WHITE PAPER

OPEN IP NETWORKS FOR INNOVATION AND PROFIT

How Carriers, Content and Applications are Changing Network Business Models to Add Value, Generate Revenue and Improve Efficiency

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Executive Summary

Increasing network traffic and over-the-top services are raising costs without similar growth in revenue for network service providers. Similar service offerings leave little room for differentiation. Avoiding the commodity trap and capturing more value from network assets means utilizing network openness and third-party collaboration to redefine business models. However, proprietary platforms and interfaces have constrained service development and restricted the options available to carriers.

Open IP networks make it possible for carriers and their partners to customize network functionality for strategic differentiation – leveraging subscriber information, session and resource intelligence, and integrated applications to increase the value per bit or reduce the cost per bit.

This paper discusses Juniper Networks® open IP development platforms and how they can enable service providers to seize opportunities for business model evolution. Specific examples show how Juniper Networks products can enhance content delivery, deliver managed application services and create operationally efficient networks.

Introduction

Companies that offer Internet and communication services are facing an economic challenge. Businesses and individuals that communicate more frequently demand the larger and faster network connections they can provide for applications such as voice, video and gaming. At the same time, network access competition keeps the pressure on prices; the number of new customers using their networks is slowing due to market saturation. Network traffic is an increasing variety of streams of bits, with varying value to the user. But business models for network services are often based on flat rate contracts, so revenue per bit is decreasing, sometimes at a significant rate. For example, last year mobile data traffic grew 360% while revenue grew only 11%. Compounding this challenge is the growing market for online services where the subscriber and usage revenues are bypassing the network service providers (NSPs) and being directly captured by the content providers. Fewer new customers, but more bandwidth per customer. Less revenue per bit, but more bits.

In this environment, network providers have to adapt their business models to compete more effectively and sustain profitability. Earlier business models assumed that revenue growth follows subscriber growth by increasing the reach of the network and by aggressively attracting new users with attractive tariffs and bundled packages. Now, facing a saturated market and a range of competitors and web-based services, revenue growth must come from adding new services and differentiating between the bits transmitted. Profitability comes from capturing more value per bit or reducing the cost per bit.

Some attributes of network operations are best suited for increasing the value per bit, while others provide an opportunity for reducing the cost per bit. Business models will typically use a combination of these to address different customer needs, market scenarios, and applications. Carriers need the ability to broker between these attributes quickly with an open and customizable network, or create distinct operating groups that aim for excellence in one area.

Increasing Value per Bit

As network and communication services grow and evolve, older applications and behaviors lose their novelty and have the potential to become commodities. New applications push the limits of the existing network infrastructure, trigger new regulations, or move in unanticipated directions. Carriers can capture more value per bit by dynamically enhancing the experience for specific users and applications, and controlling the security posture and virtualization capabilities of the network for specific enterprises. Identity information can be appropriately leveraged to make these partnerships more transparent to the user, further increasing value to the customer.

Reducing Cost per Bit

With bandwidth consumption increasing due to video, voice, gaming and a general increase in network usage, networks face cost increases without a corresponding increase in revenue. Traditionally, network infrastructures have relied on the over-provisioning of bandwidth to address peak usage issues, resulting in poor average utilization rates with high costs. And static traffic paths have further exacerbated the problems. Carriers can reduce the cost per bit transmitted via network intelligence, dynamically reconfiguring traffic paths and network resources for specific content and applications, improving network efficiency and deferring expensive bandwidth upgrades. Additionally, management functions and external operations support functionality can be automated and moved into the network, improving operational efficiency and reducing capital equipment costs.

Open for Business

Existing content or application services that run "over the top" of the NSP's network are capturing revenue with advertising, subscription and transaction business models that bypass the network providers. Changing the rules of the game to transition from basic bandwidth provider is necessary to avoid a commoditization spiral. In this new game, open network interfaces or functionality provide both network and third-party content or application providers with the opportunity to create new value and capture revenue from delivering enhanced services while reducing overall application delivery costs.

Partnerships and collaboration between network and content providers can evolve the business model for network services. It isn't feasible for one service provider or vendor to anticipate all aspects of these business model changes. As many successful companies are discovering, cooperation with complementary third parties results in an expanded portfolio of content and service options for end users and creates a significantly larger overall market with greater diversity and resilience.

This new collaborative "open garden" business model requires an open, intelligent network to enable the speed, flexibility and differentiation necessary to respond to changing market conditions.

What is an Open IP Network?

An open IP network enables carriers to leverage existing service delivery assets beyond basic bit transport - such as subscriber knowledge, session intelligence and inherent network "computing" power - to move today's external applications into the network, build new applications and interact more effectively with external partner applications.

Legacy transport network infrastructures are vertically integrated with distinct, proprietary interfaces. Basic IP networks are more horizontal, but the available interfaces are far removed from advanced packet handling and policy-based control, resulting in best-effort traffic with inefficient resource utilization. Both have limited capabilities to differentiate services.

Open interfaces at multiple levels of the network allow carriers to innovate and customize the capabilities of the network to meet the business needs of their customers and partners. Detailed policy rules can be rapidly and specifically applied to different users or applications. Traffic engineering techniques let paid video services offer bandwidth assurance, or online gaming services select a low-latency routing path. Identity information can be federated to trusted partners, with appropriate privacy considerations, to identify and act on common customers, improving the user experience.

Management applications can be distributed throughout the network to monitor and respond to changing traffic patterns. Custom routing protocols can improve traffic distribution, taking subscriber policies and service level agreements into consideration. Advanced service capabilities can be integrated with subscriber, accounting, or other information. All of these can be customized and moved into the appropriate part of the network to achieve the necessary performance and scale.

Open IP Network Solutions from Juniper

Juniper's multi-layer open IP network functionality gives service providers the most flexibility for customizing and differentiating services at the packet layer, application layer, or policy layer. Resources can be allocated more efficiently and profitability enhanced along two dimensions: increasing (and capturing) the value of bits transmitted and reducing the cost of bits transmitted. Juniper has two open networking "toolsets" - the comprehensive Juniper Networks identity and policy management solutions and the robust Juniper Networks Junos® operating system which, via the Juniper Networks Partner Solution Development Platform (PSDP), enables advanced packet processing applications to run within the Juniper routers.

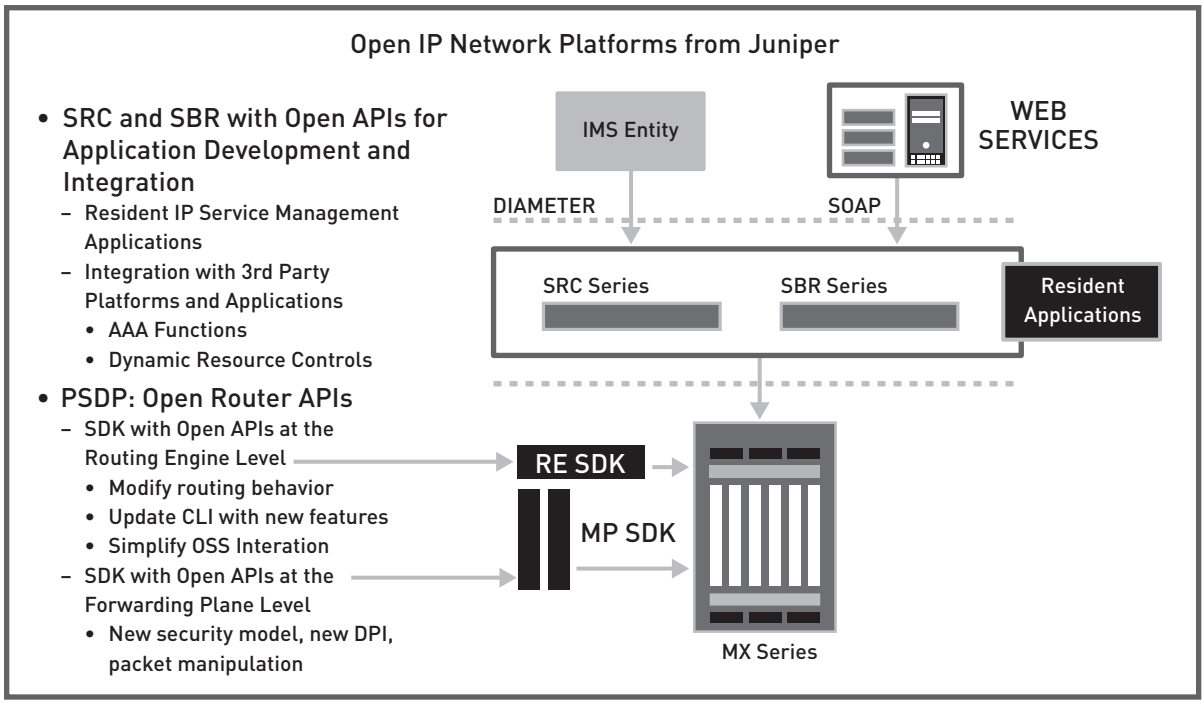

Figure 1: Open interfaces – Open IP network platforms from Juniper.

Identity and Policy Management

Network services that leverage identity, session intelligence and dynamic control can be rapidly deployed with Juniper Networks identity and policy management solutions This product portfolio includes the Juniper Networks Session Resource Controller (SRC Series) policy server and Steel-Belted Radius Carrier (SBR CE) subscriber management system.

The SRC Series policy server modules provide a broad set of options for rapid integration with internal or third-party systems for billing, customer care, order entry, provisioning and security. At the network layer, they are fully integrated with Juniper Networks routing platforms and security solutions. Using widely adopted standards-based open interfaces and protocols, the SRC Series policy server maximizes interoperability with the broadest range of carrier or third-party network elements, applications and operations support systems.

The SBR Carrier is a carrier-grade server that sits at the core of the service delivery system authenticating subscribers to the network, authorizing the appropriate level of service delivery and reliably delivering accounting data to the billing systems. It includes state-of-the-art reliability features, including load balancing and redundancy across authentication and accounting systems, and the capacity to handle thousands of RADIUS requests per second on suitable hardware.

Open, standards-based interfaces combined with carrier-grade scale and reliability means Juniper Networks identity and policy management solutions are quickly customized to meet the needs of new business models. Selected network policy attributes are adjustable by trusted partners. Subscriber identity can be federated with partners to enhance user experience. The network adds greater value to content and application delivery, strengthening relationships, opening new revenue opportunities and enhancing competitive advantage.

Integrated Junos OS Applications

For some applications and services it is desirable or even necessary to monitor and control functions inside the network. The Juniper Networks PSDP enables customers and partners to develop applications on Junos OS and deploy them on routers in the network.

The PSDP provides a powerful set of tools with secure interfaces to Junos OS routing and services functions, including a software development kit. Customers and partners can use PSDP to innovate and deliver new services within the network. Interfaces are available to build new commands into the existing interface or add management functions tailored to a carrier's operations processes. Routing protocols can be augmented to incorporate additional decision attributes.

Applications that need to monitor or modify a large number of packets have the high-performance processing capabilities necessary for carrier-scale packet handling without affecting the data path. Custom applications can use the full range of Junos OS functionality to calculate QoS data, execute deep packet inspection algorithms, or modify packets for encryption or encapsulation services. These applications can then direct traffic back to the routing engine, query a policy server, or change traffic shaping details.

Customers and partners can use the PSDP to develop unique applications for their specific requirements, providing greater choice and control of their business models. Management processes can be automated and distributed on Juniper routers. Traffic paths and patterns can be finely tuned. The network assets provide greater returns, improving operational efficiency, reducing bandwidth costs and enhancing profitability.

Business Model Evolution

The challenge for carriers lies in finding new ways to partner with content and other service providers, and leveraging different behaviors or capabilities of the network for different services. These alliances allow each party to focus on their strengths and share the successes – discovering and developing new content and services that the customer likes, or delivering network traffic with the appropriate security, reliability and priority for the content. Standards-based approaches to ensure both a common technical and business language defining these service collaborations are addressed by the IPSphere initiative, which is now a program within the TM Forum. The business evolves to connect NSPs and partners, and the network or end-to-end infrastructure evolves to enhance the content and customer experience.

There are a few different dimensions to this business model evolution. One dimension involves dynamically enhancing a consumer's experience with media content, such as gaming and video. The second is extending the NSP's role in hosting and delivering enterprise-oriented applications, such as video conferencing and software as a service (SaaS), which have stringent network intelligence, security and performance requirements. The third dimension is improving the efficiency and operations of the network itself to address economic, political and regulatory issues in specific markets.

Enhanced Content Delivery

Improving the on-line experience for consumers and content providers creates a broad set of value-added opportunities. While performance differences with email and web browsing may be barely noticeable, these applications are no longer the key attraction. Popular video applications, which are consuming more and more bandwidth and require less latency, are very susceptible to changes in traffic patterns.

Making the user experience more appealing and more consistent for video content consumption, especially emerging high-definition content, presents a real opportunity for partnerships between content providers/aggregators and network providers. Multiple tiers of service quality, including an assured or deterministic level, can expand the market for content providers and generate additional network revenue. In addition, tighter links between the network and content domains open new avenues for enhancing the value chain.

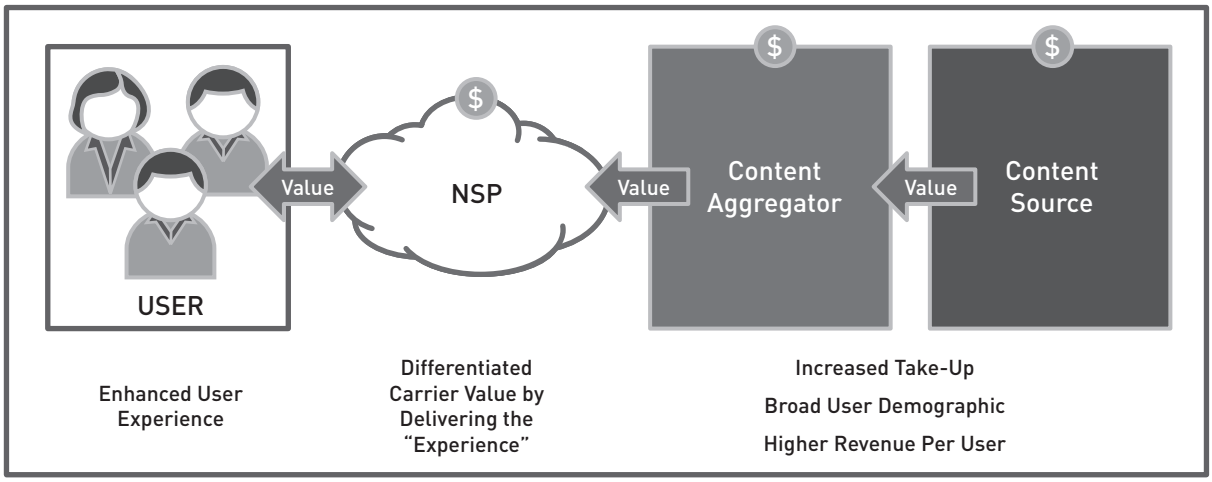

Figure 2: "Open Garden" Business Model allows NSPs and CSPs to collaborate to share revenue and enhance the user experience.

With Juniper's open IP network functionality, the network can be customized to identify and differentiate between sessions and dynamically allocate resources based on subscriber or content provider profiles. It also can monitor the session for ongoing performance tuning, redirect traffic to compensate for network traffic loads or failure recovery, and log the necessary details for billing and settlement. Since the majority of content comes from outside of the network provider's domain, this is most effectively done with a portfolio of open, standards-based interfaces and network options.

Subscriber Experience and Network Neutrality

Internet video is often associated with network neutrality issues, as some service providers strive to manage the significant amounts of traffic that can be generated by a small number of subscribers. When dealing with a best-effort-only network, some providers have applied traffic engineering constraints to one type of traffic in an effort to preserve the experience for the majority of users. This has provoked complaints from users and even regulatory actions. As an alternative, policy-based control can be used to move high-priority latency-sensitive traffic such as voice into its own path, assuring the desired service level. Standard priority traffic remains in the best-effort path.

Identity and Privacy

Privacy is an important issue to address. A trusted authentication environment will allow partners to communicate the status of mutual customers. Using identity federation standards, NSP and content partners can communicate authentication, resource allocation and other approvals without sharing demographic or usage information that might infringe on individual privacy. Open interfaces provide the ability to derive a common identity and state across a range of different access points and partners, delegate appropriate network decisions, without compromising the integrity of the core network.

The openness and flexibility of these platforms make it possible to support a range of business models such as consumer pay–per-session upgrades, tiered application subscriptions, and third-party or advertising-subsidized service delivery. Two examples of how Juniper Networks platforms can facilitate the evolution of the business model to enhance content delivery, consumer sports video and online gaming, are covered below.

Consumer Sports Video

YouTube and other video sites get a lot of media attention, but paid subscriptions for professional content is a real and growing business. Sports leagues are some of the most successful internet video content providers, with Major League Baseball's Advanced Media group generating more than $450 million in video subscription revenue last year. Offerings range from brief highlight videos to full-length games. A partnership between the sports league and network service provider could expand these offerings to include higher resolution video and assured streaming delivery.

When the subscriber initiates their video session, the network and content partners need to agree on the identity and validate the service level. This is effectively accomplished with standards-based identity protocols, such as Liberty Alliance, Security Assertion Markup Language or OpenID. Additional protocols can also be added to the Juniper Networks identity and policy management solutions via the NSP or a third-party developer. A carrier-grade identity database, such as the SBR Carrier, handles the initial subscriber sign-on. Multiprotocol support and flexible authentication methods ensure integration with existing databases.

When the video session is started, the carrier's user database asserts the subscriber's authorization for the service without having to transmit passwords or breach any privacy regulations. The SRC Series policy server then determines the appropriate policy and network resources. The traffic is mapped through the core to a specific network path with the desired latency and utilization level. A high-definition highlights clip that is being buffered at the user's end may need a high-bandwidth path but can tolerate greater latency than a lower-resolution live game. The subscriber may also be subject to an overall bandwidth cap, have a temporary bandwidth-boost option, or a monthly traffic quota. These factors can all be acted on or overridden as appropriate. For example, high-definition video consumes a significant amount of bandwidth, and one of the paid subscription benefits may be that this traffic does not count towards the monthly quota. The Juniper Networks platform can make the necessary accounting entries, both to the subscriber's account and for settlement with the sports league.

The network provider can also add value with information about the subscriber's location. Network television broadcasts typically have a mix of national and local advertisements. Indicators for the local (replaceable) ads enable the local TV station to insert spots from local sponsors. In a similar fashion, an integrated Junos OS application could monitor the video streams to detect replaceable ad markers. When a localized ad segment is detected by Juniper's

high-performance deep packet inspection function, the appropriate local ad is inserted into the stream based on the subscriber's location or other demographic info (with appropriate privacy considerations). This expands the advertising revenue options for both the content and network provider, especially for out-of-town fans.

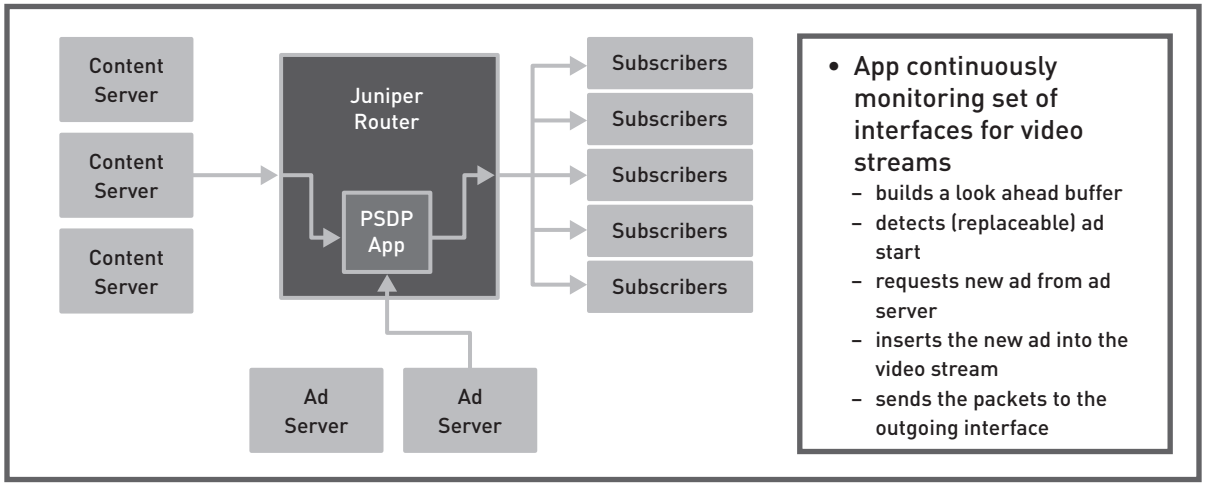

Figure 3: PSDP Example: Advertisement insertion.

Online Gaming

Playing video games with other participants on the Internet is increasingly popular. The identity of the Microsoft Xbox 360 or Nintendo Wii player in the house is different from the VPN user (even if they are the same person) or VoIP connection. The VPN link may want bandwidth priority, but voice and gaming prefer lower latency. A partnership between the gaming provider and the network can offer higher value services by federating the identity of the user to ensure they are working together.

In this scenario, the on-line gaming provider may want to request network resources for customers it has authenticated. When a user signs onto a gaming site, the gaming server sends a request to the carrier's policy server, using a web-services protocol, for specific network resources appropriate to the customer's subscription. The gaming server could also request the traffic be directed to the closest policy server or lowest latency path. Using the open authentication protocols, the gaming provider asserts the subscriber's authorization to its trusted network partner, with no exchange of user information.

As in the sports video example, the Juniper Networks SRC Series policy server identifies the appropriate policy, executes any network changes and confirms whether the desired resources are available. The gaming server can then process its own billing information. Juniper Networks' identity and policy management functions are tightly coupled, allowing these requests and decisions to be distributed to the edges of the network. Resource allocations are made in less than a second and updates propagated in less than a minute. This facilitates high-volume, low-latency decisions, ensuring large-scale resource allocation performance.

As carriers provide services with multiple access points, they end up with multiple identities for the same user (e.g. mobile, wifi, home broadband). These users also have additional identities associated with the content services they use. Connecting traditional and next-generation authentication systems makes a real-time subscriber identity practical. In addition, federation of identity between carrier and content provider makes it possible to dynamically allocate resources between the network and content provider, enhance billing and settlement, and create new subscriber services.

Expecting all partners to use the same authentication system is unrealistic, so Juniper Networks provides a range of standards-based interfaces and customization options to enable service providers and their partners to develop and deploy a trusted identity environment. Juniper Networks' combined identity and policy management solution is tightly coupled with the network to provide real opportunities to add (and capture) value to these identities.

These are just two examples of how Juniper Networks' open IP platforms can facilitate partnerships with content providers and add value to content delivery. As the range and volume of digital content options increase, delivering content with assurance that consumers get what they pay for (and not what they didn't pay for) will continue to offer new business model opportunities.

Managed Application Services

Enterprise IT is undergoing a significant shift in structure. Data centers are being consolidated and centralized, but at the same time data and applications are being virtualized and distributed. Web services, service-oriented architecture and data format standards are enabling companies and departments to quickly assemble applications from a mix of new and existing components. Collaborative work styles and applications are changing the pattern and volume of network traffic.

Managing the connections between enterprises and their data, applications, partners and customers provides a growing market opportunity for network provider partnerships. As end-user computing moves into a broad range of devices, SaaS and "cloud computing" are increasing the importance of secure and reliable communications. Ensuring that software services, data and people can connect, work together and shift with demand are critical parts of this evolution of computing.

Restricting these flows to secure paths or within geographic network boundaries is a differentiation only available with open interfaces into the packet handling layer. Combining Juniper Networks' high performance packet handling hardware with open packet-layer interfaces enables customizing packet inspection and routing decisions with additional criteria. Junos OS applications can identify traffic that requires specific routing, modify path allocations in real-time and take appropriate action on suspicious or malicious packets.

Security requirements for network traffic differ due to content, regulation and even personal preference. While some of these issues are addressed by encryption or other edge-based applications, some are best dealt with inside the network. Enhanced or specialized network security functions add value to these distributed network applications. They also make it possible to move some applications onto the carrier's network that previously required fully private networks.

Juniper Networks' open and flexible interfaces enable network service providers to absorb traditional business customer networking and applications responsibility into the NSP's network, enhancing the overall relationship and offering mutual value to both parties. Two examples of how Juniper Networks' platforms can facilitate the evolution of the business model to deliver managed application services, business videoconferencing and SaaS, are covered below.

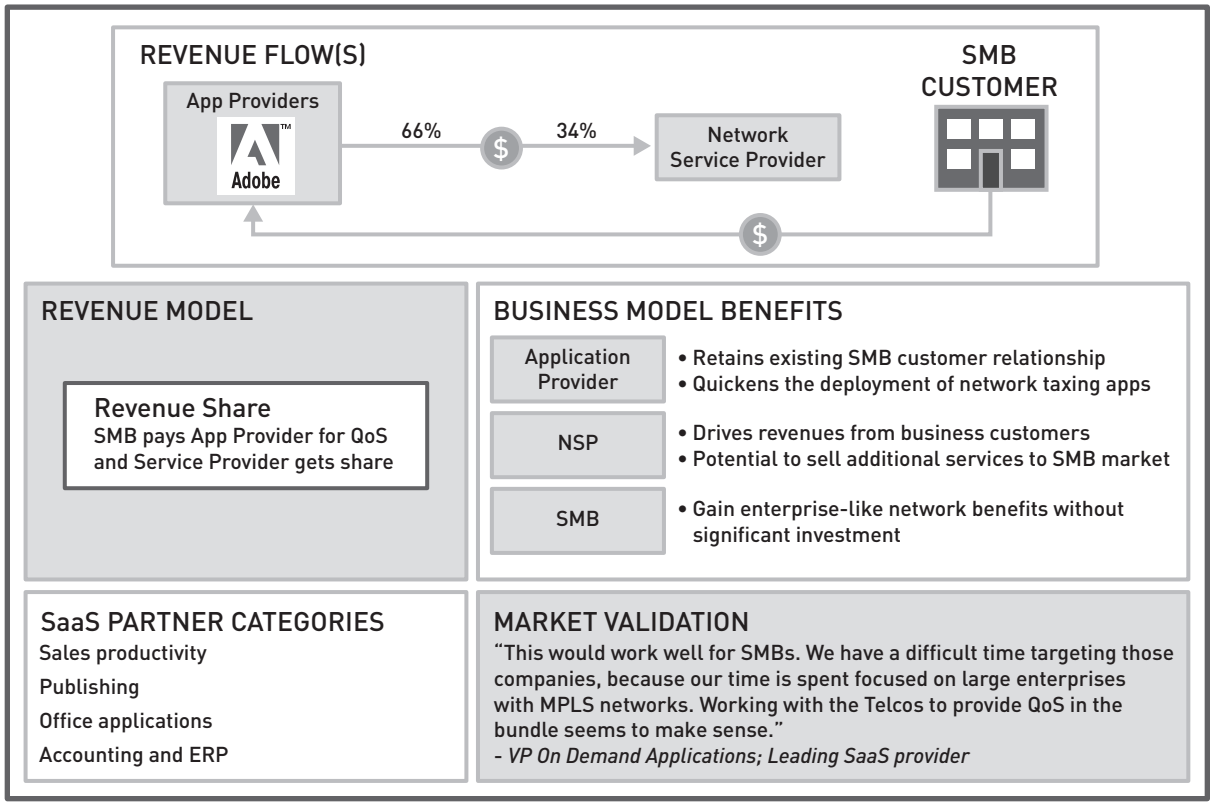

Figure 4: Enhanced SaaS delivery example.

Business Videoconferencing

Higher definition and ease of use are making videoconferencing a viable communication tool for many businesses. However, only a small fraction of high-definition-capable video calls are actually completed in high definition today. High-end systems have very significant bandwidth requirements with streams up to 20 Mbps per site. The business customer only needs this capacity when the systems are in use, requiring a dynamic bandwidth-on-demand facility. Using the flexibility of open, standards-based interfaces, signaling between the SRC Series policy server and designated video conferencing call control platforms can enable providers to readily create and offer new, innovative conferencing services to business customers that extend beyond basic connectivity.

When a videoconference call is initiated, the SRC Series policy server is queried to identify the subscriber's account and policy details. Policy management information is distributed to each router from the centralized server, so call setup and bandwidth allocation decisions are made locally and quickly. If the customer's service level agreement supports the necessary bandwidth, then the video flow is directed to the appropriate network path.

Of course, customers want to get what they pay for. An application running on the Juniper router can also include monitoring and performance tuning. Using packet filtering techniques, the routing platform can identify the video conferencing traffic and without affecting the throughput of the video stream, an embedded Junos OS application can calculate error rates, traffic jitter, data loss and other measures that affect the viewer's experience. If these calculations indicate that the video stream is not meeting the desired performance, the application is capable of logging the details for billing and settlement processing. Corrective action can be initiated, modifying the parameters of the network path or moving the traffic to an alternate path.

High-definition conferencing that works when requested is a significant value for many types of organizations, enabling faster and better quality conversations, and reducing the time and cost burdens of travel. With intelligent IP networking, the NSP can leverage an efficient, low-cost infrastructure to minimize costs for the customer while maximizing value.

Software as a Service

For businesses, SaaS is a growing option for a range of applications. Acceptable user performance of these services is as dependent on network performance as it is on server performance. NSP partnerships with third-party software providers can deliver assured experiences and service level agreements (SLAs) that will dramatically expand the market.

In this scenario, enterprise customers may prefer to manage their own identification and authentication database. When an employee or other authorized user connects to the data center hosting the applicable software, the enterprise can assert their authentication, reducing the number of user id/passwords and improving security. This could be done with open authentication protocols or in a web services approach.

While the application provider may be the primary recipient of authentication information, the network provider can also use it to make the network more than just a conduit. Partnering options include network resource allocation, SLA verification and billing. These can be integrated with existing back-end systems using the SRC Series policy server. When the business employee connects to the software portal, the service-oriented architecture (SOA) control system requests the desired bandwidth and network path. The SRC Series policy server then performs admission control checks and verifies that the appropriate network resources and network paths are available. If they are available, the traffic is mapped and confirmed. If they are not available, the SRC Series policy server can either deny the request or make other changes to the network based on the NSP's policy. As a result, the SaaS applications are delivered in a consistent and assured manner.

Accounting and settlement functions are closely coupled with identity. In all of these examples, billing options remain flexible. Subscriber billing can be owned by any one of the partners involved. Detailed resource consumption information is available in accounting log files that can be readily exported to existing billing systems. Accounting records can be written to a central database or spooled from distributed servers. Real-time usage information and volume tracking applications are available to manage usage quotas or prepaid services.

There are many other examples of how Juniper's platforms can add value and facilitate or strengthen partnerships by connecting the components of the end-to-end service infrastructure securely and reliably. As business processes and services become more specialized and virtualized, communication options that offer flexibility and assurance about where data is stored, how it is transmitted and when it is received will command a larger share of the market.

Operationally Efficient Networks

New network services may be good for revenue growth, but are of little value if they require significant cost increases. Reducing network operating costs requires the ability to efficiently allocate resources, effectively manage SLAs and other contract issues that may impose penalties, and automate network management functions. Since most networks are a mix of new and legacy equipment from a variety of vendors, this cannot be addressed with only packaged applications. Support for a range of application interfaces and protocols, third-party modules and rapid customization is necessary.

Juniper Networks' open IP networking assets can also be utilized to operate an efficient network. Packet-handling interfaces within Junos OS make it feasible to develop and deploy custom routing protocols, monitor selected traffic and respond to service level impacts. Application and policy interfaces, along with high-performance processing capacity, enable provisioning and mitigation functions to be automated and deployed deep in the network.

Decentralization for Performance and Scale

Enhanced services cannot capture added value unless they are built to carrier scale. Historically, the necessary service processing, session manipulation, authentication and policy functions were deployed within the server or IT domain. Juniper Networks is building this functionality directly into the network and routing platforms, so that policy and resource decisions can be made on-the-fly and in high volume. Subscriber identities, policies and business rules are still defined and managed centrally, but decisions are distributed throughout the network. Custom applications can be built that integrate identity and policy decisions with router functions such as multicast and packet filtering for increased flexibility.

NSPs have distinct operating conditions and assets that can be leveraged with Juniper Networks' open IP platforms. Three examples of how Juniper functionality can facilitate the evolution of the business model to improve network efficiency, network utilization, path computation and network management, are covered below.

Network Utilization

Best-effort routing protocols obviously pick the best (shortest) traffic path based on current network topology. In peak usage situations, this can result in some links being highly congested while others are nearly empty. Customizing the routing protocol to more evenly distribute traffic during peak periods can maintain the user experience and defer bandwidth upgrades.

In this scenario, routing decisions are augmented by additional information. Software agents developed within Junos OS can be active on the routers, monitoring link utilization. When a pre-determined threshold is reached, these agents can locally adjust forwarding decisions so that a sub-set of the traffic matching certain criteria will be detoured. Alternate paths are computed and used, similar to highway traffic alternates during rush hour. This may result in some traffic taking a few more hops than the shortest path, but with less congestion. Latency-sensitive traffic, such as voice or video, can be carried in traffic-engineered network paths that are unaffected by the rerouting.

Path Computation

In the previous example, routing decisions in the network were augmented based on additional information available at the routing nodes themselves. In other scenarios, it may be necessary to determine routing decisions according to external factors that cannot be evaluated within the routers. Subscribers and content providers may need to have control over the path their data follows once it leaves the local network to ensure that it does not traverse a network link that is less secure or results in a violation of national or corporate privacy policy. Nations often have specific laws about data privacy and security that may not match those of their neighbors. Network paths, however, don't always follow national boundaries. Some content providers, such as government or healthcare, may want to ensure that network sessions with their subscribers always remain within the country.

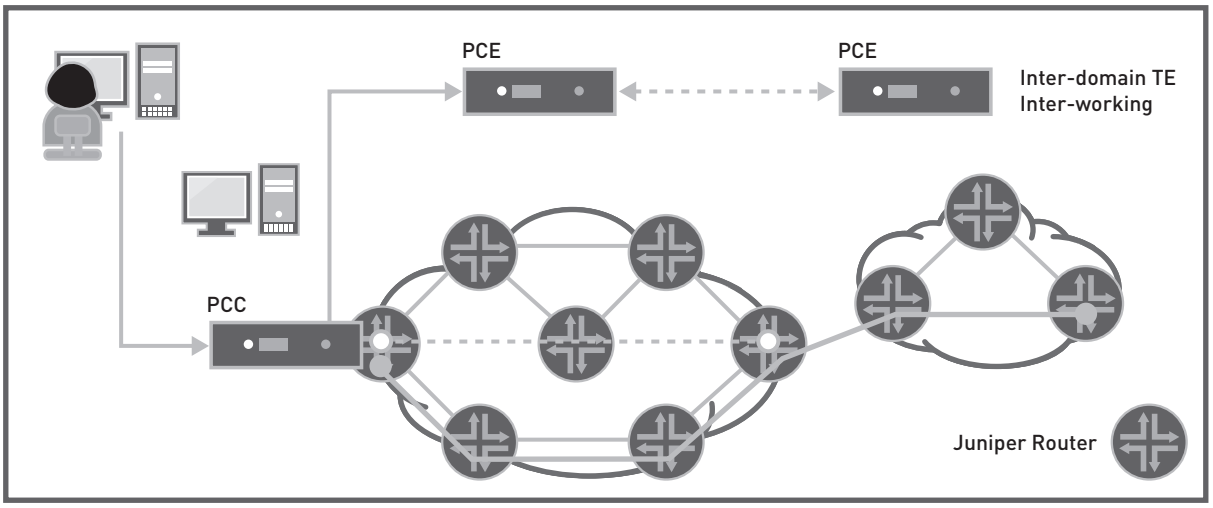

Figure 5: PSDP Example: Path Computation Client (PCC & PCE).

Using the Juniper Networks PSDP, one customer has built a path computation client that runs directly on the router. In the resulting architecture, a centralized path computation server can apply additional criteria and constraints to a routing decision, then interact with the custom Junos OS client to apply the required forwarding decision to the desired label-switched path in a fraction of a second. These criteria can include domain, commercial considerations and other external factors including the possibility of impending traffic changes, such as major weather, news, or financial activity.

This same technique can also be used to ensure the delivery of mission-critical traffic. A redundant-path Junos OS application can continuously calculate two routes between source and destination that are completely separate with no common links. Should one path become congested or cut, the other path is immediately available for a quick switchover.

Network Management

Automating network management functions is another way to reduce the cost per bit, reducing deployment times with self-service provisioning and monitoring SLAs.

SLAs are an important part of delivering business services. Not meeting a contracted service level can result in lost revenue or penalties, which may only be identified after the fact. Juniper Networks' open IP platforms make it possible to develop software agents that run within Junos OS on specific routers to actively monitor traffic flows. The customized agent first mirrors the specific traffic from the network interface to a process on the Juniper multi-services card. This ensures that the act of monitoring does not impede the traffic. The Junos OS application can then make multiple calculations on the traffic, such as packet latency, jitter, or packet loss.

When potential issues that may affect the service level are detected, the software agent can take action. Log messages can be sent to syslog or alerts can be sent to network operations center via SNMP. In addition, corrective action can be taken to change the traffic parameters of the network path or assign the traffic to an alternate path.

Improving network efficiency using open interfaces represents an opportunity for the NSP's own networking experts as well as enabling relationships with specialized third parties. Services can be customized to reflect local political and regulatory conditions. Management expertise can be codified, automated and distributed into the network. Operating efficiency becomes less dependent on any specific network vendor's offerings, which are also available to competitors, and provides an opportunity for customization and competitive advantage.

Juniper Networks Open IP Development Programs

Juniper Networks open IP development partner programs facilitate the creation of new applications or service capabilities that build differentiation into the network at the packet, application and policy layer. These programs provide the tools and technical consultation support for network providers, content providers and third-party developers to partner and expand their business.

Juniper Networks Open IP Service Creation Program supports application development for Juniper Networks identity and policy management solutions. Program participants can utilize standards-based, open interfaces to create new, innovative IP services and service management applications for the Juniper Networks SRC Series and

SBR Series products. Multiple program tiers support the development of a basic "proof-of-concept" functionality through to the development of more advanced production-level solutions by NSPs, independent software vendors (ISVs), or systems integrators (SIs).

Juniper Networks Open IP Solutions Development Program supports the development and deployment of applications on Junos OS using the PSDP. Customers or third parties selected to join the program must have a base level of networking and software engineering experience, and a specific targeted application. Juniper Networks provides program participants with both technical and business support for their development activities.

Conclusion

Transforming the NSP business model is necessary and inevitable. Network providers who are embracing open IP networks are better positioned to compete through service customization, rapid adaptation, and content and application ecosystems. Juniper Networks offers intelligent open IP networking functionality at different levels of the network, providing the flexibility to support new, customized business models. Advanced network functionality, achieved via communications between the network and content/applications domains or via integrated network/router-based applications, enables NSPs to generate new partnerships. Value can be enhanced and captured in a way that is most appropriate to the content/application supplier and the end subscriber. Rapid development and deployment makes it possible to experiment with a variety of tactics. The scope of the business can grow and change depending on the desired strategy and available resources.

The Internet has facilitated the creation of a broad and unpredictable set of content and applications. Much of this innovation has happened outside of the NSPs' network, supported by open computing platforms and application interfaces. Extending this openness and application computing power to the NSPs' infrastructure gives the NSPs powerful tools of innovation to create new services, new business models and new user experiences while also offering new levels of operational control and efficiency.

Juniper Networks offers customizable, open products and supporting partner programs that give NSPs opportunities to enhance content delivery and connect services that capture value from their network, or improve operating efficiency to reduce costs and enhance profitability. No longer bound by the features and development priorities of an end-to-end network, NSPs have entered 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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