WHITE PAPER

BUILDING A UNIVERSAL ENTERPRISE WAN

High Performance and Secure Solutions for Large-Scale Connectivity

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Executive Summary

Enterprise IT executives are constantly challenged to drive down OpEx and CapEx while at the same time meeting the demands of all internal users—mobile and SOHO users included—for a secure, resilient and optimized experience globally. This paper discusses enterprise WAN requirements and some of the trends that influence network design and investments.

The midrange router additions to Juniper Networks® MX Series 3D Universal Edge Routers portfolio and configuration updates to the Juniper Networks SRX Series Services Gateways deliver a comprehensive set of WAN networking solutions to meet the enterprise IT executive's needs.

The MX Series midrange portfolio provides a "pay-as-you-grow" investment model, service flexibility and extensive feature support powered by one OS, Juniper Networks Junos® operating system, at a performance that is three to five times greater than the competition. Juniper Networks Junos Space Service Now for both the MX Series and SRX Series branch routers enables proactive troubleshooting, which reduces maintenance needs—leading to a lower total cost of ownership (TCO).

Introduction: Enterprise Trends and WAN Pressures

Modern day enterprises' reliance on IT infrastructure continues to grow globally and business agility demand continues to rise. While IT infrastructure has become a source of competitive differentiation for today's enterprise, CIOs are challenged to look at ways to reduce costs while growing business value. Ideally, they are looking at investing in a secure infrastructure that provides maximum business continuity and a flexible and simple architecture to support a "pay-as-you-grow" model to future-proof the network.

The ultimate goal is to optimize the user experience. Today's enterprise network is stretched in multiple dimensions to meet the needs of the many types of users (mobile, SOHO, etc.) and devices. Figure 1 illustrates the key components of the network. At the back end are compute and storage resources in all super data centers that are subject to very high scaling demand for real-time, business-critical applications. The past few years of explosive growth in regional data centers and continued demand for compound scale for business applications are driving a trend toward data center consolidation. Server virtualization and use of virtual machines across physical servers in different locations are another way of addressing the scaling demands on today's data centers. Enterprise businesses rely on "live server migration" applications across enterprise WAN clouds (public, private or hybrid) connecting the data centers.

On the user end, exponential growth in smartphones and the proliferation of high-bandwidth applications have directly translated into bandwidth upgrades all the way from the edge of the network to the data center. In addition, globalization of businesses and workforces also means the network has to be reliably available 24x7. All this has translated into higher performance and bandwidth upgrades in the enterprise WAN.

This paper discusses enterprise needs of a high-performance, universal WAN that essentially becomes a fabric itself to provide integrated support for both the front end (for instance branch, home or campus) and back end (data center).

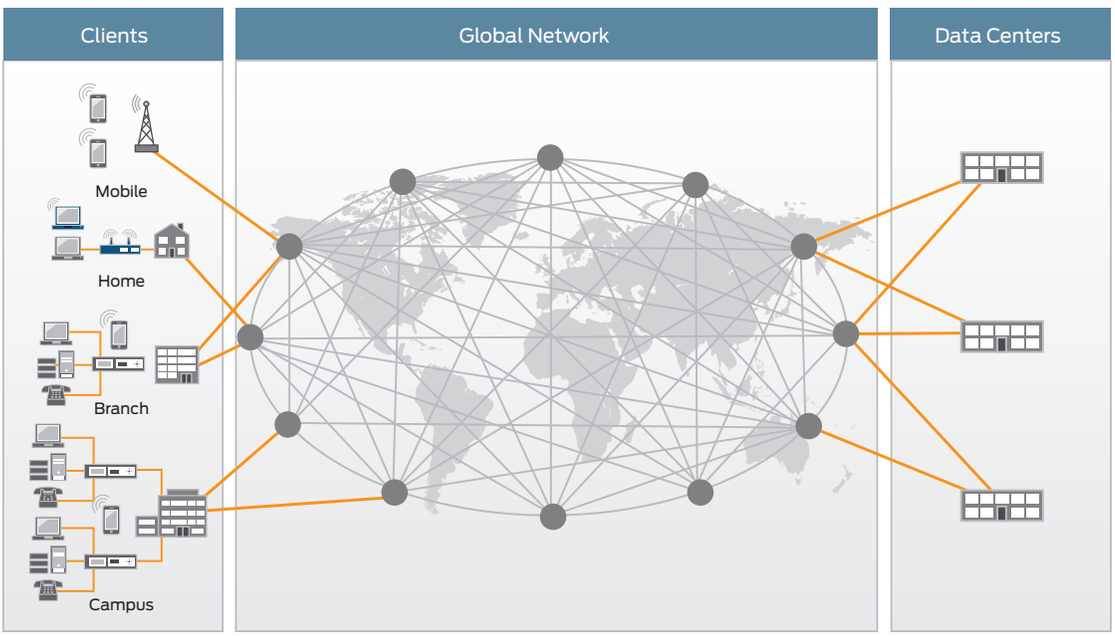

Figure 1: Enterprise network architecture and traffic trends

Enterprise WAN Use Cases and Requirements

There are many application scenarios and connectivity requirements for routers in today's enterprises. Some key scenarios and requirements are discussed in this section.

Data Center Interconnect

Enterprise networks have become critical to business and can provide companies with a competitive advantage. The new network and the data center are viewed as a global resource for the enterprise and are stretched in multiple dimensions. Consolidation, virtualization and cloud readiness are strong design trends for data centers that drive specific requirements for data center interconnect (DCI) routers.

Key requirements include:

- Flexibility and performance
- Service segmentation and classification
- Class of service and policy control
- Availability and resilience
- Standards-based multivendor implementations

Figure 2 shows an example of two data centers running a live server migration application over an MPLS-based enterprise WAN. We briefly explain how all of the previous requirements come into play in this sample design.

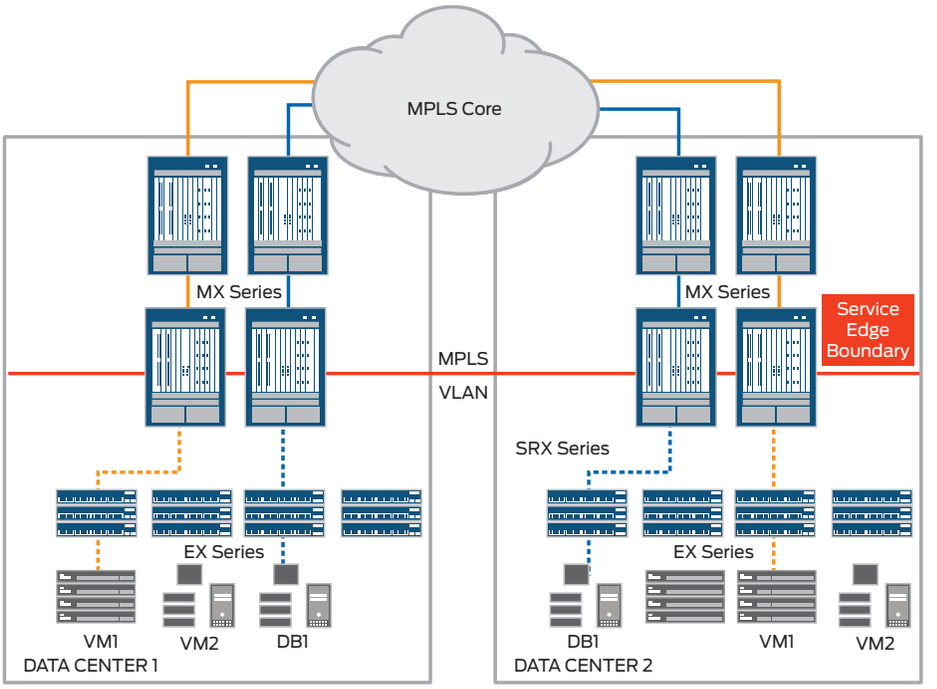

Figure 2: Data center interconnect with virtual machines over MPLS core

First, let's consider flexibility and performance. Packet processing power at high bandwidth is a fundamental requirement. A range of LAN and WAN interfaces (DS3 to 10 GbE including 40 GbE/100 GbE at the high end) is required at differing stages of the network growth. Flexibility and easy deployment of bandwidth upgrades ensure business continuity and deliver business agility.

Then there is the question of service segmentation. Data center virtualization and consolidation are a means to scale, optimize costs and maximize utilization of resources. There are various virtualization technologies required across the many layers in the network and compute/storage devices. For server virtualization across geographically diverse locations, extending the reach of Layer 2 and Layer 2-like technologies has been a key requirement for enterprise businesses needing the ability to virtually move/separate or combine servers/resources on servers.

DCI routers must be able to support the many virtualization requirements in the data center in a resilient manner at both Layer 2 and Layer 3. Feature-rich software with support for standards-based VPLS, MPLS, GRE, and multicast at high scale becomes a necessity. Illustrated in Figure 2 is Layer 2 service separation where VLANs are mapped into and carried through an MPLS network.

The DCI router must also support classification and policies to guarantee resources for critical applications and dynamic allocation to optimize utilization. Granular and hierarchical "class-of-service" differentiation is critical to support delay-sensitive, mission critical applications versus other low-priority traffic on the network. This is required for Layers 2 and 3 as well as the Layer 2 stretch technologies such as EoMPLS, VPLS and GRE. A common policy that carries itself transparently across the many layers significantly simplifies deployment and operations—these include Layer 2/Layer 3 segmentation, mapping of Layer 2 services into Layer 3 when needed, and policies for both unicast and multicast traffic. Furthermore, QoS and policy characteristics must be applicable on a per-VPN basis without affecting performance.

As businesses rely heavily on data center infrastructure, network availability is crucial to the enterprise. Also, colocation of data centers is factored into designs to provide resiliency and disaster recovery. Routers essentially have to be carrier class with redundancy built into the hardware and software.

Finally, there is the question of interoperability. A data center interconnect implementation must be standards based to ensure operation with best-in-class solutions and avoid a costly, artificial "lock-in" on proprietary implementations.

Internet Edge

The requirements for an Internet edge router have evolved over the years with the global scale of bandwidth and applications over the Internet. Flexibility in the range of physical interface support with a "pay-as-you-grow" model helps reduce costs and maintain investment protection. With many applications running over the Internet, reliability and resiliency are key requirements. Increasing route table scale to support Internet route table size, IPv6 and large-scale multicast are also essential for virtualized services on the Internet edge router. To provide resiliency and guarantee uptime, many enterprise networks have dual-homed connections to multiple ISPs (Figure 3). This in turn adds requirements for higher control plane resources (multiple BGP feeds) and support for fast convergence of BGP.

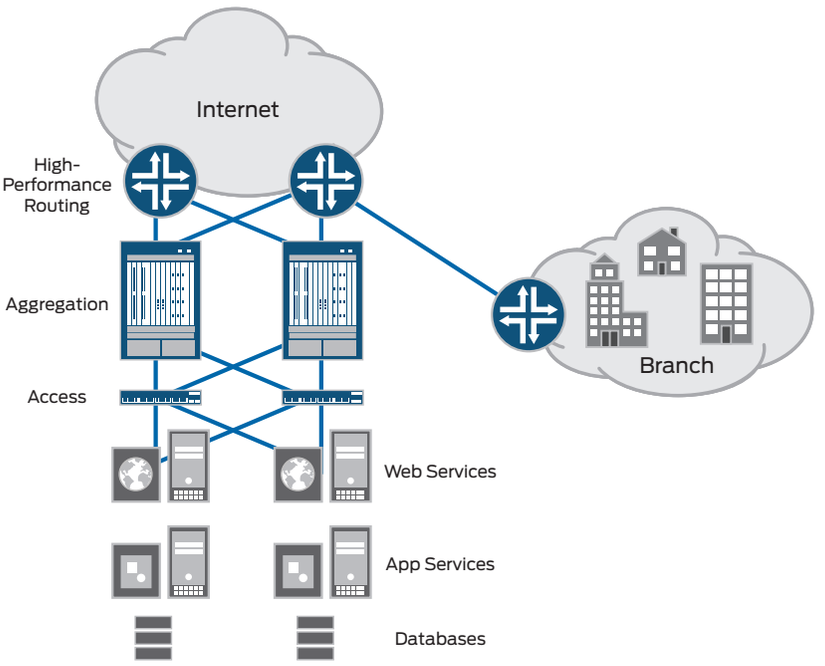

Figure 3: Dual-homed Internet edge

Security policies are critical when deploying an Internet edge router. Several aspects of security policies are needed to allow applications to operate over the Internet and at the same time have the right level of protection for network and data center infrastructure. Key features include support for extensive and easy-to-implement firewall filters, IDP and DPI, and scalable route table policies.

Traffic segmentation and classification are critical tools to enable prioritization of critical and non-critical data, video or voice traffic while simultaneously guaranteeing resources on the control plane for both unicast and multicast applications.

On the management plane, proactive monitoring, capacity planning and ongoing operational activities such as configuration management and fault management support are essential for smooth operations and reduced TCO.

WAN Core

Many large enterprise networks have provisioned their own enterprise WAN networks and act as providers to individual departments within the enterprise (see figure 4). These enterprises look for ways to optimize cost, simplify network design, streamline operations, meet projected internal service-level agreements (SLAs), and (most of all) make smart investments to future-proof the network. These business requirements translate into critical technical requirements, which are discussed in the following section.

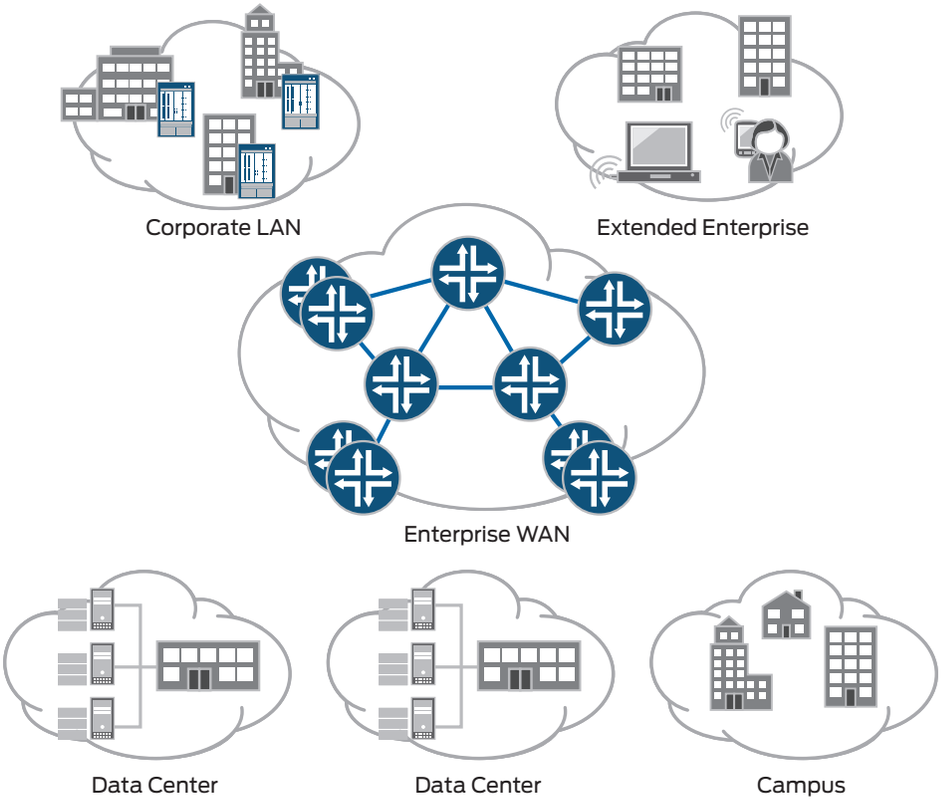

Figure 4: Wan Core – private WAN cloud connecting central and branch sites

The edge routers feeding into the WAN core are typically the network points where routing policy, scalability, virtualization, and quality of service (QoS) are baseline requirements. These routers are the BGP speakers on the network where the majority of the routing policies are defined to achieve the most efficient network utilization. For example, mission critical data center apps can be directed toward and traffic-engineered to use the least latency links with BGP policies or MPLS-TE.

Also in the WAN core, service classification with QoS is set up or transparently carried through from the originating campus/branch. Layer 3 virtualization can be carried in MPLS VPNs, and Layer 2 stretch can be achieved with VPLS. Services can be logically defined and resources on one physical router can be segregated into logical or virtual routers to meet individual service operations and management needs.

With a private WAN core, carrier-class reliability is critical for the enterprise to manage and ensure business continuity. Resiliency is approached in many ways—link-level technologies such as BFD and device-level redundancy with multichassis LAG, and MPLS traffic engineering (with fast reroute) or fast convergence (with an IP core) are critical. Support for high availability with technologies such as graceful restart for routing protocols helps maximize network uptime and service availability.

Scalability for routers can be viewed in multiple dimensions—data plane, management plane and control plane scale. Data plane scale includes a broad range of physical interface support, port density and bandwidth upgrades within one form factor to provide higher throughput and packet processing.

Control plane scalability includes support for large-scale routing tables to support MPLS VPNs or a large number of VPLS instances, with support for scalable routing policies.

Enterprise IT executives are looking for efficient ways to future-proof their investments for both functionality and performance with compound scale in a dynamically changing environment. A "pay-as-you-grow" model without the need for future forklift upgrades is perfect for meeting these goals.

WAN Aggregation

One application for a WAN aggregation router is to aggregate connections from the smaller branch locations and to provide access to centralized services (see Figure 5). All of the service intelligence is handled by this router and helps keeps the branch routers simple, easy to configure and troubleshoot, and helps drive OpEx lower.

Support for a wide and flexible range of LAN and WAN interface types helps reduce the number and types of aggregation routers. Service segmentation and traffic classification are important requirements to provide the right allocation of resources to business-critical applications versus low-priority applications.

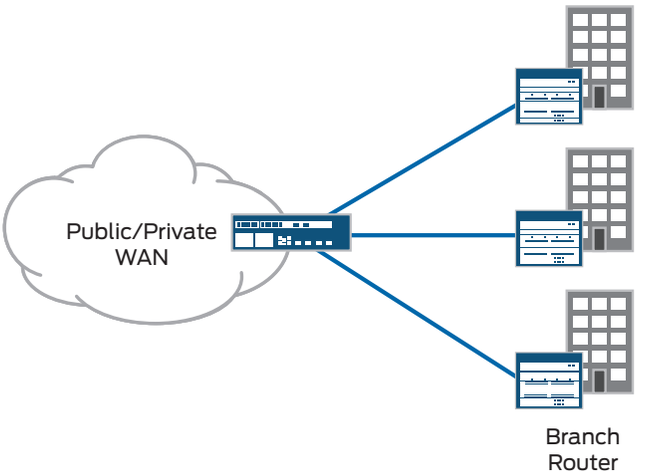

Figure 5: WAN aggregation

The ability to independently control LAN and WAN services is an additional benefit for ease of operations and trials for new services and applications. Along with versatile hardware and software capability, availability and business continuity are critical for WAN aggregation.

Another scenario with WAN aggregation is to combine LAN services for large campus core sites (see Figure 6) and provide aggregated access to the WAN.

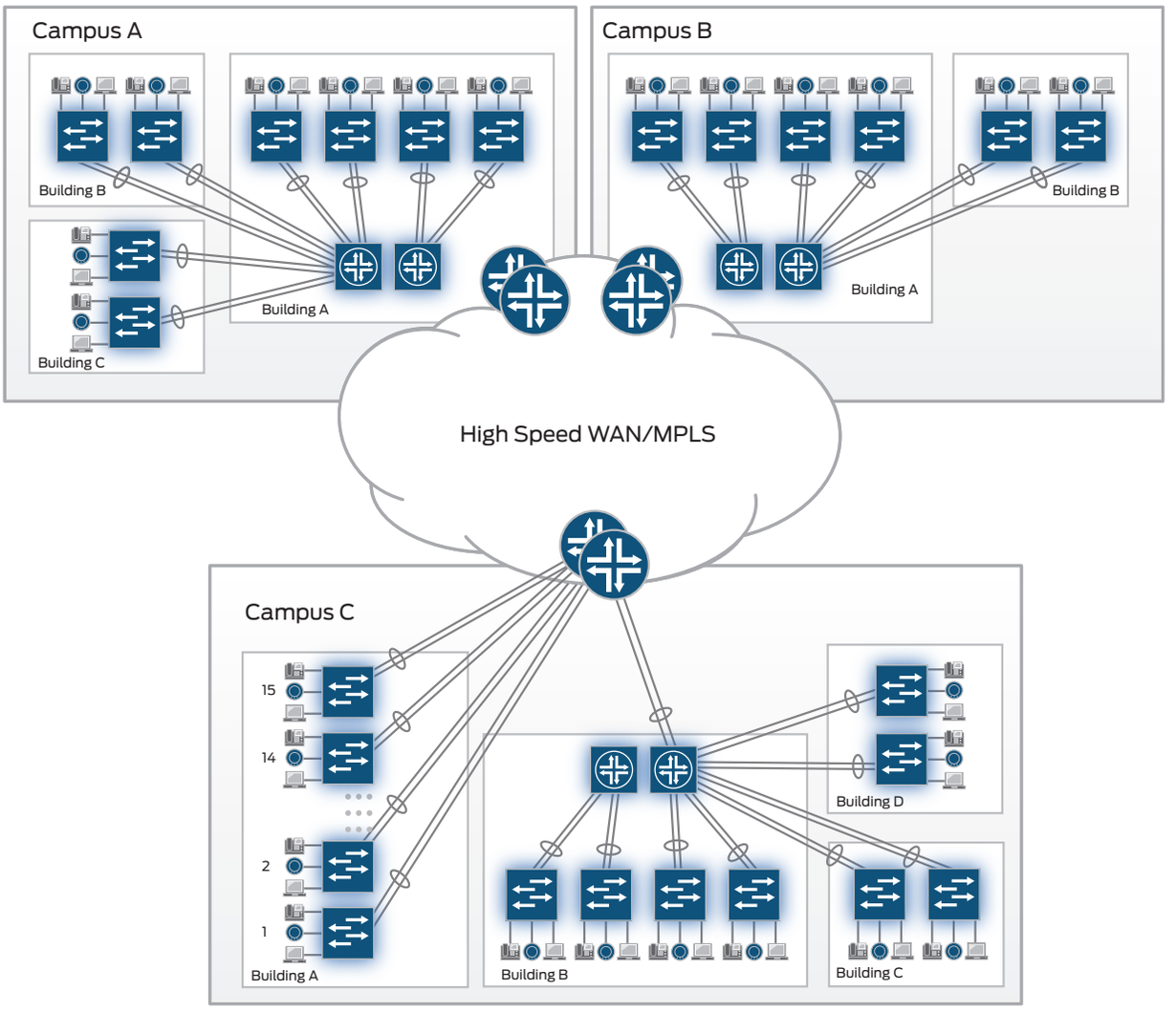

Figure 6: WAN aggregation for campus core

Branch

The requirements for a branch router are comparatively straightforward. These include ease of deployment, remote management, operational simplicity, and the means to upgrade capacity without needing a forklift upgrade. In order to keep operational costs low, startup and operational simplicity play a major role when enterprises are selecting branch routers.

Juniper's Universal WAN Portfolio

Juniper's universal WAN is composed of new compact form factor additions to the MX Series 3D Universal Edge Routing portfolio and configuration updates to the SRX Series Services Gateways. The combined solution delivers a comprehensive enterprise and branch routing portfolio that drives business continuity and flexibility while enabling new levels of deployment, maintenance and support simplicity. The complete Universal WAN solution is powered by Juniper Networks Junos operating system with consistent update releases that further increase manageability and resiliency.

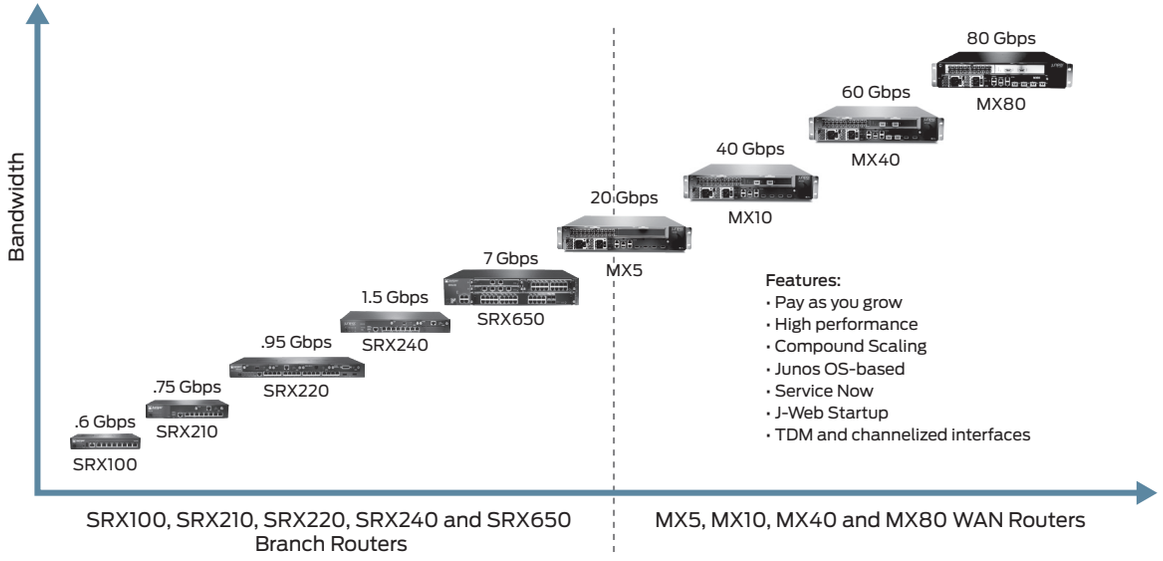

Figure 7: Introducing the MX Series midrange routers and SRX Series branch routers

The new additions to the MX Series portfolio provide a scalable "pay-as-you-grow" portfolio with easy upgrades to system capacity using software licenses and providing the industry's widest range of interfaces for both Ethernet and TDM in a compact form factor. The SRX Series also features Juniper Networks Junos Space Service Now to simplify and automate technical support by eliminating most manual support operations. Both the MX Series and the SRX Series also feature Juniper Networks J-Web Software, a web-based application that enables seamless connectivity and management of the branch devices and further reduces onsite support requirements.

MX Series Midrange Routers

Juniper Networks MX5, MX10, MX40 and MX80 3D Universal Edge Routers create a scalable and flexible upgrade path for growing enterprise or service provider needs. Extending the battle-hardened capabilities of Juniper Networks MX Series 3D Universal Edge Routers (MX240, MX480 and MX960) from service provider networks to the enterprise, MX Series midrange routers are designed to provide the 3D scaling necessary to address today's advanced Ethernet requirements even in the smallest of environments. Powered by Junos OS and the high-performance Juniper Networks Junos Trio chipset, the midrange router series enables enterprises and service providers to make network-purchasing decisions with the confidence that the routers can scale along with their changing requirements.

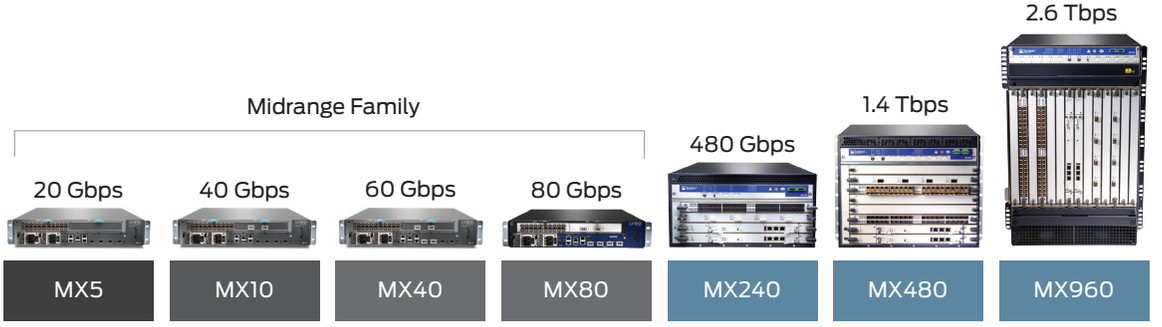

Figure 8: MX Series 3D Universal Edge Routers Portfolio

Each router in the MX Series can be upgraded using a software license in a "pay-as-you-grow" model (see Figure 9). The midrange router series contains the most compact members of the MX Series product family. They are two rack units (RUs) high and built to support optional redundant power supplies and fans. These platforms are perfectly suited for smaller-scale environments requiring full Ethernet capabilities and the MX Series advanced services and features. All MX Series services and features are supported across the midrange routers.

MIDRANGE ROUTER	FIRST MIC SLOT	SECOND MIC SLOT	10GBE PORT	SOFTWARE LICENSE UPGRADEABLE
MX5	✓	X	X	✓
MX10	✓	✓	X	✓
MX40	✓	✓	✓ (2)	✓
MX80	✓	✓	✓ (4)	N/A

Figure 9: Key hardware differences and upgrade options for MX Series midrange routers

This flexibility and upgradability (easy upgrades from MX5 all the way to MX80 as required) make the MX Series midrange routers ideal for campus, data center interconnect and service provider WAN connectivity deployments. The MX5, MX10, MX40 and MX80 are designed to drive down the TCO and increase operational efficiencies in both enterprise and service provider deployments.

There is a wide range of applications enabled by the MX Series family of routers and supported with the midrange series. The rest of this section highlights the features supported and how they meet the requirements for each of the enterprise WAN use case scenarios.

For interconnectivity between data centers, the MX Series midrange routers have the most optimum mix of hardware options and extensive feature support to meet the versatile requirements of the data center interconnect router. Layer 2 stretch with support for non-proprietary VPLS and pseudowires, and service separation with large-scale MPLS L3VPNs enable cloud readiness for the data center—and they allow seamless virtualization and data center mobility. The MX Series takes service segmentation to a higher level of virtualization and segmentation of router resources per service type with support for logical routers. Business continuity is ensured with features such as MPLS fast reroute, BFD and multichassis link aggregation group (LAG). A rich and granular QoS feature set enables service classification. MX Series midrange routers have industry-leading performance with flexibility in hardware options and easy upgrade choices.

At the Internet edge, MX Series midrange routers can all support multiple BGP feeds and large-scale routing tables that are essential for multi-homed Internet edge routers connected to multiple ISPs. The flexibility in choice of hardware in compact and packet processing performance is unmatched in this form factor in the industry. Support for extensive firewall filters and IDP/DPI—and easy deployment of security and routing policy—make the MX Series midrange routers very robust for the Internet edge application.

In the WAN core, service separation and classification are commonly deployed on the edge routers feeding into the WAN core. The MX Series midrange routers support a rich feature set to enable and separate services at Layer 2 with VPLS and Layer 2 pseudowires and at Layer 3 with a rich MPLS VPN feature set. Traffic classification is supported with hierarchical QoS to meet SLA needs for critical and non-critical applications. Business continuity and reliability features of the MX Series include link virtualization, BFD support, multichassis LAG, and features such as fast reroute and graceful restart for routing protocols. Easy upgradability with software licenses on the MX Series prevents short-order forklift upgrades and minimizes OpEx and CapEx expenditures for enterprise networks.

For WAN and campus aggregation, the MX Series midrange routers support a rich Layer 2/Layer 3 segmentation and QoS feature set, native support for IPv6 to enable new services, and a rich and extensive multicast feature set to support video distribution applications with IPTV. The broad range of interface options and easy upgradability make the MX Series midrange routers a very attractive offering for the changing requirements and scaling needs for WAN aggregation.

Branch SRX Series Routers

At the branch, ease of deployment and simplicity in operations are the leading requirements for branch routers. On the SRX Series routers, support for enhanced manageability with the Junos Space Service Now automated incident management system can simplify operations with proactive management of more than 400 conditions.

Powered by Junos OS, the SRX Series for the branch consists of secure routers that bring high performance and proven deployment capabilities to enterprises that need to build a worldwide network of thousands of sites. The wide variety of options allows configuration of performance, functionality and price scaled to support anywhere from a handful to thousands of users.

Ethernet, serial, T1/E1, DS3/E3, xDSL, DOCSIS3, Wi-Fi, and 3G/4G wireless are all available options for WAN or Internet connectivity to securely link your sites. Multiple form factors allow you to make cost-effective choices for mission critical deployments. Managing the network is easy using the proven Junos OS command-line interface (CLI), Juniper Networks Junos Space, scripting capabilities, a simple-to-use web-based GUI, or Juniper Networks Network and Security Manager.

Junos Space Service Now

Junos Space Service Now is the center point of the Juniper service automation solution, enabling users to automatically detect incidents with Advanced Insight Scripts, collect diagnostic data and simplify incident escalation. Service Now automates inventory management, thus reducing time spent in manual asset tracking.

These capabilities increase efficiency and uptime while decreasing downtime and mean time to resolution (MTTR). Juniper Support Systems (JSS) are expert systems—located within Juniper's premises and securely integrated with Service Now—that provide an interface to Juniper's Customer Support Center (CSC) case management, contract management systems and knowledge repositories. JSS collects event and incident information and diagnostic details for ticket creation from Service Now.

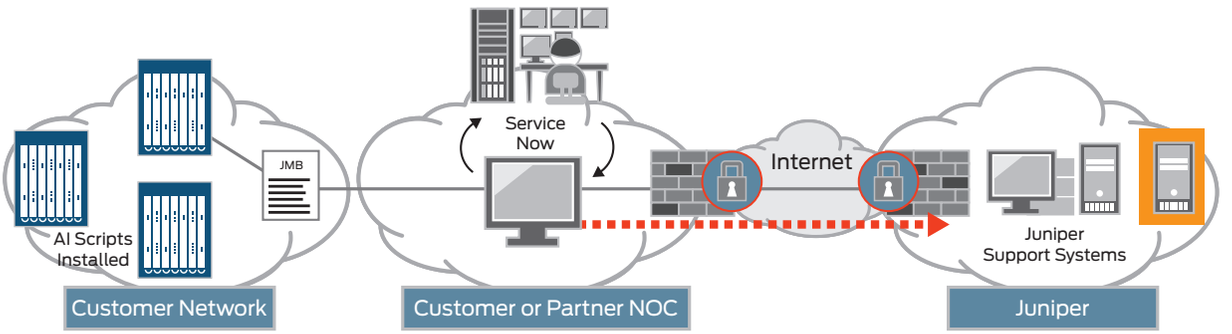

Figure 10: Junos Space Service Now incident management process flow

Juniper's service automation provides a seamless and secure solution that simplifies operational processes, thus enhancing staff productivity. When labor-intensive tasks such as asset inventory management are automated, staff can focus on the tasks most critical to the business.

Junos OS End to End

Junos OS is a world-class operating system with proven stability coupled with routing protocols, flexible policy language and leading MPLS/VPN implementation. When building your Ethernet-centric infrastructure, Junos OS is a tremendous asset as a flexible and reliable operating system.

Junos OS runs on all Juniper Networks MX Series 3D Universal Edge Routers, M Series Multiservice Edge Routers, T Series Core Routers, as well as EX Series Ethernet Switches, J Series Services Routers, and SRX Series Services Gateways. Junos OS—the first operating system developed specifically for Internet routing—is especially designed for large production networks. With native support for both IPv4 and IPv6 protocols, as well as advanced interworking capabilities, Junos OS also eases the transition to IPv6 and ensures long-term investment protection.

Junos OS offers XML interfaces for advanced scripting capabilities, and it has been designed to configure the routing protocols that run on the MX Series and the properties of its interfaces. After a software configuration is activated, Junos OS has been designed to monitor the protocol traffic passing through MX Series devices, as well as troubleshoot protocol and network connectivity problems.

Conclusion

The Universal WAN solution, MX Series midrange routers and SRX Series branch routers provide new levels of scalability and performance in compact, flexible, "pay-as-you-grow" platforms.

The MX Series delivers the industry's highest throughput scalability, ranging from 20 Gigabits throughput of the MX5 up to 2.6 terabits of the MX960 (see Figure 8).

Each of the midrange routers can be upgraded in situ to the next higher level with the simple addition of a software license.

The Universal WAN solution meets the most demanding enterprise IT requirements, providing best-in-class WAN network solutions while simultaneously reducing OpEx and CapEx.

Appendix A: For More Information

MX Series Midrange Routers Literature
http://www.juniper.net/us/en/products-services/routing/mx-series/

MX Series Midrange Routers Datasheet

www.juniper.net/us/en/local/pdf/datasheets/1000374-en.pdf

SRX Series Literature
www.juniper.net/us/en/products-services/security/srx-series/

Enterprise WAN Reference Architecture
www.juniper.net/us/en/local/pdf/reference-architectures/8030009-en.pdf

Non-Ethernet MICs for MX Series
www.juniper.net/us/en/local/pdf/datasheets/1000378-en.pdf

About Juniper Networks

Juniper Networks is in the business of network innovation. From devices to data centers, from consumers to cloud providers, Juniper Networks delivers the software, silicon and systems that transform the experience and economics of networking. The company serves customers and partners worldwide. Additional information can be found at **www.juniper.net**.

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