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Gi and NFV: Low-Friction Service Selection and Innovation

How the service edge can help operators add value to their networks with SDN and NFV

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About the author

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Area of expertise: IMS, mobile access network technologies, femtocells, backhaul, network APIs.

"As LTE is being deployed throughout the world, mobile operators are finding it hard to strike balance between network investments, new pricing schemes' and increasing traffic. Several initiatives are being deployed, including capacity upgrades, optimization, offload, and policies to tackle all of these challenges."

Dimitris Mavrakis is a principal analyst with Informa Telecoms & Media. He is part of the Networks team where he covers a range of topics including Next Generation Networks, IMS, LTE, WiMAX, OFDM, core networks, network APIs and identifying emerging strategies for the mobile business.

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Introduction

The telecoms market is changing. Several tectonic shifts are happening at the same time, some threatening, and some offering new opportunities for established players. Services, competition, technology, and business models are shifting, driven by the rapid growth in OTT applications and cloud-based service models.

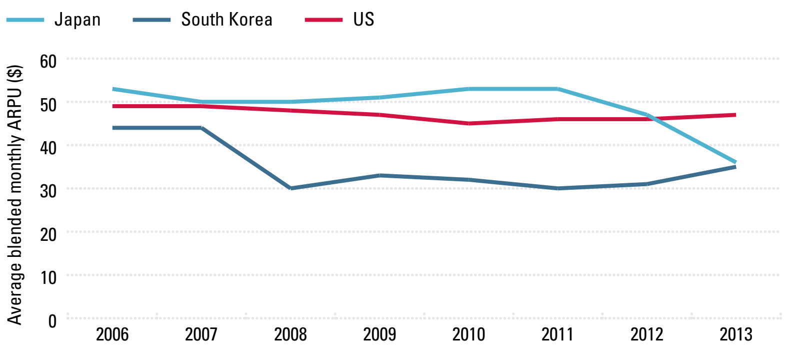
Mobile service revenues have traditionally relied on access, mainly voice, SMS, and, most recently, data. The challenge for operators is to find a sustainable and profitable business model in the face of shifting customer perceptions of value, the commoditization of traditional mobile revenue, and the need to continually invest in higher speed infrastructure.

The challenge is increased for telecoms operators that have invested massively in new LTE networks: LTE is the first purebred data-access technology and it puts increasing pressure on the operators to find new business and revenue models. Ultimately, service providers need a flexible service enablement platform that enables them to enable new capabilities and features quickly, and at a low cost. Then they can begin to move beyond access, speed, and coverage to offering differentiated services which add value for their subscribers.

LTE – the service driver?

As LTE network deployments progress, mobile operators are getting accustomed to operating a true IP data network. According to Ovum's World Cellular Information Service, 50% of global GSM operators have launched LTE, while the early technology adopters are now operating LTE at its full commercial capabilities. Verizon Wireless in the US, NTT DoCoMo in Japan, SKT in South Korea, EE in the UK, and several other leaders are now assessing the viability of new business models, seeking to create more value for their subscribers while also ensuring that their networks provide a considerable return on investment without relying solely on access revenue. The mobile ARPU levels in Japan and South Korea have been consistently dropped since 2008, but the US has maintained a fairly steady ARPU over the same period (see Figure 1). As no killer application has emerged for LTE as of 3Q14, it is interesting to see how mobile network capex and service revenues have evolved over the past few years and how Ovum expects these to trend in the future.

Figure 1: ARPU in the US, Japan and South Korea, 2008-13



Source: Ovum

LTE services and revenues

The largest percentage of mobile network capex has depended on LTE network rollouts in the past two years and LTE still drives the infrastructure market. As only half of the world's mobile operators have deployed commercial LTE services and all mobile network technologies will converge on LTE, it seems as if the market evolution of LTE is experiencing its "middle age" when some mobile operators have deployed services and have found out – often the hard way – what works and what doesn't.

While investing in LTE has taken the largest percentage of mobile network capex, the opportunity to profit from the upgrade has been elusive.

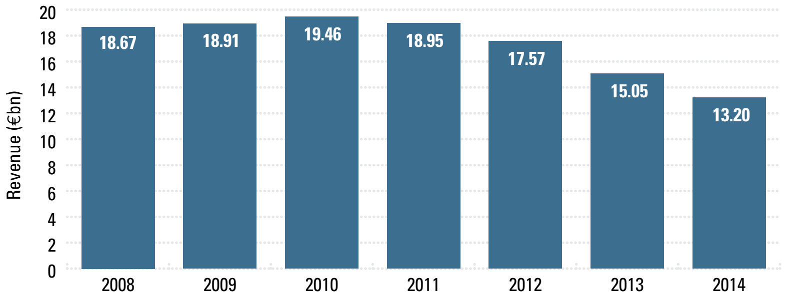
France is a particular – and brutal – example of market forces at work. In October 2012, Orange France executives stated publicly that LTE would command a premium and that customers were willing to pay for higher speeds. By December 2013, Orange had included LTE access in one of its medium-tier pricing plans worth €24.99 ($32) per month without any differentiation from HSPA. It is clear that there is no long-term price premium for speed.

The second lesson from the French market came with the emergence of Free – the disruptive entrant in the mobile market. When Orange claimed in April 2014 that data-access prices had reached "floor level" in France, Free was able to drop the price even lower. As a result, mobile service revenue in the French market has fallen by an astonishing 32%, from €19.4bn in 2010 to an estimated €13.2bn in 2014 (see Figure 2).

Although other mobile markets have not yet experienced the same fate, it may only be a matter of time before they all become fiercely competitive and prices – and, as a result, revenues – fall.

There are several service trends in the market that are likely

Figure 2: France, mobile services revenue, 2008–14



Source: Juniper, regulatory filings

to help operators maximize profitability for these new networks, including:

- **App-based or freemium pricing**: These include prepaid bundles that allow unlimited access to a specific application, the most prominent is Facebook. Social networking, music streaming, and instant messaging are a few examples with which app-based pricing has allowed operators to increase data access in emerging markets. A freemium model may offer "normal quality" content for free and charge extra for higher quality.
- **Wholesale data**: This is effectively a two-sided business model, where the operator charges third parties, for example content providers, for data access. An example is AT&T's toll-free data, and it may apply to premium/paid video delivery services like Netflix.
- **Bundling**: Hybrid operators are in a position to bundle mobile, fixed, TV, and Web services to increase revenues. Operators in developed markets can also bundle both access (DSL) and content to increase their footprint in the home environment.
- **Small cells**: Operators are deploying mixed-technology access networks that include a mixture of cellular and Wi-Fi, bringing the access point nearer to the subscriber and opening up new types of services. These may include Augmented Reality, virtual reality or applications that require very low latency, e.g. automotive.

These new business models are currently powered by a variety of technologies and frameworks and the same service may be powered by a completely different set of enablers in separate networks.

Regardless of these early implementations of relatively innovative services, operators are in need of a service framework that enables them to innovate quicker, fail faster, and partner with third parties much more easily. All of these need to be enabled by a telco service framework, which will provide a single consistent point of entry for new services.

Telco service framework

A telco service framework needs to be a friction-free, cost-effective platform that enables new services in the network. Although several telecoms-specific initiatives have been discussed in the past, none have been as successful as originally planned, especially IMS and the Wholesale Application Community (WAC). However, competition from the Web-service companies is now demanding that telecom operators are more agile and quick to market. In fact, the Web world can provide lessons for telecoms operators, which are, in a way, following their Web competitors' lead in service enablement.

Personalization and service customization

Consumers expect, now more than ever, a customized experience in every aspect of their lives. Starbucks claims there are 87,000 unique drink combinations available to their customers, and there are over 1.2 million applications available in Apple's iTunes store.

The opportunity for mobile providers is to move beyond access and small, medium, and large data buckets. They should create **value** for their subscribers by customizing and personalizing the mobile data experience. Differentiation and customization translates into increases in customer loyalty, trust, and a willingness to buy or try new capabilities.

Mobile networks are a treasure trove of information. As service providers dig in and understand the value of their data, it's clear the infrastructure and service delivery platforms do not have the agility to react in real-time to changing consumer requirements.

Learning from Web services

Web-service pioneers have emerged from basements, garages, and small offices to become companies that are challenging telecoms giants and causing them great distress about their future. So it is interesting to consider what these pioneers have used to enable their services and how these platforms have evolved.

At every stage, agility has been the biggest driver behind infrastructure decisions, especially as early Web business models have been based on free or freemium options. The ability to scale quickly, adapt services in real time, and carefully manage cash-flow and investments (capex) has led to innovation at a breakneck pace.

Web services companies are relentless about mining network and consumer data and acting upon the findings. Features and capabilities are added, monitored, and then either adopted or dropped in a matter of weeks. For example, in the first nine months of 2014, Amazon Web Services released over 200 new features , that's nearly one per day. These are not major functional changes, nor are they all billable, but, when contrasted with the typical 6-18 month innovation cycle of a traditional telecoms provider, it is clear that a new model is required.

Mobile operators are still in their first stage of evolution, relying on proprietary platforms. The industry is attempting to move towards software-driven architectures, to some extent following in the footsteps of the cloud service model already tried and tested by their Web-service competitors.

Technologies to aid network monetization

A handful of network technologies are now being discussed in the industry (see Figure 3).

Most technologies that will result in considerable business opportunity are expensive to deploy in the telecoms operator's network. For example, Big Data and analytics require the consolidation of

Figure 3: Selection of technologies to help network monetization

Technology	Details	Service opportunities	Cost to deploy	Cost driver
Big Data	Using analytics to understand customers and use data internally and externally	High	High	IT integration
CEM	Improving customer experience and making customer support more effective	Medium	Medium	Culture and business processes
NFV	Virtualizing network components for a more scalable and flexible network	Low to high	Low to high	IT platforms and software licensing
SDN	Software and centralized control for traffic switching/ routing	Medium to high	High	Infrastructure and controller

Source: Ovum

databases, which is often an expensive IT exercise. Customer experience management (CEM) requires a paradigm shift and a cultural reboot of support workflow, apart from the underlying infrastructure. Both of these technologies represent a very desirable improvement on current mobile services but are a major challenge to deploy.

Due to its ability to automate manual actions and network moves/adds/changes, SDN is also an enabler for many new services (e.g. software VPN for the enterprise). Depending on the SDN approach (OpenFlow, OpenDaylight, overlay networking ….), it may require "forklift upgrades" of existing routers/switches that are unable to support these protocols.

Network functions virtualization (NFV) is a new architectural framework that uses a common, generic pool of hardware resources for software applications. This paradigm shift decouples software applications from hardware platforms, enabling the service provider to rapidly scale up or scale out an application's capacity cost-effectively.

At the moment, if an operator decides to replace working infrastructure with virtualized, it is going to spend considerable capex and effort to do so, without any immediate service or revenue opportunities. Despite this, it is this evolution that is the foundation for new service innovation.

Today there are network locations where NFV will provide an easier route to new services: These are the prime focus of the ETSI NFV discussions and include customer premises equipment (CPE) and service chaining in the SGi interface.

Value – the third investment variable

For many service providers, the high cost of implementing change or adding functionality to the network has forced a draconian business case decision model. Network investments are bucketed into 'revenue drivers' and 'cost savers'. Without a clear case to show a return on investment, either through revenue upside or direct cost savings, it is very difficult for service providers to implement network change.

By lowering the cost barriers (time, capital) of implementing new functionality, service providers will be able to begin to address value-based investments. Application-specific and zero-rate pricing is a good example: As the cost barrier to apply zero-rating to specific services has dropped, service providers have been able to use this as a lever to introduce a new level of value – and service customization – to their subscriber base.

> The focus on 'business model first, user experience second' has often put telco... services at a disadvantage... For consumers, experience is the product.
>
> Amazon

To remain competitive, particularly as voice, SMS, and data access continue towards commodity, mobile providers must continue to differentiate through targeted, user-specific features, and capabilities.

SGi: Service opportunities at the service edge

Although there are several areas where service innovation can be introduced in the mobile network, there are only a few where innovation may be introduced in a cost-effective manner. An early NFV adopter may choose to replace existing equipment with virtualized infrastructure and offer services that are ahead of competition.

On the other hand, the deployment of several virtualized components may cost more than proprietary appliances, which may also be powered by custom hardware, particularly when customized software programs are considered for automation and service orchestration. Although network virtualization may be the long-term evolution of any telecoms network, financial restrictions may not allow its deployment in all parts of the network.

As discussed above, there are network areas where virtualization is expected to lead to considerable service opportunities and provide the ground for innovation. ETSI NFV has identified two immediate areas: virtualized CPE; and the SGi interface in 3G and LTE networks.

Innovation at the service edge: The SGi interface

The mobile network is described by a relatively well-documented and standardized architecture. 3GPP specifications have guided the industry for more than 15 years and the standards for LTE network infrastructure are no different. While 3G networks partly rely on network components that include proprietary interfaces, operators demand that vendors conform to 3GPP specifications so that multi-vendor networks are possible. As such, network equipment, and particularly the EPC framework, is now heavily standardized by formal specifications, which have moved the market past proprietary interfaces. Despite being comprehensive, 3GPP specifications have focused on what operators needed at the time: well specified standards focusing on network operation, which in a way has not allowed any room for innovation.

Figure 4: Innovation in mobile network domains

Network area	Innovation	Cost to deploy virtualization
Access network	✓	✓✓✓✓✓
Core network	✓✓	✓✓✓✓
Interface to public networks	✓✓✓✓✓	✓

Source: Ovum

The SGi interface in 3G/LTE, which signifies the demarcation point between the 3GPP-prescribed Evolved Packet Core (EPC) and the public IP network, is a very suitable area for service innovation.

Although virtualized EPC is also being discussed as a target for NFV, its heavy specifications are likely to focus on cost reduction rather than service opportunities. On the other hand, the SGi interface is more relevant because:

- As most services and applications now rely on the public Internet, the SGi interface can be perceived as a service gateway.
- Traffic through the SGi interface can be identified by the user IP, making user and service differentiation possible.
- There is less 3GPP formality in the SGi LAN versus the EPC where interfaces and functionality are well structured.

The SGi interface is less moderated by standards and is actually a reference point described as an IP interface. It is considered an easy point of entry for value-added services without needing applications to be aware of the internal EPC interfaces, making innovation opportunities easier to achieve. But, in order to understand the possibilities, it is interesting to identify what services could be possible, especially when combining network information with virtualized infrastructure in the SGi interface.

Monetization opportunities at the service edge

The SGi interface can be regarded as a key enabler for new services. When it is coupled with network analytics (e.g. based on insight gained using techniques such as deep packet inspection (DPI), a mobile operating system, service, or even individual user may be identified and treated separately. While DPI and the associated analytics have been available for some time, mobile providers have only been able to capture a fraction of the value due to limitations in infrastructure agility.

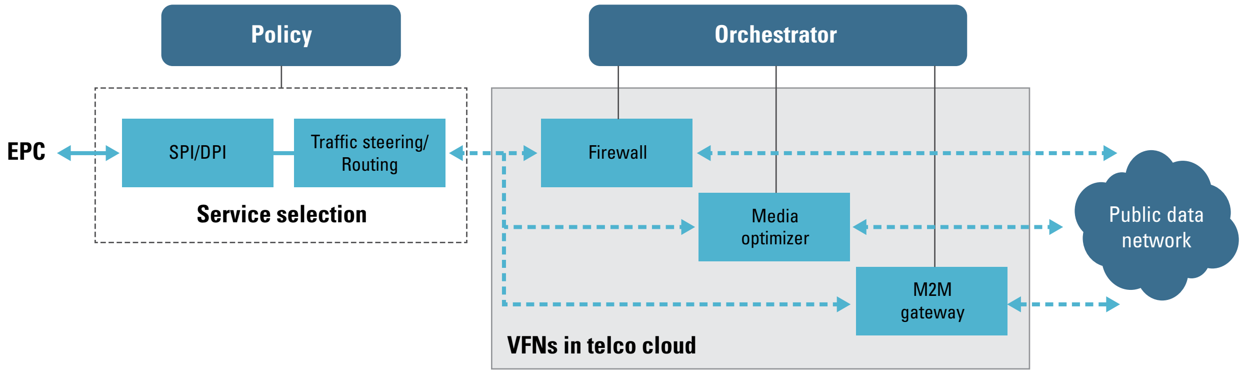
Combining subscriber/device/application insights with policy and granular traffic steering creates actionable network intelligence that can be used to customize a service experience based on a range of insights. With dynamic, policy-based service selection, mobile service providers can begin to combine customer insights with usage/device information and network services to create unique experiences.

Some services that could be enabled are:

- **Video/sports enthusiast**: Run all streaming video through a cache/optimizer and adapt access network to gain added bandwidth. Detects activities and creates real-time upsell opportunities, targeted at sports fans. Premium video delivery services (e.g. NetFlix, Amazon Prime) may contribute to a two-sided business model to ensure optimized content delivery. Football or sports clubs may also be a part of this example as well.
- **Personal security**: Beyond firewalling, enables an antivirus engine and routes all traffic from infected devices through it. Combine with IPS/IDP and URL filtering to offer secure Web browsing and email. Users may be notified and offered a freemium or paid virus protection subscription. Easy to target at families wanting protection from harmful content or sites.
- **Social media optimizer**: Beyond zero-rating traffic, the network can overlay an optimization function for popular social media services, targeting basic service plans to reduce the resolution of videos and pictures and save bandwidth. Alternatively, the service provider can optimize all traffic by default, and then offer a paid "premium" version with higher-resolution photos and videos.
- **M2M traffic**: Traffic originating from machines may be identified and expensive processing elements may be bypassed. The same traffic may be routed through a special service which is specific to M2M/IoT.
- **Smartphone control**: Traffic originating from specific operating systems or even devices may be directed through specific service gateways, customizing the user experience. A better experience for high spenders or blocking traffic to devices that are network offenders.
- **Enterprise security**: Traffic originating from smartphones and tablets that belong to bring-your-own-device (BYOD) schemes may be identified and routed through security appliances. This will allow enterprise IT services to control employee services better while not restricting BYOD schemes.
- **Cloud-managed CPE**: With the advent of LTE, mobile providers have an access network with characteristics similar to fixed-line broadband networks. By harnessing the power of NFV/SDN, they are able to address the small-to-medium business (SMB) market with low-cost LTE network interface devices, and provide value-added services as virtual objects from the network. Through automation and customer self-service portals, mobile providers can deliver a differentiated service that measures time-to-service in a matter of hours.

The opportunity in these examples is clear; the challenge is to enable them in a cost-effective manner. NFV is now allowing the easier introduction of these services and the creation of an environment that may allow both faster innovation and a faster "ability to fail." Although this may be considered as a paradox, success comes from failing several times. This is well understood in the Web domain,

Figure 5: Service edge framework, SGi interface



Source: Ovum

where successful companies often pivot several times before reaching millions of users and large service providers have developed dozens of products or services from which only a few are successful. The use of a cloud-services model means that new service opportunities can be explored with low barriers to entry, meaning that extensive business-case modeling and sensitivity analysis is less likely to be required. If the service opportunity is not viable, the service can easily be decommissioned and infrastructure reused for the next opportunity with low incremental costs.

The telecoms domain should be no different but the ability to fail faster will only come if services can be developed in a matter of days or weeks. Today, telecoms operators cannot afford to fail if service development takes years, which makes the decision to develop a new service much harder. Faster service creation and destruction is a key priority for telecom operators currently, making NFV the most important network concept.

Nevertheless, NFV on its own does not guarantee service innovation. But using NFV in an intelligent manner at the service edge may create all the new service – and revenue – opportunities discussed above.

The NFV service edge

The NFV service edge consists of four network components: DPI, traffic steering, policy, and orchestration. As illustrated in Figure 5, the operation of the EPC is not disrupted when new services and the virtual network functions (VNFs) for the new services are introduced. This introduction also does not disrupt existing legacy – and virtualized – services.

Granular service selection can be achieved by combining DPI insights with a traffic-steering function. When driven by policy, service providers can identify and steer traffic into unique service paths. Virtualization can allow for the inspection of all traffic, allowing for more granular decisions in the service edge.

The proposal shown in Figure 5 may be a key component of what is now being identified as the "telco cloud." The SGi interface is a fertile environment for service innovation and a private cloud may ensure this network domain remains flexible and scalable.

Conclusions and recommendations

Operators are continuing to invest in LTE rollouts but still need to find ways to monetize the previous access-based business models. NFV is a new architectural approach to building and deploying services in the network which can significantly improve agility, flexibility, and scalability. However, NFV does not, by itself, guarantee service innovation in a cost-effective manner. Deploying NFV at the service edge, coupled with a powerful routing platform and packet inspection will allow telecoms operators to create an environment that will foster service innovation.

At the moment, telecoms operators are largely focusing on cost savings to drive NFV deployment, which means that capex plans are not disrupted and virtualized appliances will only replace equipment that has reached the end of its life. New service and revenue opportunities in the service edge may provide a much needed revenue injection in a financially challenging environment.

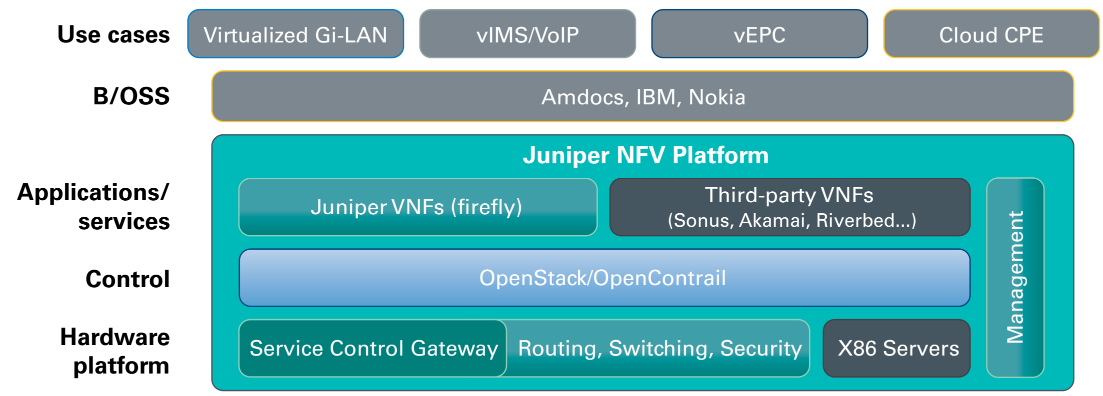
Juniper NFV Platform

Juniper's NFV Platform offers a secure, policy-driven, Telco-grade solution which seamlessly blends both physical and virtual service functions:

- **Open**: The foundation of Juniper's approach to NFV is to provide an open ecosystem. By selecting and building from open source components (OpenStack, Open Contrail), and partnering with third party network functions (Sonus, Checkpoint, Sandvine, Akamai, Guavas,...) Juniper is working hard to ensure maximum flexibility for service providers as they build out their NFV systems.
- **Secure**: Juniper's NFV Platform architecture offers unmatched security—both horizontally and vertically. With virtualized security objects, service providers can become surgical with the placement of security within the NFV data center, providing specific protections to individual network elements.
- **Policy Driven**: Juniper leverages existing policy engines combined with powerful DPI capabilities to dynamically steer traffic to the appropriate service chains, providing maximum control and flexibility.
- **Telco Grade**: The new NFV Platform must meet the responsiveness and uptime requirements of traditional Telco deployments. Juniper's NFV Platform is designed with integrated physical and virtual reliability, and includes system level reliability with distributed load balancing and comprehensive system analytics. Contrail's analytics engine monitors the health and performance of virtualized network objects, using native load balancing to quickly identify, isolate, and restart or repair unresponsive nodes.

To accomplish this, Juniper Networks provides a complete product portfolio for building the NFV Platform architecture platform.

Figure 6: Juniper NFV Platform ecosystem



Source: Juniper Networks

Hardware Platforms

Juniper's wide range of industry-leading routing, switching, and security products provide a solid NFV foundation.

The Juniper Networks® MX Series 3D Universal Edge Routers provide the ideal gateway for NFV Platform architecture. Each cloud architecture (or NFV system or telco cloud data center) must interface with the physical transport network, and the MX Series' ability to bridge the physical and virtual network environments is unparalleled.

The MX Series also supports interfaces to a range of existing policy engines, including Policy and Charging Rules Function (PCRF) and authentication, authorization, and accounting (AAA). The MX Series interfaces to the online charging system (OCS) within a mobile network; combined with DPI/TDSF, the MX Series performs a Policy Control Enforcement Function (PCEF), directing traffic on a per-flow basis into customized service chains.

Juniper's Service Control Gateway (SCG), built on the MX platform, includes L4-7 DPI and 3GPP Traffic Detection Functionality (TDF). By combining traffic classification and subscriber identification with routing and policy, the SCG functions as a highly efficient NFV Service Edge directing traffic in unique service paths.

Additionally, Juniper Networks EX Series Ethernet Switches and QFX Series switches deliver carrier-class, high-density, and high-performance platforms that are ideal for scaling a telco cloud.

Multilayer, multidomain security is critical for a telco cloud deployment, and Juniper Networks SRX Series Services Gateways for the high end have the capacity and scalability to protect the largest data centers. In addition, Juniper's virtualized security objects can be deployed throughout virtualized network functions to provide protection between network elements.

Control

Contrail, Juniper's NFV/SDN network virtualization and control solution, dramatically extends the power of the OpenStack framework by simplifying the process of creating virtualized networks and service chains. The controller, a redundant software service with RESTful APIs, contains an analytics engine that provides detailed reporting of the performance and health of the virtual network. The full version of Contrail is available as an open source Apache licensed distribution from www.OpenContrail.org.

Contrail interfaces into OpenStack as a Neutron plug-in. OpenStack is a proven, open approach to orchestration. Juniper offers an OpenStack distribution, integrated with Contrail, as a convenient package for network function orchestration. Juniper also supports OpenStack distributions from leading providers (RedHat, etc.).

Applications and Services

Juniper provides several security-focused virtualized network functions (VNFs) such as Firefly Perimeter. Juniper's application firewall, Firefly Perimeter can be used to protect between VNFs—for example, between evolved packet core (EPC) and IP Multimedia Subsystem (IMS) functions—as well as to provide a virtualized firewall service direct to consumers and small business.

Likewise, the new DDoS Secure appliance can secure critical network functions such as domain name system (DNS) and can be deployed as a physical or virtual application.

Most importantly, Juniper supports both virtualized and physical network functions from third-party providers. With support for KVM, ESX, and Xen, Juniper's NFV Platform supports a broad range of hypervisors. Juniper has tested/validated with Sonus, Checkpoint, Sandvine, Riverbed, Akamai, Guavas, and many others.

Management

Juniper Networks Junos® Space Network Management Platform provides an open, programmable framework for managing both the physical and virtual network elements of a telco cloud. Junos Space provides standard fault, configuration, accounting, performance, and security (FCAPS) for hardware elements. And as a platform, it supports applications developed to manage the configuration and provisioning of virtual network elements like Firefly Perimeter.

In addition, Juniper's open framework can interface into B/OSS systems from companies like Amdocs, IBM, and Nokia.

Distribution

Beyond physical components, one of the key elements of Juniper's NFV Platform architecture is the ability to geographically distribute capabilities based on performance and customer requirements. Traditional telco clouds are deployed in large, centralized data centers; however, while it is true that many network functions benefit from a centralized deployment as the number of subscribers grows and connections evolve into things rather than people, there emerges a need to push functionality closer to the subscriber edge. Caching, security, and even subscriber access can benefit from being deployed in small, more disbursed locations.

ABOUT OVUM

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