94089 USA  
Phone: 888.JUNIPER (888.586.4737)  
or +1.408.745.2000  
Fax: +1.408.745.2100  
[www.juniper.net](http://www.juniper.net)

**APAC and EMEA Headquarters**  
Juniper Networks International B.V.  
Boeing Avenue 240  
1119 PZ Schiphol-Rijk  
Amsterdam, The Netherlands  
Phone: +31.0.207.125.700  
Fax: +31.0.207.125.701

PN: 7400099-002-EN

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