

ACCELERATING THE PACE OF INNOVATION IN THE HIGH-PERFORMANCE NETWORK

Executive Essays on Innovation and the Partner Solution Development Platform

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Executive Summary

The power of the network is its ability to readily connect people with content, applications and each other. Today's converged IP networks carry communications, entertain, improve productivity, drive revenue growth and much more. However, the requirements of an increasingly disparate and global marketplace are creating pressure for greater network innovation that extends beyond the capabilities of any single vendor.

Juniper Networks® is delivering the Partner Solution Development Platform (PSDP) to meet the challenge for greater innovation by enabling customers and partners to develop their own specialized applications on our trusted Juniper Networks JUNOS® Software. The industry's first partner development platform for a carrier-class network operating system gives our customers greater choice and control while opening new opportunities for business growth and productivity.

With over a decade of delivering market-changing innovation, JUNOS has become the network operating system of choice for high-performance businesses. Enabling a powerful combination of the unique expertise of customers and partners with the high-performance operations of JUNOS will accelerate the pace of innovation in our industry.

This paper provides a series of perspectives on the imperative for innovation across our fast-expanding industry and the opportunities enabled by the Partner Solution Development Platform from leaders on the Juniper Networks executive team.

Our Industry Imperative: Accelerate the Pace of Innovation

Scott Kriens, Chairman of the Board, Juniper Networks, Inc.

The opportunities for high-performance networks to provide greater value for communications, consumer entertainment, and enterprise productivity and growth are increasing the pressure for innovation in our industry. The market can no longer wait for individual vendors to deliver integrated networking solutions with the required performance and functionality, following the slower, proprietary development model of the past.

As the economic pressure to quickly deliver new products and services grows, business innovation is evolving from an internal activity to one that involves customers, suppliers and partners. Leading companies that adopt this open approach are more agile and benefit from a wider range of ideas and a greater rate of new offerings for their customers. Juniper sees this approach as the right way to fundamentally increase the rate of network innovation—improving the user experience and the revenue and profit potential of the network through improved communications, entertainment and business productivity.

Introducing the Partner Solution Development Platform

When Juniper Networks was founded, the primary discussion across the industry was how to build scalable, reliable networks that worked together. Our best-in-class solution to this challenge provided a new modular network operating system, coupled with scalable hardware, and support for open interfaces and standards.

Now, complementing Juniper's long standing best-in-class focus on performance, reliability, scalability, intelligence and total cost of ownership, Juniper is adding the imperative to accelerate the pace of network innovation. The introduction of the industry first Partner Solution Development Platform (PSDP) for a carrier-class network operating system allows our customers and partners to incorporate their unique, specialized expertise in applications that they develop to run on Juniper's high-performance networking platforms.

The PSDP offers a powerful set of resources that include a software development kit (SDK) with intelligent and secure interfaces to JUNOS Software routing and service functions. These tools provide customers and partners with greater choice and control in designing, developing and deploying specialized applications for the network.

Providing Carrier-Class Reliability with Innovation

Our best-in-class approach to hard problems is a fundamental value that Juniper solutions deliver to our customers. In designing the PSDP for licensed customers and partners, we have carefully preserved the best-in-class attributes of JUNOS. Our disciplined JUNOS engineering foundation based on a single release train, modular independent processes, and consistency of implementation is the prerequisite starting point. This well established foundation makes it possible for us to now give our customers greater control of their network – by developing on their own or choosing from partners specific applications for the unique opportunities and needs of their business without affecting network stability and reliability.

Delivering the Future

The claim of a commitment to openness is common. Some vendors assert that their products are open because they adopt standards such as IP. Others allow partner code to run on generic processors that are physically located in the same chassis. While this loose integration is sufficient for some applications, it falls short of the full power of open, integrated development.

Juniper is taking a different approach. The Partner Solution Development Platform recognizes the power of many to drive innovation in our industry at the speed of business. Partner applications can securely access data streams and JUNOS Software features, leading to a much deeper integration between these applications and the network. This is the only option for services where network performance is critical to business success. This is the path that the entire industry will ultimately travel. Juniper is delivering that future—today.

Introduction to the Partner Solution Development Platform

Jan Stip, Vice President of New Business

Craig Bardenheuer, Vice President, Joint Development and Product Partnerships

The requirements of an increasingly disparate and global networking marketplace create an innovation imperative reaching far beyond the capabilities of any single vendor. In introducing the Partner Solution Development Platform (PSDP), Juniper Networks is broadly extending its commitment to partnership with our customers, channels and solution providers to drive more creative and diverse network innovation. The potential power of a dynamic ecosystem of innovation fuels new and unforeseen opportunities for game changing, revenue-driving services and highly automated operational efficiencies.

Inviting customers and partners to create advanced solutions with the PSDP combines their specialized expertise in applications, industries and technologies with the extensive networking functionalities of JUNOS Software. In developing JUNOS, Juniper will continue to focus and execute on the complex problems associated with reliable and scalable secure networking. Our focus opens the opportunity for our partners to add their expert knowledge as new value to our customers. And customers can use the PSDP to build unique applications that no one else has, in order to pursue specific competitive advantage or strategic growth opportunities custom fit to their business. The development independence enabled by the PSDP lets these partners build applications at their own pace of innovation with little necessary coordination with Juniper beyond the initial agreement.

Opening Development

There is an important distinction between the Juniper PSDP and open source software that is worth noting early in our discussion. The PSDP introduces open interfaces and provides many of the benefits of open source—letting the proven JUNOS foundation be available to invited partners so as to extend its capabilities. Even so, the PSDP only enables application access to these interfaces in a highly secure and protected way to fully shield and safeguard the underlying operations of the network operating system. Unlike open source development environments, PSDP users are not required to share their developments with Juniper or the broader community. Further, customers must explicitly load applications (and each requires an authentic signature), so each of our customers can choose for themselves whether or not they want to leverage the power of the PSDP.

Open IP Solution Development Program (OSDP) for Partners

Juniper provides access to the PSDP technology, as well as technical and business support to partners through its Open IP Solution Development Program (OSDP). Juniper recommends that candidate OSDP partners have a base level of networking and software engineering experience and a targeted application. Customers or partners joining the program must execute a PSDP License Agreement that specifies the annual licensing and support of the program.

Juniper provides a dedicated PSDP support team of experienced JUNOS Software engineers who know the details of the available tools and programming interfaces. Along with reviewing code and providing insight into the internal workings of JUNOS, they develop toolkits and supporting documentation and can supply code fragments and sample applications.

Common types of development partnerships include:

- **Customers:** Customers can develop applications for private use on their networks, developing and rolling out new applications in broad adoption or in narrowly deployed trials to test new opportunities. This allows both service providers and enterprises to enhance privacy and security, improve productivity, and differentiate their network functionality for unique service offerings and competitive advantage. Customers can also work with a Juniper PSDP integration partner in the development of their confidential solution.
- **Integration Partner and OEM:** At the core of the PSDP program are the Juniper channel partners, system integrators, independent software vendors (ISVs) and original equipment manufacturers (OEMs). The PSDP helps these partners to accelerate their own business objectives for bringing new innovation to market. Among the potential markets for their developed applications is the large installed base of Juniper customers worldwide. Alternatively, some partners will use the PSDP to target and build new markets. In both cases there may be opportunities to co-market with Juniper.
- **Universities and other research organizations:** Academic research is an essential part of innovation. The PSDP provides a flexible platform to investigate, experiment and prototype emerging issues in network science. Interactions between the corporate and academic communities make it easy to explore commercialization opportunities in promising research areas.

Advanced Security Services

Organizations looking to further enhance their network security can use the PSDP to develop additional encryption, intrusion detection or other deep packet inspection functionality. Enhanced customizable security will be particularly valuable for large organizations that are often subject to a disproportionate share of network attacks. They can use the PSDP to leverage their experience of attack patterns to develop custom intrusion detection or other defense mechanisms as an internal solution or as an enhanced service offering. Additionally, security software vendors can leverage the PSDP to integrate their security and update services as applications for JUNOS Software-based devices.

Integrating these capabilities into the router reduces overall vulnerability by executing these functions directly within the device. The Juniper Networks Multiservices PIC (MS-PIC) provides high-performance traffic processing for intensive encryption or packet inspection.

Building Applications with the PSDP

The Partner Solution Development Platform allows developers to create applications through well defined interfaces, software libraries and build environments. With the PSDP, licensees can build many types of applications that can run across a full range of JUNOS Software-based devices from branch to core deployments. Example types of applications include event optimized routing, customized bandwidth management, advanced security services or extended operations toolsets.

The PSDP is particularly valuable for applications that need to be co-resident within the router or run in a specific, highly distributed way in the network. By building on top of JUNOS, partners can save time and money in application development by leveraging the many network protocol stacks and features of JUNOS, while their customers benefit by avoiding the deployment and ongoing operations of a now unnecessary stand-alone device. Close application integration enables the processing of packets at line rate, while keeping traffic on the router for improved security and efficiency.

Partners use the PSDP to generate the application code with all applications signed by a certificate authority identifying its source. Developers can choose to run their applications on either the Routing Engine (RE) of the Juniper Networks hardware or on a Multiservices PIC, as shown in Figure 1 below.

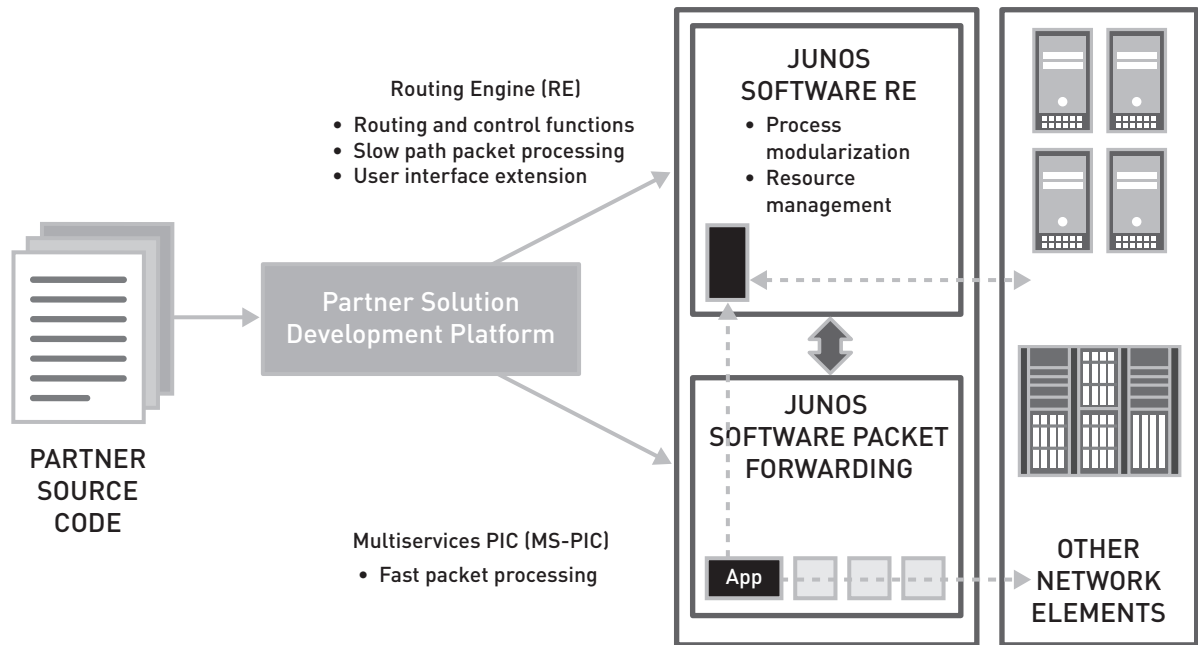


Figure 1: How the partner solution development platform works

- Control plane packet processing and “slow path”:** The Routing Engine is most suitable for applications processing the limited volumes associated with control traffic; for example, network routing protocols, or user traffic protocols such as Session Initiation Protocol (SIP) or Real-Time Streaming Protocol (RTSP). Limited volumes of user traffic can also be processed on the RE. To protect the other network processes running on the RE, filters control traffic reaching the RE from the forwarding plane, and resource managers control the processing and memory resource allocated to each application module.
- High-speed data plane packet processing:** The Multiservices PIC (MS-PIC) is a highly parallelized processing module which provides additional processing and memory power on many Juniper routing platforms. It is most suitable to run applications requiring access to network traffic, such as those dependent upon deep packet inspection or with a requirement to modify high-bandwidth or latency-sensitive traffic. Multiservices PICs provide great flexibility in matching developed applications to needed packet processing horse power. Customers can choose to dedicate partial, single or multiple PICs to run each PSDP developed application.
- Distributed application processing:** Additionally, developed application processes, either in the RE or the MS-PIC, can communicate directly with other networking elements or even external servers. This allows a great deal of flexibility and interoperability to leverage intelligence beyond the box, or even beyond the network, for network decision-making. For example, a PSDP application running on a router could tie into an application that alerts it to power outages or other events that trigger preplanned changes in network configurations.

Running Applications

Running a developed application requires that it carry a valid signature and that a network administrator with the appropriate authorization load and enable it on a JUNOS Software-based device. By configuration defaults, no PSDP developed applications can run on any JUNOS Software-based device unless an authorized administrator explicitly permits them, with options available to restrict the valid sources of the permitted applications. To complete the install, the administrator then explicitly loads the selected applications.

In ways fundamental to the inherent operations of the overall operating system, the modularity of JUNOS protects both the network operating system functions and the enabled PSDP applications. PSDP applications are completely separated and self-contained, running on top of, instead of being deeply imbedded into the operating

system, so as to fully protect the security and stability of JUNOS operations. No JUNOS processes, including those developed using the PSDP, can consume an excess amount of CPU or memory resources or write in the memory space of another process, thereby protecting the underlying network operating system, even if an application malfunction were to occur.

JUNOS Software Engineering Discipline Delivers Development Efficiency

The single source code model of JUNOS, with new versions predictably released along a single software train, is a significant business advantage for Juniper. Our firm commitment to our best practices software development process means that our customers and partners can write PSDP applications knowing that these can readily work with new releases of our code.

The application programming interfaces (APIs) of the Partner Solution Development Platform are built and tested at the same time as the rest of JUNOS and will continue to be enhanced in step with the JUNOS release schedule. Partners using the PSDP have only the one JUNOS release train to follow, with its regular schedule of new release versions. Forward compatibility with future versions of JUNOS is an important discipline for Juniper with respect to all of our features, and PSDP developed applications will at most need to be recompiled and regression tested when customers upgrade to new versions of JUNOS Software.

Innovation Advantages for Enterprises

Kim Perdikou, Executive Vice President and General Manager, Infrastructure Products Group

Accelerate Innovation with New Services and Applications

As proven leaders of their markets, high-performance businesses seek new and better ways to run their business and meet customers' needs, recognizing the strategic value of IT in delivering new innovations. They choose Juniper Networks for high-performance network infrastructure because our best-in-class products and solutions provide the performance and flexibility they need to compete and win.

To help our customers further accelerate their pace of innovation, Juniper is introducing the Partner Solution Development Platform (PSDP). The PSDP provides open interfaces that enable the development of specialized applications that run on our high-performance networking platforms. With these tools our customers can build new software applications that combine their unique business knowledge with the best-in-class expertise of our partners and the advanced security and networking functions of JUNOS.

The Network Foundation of the High-Performance Business

The value of many new business innovations and initiatives is fundamentally shaped by the capabilities of the network. JUNOS Software provides a more available, operationally efficient and flexible foundation to the network, saving our customers time and money. The high-performance operations of JUNOS help our customers to shift their focus beyond the functions necessary to run the business to the projects that accelerate business growth and profitability. These advantages come from the advanced continuous systems and automated operations features of JUNOS, along with its underlying modular software design and strict software release discipline.

A 2007 study by Lake Partners Strategy Consultants highlights the high-performance operations benefits of JUNOS based on interviews with 122 network operations team leaders from different industries. For example, when asked about the differences in network operating systems, these users reported that JUNOS reduced the number and duration of unplanned events by an average of 24 percent and 30 percent, respectively and that on average they experienced a total of 25 percent time savings compared to when they used a competitor's operating system. You can find the full report at <http://www.juniper.net/lakepartners>.

Innovate with Open Network Architectures

Flexibility is vital to innovation. One size fits all is really one size fits none. The right way to build a network to meet business requirements is specific/individual to each company, with the most value being derived from mixing components from different vendors and partners. The Open Network Architecture approach of Juniper provides

our customers greater choice and control in bringing together the best technology, suppliers and partners for each customer's specific requirements. The Partner Solution Development Platform significantly extends our capabilities for providing flexible open solutions by enabling applications to tightly integrate to the network so as to enhance their delivery with specific access, performance and security policies and controls.

Build Competitive Advantage

If you can achieve deeper integration between the network and its most strategic applications, you can fundamentally change internal operational efficiency, user experience and even business models. The Partner Solution Development Platform gives our customers enhanced flexibility and control to build this integration while ensuring the security, performance and reliability of their network. With the powerful development toolset of the PSDP, high-performance businesses can bring together the creative power of many in building solutions tailored to their specific business needs and go-to-market opportunities. By enabling our customers to do things differently, the PSDP can accelerate our customers' pace of market-driving innovation, build competitive advantage, and extend their market leadership.

Dynamic Trading Networks

The options for customization enabled by the PSDP can help customers build solutions that are the right fit for them. For example, in financial services applications and trading actions, a diverse mix of circumstances and events affect network traffic patterns. With the Partner Solution Development Platform, a custom application might trigger network configuration or application/user priority changes in response to an external event that is known to impact trading volume. Since each company will have different criteria in its decision-making for these network actions, the PSDP lets our customers build the application in a way that's best for their business.

Integrating these functions onto the networking platform means faster reaction times and simplified operations. It also makes it possible to analyze traffic patterns and identify opportunities for new products and services or ensure compliance with regulatory issues, without impeding normal business operations.

Innovation Advantages for Service Providers

Judy Beningson, Vice President, Strategy and Planning, Service Providers

Service providers are evolving towards a converged next-generation network (NGN) capable of delivering a dynamic mix of new and integrated multiplay, business and mobile services. Open interfaces enable this convergence by easing integration between disparate types of equipment and support systems that were originally built for the standalone needs of wireline, Internet, wireless or video traffic.

Given the variety and complexity of these converging systems, service providers often require very specific new development for their individual integration needs and targeted market opportunities. The increasing diversity of the environments often exceeds the pace of development now available in the market. The Partner Solution Development Platform (PSDP) from Juniper Networks provides a unique and powerful tool to increase the rate of industry innovation. With the PSDP, service providers or their development partners can independently create customized applications that streamline operations and enable rapid entry into new services markets.

Solve Immediate Operational Challenges

Among the first PSDP developments for service providers are applications addressing immediate operational challenges to improve service delivery and increase productivity in newly converged systems. Building on top of the stable and operationally mature JUNOS, service providers can extend the Command Line Interface (CLI), automate custom operations or integrate into legacy OSS/BSS and network systems. They can also implement monitoring tools for specific services or types of customers, improving service-level agreement (SLA) compliance while reducing overhead. Integrating these functions into the existing JUNOS Software-based devices—rather than on separate platforms—takes advantage of our hardware performance and scalability, decreases the number of devices to manage, and reduces the overall footprint of the solution.

Ensure a High-Performance Environment

The disciplined foundations of JUNOS engineering and its modular architecture design have made it possible to extend this opportunity of flexible application development to our customers and partners. Through the business procedures and technology of the Partner Solution Development Platform, Juniper retains the needed control to ensure the integrity of JUNOS operations, yet provides sufficient business flexibility and interface intelligence to enable the development of advanced applications. For example, the modular architecture of JUNOS provides a layer of separation and abstraction between the developed applications and the underlying network operating system. Moreover, customers have complete control over what, if any, PSDP applications run in their networks.

Differentiate Services with the PSDP

An emerging trend in network services is mass customization—giving individuals greater control and choice over their network experience in real time. This can involve providing services on demand, building a customized service bundle or allowing a personal selection of video channels. In many cases distributing the enabling application into the network element using the PSDP allows a greater level of granularity, performance and control than is possible with a separate non-integrated application.

Additionally, the PSDP provides tools for these niche network services to be quickly developed, regularly tested and continuously enhanced based on market actions and customer feedback—with fewer constraints on the underlying platforms and vendor road maps. Service providers may keep the service innovations to themselves, allowing them greater opportunities for differentiation.

The PSDP offers a powerful tool to Juniper and its customers for problem solving and creative collaboration in the delivery of new services. The enabled flexibility introduces many new options to our service provider customers for accelerating their own rate of services innovation, adding value per bit, and building a diverse and growing set of revenue streams, while preserving their high-performance service operations.

Managing Network Performance

Service providers are experiencing rapid, yet inconsistent, traffic growth. Many report fast-moving “hot spots” that complicate capacity planning. Meanwhile the very high growth rates for voice and video result in more and more of the traffic being especially sensitive to changes in network performance. Successfully managing traffic in this environment requires deeper information for a greater number of packets.

Integrating performance and monitoring management tools directly into the network device simplifies operations and improves scalability to deal with modern network traffic. Further, the PSDP allows monitoring applications to be distributed throughout the network. With more insightful monitoring and analysis tools that leverage distributed network intelligence, including information of events beyond the network, networks can respond more quickly to equitably distribute load and ensure performance for high-priority services and users.

Concluding Remarks—The Impact of the PSDP on Customers, Partners and Juniper

Spencer Greene, Vice President, Customer Advocacy

The introduction of the Partner Solution Development Platform (PSDP) presents many opportunities to our customers and partners and Juniper Networks to offer new, innovative products and services. The varied possibilities evolve from the rich combination of ideas that open interfaces enable, along with the customization now economically feasible. While some opportunities may be large, the PSDP also importantly enhances the ability of Juniper and its partners to serve previously unaddressed niche and specialized market needs.

Increasing Innovation Inside Juniper

In delivering the PSDP, Juniper engineers have built on the existing structure and modularity of JUNOS, developing new interfaces, adding additional levels of abstraction and separation, and augmenting the existing documentation. As a result, we have advanced our own engineering efficiency and significantly expanded our internal innovation engine. By providing a robust platform for technical collaboration, the PSDP lowers the time and cost effort to integrate new functionality not only built inside, but also acquired from outside, the company.

Accelerating Innovation for Customers and Partners

The intersection of market opportunity, business function and technology assets is unique to each company. The value of the PSDP is in giving our customers and partners a standard set of interfaces and tools for addressing opportunity at their own pace and in their own way. The pathways to providing greater value in the network—through more aware user and application interaction, deeper technology integration and new sources of intelligence, even from beyond the network—become far more numerous and diverse with the development capabilities of the PSDP. The PSDP even holds value for our customers who choose not to yet use it, bringing a level of investment protection for their Juniper solution through greater flexibility to meet the new, but now unknown, requirements of the future.

Most interesting to consider are the possibilities that the PSDP might enable by making it easier to integrate expertise from outside the traditional domains of security and networking—for example, knowledge of business software, industries, culture or entertainment. By enabling richer, deeper collaboration, the PSDP opens opportunities to pursue new ideas and markets with less risk. As the number of developed applications grows, our customers and partners will be able to intermix them into a powerful set of value-creating “JUNOS Software mashups” that add new potential for waves of innovation.

The Opportunity of the Unknown

The biggest lesson from other open innovation initiatives is that you cannot possibly anticipate all of the ways that people will use a partnering platform such as this. Different people, with a variety of knowledge and objectives, will be very creative. They are going to surprise us.

There are perspectives of networks that are, in reality, simply an artifact of their implementation, not of their full value potential. Many companies settle for what the network can do for them today, without considering how the network might be able to do much more.

In the long view, by fundamentally lowering the barriers of change to the network, the Partner Solution Development Platform and its ecosystem of innovation partners have the potential to kindle a profound shift in how we view the network and its capacity for value in delivering rich service and entertainment experiences to users.

Unleashing the Power of Networks

The power of networks is their ability to connect people with different areas of knowledge or expertise in order to produce something that neither could have done individually. This is visible in the rapid development of often unanticipated applications that are taking advantage of network reach and ubiquity. It is ironic that the Internet, an open infrastructure that has enabled many of these innovations, is itself built on predominantly closed platforms. This has pushed much of the innovation into the applications on the periphery of the network, constrained the opportunity to deliver enhanced user experiences, and resulted in the need for frequent bandwidth increases to compensate.

The primary vision of the Partner Solution Development Platform is one of enablement—giving customers and partners powerful tools to innovate as they have never been able to before. The Partner Solution Development Platform, along with many other innovations from Juniper Networks, marks the beginning of the end of this era of closed networking and the start of a new era of network innovation.

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.

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