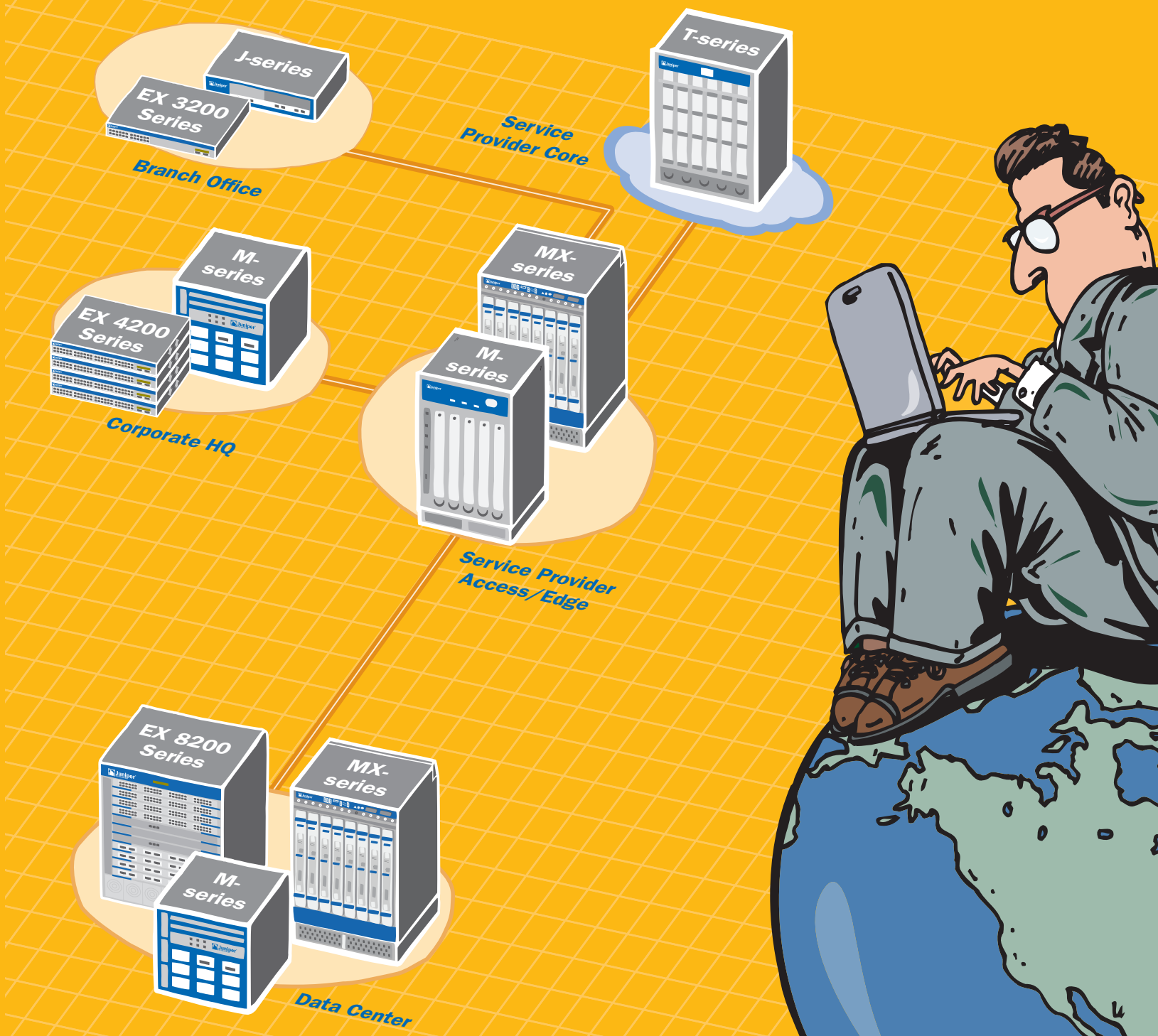
Product Brochure

Juniper Networks JUNOS Software

Network Operating System with a Difference: Delivering Network Availability, Operational Efficiency and Flexibility to Fuel Innovation



Your network is the foundation of your business. How does it set you apart to scale, to compete, and to innovate?

JUNOS software is the network operating system with the strategic design and development differences to deliver the network availability, operational efficiency, and flexibility that can fuel your innovation.

What sets JUNOS™ software apart from other network operating systems is the way it is built—one operating system enhanced through one release and developed from one modular architecture.

These strategic differences are the foundations for delivering long-standing JUNOS software values, including:

- **Continuous Systems:** Improve network availability and the delivery of applications and services through high-performance software design, High Availability (HA) features, prevention of human errors, and proactive operations measures.
- **Automated Operations:** Drive efficiency to lower operational expenses by reducing complexity with consistent feature implementation, error-resilient configuration, automated scripts for operational tasks, and the upgrade ease of one software release train.
- **Accelerated Innovation:** Enhance flexibility to deliver new services and applications through the open, standards-based philosophy and graceful extensibility of JUNOS software, including tools that open development to partners and customers.

Increasing Demands on Your High-Performance Network

The network fundamentally shapes the potential of innovation in high-performance enterprise and service provider businesses. However, complex networks that require extensive rework to change can slow down competitive response and new business initiatives.

While old hardware and outdated or poorly integrated technologies contribute to the challenges, it is the software running in IP networks that consumes the most operational time, causes the majority of operational headaches, and creates the obstacles to change. Largely based on source code initially built decades ago, legacy network software carries a number of limitations, including:

- **Monolithic software architectures**, which impact network stability, performance and security with co-mingled processes vying for the same shared computing resources and where even a small problem in one process can cascade to affect many others.
- **Complex, error-prone operations tasks**, which add not only time and effort to routine activities but also multiply the risk of human error that can cause extensive outages or create security vulnerabilities.
- **Multiple release trains and software versions**, which slow down network upgrades with requirements for extensive testing, qualification and training while impacting the predictable delivery of new service features and fixes.

So, how does your high-performance business innovate to deliver new high-value services while maintaining the operational stability of your infrastructure?

The solution begins with greater confidence in the underlying network foundation. If you can place greater reliance on the software supporting your infrastructure, particularly in its most strategic and distributed components, your network operations staff can focus more of their time and effort on projects that can drive your business growth and productivity.

JUNOS Software: The Foundation of High-Performance Networks

High-performance businesses look to Juniper Networks to help solve network challenges as they scale, compete and innovate. JUNOS™ software, the trusted network operating system of Juniper Networks, is the foundation of this high-performance network.

Different by Design and Development

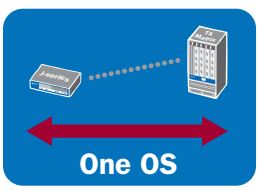
The key advantages of JUNOS software derive primarily from how it is built—what Juniper calls the 1-1-1 differences:

- One operating system with a single code source for consistent implementation of features
- One software release extended by a highly disciplined, firmly scheduled development process
- One modular software architecture that scales across platforms from the branch to the core

One Operating System

The truly unique nature of JUNOS software begins with its most fundamental virtue: a single code source. Unlike other network operating systems that share a common name but splinter into many different programs, JUNOS software has remained a single, cohesive operating system throughout its existence.

A single code source means that our engineers develop JUNOS software features once. Whenever a new platform requires a control plane feature, the engineers use the existing code rather than redeveloping the feature, which is often the case in other systems. The single code source not only streamlines the development process, but also extends many benefits to our customers.



Benefits of a Single Code Source

For those who operate your network, JUNOS software streamlines the training required for new features. A single common interface lets administrators generally configure and manage each feature in the same way. Additionally, your teams can use the same set of tools to monitor, manage, and update the network. When they first start using JUNOS software, those with a UNIX background will find its familiar UNIX environment advantageous and helpful.

For those responsible for changes to your network, the inherent interoperability of a consistent implementation, regardless of platform or software version, simplifies new feature deployment, software upgrades, and other network modifications. For example, a control plane feature validated in one platform doesn't require extensive re-qualification in other platforms, since the code specifying the feature is the same.

One Software Release

Juniper Networks methodically enhances the single code source of JUNOS software through a highly disciplined process with a single release train and strict development principles. Each new version of JUNOS software is released concurrently for all product lines following a preset quarterly schedule. A new production release cannot omit features that were working previously, and must achieve zero critical regression errors, ensuring reliable operations for the entire release.

Other network operating systems do not follow as strict and disciplined a development process as JUNOS software. As a result, competitive operating systems have splintered into many disparate release trains—counted in hundreds or even thousands—creating several levels of inconsistency and adding untenable complexity to the network. Waiting for new releases and features in these systems is famously unpredictable. Implementing new features introduces the risk of disrupting the network. To avoid such risks, many businesses dedicate large teams of engineers to test and verify new updates before they are deployed; others simply avoid upgrades and make do with old versions of the software, sacrificing functionality for stability.

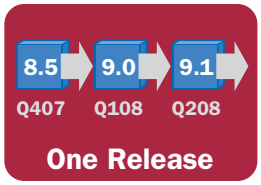
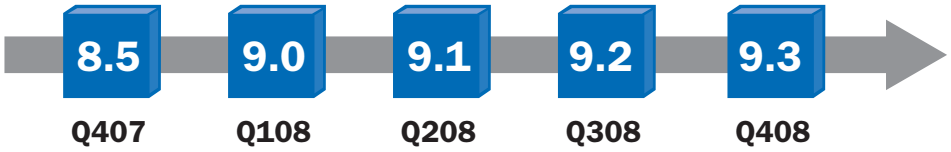


Figure 1: JUNOS Software—A Single, Predictable Release Train



Benefits of a Single Release

The benefits of the JUNOS software approach to development are a more stable code base that not only reduces the number of unplanned system events but also the time and trouble of planned maintenance and upgrades. To upgrade, you simply choose and qualify a higher release number. Our customers have confidence in the reliability and predictable behavior of JUNOS software and consider upgrades a routine, concisely scheduled maintenance task, rather than a high-risk, time-consuming network project. While they don't need to, many upgrade at least once a year to ensure that they have ready access to the latest features, which they then simply activate in their deployed release whenever they are ready.

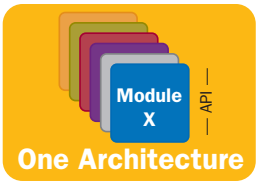
One Modular Software Architecture

Underlying the methodical enhancement of JUNOS software is its modular architecture, providing an advanced software design for flexible but stable innovation across many platforms. Fundamental to the architecture is the Juniper Networks pioneering innovation to separate the functions of packet control from packet forwarding. Complete separation enables high availability, as each function can operate independently of the other and support a variety of redundant hardware designs.

The individual modules of JUNOS software communicate through well-defined interfaces. Each runs in its own protected memory space, preventing one module from disrupting another and also enabling independent restart of each module. This contrasts to monolithic operating systems where a malfunction in one module can ripple to others and cause a full system crash/restart.

Benefits of a Modular Architecture

The innovative, distributed architecture of JUNOS software provides high-performance, high availability, security and device scalability. As an example, the command-line interface (CLI) never locks up, even during Distributed Denial of Service (DDoS) attacks. The necessary computing resources are always available to the control plane so that administrators can add new filters to drop or rate-limit attack traffic.



Moreover, the modular architecture of JUNOS software streamlines new development and enables complete, holistic integration of newly added services that is much more powerful than the typical bolt-on approach. In developing new capabilities, our engineers can choose to add new modules or to update existing modules, without requiring a total overhaul of the entire code. Over the years, we have added several dozen new modules to the original network operating system to support a richly expanding set of new services and features.

Delivering a High-Performance Network Foundation

The fundamental design and development differences of JUNOS software has allowed it to evolve over the years to accommodate increasingly complex application and service needs, with increasingly stringent performance and reliability requirements. The steady stream of features delivered in four new releases every year adds to its many strategic advantages, including:

- **Continuous Systems:** Improve network availability and the delivery of applications and services through high-performance software design, high availability features, prevention of human errors, and proactive operations measures.
- **Automated Operations:** Drive efficiency to lower operational expenses by reducing complexity with consistent feature implementation, error-resilient configuration, automated scripts for operations tasks, and the upgrade ease of one release train.
- **Accelerated Innovation:** Enhance flexibility to deliver new services and applications through the open, standards-based philosophy and graceful extensibility of JUNOS software, including tools that open development to partners and customers.

Table 1: JUNOS Software Operations Results (Lake Partners 2007)

Survey of 122 Network Operations Team Leaders	
Network Operations Tasks	**Average Time Savings Reported in Using JUNOS Software**
Troubleshooting and Unplanned Events	54%
Monitoring and Optimizing	24%
Upgrading and Maintenance	23%
Adding Infrastructure	29%
All Network Operations Tasks	**25%**

Continuous Systems

The consequence of an outage in a modern multiservice network can be extraordinarily expensive in terms of lost customer connections and transactions, service-level agreement (SLA) impacts and penalties, and damaged customer confidence. Yet, operations teams face many challenges to increasing network availability. Network equipment downtime can come from planned maintenance activities, unplanned hardware or software events, and most often, according to many different studies, human error. Addressing downtime requires a multifaceted approach to designing systems that proactively considers all of its underlying factors.

JUNOS software devices have a well-deserved reputation for continuous performance and operational stability. The engineering foundations of continuous systems are rooted in the long standing design and development philosophies of JUNOS software; this is not a feature or

attribute that can be easily retrofitted. JUNOS software provides a long and growing list of features for high availability. Among the many recent additions are the transparent switchover of routing and bridging functions and the clustering capabilities of our branch routers and switching platforms.

Additional JUNOS software innovations for continuous systems include a rich set of customizable scripting tools that run on-box to ensure error-free configuration and accelerate problem resolution. The following section discusses multiple tools for automating operations to not only provide fail-safe mechanisms that avert human error, but also reduce the severity and duration when unplanned network events do occur.

Automated Operations

The operations benefits of JUNOS software derive not only from the reliability, performance and security of its design, but also from a dedicated focus on simplified, error-resilient tasks across all operations functions. The hindsight that comes from prior experience has helped JUNOS software engineers find better ways to design operations steps, interfaces and tools. Many of these improvements simplify and reduce human error in procedures through increased automation.

Configuration

The JUNOS CLI is easy to learn, with a feel that is similar to other command sets. Prominent improvements over other systems include multiple features for error-resilient configuration that store changes in a candidate file, enable rollback to 50 prior configurations and can trigger automated rollback in remote systems accidently isolated during configuration changes.

The most frustrating of human errors are ones that have happened before because they are repeating known mistakes that operations teams could ideally prevent. JUNOS software commit scripts directly address this challenge through the customization of the commit verifications that run before a candidate configuration becomes active. A library of scripts can be developed and maintained by your most experienced network engineers to ensure that configurations are compliant with your business and network policies. Moreover, these advanced scripting tools include a macro capability that can condense repeated complex configurations to only a few configuration lines and variables.

Monitoring, Troubleshooting and Problem Resolution

While most network operations groups spend the majority of their time in reactive mode, proactive discovery of potential issues is the preferred approach. Extensive monitoring and instrumentation capabilities within the JUNOS software give your operations team complete visibility into system health and device performance.

One of the characteristics of complex systems is the cascade effect of errors. Small problems can rapidly escalate into major ones. Instead of waiting for an outage that is significant enough to trip alarms and notify administrators, JUNOS software operation scripts and event policies allow network engineers to automate early warning systems that not only detect emerging problems, but can also take immediate steps to avert further issues and outages and restore normal operations. Your operational procedures can be captured in scripts instead of on paper, leveraging expertise across your company. Scripting enables a continuous improvement capability as each network outage is diagnosed, and proactive avoidance steps are scripted by your best engineers.

Accelerated Innovation

Juniper Networks has assertively promoted and adopted open standards and interfaces on our networking platforms to make it easier to manage and operate them in multi-vendor networks. The time tested interoperability and integration capabilities of JUNOS-based platforms are evident in deployments in the 40 largest service providers worldwide and in tens of thousands of enterprise and government networks. The open, standards-based philosophy and graceful extensibility of JUNOS software provide the flexibility to evolve your own network architecture to adapt to new, perhaps unforeseen applications and service needs with minimal cost and risk.

The commitment to open standards extends to open interfaces for policy control, network management and other operations systems. One example is the use of XML (eXtensible Markup Language) as an interface to device configuration and state information. And, the Juniper Networks Session and Resource Control Portfolio (SRC) uses the open policy interfaces of JUNOS software for policy-driven control of network resources to enable the end-to-end delivery of high-value differentiated services across multi-vendor networks.

The Partner Solution Development Platform (PSDP) from Juniper Networks enables customers and partners to develop and deploy new applications on JUNOS software. The PSDP provides a powerful set of secure tools and resources, including a software development kit (SDK) with intelligent and secure interfaces to JUNOS routing and service functions. By securely building on top of JUNOS software, customers and partners can develop solutions tailored to their specific go-to-market opportunities and business needs, saving time and money not only in application development, but also in the deployment and ongoing operations costs of the solution.

The Juniper Networks Portfolio of JUNOS Switching and Routing Platforms

Juniper Networks aggressively drives JUNOS software innovation through its disciplined development as a single-source network operating system that integrates routing, switching, security and other services. Our extensive portfolio can connect enterprise branch and regional offices, central sites and data centers, along with the metro, edge and core sites of service provider networks. Juniper will continue to leverage its heritage in best-in-class security in delivering JUNOS software innovation.

The Juniper Networks EX-series Ethernet switches address the access, aggregation and core layers of branch office, campus and data center applications. The EX-series Ethernet switches advance the economics of networking, lowering operational expenses by running JUNOS software, using a single management application, and lowering recurring power and cooling costs. They also reduce capital expenses by collapsing or eliminating network layers. The series meets today's most advanced switching requirements for security and unified communications with integrated access control policy enforcement and extensive quality of service (QoS) features.

The Juniper Networks J-series Services Routers offer predictable high performance and a variety of flexible interfaces that deliver secure, reliable network connectivity to remote, branch and regional offices. The J-series are Avaya voice-ready and all models run modular JUNOS software, which offers many advanced routing and security services delivering high levels of security, uptime and performance at reduced operational costs. The J-series offers the performance headroom and extensible memory to meet future integration needs and other demands of the network.

The Juniper Networks M-series Multiservice Edge Routing Portfolio, spanning from 5 Gbps up to 320 Gbps of throughput, uniquely combine best-in-class IP/MPLS capabilities with unmatched reliability, stability, security and service richness. These multi-service edge routing platforms —deployed predominantly at the service-provider edge and in high-end, high-performance enterprise applications—enable consolidation of multiple networks onto a single IP/MPLS infrastructure without performance or feature compromise.

The Juniper Networks MX-series Ethernet Services Routers, spanning from 240 Gbps up to 960 Gbps of throughput, establish a new industry standard for Ethernet capacity, density and performance. Offering efficient support of high-density interfaces and high-capacity switching throughput, the MX-series supports a wide range of business and residential applications and services, including high-speed transport and VPN services, next-generation broadband multiplay services and high-volume Internet data centers.

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The Juniper Networks T-series Core Routers, spanning from 320 Gbps to 2.5 Tbps of throughput, provide high availability, reliability, performance and scale, reducing operational and capital costs. The T-Series offer sophisticated processing capabilities on a true multiservice platform with seamless integration with optical transport networks. Building core next-generation networks (NGN) with T-series core routers offers a "pay-as-you-grow" path. Providers can reduce operational and capital expenses while easily customizing the network solution set and user experience.

The Juniper Control System (JCS) 1200, is the industry's first high-performance control plane scaling system. JCS 1200 introduces independent scale of control and forwarding plane resources to maximize service growth, operational efficiencies and control. This unique architecture enables service providers to rapidly expand their service offerings and helps to reduce capital and operating expenditures.

Getting Started with JUNOS

Adoption of any new product or technology initially requires expanded effort; however, our customers have consistently found the short-term activities of JUNOS software adoption to be far outweighed by the long-term benefits. As a Juniper Networks customer you have available to you all the tools that you need to make the migration to JUNOS software simple and safe, from the inherent characteristics of JUNOS itself to a wealth of support services.

Juniper Networks Education Services

Certified networking professionals are in greater demand than ever before, adding value to your organization through their extensive knowledge, particularly when that knowledge extends across multiple vendors to design best-in-class solutions for your business. Juniper Networks provides a wide array of training programs and a range of technical certifications. See the complete list of the JUNOS training and certifications at: http://www.juniper.net/training/.

For enterprise teams new to JUNOS software, the Juniper Networks Technical Certification Program (JNTCP) Enterprise Routing and Switching certification tracks allows participants to gain practical competence with JUNOS-based router and switch deployment and operations. The Juniper Networks Certification Fast Track Program significantly reduces the time and costs of training and certification for experienced networking professionals with existing routing and switching knowledge. Find out more at: http://www.juniper.net/training/fasttrack/.

About Juniper Networks

Juniper Networks, Inc. is the leader in high-performance networking. Juniper offers a high-performance network infrastructure that creates a responsive and trusted environment for accelerating the deployment of services and applications over a single network. This fuels high-performance businesses. Additional information can be found at www.juniper.net.

To purchase Juniper Networks solutions, please contact your Juniper Networks sales representative at 1-866-298-6428 or authorized reseller.