THE INTELLIGENT SERVICES EDGE

Driving Service Innovation with Versatile Edge Routing Platforms

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Executive Summary

Unfortunately for service providers, increased traffic growth has not translated into increased profitability. This is due to several factors, including fierce competition that has commoditized basic network connectivity and transport services, as well as continuous capital and operational investment in the network, to name just two.

Seeking to improve their margins, service providers have responded to these challenges in several ways, perhaps most notably by transitioning to packet-based infrastructure and by consolidating service-specific networks to IP/MPLS. To make further gains, service providers are now looking to shift their edge infrastructure investments towards equipment that can concurrently provide high capacity and performance as well as service flexibility and service velocity, without imposing operational penalties or compromising reliability.

Juniper Networks® provides high-performance network infrastructure for service providers and enterprises that require the highest levels of network reliability and performance, and helps create a responsive and trusted environment for accelerating the deployment of services and applications. Key to achieving this end is a comprehensive edge routing portfolio that leverages ground-breaking routing platform design, and a true carrier class network operating system.

This paper discusses Juniper's Intelligent Services Edge, a portfolio of service-enabling features that are primarily applicable to Juniper Networks M Series Multiservice Edge Routers and Juniper Networks MX Series Ethernet Services Routers. The Intelligent Services Edge leverages Juniper's unmatched architectural integrity to support high performance and scale, provide service flexibility and velocity, and increase operational efficiency. Taken together, these features enable service providers to effectively monetize their networks and increase their competitive differentiation.

Introduction—Service Provider Challenges

For service providers of all types, the one constant is change, and network operators relentlessly adopt new technologies that improve the economics of service creation, delivery, and assurance. One example is the transition to packet-based infrastructure and service delivery. Another example is the mass adoption of IP/MPLS, which permits the consolidation of multiple services over IP (it is less expensive to build and operate a single network that can support many services than to build and operate multiple single service networks). Still, many business and technical challenges remain to be solved, including:

- Protecting service revenue and margins, given fierce competitive market pressures
- Adopting a flexible edge infrastructure without abandoning existing network investments
- Containing and controlling costs in an ever growing and complex network footprint

These challenges are interrelated, and as service providers consolidate their services into a single, converged network, the best approach is to address them as a set of interdependent issues.

Competitive Market Pressures

The service provider market is highly competitive, and business and residential consumers have many choices for telecom services. Both cable operators and telecom network operators have broad service portfolios that include voice, video, data, and wireless packages for every market—from individual residential subscribers to the largest enterprises and everything in between. As a result competition is fierce, with the prices of most basic services falling by 10 percent annually even as their adoption rates increase by almost 15 percent year over year.

This price erosion is just one manifestation of the difficulty service providers have in differentiating their service offerings; in markets where products and services are commoditized, price is a primary differentiator. One way for service providers to change the game is by broadening their service portfolios, which requires a flexible network infrastructure, particularly at the network edge.

Adopting a Flexible Infrastructure

In the past, services were built using a 'silo' approach, with each service supported on service-specific network elements, and each service network overlaid on top of a time-division multiplexed (TDM) core. Service providers have since moved away from this inflexible and expensive infrastructure model and have selected packet-based infrastructure and IP/MPLS as strategic technologies that enable cost-effective service and network convergence.

Yet even as service providers implement these strategic technologies, they continue to sell traditional services and must support their installed base of SONET/SDH equipment. This is especially true for edge routers; while broadband aggregation has moved to Ethernet, access and metro SONET/SDH rings remain prevalent. Equally important, edge platforms must flexibly support all types of data, voice, and video services in order to enable service providers to enhance their service portfolios, create competitive differentiation, and maximize return on investment (ROI).

ROI is an important metric for determining the success of network investment, and the capital spend for edge infrastructure is heavily influenced by the time it takes to achieve a positive ROI. The best way to contain capital expenses in the network edge is by directing investments toward routing platforms that flexibly accommodate multiple technologies and services, and by avoiding spend on service-specific appliances.

Controlling Costs

Expanding and operating cable and telecom network infrastructure constantly challenge service providers' budgets, from both capital and operational perspectives.

On the capital expense side, ever-increasing traffic growth has necessitated continuous network investment to increase capacity, scale and performance. This traffic growth is attributable to the fact that more consumers are accessing networks more often and from many different devices, while at the same time the global economy drives nonstop information exchange within and between geographically dispersed businesses, with both employees and partners highly dependent upon uninterrupted network access.

From an operational perspective, although IP/MPLS and packet-based infrastructure promise service consolidation and network simplification, new service introductions have traditionally required the deployment of service-specific appliances elements that must be integrated with the routed infrastructure, as well as with management and operational support systems. Operationalizing services and appliances is a time consuming, expensive and risky endeavor task that slows the pace of service innovation.

Successfully addressing these challenges is a prerequisite to improving service providers' profits and margins; failing to address these issues means investing in infrastructure without the ability to fully monetize the investment—an undesirable and unsustainable business model over the long term.

In this document, we will discuss how Juniper Networks Intelligent Services Edge portfolio helps service providers solve these difficult challenges by providing network infrastructure that addresses scale and performance, while providing the versatility to quickly and efficiently accommodate unforeseen service opportunities. Furthermore, the Intelligent Services Edge is economically efficient to deploy and operate, so that total cost of ownership doesn't increase exponentially as the customer base grows and the service portfolio expands. Reducing, containing, and controlling operational expenses helps service providers reduce margin pressure and increase profitability.

Architectural Integrity

Before introducing the components of the Intelligent Services Edge, it is important to highlight architectural integrity; a key product design and development philosophy that Juniper Networks has adhered to since we introduced the industry's first true carrier-class router in 1998. Specifically, architectural integrity refers to the clean separation—and tight coupling—of the forwarding plane, control plane, and services plane, across Juniper's routing portfolio.

The separation of these planes is important because they eliminate resource contention. The fundamental functions of an IP router are packet forwarding, route processing, and service processing, and problems develop when these functions contend for system resources. Traffic loads, routing updates, and service treatment are not normalized, "steady state" events; they can and do spike at unpredictable intervals. When these functions share system resources, and one function consumes more resources, the other two functions are penalized, resulting in performance degradation within each plane and system instability.

Packet Forwarding:
The reading of incoming packet header information, making packet treatment decisions, and directing the packet to the correct outgoing interface.

Route Processing:
The inter-router exchanges of network layer information that help determine the best path to all known destinations based on some algorithm.

Service Processing:
Specialized manipulation of packets, sessions, and flows.

To avoid resource contention under all network conditions, Juniper's routers perform packet forwarding, route processing, and service processing in separate physical entities within the router, each with its own resources as shown in Figure 1. In Juniper's approach, each plane draws on its own dedicated resources, without robbing processing cycles from the other functions. This improves the performance and stability as each plane can perform to full capacity without affecting the scale, reliability, or performance of any other plane.

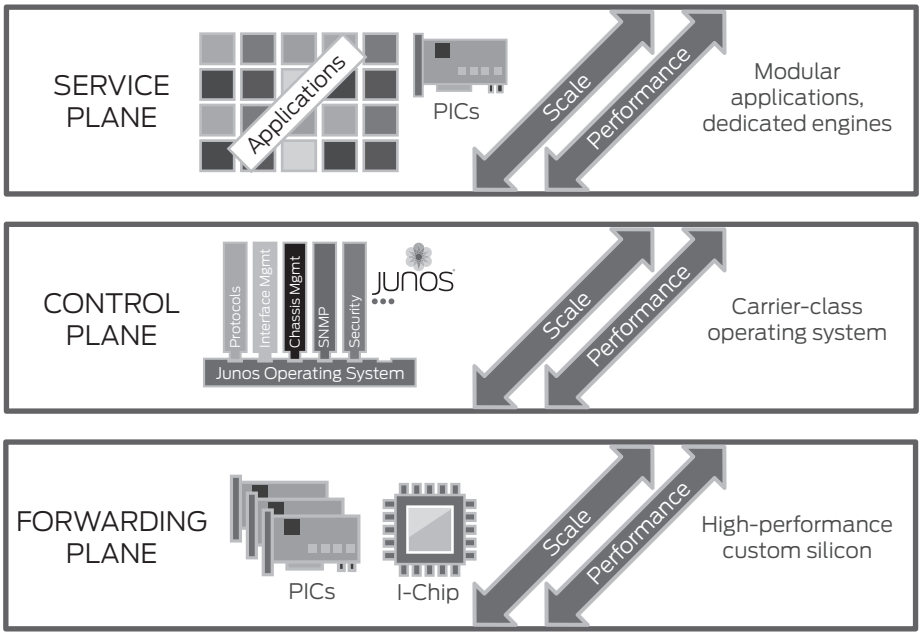

Figure 1: Juniper Networks architectural integrity schema

Architectural integrity brings many benefits to Juniper's router portfolio and to our customers:

- Enables parallel, non-disruptive innovation within each functional plane.
- Each plane can be independently scaled to address unique business and technical requirements.
- All planes are tightly integrated with Juniper Networks Junos® Software, so that new features can be introduced with predictability and consistency across the Juniper product portfolio, without risking operational disruption.

The Intelligent Services Edge

The Intelligent Services Edge is a portfolio of advanced service-enabling hardware and software features primarily intended for Juniper Networks M Series and MX Series edge routers. In this section, we will discuss how the Intelligent Services Edge helps address the challenges that today's service providers and large enterprises typically face. Note that all of the new features introduced by the Intelligent Services Edge leverage existing Juniper Networks centers of excellence, allowing the efficient introduction of high-quality, well proven, and broadly deployed technology to our edge router portfolio.

At this point, a brief overview of the M Series and MX Series router portfolios is appropriate.

M Series Multiservice Edge Routers

The M Series includes the Juniper Networks M7i, M10i, M40e, M120, and M320 Multiservice Edge Routers, which offer a single point of edge aggregation over any access type—ATM, Frame Relay, Ethernet, and TDM—and at any speed from DS0 up to OC-192/STM-64 and 10-Gigabit Ethernet. This broad set of capabilities addresses the widest possible set of service provider and enterprise applications. M Series Multiservice Edge Routers support business services such as private line services, as well as an array of layer 2 and layer 3 VPN services for IPv4 and IPv6, all with high performance and reliability.

MX Series Ethernet Services Routers

The MX Series consists of a family of Ethernet services routers that include the large capacity MX960, the mid-range MX480, the smaller MX240, and the compact MX80. The MX Series offers cost-effective Ethernet service deployment options, with support for service rates from 10 Mbps to 10 Gbps. The larger MX Series platforms support a wide range of business and residential applications, including high-speed transport and VPN services, next-generation broadband multiplay services, and high-volume Internet data center internetworking while the MX80 is optimized for mobile backhaul hub site aggregation, metro ring access nodes, cable and MTU aggregation, distributed PE and high-end CPE applications. The portfolio combines comprehensive Layer 3 routing (IPv4 and IPv6), and Layer 2 switching with Ethernet-centric class-of-service (CoS) features to efficiently support high service and customer density.

Intelligent Services Edge Forwarding Plane Features

Modular Port Concentrators (MPCs)

MPCs are next-generation advanced line modules for the MX Series that deliver performance, services and scalability for today's advanced IP Edge networks. Designed for flexibility, MPCs support a variety of modular 1GbE and 10GbE interfaces that allow customers to mix and match interfaces to create highly customized and efficient 'pay as you grow' configurations. Each MPC leverages Juniper's Junos Trio silicon technology, which consists of multiple advanced service specific ASICs that work together to deliver comprehensive Layer 3 routing (IPv4 and IPv6), Layer 2 switching, in-line services and advanced H-QoS.

Enhanced Compact Forwarding Engine Board (CFEB-E)

The CFEB-E is an I-chip powered forwarding engine that enhances quality of service (QoS) and improves system capacity, routing scale, and service performance for the M7i and M10i WAN edge routers. There are three enhanced CFEBs to choose from:

- CFEB-E base model
- CFEB-E with an integrated Adaptive Services PIC
- CFEB-E with an integrated Multiservice PIC (MS-PIC)

The CFEB-E with integrated MS-PIC supports hardware acceleration for a variety of services such as Network Address Translation (NAT), stateful firewall, IPsec, and JFlow accounting. Taken together, the CFEB-E feature-set significantly increases capacity, performance, and service flexibility at the WAN edge.

Enhanced Intelligent Queuing Physical Interface Card (IQ2E PIC)

The IQ2E PICs are a series of advanced Ethernet modules for the M Series (and Juniper Networks T Series Core Routers) that offer advanced CoS, scheduling, queuing, and statistics collection capabilities.

The IQ2E PIC supports features that ensure the proper treatment of traffic types such as hierarchical QoS applied at both the physical port and logical VLAN level, which is ideal for prioritizing business services. The increased scale and CoS support offered by the IQ2E PIC helps service providers increase service flexibility at the network edge.

MX Flexible Port Concentrator (MX-FPC)

The MX-FPC introduces support for non-Ethernet technologies to the MX Series, with initial support for OC-192, OC-48, and OC-3/12 Packet over SONET to enable the efficient aggregation of SONET/SDH rings.

By integrating these traditional topologies and technologies into the MX Series, the MX-FPC provides design flexibility to network planners who are challenged to maintain existing network services and infrastructure investments while concurrently evolving to newer services and technologies. Integrating traditional services and networks onto the MX Series also increases operational efficiency by reducing the space, power, cooling, and operational tasks associated with maintaining multiple independent network elements for Ethernet and SONET/SDH connectivity.

Intelligent Services Edge Control Plane Features

Subscriber Management for Junos Software

Juniper Networks is well recognized as a leader in subscriber management, and our E Series Broadband Services Routers support many tens of millions of subscribers in some of the world's largest broadband networks. Now, as part of the Intelligent Services Edge portfolio, Juniper extends these advanced broadband service capabilities to the M Series and MX Series platforms.

The MX Series with subscriber management is an ideal platform for efficiently aggregating video-centric services delivered over high-bandwidth access networks, while the M Series with subscriber management efficiently supports business DSL services, an adjacent market opportunity for service providers that currently use the M Series to support business VPN services.

Intelligent Services Edge Services Plane Features

Multiservice DPC (MS-DPC)

The Multiservice Dense Port Concentrator (MS-DPC) is a hardware acceleration engine that significantly expands

the service flexibility of the MX Series by providing dedicated processing power to a broad range of applications. The MS-DPC leverages the advanced design of the MS-PIC, a service engine that is already widely deployed across the M Series portfolio.

MS-DPCs and MS-PICs support a wide array of processing-intensive applications, such as Session Border Controller (SBC), stateful firewall, intrusion prevention system (IPS), IPsec, Dynamic Application Awareness, video monitoring, and many others. This application flexibility provides both capital and operational benefits, and also increases service velocity.

Because the MS-DPC and MS-PIC implement all services on the router itself, they eliminate service specific appliances as well as the layers of interconnection, administration and management required to support them, resulting in faster service deployment at lower total cost and lower risk. Additionally, MS-DPCs and MS-PICs can be incrementally added to the router over time, permitting low start-up costs with the ability to cost-effectively scale services as needed.

Session Border Control for Junos Software

The SBC for Junos Software consists of several modular applications that integrate voice and multimedia session support onto the M Series, and MX Series (as well as T Series) via the high performance MS-PIC and MS-DPC.

The Juniper Networks SBC portfolio includes a router integrated Border Signaling Gateway (BSG) and a router integrated Border Gateway Function (BGF); these applications are individually licensed and can be deployed independently or optionally combined. Additionally the BSG and BGF applications can be optionally combined with a complimentary set of router integrated IPS, IPsec, and firewall applications to create an integrated multiservice gateway. Together, these features ensure the appropriate handling of real-time services and open the door to new service opportunities.

Dynamic Application Awareness for Junos Software

Dynamic Application Awareness integrates advanced technology from Juniper Networks security product portfolio to provide router-integrated application identification, via the high performance MS-PIC and MS-DPC with application identification capabilities. The ability to identify applications and collect application-layer statistics greatly improves the network operations environment by enhancing route and capacity planning activities, providing real data for modeling the impact that specific applications have on the network, and helping better align infrastructure investments with actual application requirements.

Dynamic Application Awareness is fully integrated with all Junos Software services, including subscriber management, which permits highly detailed application identification, analysis, and security on a per subscriber and per session basis. Service providers can use this data to design highly differentiated service offerings for residential and business customers.

Intrusion Prevention for Junos Software

This modular application integrates advanced technology from Juniper Networks security product portfolio to provide router-integrated intrusion prevention system (IPS), which offers the latest capabilities in network intrusion prevention to protect the network from a wide range of attacks, including zero-day protection against worms, trojans, spyware, keyloggers, and other malware.

Our advanced IPS capabilities include Stateful Signature Detection Signatures, Protocol Anomaly Detection, Traffic Anomaly Detection and a pre-configured real-time reporting capability that provides application layer protection against attacks using illegal protocol variants. IPS for Junos Software runs on the high performance MS-PIC and MS-DPC, and can be configured to work together with other M Series and MX Series security tools such as powerful firewall capabilities, fine-grained packet filtering and rate limiting.

StreamScope embedded Remote Monitor

Router-integrated analysis of video streams is offered with the StreamScope embedded Remote Monitor application, which helps service providers quickly identify video quality issues in IPTV and cable networks. Embedded real-time MPEG analysis on the M Series and MX Series simplifies operations while ensuring customer satisfaction through improved service quality.

StreamScope eRM is based on the StreamScope™ application from Triveni Digital, a leading provider of digital signal monitoring and analysis solutions and a member of Juniper Networks Open IP Solution Development Program (OSDP). Triveni utilized the Partner Solution Development Platform (PSDP), which offers a powerful set of resources, including a software development kit (SDK), to integrate StreamScope with Junos Software, the MS-PIC and the MS-DPC. StreamScope eRM reduces the need for standalone video probes, and enables automated, network layer actions based on real-time video traffic analysis.

Telchemy enhanced Performance Monitor

TePM is a router integrated performance monitoring application for VoIP, IPTV and Videoconferencing that facilitates service level monitoring and troubleshooting for M Series and MX Series routers. TePM was developed with Telchemy and integrated with Junos via the PSDP. TePM will be help network operators quickly identify and act on IP and VoIP quality issues.

TePM was developed in partnership with Telchemy, a leading provider of IP service monitoring and analysis solutions and a member of Juniper Networks Open IP Solution Development Program (OSDP). Telchemy utilized the Partner Solution Development Platform (PSDP), which offers a powerful set of resources, including a software development kit (SDK), to integrate their technology with Junos Software, the MS-PIC and the MS-DPC. TePM integrates performance monitoring with the routed infrastructure, and reduces the need for external probes.

Driving Service Flexibility, Velocity, and Consistency

Intelligent Services Edge features can be added to the network with ease and speed, a real game-changer for service providers, where network upgrades and new service introductions are traditionally very expensive, lengthy and high risk activities. With the Intelligent Services Edge, new products and services can be incrementally added to the network quickly, efficiently, and with very low risk. This approach has many advantages, which are highlighted in the following sub-sections.

Increasing Service Flexibility

Juniper Networks provides service flexibility at the platform, network, and application levels.

- At the platform level, all applications are optional, modular, independent of each other, and individually licensed, allowing the flexible, cost-effective placement of the right services in the right location.
- At the network level, applications and services can be located individually or in combination, where and when they are needed, to accommodate a variety of edge architectures and service delivery models. This flexibility ends debate over single edge versus multi-edge architecture and distributed edge versus centralized edge models; with Juniper's Intelligent Services Edge, services can be flexibly placed where they make the most technical and business sense.
- Uniquely, Juniper also promotes application-level integration via the Open IP Service Creation Program (OSCP) and the Open IP Solution Development Program (OSDP).
  - The OSCP allows partners to create innovative IP service management functions by integrating software applications with Juniper Networks SRC Series Session and Resource Control Modules. The SRC Series enables application-aware service delivery based on provider-defined policies.
  - The OSDP provides the mechanisms and support that allow partners and customers to integrate their unique applications with Junos Software, the MS-DPC and the MS-PIC into Juniper Networks routers. With the OSDP integrated applications, service providers can accelerate innovation to deliver revenue-generating services faster and with less expense. Ultimately, the OSDP gives operators a full ecosystem of router integrated applications that they can selectively implement to complement and extend service offerings, and to gain and maintain a competitive edge.

Improving Service Velocity

In "Internet time," new applications and services, new business and distribution models, new collaboration and revenue opportunities move from the drawing board to mainstream adoption rapidly and often unpredictably; companies that are agile enough to use this to their advantage are richly rewarded. To date, most service providers have been unable to use "Internet time" to their advantage due, in large part, to the cost, complexity and risk associated with introducing new products and services to the network. For service providers, adding new services often means adding service-specific appliances, which is a long and expensive process.

- The appliances must be tested against an exhaustive list of criteria involving individual and system level features encompassing performance, reliability, recovery, upgrade/downgrade procedures and behaviors, standards conformance, and a host of other important considerations.
- The appliance must also be integrated with the service provider's operational environment. Integration with a multitude of management tools, operational support systems (OSS), and business support systems (BSS) requires significant resource investment, followed by exhaustive testing.
- Once the appliance has successfully passed these hurdles, the service provider must create detailed deployment, sparing, and support plans. Network planners must carefully evaluate space, power, and cooling requirements, ensuring that all facilities can accommodate the new equipment.

All in all, the first office deployment of new equipment often begins 12-24 months after the project was initiated, involves major upfront investment, and comes with significant risk—what if the market doesn't adopt the new service?

By flexibly integrating, field proven applications with our router portfolio, Juniper Networks removes much of the cost, complexity, time, and risk associated with new service introductions. For example, the enhanced IQ2, MX-FPC, and MS-DPC can be non-disruptively added to our edge routers, resulting in a low-risk and inexpensive performance upgrade. Furthermore, all of the new Intelligent Services Edge applications are Junos-based, so there is little impact to the operational environment, permitting simpler, shorter, and less expensive qualification cycles.

Importantly, adding new hardware and software to Juniper's routers also minimizes environmental impact. For instance, MPCs, the enhanced IQ2, MX-FPC, and MS-DPC consume no additional rack space, a major advantage to network planners who must design for space constrained facilities. And adding new software does not increase power draw, an important advantage to network planners who must consider power availability and power costs in their designs.

Addressing Operational Considerations

Telecom and cable networks are complex, and this complexity is greatest in the edge network where services are created and delivered. This complexity if further exacerbated as more elements are added to the edge network.

Juniper Networks understands that no matter how flexibly and quickly a router can introduce new services, if the services are unreliable, lack scale, or are operationally inefficient, they have little value. Key operational considerations regarding service reliability, service performance, service modularity, and service efficiency are discussed in this section.

Service Reliability

Maintaining carrier class service reliability is an overarching concern for service providers. There are many negative consequences resulting from unscheduled downtime: lost revenue and service level agreement penalties, diminished brand reputation and customer satisfaction, and the potentially incalculable costs that can occur if a mission-critical network fails.

Juniper Networks designs for reliability at the service, network, and system levels, for both hardware and software. The M Series and MX Series routers are built for "always on" operation and offer fully redundant hardware configuration. The modular Junos Software architecture also promotes nonstop operation, and Junos supports unified in-service software upgrade (unified ISSU), which enables non-service affecting upgrades between major releases), as well as Graceful Routing Engine switchover (GRES), Virtual Router Redundancy Protocol (VRRP), Automatic Protection Switching/Multiplex Section Protection (APS/MSP), Bidirectional Forwarding Detection protocol (BFD), and Link Aggregation Control Protocol (LACP).

Service Performance

Maintaining high levels of service performance is very important, and many negative consequences can result from poor performance—when video and voice service performance degrades, you don't need a sophisticated probe to alert you, subscribers will call to tell you…if they aren't calling the competition.

Juniper Networks ensures deterministic high service performance at scale by dedicating appropriately sized resources to the forwarding, control, and service planes. The MS-PIC and MS-DPC provide dedicated resources to the services plane, and additional MS-PICs and MS-DPCs can be added to maintain performance goals as requirements grow.

Service Modularity

Service modularity refers to the ability to license and implement some, all, or none of Juniper's service plane features, as needed. This approach pays many dividends, for example, customers can flexibly:

- Purchase and deploy a Juniper Networks edge router for strictly for routing applications, and if, at some future point, they want to offer additional services, they can easily add them. Benefit: Low start-up cost with future proof investment protection.
- Select and purchase just the services they want to support, and only for the platforms on which they need them. Benefit: Capital and operational efficiency with service flexibility.
- Implement services on the MS-DPC and MS-PIC which provide dedicated hardware acceleration for packet processing intensive services. Benefit: Add services without impacting control plane stability or forwarding plane performance.
- Deploy additional MS-DPCs and MS-PICs on one router or across multiple routers, to accommodate service growth or additional services as technical and business requirements dictate. Benefit: Cost-effectively accommodate service growth with targeted investments.
- Establish multiple services on a single edge router to create a "service chain," for example, combining SBC with IPS, stateful firewall, and an IPsec termination point—all on a single router. Benefit: Chaining services in a single product provides a comprehensive service solution with operational and capital savings.

Service modularity pays many dividends. It enables service providers to address diverse service requirements from a single platform, regardless of the way customers are connected to the network or the way services are deployed and delivered—any Juniper Networks router can deliver any service. It also eliminates the need to qualify and implement point solutions, which is important to avoid when planning for, and costly service specific applicances and allows services to accommodate shifts in service delivery over time. For instance, as networks evolve, a service location may change based on its growth and lifecycle (service location dramatically impacts scalability and OpEx). In effect, modualrity permits locating and relocating anywhere to adapt in the most technical and business sense.

Service Efficiency

Often, legacy edge routers lack scale, performance, and service capabilities and service-specific appliances are often required to support new services, resulting in a complex and inefficient network design. Complexity increases as service-specific appliances are added to the edge network, each with its own operating system, maintenance release schedule, and feature set. Worse, as complexity increases so does costs, even as network efficiency and reliability decrease. Service efficiency, on the other hand, is maximized when the number of network elements and operating systems are minimized.

The services introduced by the Intelligent Services Edge are supported in a consistent manner across the M Series and MX Series, with a common OAMP environment. This consistency is made possible because Juniper Networks maintains:

- Architectural integrity
- No platform-specific Junos Software versions
- No feature-specific Junos Software versions

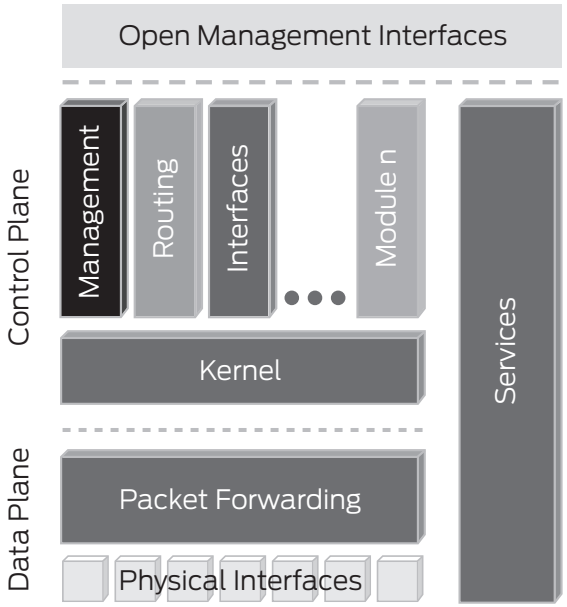

Figure 2: Junos Software integration with forwarding, control, and services plane resources

Conclusion

Basic connectivity and transport have become highly commoditized services, and, introducing new differentiated services is a time-consuming, expensive, and high risk undertaking. Making matters worse, service providers must continuously invest in infrastructure to increase capacity, performance, and scale. The unfortunate result is that traffic growth has not translated into increased revenue, and service providers are experiencing margin pressure.

To address these challenges, Juniper Networks Intelligent Services Edge portfolio introduces high-performance edge infrastructure that supports operationally efficient service innovation. Alone and in combination, the Intelligent Services Edge feature set improves performance and scale, provides service flexibility and service velocity, and increases operational efficiency.

While innovative new service introduction is traditionally a difficult and expensive exercise for service providers, the Intelligent Services Edge removes much of the cost and complexity, helping service providers offset the rapid price erosion of basic services with the frequent introduction of new services, including contextual, policy-based services based on a combination of identity, location, device, application, and network state. This is not only possible with the Intelligent Services Edge portfolio; it is achievable—without compromising performance, scale, or reliability.

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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