

ALCATEL-LUCENT IP MOBILE CORE

EMBRACING A NEW ERA OF MOBILE BROADBAND

TECHNOLOGY WHITE PAPER

The game has changed in mobile networking. The industry is rapidly embracing all-IP networks, as demonstrated by the voracious worldwide adoption of long term evolution (LTE). Mobile network operators (MNOs) therefore have many challenges because their legacy networks must evolve to handle massive data growth and unpredictable signaling requirements. Increasingly, MNOs must also tailor services to the demands of millions of subscribers and their individual mobile lifestyles. At the same time, the transition toward new virtualized, cloud-based solutions is transforming how MNOs design and deliver consumer and enterprise services. Combined, these challenges provide an incentive for MNOs to reconsider their mobile packet core network design and to choose an approach that is optimized for the delivery of next-generation mobile broadband services.

MNOs that have implemented the right solutions and have chosen the right partners can take advantage of these shifts to unlock new revenue opportunities while bolstering their subscribers' loyalty and experience. This paper describes the Alcatel-Lucent IP Mobile Core as an enabler for MNOs worldwide to tackle these challenges and succeed in the new mobile broadband generation.

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LTE, THE NEW REALITY FOR MOBILE BROADBAND

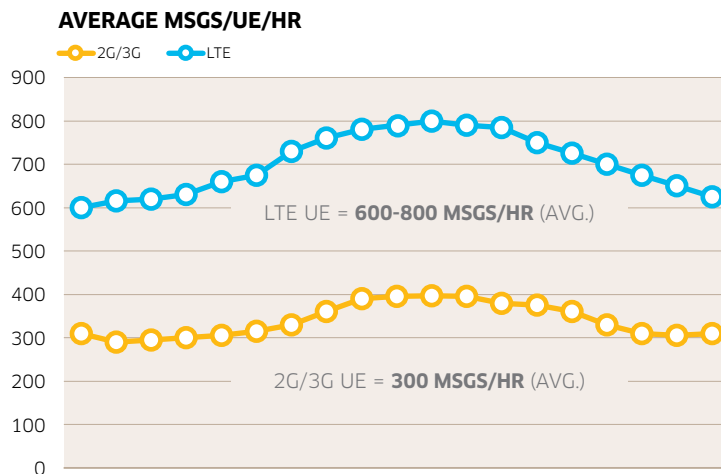
We are seeing a major shift in the mobile broadband market. Mobile network operators (MNOs) are increasingly making the move to long term evolution (LTE) for faster speeds, lower latencies, and flatter, simpler, all-IP networks that are more cost-effective to operate. A recent Global mobile Suppliers Association (GSA) report shows that LTE is taking off, with 474 operators currently investing in LTE in 138 countries.¹ Moreover, Alcatel-Lucent has analyzed LTE trends with actual customer data in the North American market for 2013.² The study found that, on average, the number of active LTE subscribers increased by 20 percent per month, and LTE data volume increased by 31 percent per month.

Implications of LTE for MNOs

The Alcatel-Lucent study also implies that the amount of LTE per-user traffic will become much higher. This phenomenon will have significant impact on the data-processing capabilities of packet core elements, such as the Serving Gateway (SGW) and Packet Data Network (PDN) Gateway (PGW). The packet core elements will need to support a huge increase in the number of users and connections as well as to process an ever-increasing number of packets per user.

Signaling requirements will also be much higher in the LTE Evolved Packet Core (EPC) compared to the 2G/3G packet core. Mobility management functions in LTE networks shift exclusively to the EPC Mobility Management Entity (MME), and the use of applications and services increases with more capable networks. For example, Figure 1 shows User Equipment (UE) messaging growth for LTE networks compared to 2G/3G networks over a typical day. Based on an analysis of real LTE networks, LTE networks handle more than twice the messaging of 2G/3G networks.

Figure 1. Hourly signaling increases in LTE networks



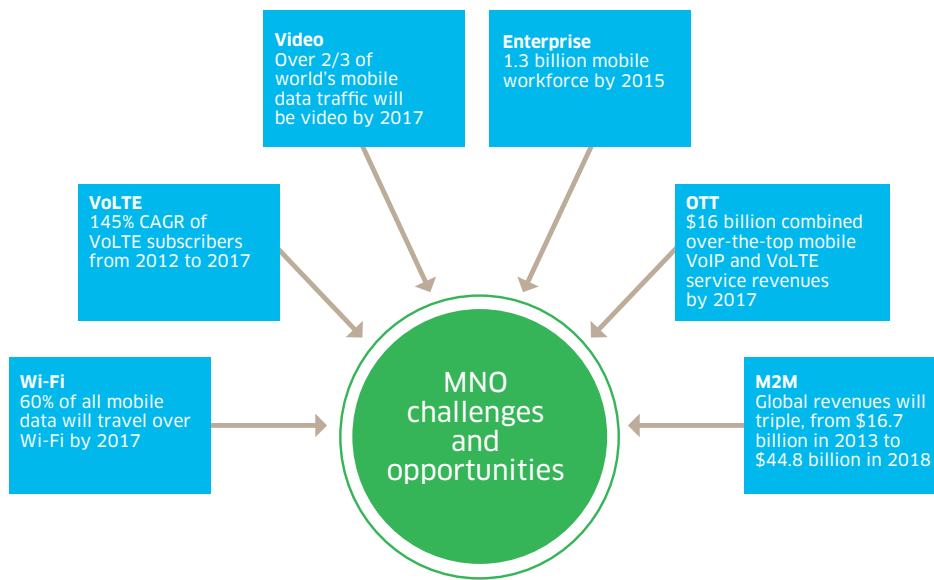
1 Global mobile Suppliers Association, *Evolution to LTE report: 175 commercial LTE networks launched in 70 countries; 100 launched in past year*. May 2013. http://www.gsacom.com/news/gsa_376.php
2 Alcatel-Lucent (Patrick Tan, General Manager, Network Intelligence), *2013 insights: real proof that 4G speed brings consumers, content and cash*. January 2014. <http://www2.alcatel-lucent.com/blogs/corporate/2014/01/2013-insights-real-proof-that-4g-speed-brings-consumers-content-and-cash/>

New service demands and opportunities

Service demands are forcing MNOs to deliver data services that more closely match their subscribers' particular lifestyles and performance expectations and to transform their broadband data and service offerings. With new services, MNOs also have an opportunity to offset decreased revenues from their legacy voice and Short Message Service (SMS) services.

As shown in Figure 2, several emerging service trends are providing opportunities for MNOs to reconsider their mobile packet core network designs and to choose approaches that are optimized for the delivery of these emerging mobile broadband trends. These trends also reflect opportunities for MNOs that are equipped with the proper service-orientated packet core to generate new revenue while increasing Quality of Experience (QoE) for their subscribers.

Figure 2. New service demands for the next generation of mobile broadband



Addressing new service demands with EPCs

New service demands all require intensive processing at the heart of MNO networks: the packet core. In the packet core, specific data connections are dynamically set up, defining each subscriber's unique service requirements — for example, flow identification, filtering, redirection, Quality of Service (QoS), charging, accounting, reporting and billing.

The data connections and associated requirements must be created across millions of subscribers and devices in real time. Reacting to these new demands, MNOs are planning to rapidly upgrade or renovate their existing packet core to implement new EPCs. Infonetics Research forecasts that cumulative EPC revenue will increase to \$8 billion³ by the end of 2017.⁴ This makes a lot of sense for the MNO: a recent Alcatel-Lucent Bell Labs study indicates that MNOs that start to deploy LTE now will ultimately realize a 57 percent lower cost per bit than MNOs that grow their 3G network and deploy LTE later.⁵

However, not all EPCs are created equal, and those that are not specifically designed for these new service demands are at risk of delivering poor subscriber performance while increasing OPEX and CAPEX.

³ All dollar amounts are in US dollars.

⁴ Alcatel-Lucent, *Destination LTE Express*. <http://resources.alcatel-lucent.com/?cid=171329>

⁵ Ibid.




ALCATEL-LUCENT IP MOBILE CORE

As a high-performance, scalable and highly reliable EPC, the Alcatel-Lucent IP Mobile Core has been optimized from inception for the delivery of the next generation of mobile broadband services⁶. The IP Mobile Core also represents the converged packet core for all radio technologies, including 2G/3G/LTE and Wi-Fi*.

With the IP Mobile Core, MNOs can ensure the highest QoE while reducing total cost of ownership (TCO). The IP Mobile Core is specifically designed for the current extreme increase in the number of users, devices, and applications while supporting the next generation of mobile data and signaling growth driven by new service demands.

Unique values of the IP Mobile Core

The IP Mobile Core is built on three key values: service delivery, seamless experience and scalable growth.

	<p>Service delivery</p> <p>The foundation of the IP Mobile Core is the uncompromised delivery of mobile broadband services across all wireless access technologies, including 2G, 3G, LTE/4G and Wi-Fi. The IP Mobile Core is unique because its enhanced data-processing capabilities, advanced mobility-management features and flexible, easy-to-use policy-creation environment have all been designed to handle demanding and unpredictable traffic from a variety of services.</p>
	<p>Seamless experience</p> <p>With the IP Mobile Core, MNOs can ensure that subscribers receive a seamless, persistent and secure mobile broadband experience across all access methods (2G/3G, LTE or Wi-Fi). Subscribers can enjoy their mobile broadband experience “on the move” without interruptions or security concerns and without being aware that they are accessing services from various technologies.</p>
	<p>Scalable growth</p> <p>The IP Mobile Core and its components are designed for scalable growth and uncompromised performance with LTE and beyond. Today’s mobile broadband services are moving from fitting into best-effort pipes to being delivered on their own dedicated connections that are reserved for each service, each with specific QoS and charging requirements. Whether deployed in a traditional or virtualized cloud environment, the IP Mobile Core is designed to scale across these conditions.</p>

⁶ Alcatel-Lucent IP Mobile Core. <http://www.alcatel-lucent.com/solutions/ip-mobile-core>

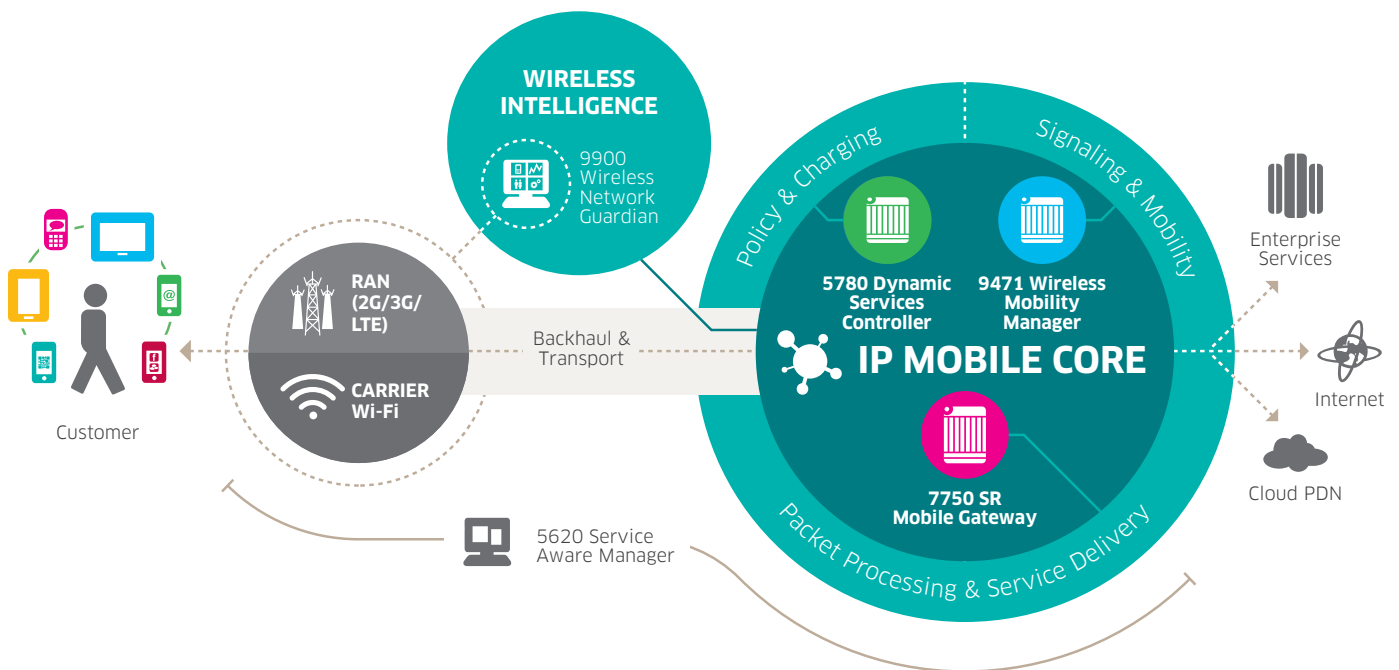
IP Mobile Core architecture

The IP Mobile Core comprises an ecosystem of pre-integrated components that are also compatible with third-party components. The core components are:

- Alcatel-Lucent 7750 Service Router (SR) Mobile Gateway⁷
- Alcatel-Lucent 9471 Wireless Mobility Manager (WMM)⁸
- Alcatel-Lucent 5780 Dynamic Services Controller (DSC)⁹

The elements that support the core components of the IP Mobile Core are the Alcatel-Lucent 9900 Wireless Network Guardian (WNG)¹⁰ and the Alcatel-Lucent 5620 Service Aware Manager (SAM)¹¹. Figure 3 shows the complete IP Mobile Core architecture.

Figure 3. Alcatel-Lucent IP Mobile Core architecture



7 Alcatel-Lucent 7750 Service Router - Mobile Gateway.
<http://www.alcatel-lucent.com/products/7750-service-router-mobile-gateway>
 8 Alcatel-Lucent 9471 Wireless Mobility Manager.
<http://www.alcatel-lucent.com/products/9471-wireless-mobility-manager>
 9 Alcatel-Lucent 5780 Dynamic Services Controller.
<http://www.alcatel-lucent.com/products/5780-dynamic-services-controller>
 10 Alcatel-Lucent 9900 Wireless Network Guardian.
<http://www.alcatel-lucent.com/products/9900-wireless-network-guardian>
 11 Alcatel-Lucent 5620 Service Aware Manager.
<http://www.alcatel-lucent.com/products/5620-service-aware-manager>

7750 SR Mobile Gateway

The 7750 SR Mobile Gateway provides combined LTE PGW, Gateway General Packet Radio Service (GPRS) Support Node (GGSN), and SGW network functions. The 7750 SR Mobile Gateway is based on the industry-leading 7750 SR and the feature-rich Alcatel-Lucent Service Router Operating System (SR OS).¹²

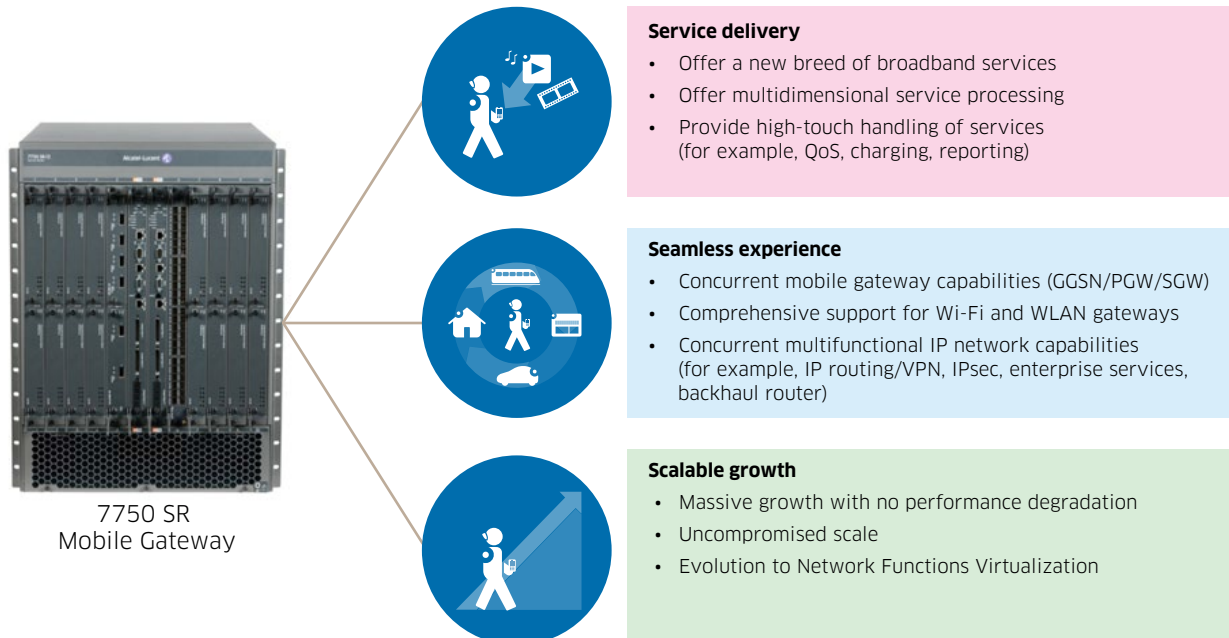
The PGW/GGSN represents the IP anchor point of the subscriber's connection. It provides the entry and exit points of traffic from the mobile provider's network to the UE (the user's mobile device). The PGW/GGSN also represents the service edge of the mobile provider's network, where much of the packet processing is performed. PGW/GGSN functions for each UE and each service include:

- Creation and termination of bearer channels
- Packet inspection and filtering (determination of the appropriate bearer channel based on the type of service/application)
- Policy enforcement (QoS and charging support assigned to each bearer as defined by the user's individual package)
- Accounting and reporting

The SGW is critical to the user's mobility. Like the PGW, it routes and forwards user data packets through the bearer channels. The SGW also represents the mobility anchor, ensuring that packets are continuously delivered even if the user changes location.

Figure 4 lists key 7750 SR Mobile Gateway capabilities that support the values of the IP Mobile Core.

Figure 4. Alignment of 7750 SR Mobile Gateway key capabilities with IP Mobile Core values



¹² Alcatel-Lucent Service Router Operating System. <http://www3.alcatel-lucent.com/products/sros/>

9471 WMM

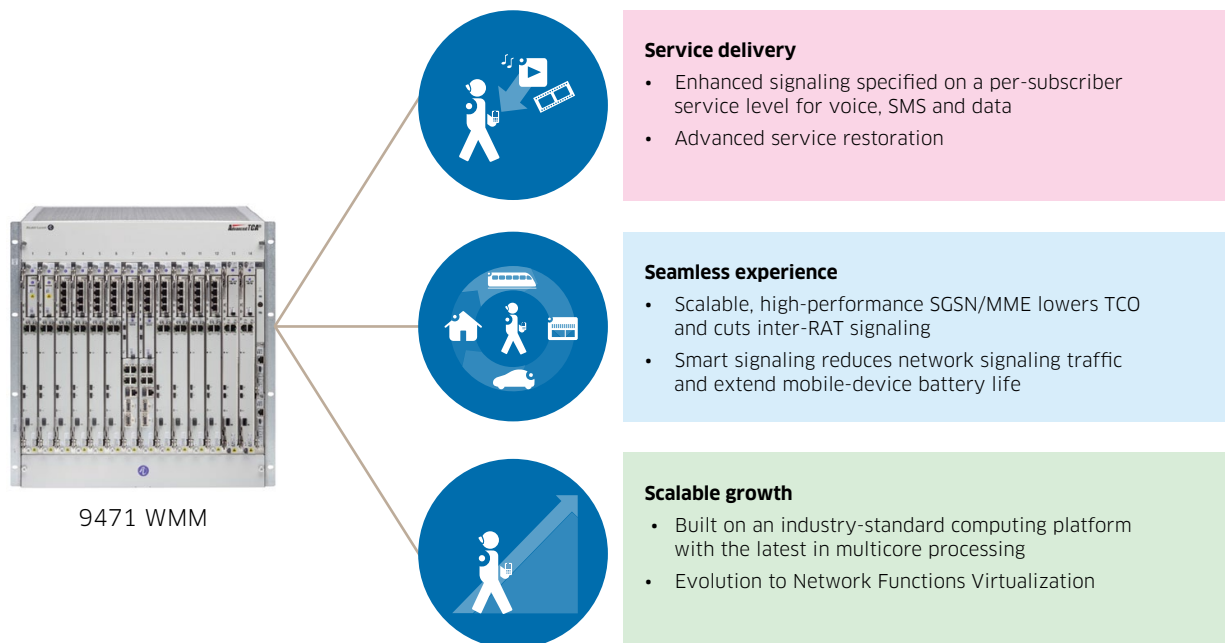
The 9471 WMM is built on a standards-based computing platform that is optimized to support increasing signaling loads on the packet core. The 9471 WMM provides the MME and Serving GPRS Support Node (SGSN) functions.

As an MME, the 9471 WMM operates entirely in the control plane, where it issues and receives instructions related to the network, services and applications. The key responsibilities of the 9471 WMM are:

- Assignment of each UE to the proper SGW
- Orchestration of the establishment of bearer channels in the network
- Tracking of the UE, assigning and optimizing network resources as the user changes locations
- User authentication by interacting with the Home Subscriber Server (HSS), which is like a huge database of information for the LTE network
- Security management between the user device and the network

Figure 5 lists key 9471 WMM capabilities that support the values of the IP Mobile Core.

Figure 5. Alignment of 9471 Wireless Mobility Manager key capabilities with IP Mobile Core values



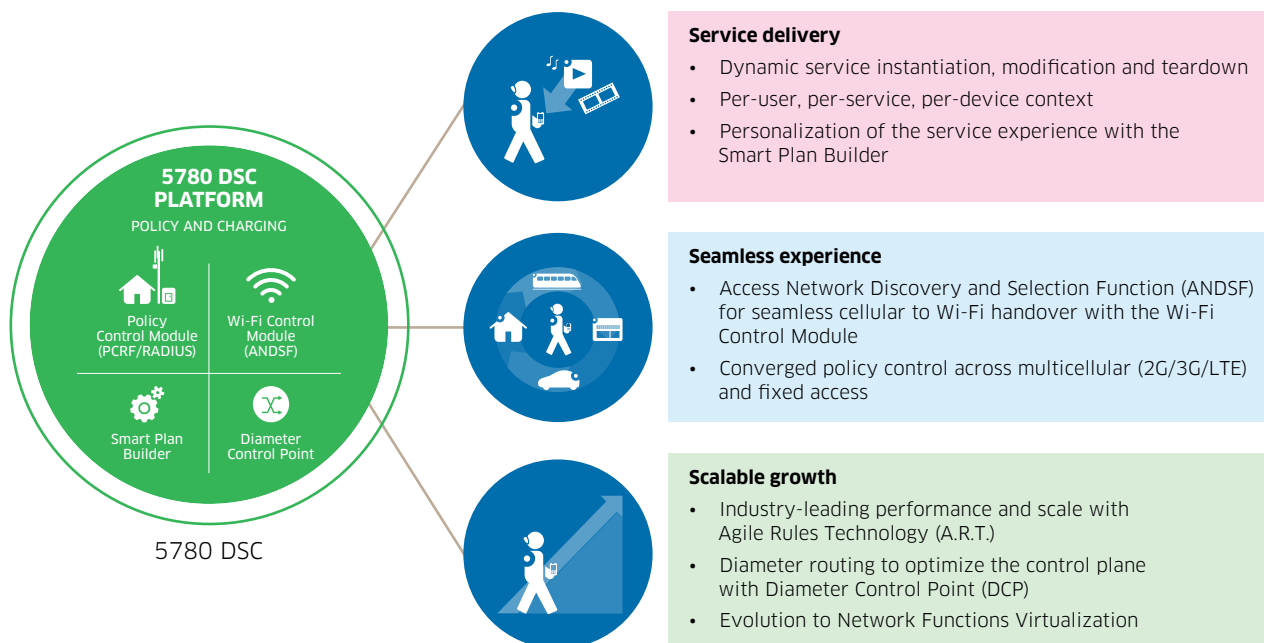
5780 DSC

The 5780 DSC is a multifunctional, software-based product. It defines subscriber, application and network policies using a highly flexible rules engine, which enables the dynamic adjustment of subscriber services and network resources based on many criteria (for example, current network conditions, subscriber profile, location, entitlements and data usage). This capability optimizes the use of network assets and enables the personalization of services to generate new revenue streams. The 5780 DSC can be deployed on a variety of industry-standard computing platforms and supports the following modules:

- Base module, with Policy and Charging Rules Function (PCRF)
- Diameter Control Point (DCP), for complete Diameter routing support
- Wi-Fi Control Module, for simple, seamless and secure Wi-Fi support
- Smart Plan Builder, for customized and personalized data-plan service creation

Figure 6 lists key 5780 DSC capabilities that support the values of the IP Mobile Core.

Figure 6. Alignment of 5780 DSC key capabilities with IP Mobile Core values



9900 WNG

The 9900 WNG is a mobile network analytics product that offers network performance, user QoE and trend analysis for operations, engineering and planning organizations. WNG is a real-time, multivendor, multi-technology (2.5G/3G/LTE) product that taps into the signaling and IP flows generated by mobile devices across the RAN, backhaul and packet core. It correlates data from six dimensions — subscriber, device, application, network, signaling and IP flow — creating an unprecedented level of mobile intelligence.

5620 SAM

The 5620 SAM is an integrated element management system/network management system (EMS/NMS) that provides service-level visibility, simplified operations and enhanced IP troubleshooting capabilities across the entire wireless network, including the LTE Radio Access Network (RAN), backhaul and packet core. The 5620 SAM is also supported on a variety of industry-standard computing platforms.

VIRTUAL EVOLVED PACKET CORE

MNOs can realize multiple benefits by moving network functions from dedicated hardware and software to high-volume, general-purpose computing platforms and virtualization software. This shift has led to a new operator initiative: ETSI Network Functions Virtualization (NFV),¹³ which introduces cloud computing and networking technology and innovations to wireline and wireless networks as an initial step in the evolution to cloud-based architectures.

Alcatel-Lucent is committed to helping its customers achieve these benefits by ensuring that the IP Mobile Core network functions can easily transition to operating in an NFV/software-defined networking (SDN) environment.

All aspects of the Alcatel-Lucent Virtualized EPC (vEPC) offering — including control-plane elements (vMME, vPCRF), data/user-plane elements (vPGW, vSGW, vGGSN) and management plane elements (vEMS, vNMS) — have been designed in alignment with the following values:

- Transparent operation of all EPC network functions on dedicated high-performance and open computing and networking hardware architecture
- Architecture designed to leverage NFV/SDN, including:
 - Full hardware and platform independence with open APIs
 - Sub-functions for efficient scaling
 - Flexibility and agility in the facilitation of new services and service models

With the IP Mobile Core, MNOs can fully realize the capabilities of NFV/SDN:

- Fewer specialized hardware platforms to manage and operate
- Improved agility and response times for network updates and changes to better match market needs
- Increased service innovation with an open ecosystem

SOLVING TODAY'S MOBILE BROADBAND CHALLENGES

Video is living up to its reputation as a major contributor of mobile data bandwidth and is increasingly popular as higher-capacity networks such as LTE become available. Strategy Analytics indicates that data-intensive services such as video streaming will represent the vast majority of the boom in mobile data traffic.¹⁴ The company reports that mobile video will increase by 42 percent and video traffic will grow to 8.6 exabytes of data in 2017.¹⁵ Progressive MNOs are already starting to leverage LTE to offer their own mobile video services, such as Verizon has done with its NFL mobile video app.¹⁶

¹³ European Telecommunication Standards Institute, *GS NFV 002 v1.1.1 (2013-10) Network Functions Virtualization (NFV); Architectural Framework*. October 2013. http://www.etsi.org/deliver/etsi_gs/NFV/001_099/002/01.01.01_60/gs_NFV002v010101p.pdf

¹⁴ Strategy Analytics (Nitesh Patel), *Handset Data Traffic (2001-2017)*. June 2013. <http://www.strategyanalytics.com/default.aspx?mod=reportabstractviewer&a0=8623>

¹⁵ Ibid.

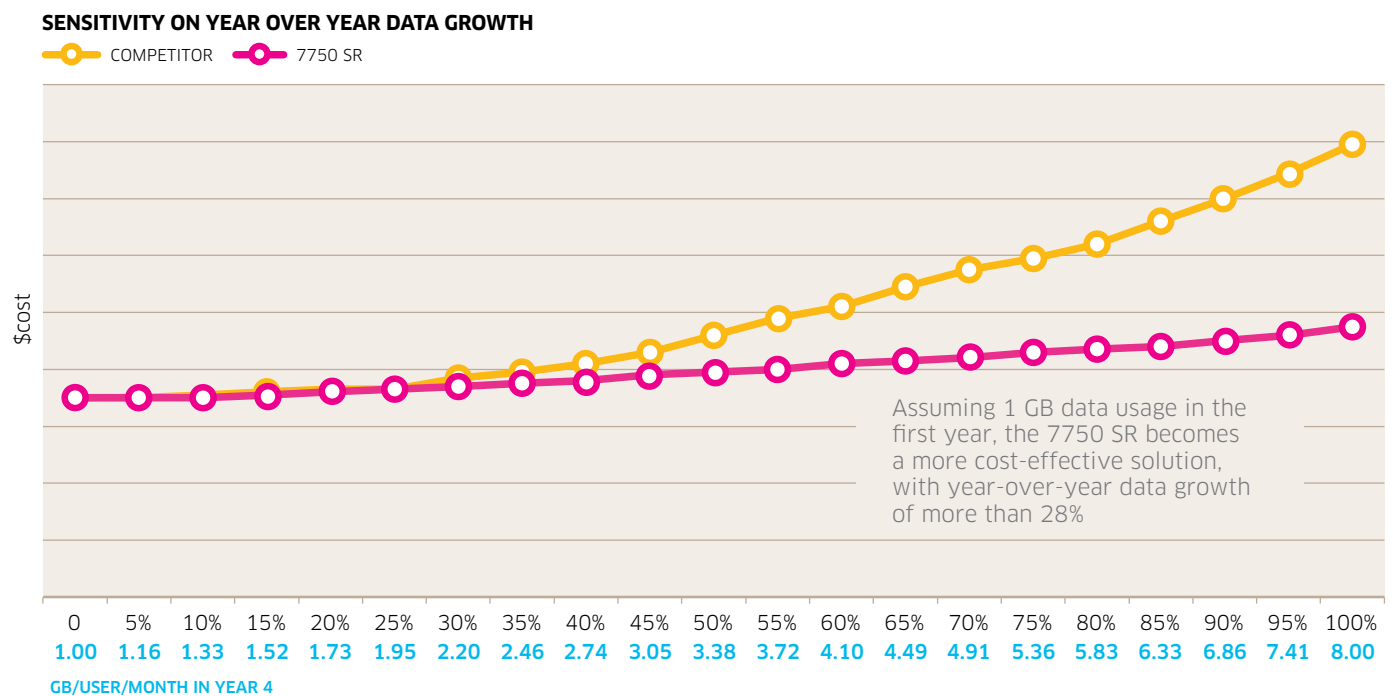
¹⁶ Verizon®, NFL Mobile video app. <https://insidersguide.vzw.com/inside/nfl/>

Delivering video with other high-touch services

MNOs' main challenges are the huge bandwidth and QoS requirements to successfully deliver streaming video with other high-touch services. Subscribers expect a high-quality experience if they are to pay extra for it, and the IP Mobile Core is ready for this challenge.

Figure 7 shows the results of a Bell Labs study, which demonstrated that, as the volume of per-subscriber data traffic increases month-over-month (much of which is video) — projected with a year-over-year growth of 28 percent — using the 7750 SR as a PGW becomes dramatically less costly than a competitor's approach. The multidimensional packet-processing capability of the 7750 SR Mobile Gateway scales easily for advanced high-touch services such as video and voice, resulting in much less hardware that some competitors' mobile gateways require.

Figure 7. Cost of deploying a mobile gateway as per-user bandwidth increases



Source: Alcatel-Lucent Bell Labs

VoLTE and the challenge of small packets

Voice over LTE (VoLTE) is a key business opportunity for MNOs that are deploying LTE. With VoLTE, MNOs are able to differentiate their mobile service offerings by providing better mobile voice — high-definition (HD) voice with low latency and setup times — while helping to reduce the impact of diminishing legacy voice and SMS revenues. The industry is reflecting these drivers: Infonetics Research forecasts a 145-percent compound annual growth rate (CAGR) in the number of VoLTE subscribers from 2012 to 2017, leading to \$16 billion in overall total potential voice revenue by 2017.¹⁷

¹⁷ Infonetics Research, *Infonetics Research raises VoLTE forecast; Over-the-top mobile VoIP subscribers nearing 1 billion mark*. July 2013. <http://www.infonetics.com/pr/2013/Mobile-VoIP-Services-and-Subscribers-Market-Highlights.asp>

The processing requirements for mobile gateways are challenging for VoLTE delivery. With VoLTE, the underlying IP packets are small and require a higher packet-processing rate than other packet flows, resulting in higher processing demands. In addition, processing is increased because each VoLTE packet must be delivered with little delay while being assigned a specific QoS and charging profile. However, requirements are different for the delivery of video and multiple other services, which the MNO must concurrently deliver.

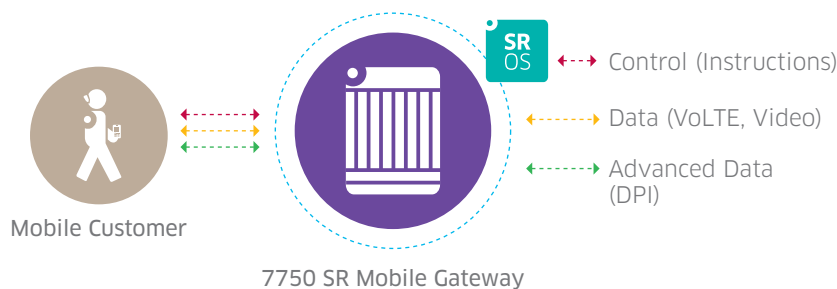
In parallel to these processing demands, there is an increased demand on mobile gateways to process control traffic: network instructions used to establish and tear down connections (bearer channels) with unpredictable user and application behaviors. Projecting these processing requirements across millions of users and connections makes it clear that a new generation of processing capabilities is needed.

As shown in Figure 8, the 7750 SR Mobile Gateway offers three independent, dedicated processing paths that scale independently across the:

- Control plane, for network instructions
- Data plane, for applications such as VoLTE and video
- Advanced data plane, for advanced levels of data processing that require Layer 4 to Layer 7 Deep Packet Inspection (DPI)¹⁸

Mobile gateways for LTE and beyond require this multidimensional scalability.

Figure 8. 7750 SR Mobile Gateway multidimensional processing



Integrating Wi-Fi with the packet core

Wi-Fi use is exploding: Juniper Research forecasts that by 2017 more than 60 percent of all mobile traffic will go through Wi-Fi¹⁹. Service providers used to adopt Wi-Fi as a way of offloading precious licensed radio spectrum, but today Wi-Fi is becoming an integral part of their mobile broadband strategies.

¹⁸ Alcatel-Lucent TECHzine (Patrick McCabe), *How To Deliver VoLTE With Scalability and High Performance*. July 2013. <http://www2.alcatel-lucent.com/techzine/how-to-deliver-volte-with-scalability-and-high-performance/>

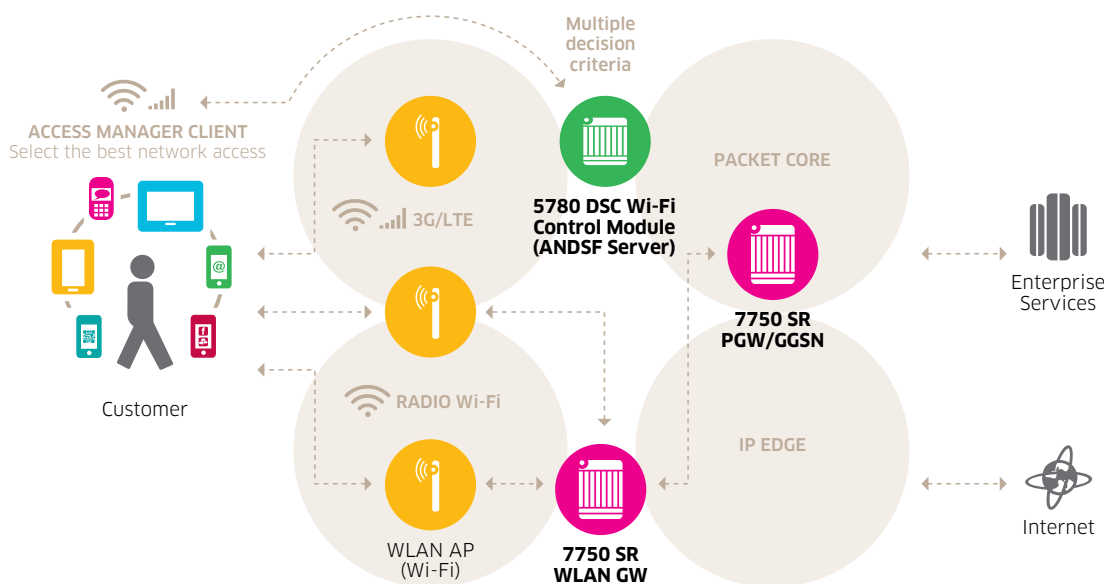
¹⁹ Juniper Research, *Mobile Data Offload & Onload Wi-Fi, Small Cell & Carrier-Grade Strategies 2013-2017*, October 2013

The Wireless Broadband Alliance indicates that MNOs and mobile service providers will deploy Wi-Fi hotspots in over 55 million locations by 2017.²⁰ They want to include carrier Wi-Fi in their multi-access infrastructure and to manage Wi-Fi with a common packet core, gaining control and visibility — QoS, charging and accounting — of this traffic. These actions will enable service providers to monetize carrier Wi-Fi traffic by offering new services and data plans.

The expanded capacity and footprint of carrier Wi-Fi must be integrated with the packet core to extend security, seamless connectivity and mobility between Wi-Fi and cellular networks. Alcatel-Lucent tackles these challenges with its Carrier Wi-Fi Solution.^{21, 22}

Figure 9 shows the integration of Alcatel-Lucent Carrier Wi-Fi with the packet core. The 7750 SR Wireless LAN (WLAN) Gateway ensures secure, seamless connectivity and mobility between carrier Wi-Fi and cellular access networks. The 7750 SR WLAN Gateway also enables MNOs to maintain a per-subscriber context and control, adding Wi-Fi as a way for subscribers to receive their services.

Figure 9. Alcatel-Lucent approach for integrating carrier Wi-Fi



The 5780 DSC Wi-Fi Control Module uses the Access Network Discovery and Selection Function (ANDSF). The ANDSF enables service providers to maximize subscriber performance by dynamically controlling Wi-Fi and cellular access based on many criteria, such as location, profile, entitlements and usage.

20 Wireless Broadband Alliance, *Wireless Broadband Alliance Industry Report 2013: Global Trends in Public Wi-Fi*. November 2013.

21 Alcatel-Lucent TECHzine (Nicholas Cadwgan, Laurent Guégan), *Policy Empowered Carrier Wi-Fi Control*. <http://www2.alcatel-lucent.com/techzine/policy-empowered-carrier-wi-fi-control/>

22 Alcatel-Lucent (Nicholas Cadwgan), *Putting the carrier in carrier Wi-Fi*. May 2013. <http://www2.alcatel-lucent.com/blogs/corporate/2013/05/putting-the-carrier-in-carrier-wi-fi/>

Delivering enterprise services to mobile workforces

IDC forecasts that the mobile worker population will increase to 1.3 billion by 2015, representing 37.2 percent of the total workforce.²³ Many enterprises are recognizing the importance of empowering their mobile workforces with high-performing, persistent and secure mobile access to key business applications, such as unified communications, sales force automation and customer relationship management (CRM). Since 2011, these business applications have grown by 29 percent, 66 percent and 74 percent, respectively.

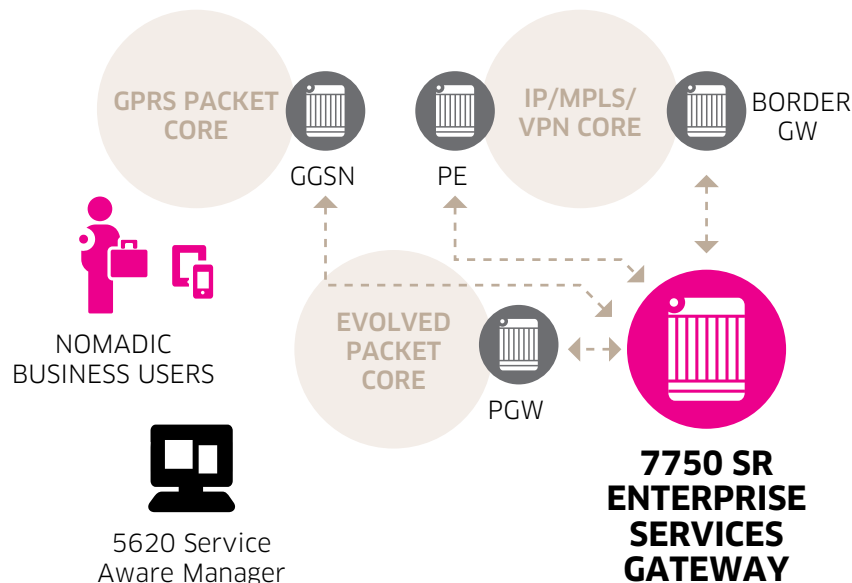
Empowering the mobile workforce brings many benefits:

- Improved customer experience: Increased face-to-face client meetings with real-time answers to customer inquiries
- Reduced administration: Task-oriented applications that embed critical information at the point of interaction
- Improved CRM utilization: Dynamic capture of real-time information
- Increased field sales time: Elimination of cumbersome pre-planning
- Increased win rates: Improved networking and available social media information

To fully realize these benefits, the enterprise “nomadic” user must have mobile access to key business applications — with the assurance of high performance, persistent access without constant re-authentication. Providing these services necessitates a shift within the MNO’s existing network virtual private network (VPN) and packet core infrastructure.

As shown in Figure 10, the 7750 SR as an Enterprise Services Gateway (ESG) cost-effectively replaces a range of infrastructure elements, simplifying the network and provisioning process.

Figure 10. Alcatel-Lucent 7750 SR Enterprise Services Gateway



23 eWeek®, *Mobile Worker Population to Reach 1.3 Billion by 2015*: IDC, January 2012.
<http://www.eweek.com/c/a/Mobile-and-Wireless/Mobile-Worker-Population-to-Reach-13-Billion-by-2015-IDC-238980/>

An Alcatel-Lucent Bell Labs study modeled the scenario in Figure 10 with a mid-sized European operator. The results showed that offering mobile VPN access to enterprises within the operator's footprint would yield a potential revenue increase of over \$130 million over a five-year timeline. The same study showed that using the 7750 SR as an ESG would provide a net present value of more than \$6 million, with significant revenue, OPEX and CAPEX advantages compared to a traditional approach of offering the same service.

M2M and the new mobility requirements

Machine to machine (M2M) is an emerging service in which a variety of machine devices — for example, appliances, utility meters, electronic signage, medical imaging machines and vehicular fleets — coupled with telematics applications are removing the need for human interaction and are automating communications among other devices. These machine devices and applications are often connected over wireless networks. M2M represents an opportunity for MNOs to offer new services for non-traditional customers such as utilities, hospitals and delivery companies. A recent Ovum study forecasts that global M2M revenues will triple from \$16.7 billion in 2013 to \$44.8 billion in 2018.²⁴

The challenge in delivering M2M services is recognizing that M2M presents a different traffic profile than traditional consumer mobile data services. M2M requires massive scaling but in many cases requires less bandwidth per connection, with less stringent real-time delivery requirements. MNOs need to offer flexible deployment options to handle these services cost-effectively.

The IP Mobile Core offers the level of flexibility required to effectively handle M2M services. Delivering M2M services with the vEPC provides scaling to support potentially millions of connected devices and results in a lower cost structure to meet the required price points.

CONCLUSION

MNOs are faced with new data and signaling requirements and service demands. The global shift to LTE and an all-IP infrastructure is introducing major challenges along with many opportunities for MNOs.

The IP Mobile Core offers the performance, scale and reliability MNOs need to deliver a seamless customer experience across all mobile broadband services. In addition, the IP Mobile Core is designed to flexibly evolve into a virtualized deployment model without disrupting service delivery.

The IP Mobile Core offers a powerful way to tackle current shifts in traffic patterns and increasingly unpredictable signaling requirements. With the IP Mobile Core, MNOs can pursue new revenue opportunities, increase customer loyalty, and dramatically alter the user experience.

²⁴ Ovum, Ovum outlines operators' M2M opportunities as it forecasts revenues will more than treble over the next five years. January 2014. http://ovum.com/press_releases/ovum-outlines-operators-m2m-opportunities-as-it-forecasts-revenues-will-more-than-treble-over-the-next-five-years

ACRONYMS

2G, 3G, 4G	Second Generation, Third Generation, Fourth Generation	M2M	machine-to-machine
5620 SAM	Alcatel-Lucent 5620 Service Aware Manager	MME	Mobility Management Entity
5780 DSC	Alcatel-Lucent 5780 Dynamic Services Controller	MNO	mobile network operator
7750 SR	Alcatel-Lucent 7750 Service Router	MPLS	Multiprotocol Label Switching
9471 WMM	Alcatel-Lucent 9471 Wireless Mobility Manager	NFV	Network Functions Virtualization
9900 WNG	Alcatel-Lucent 9900 Wireless Network Guardian	NMS	network management system
A.R.T.	Agile Rules Technology	OPEX	operating expenditures
ANDSF	Access Network Discovery and Selection Function	OTT	over-the-top
API	application programming interface	PCRF	Policy and Charging Rules Function
CAGR	compound annual growth rate	PDN	packet data network
CAPEX	capital expenditures	PE	provider edge
CRM	customer relationship management	PGW	PDN Gateway
DCP	Diameter Control Point	QoE	Quality of Experience
DPI	Deep Packet Inspection	QoS	Quality of Service
EMS	element management system	RADIUS	Remote Authentication Dial-In User Service
EPC	Evolved Packet Core	RAN	Radio Access Network
ESG	Enterprise Services Gateway	RAT	Radio Access Technology
ETSI	European Telecommunication Standards Institute	SDN	software-defined networking
GGSN	Gateway GPRS Support Node	SGSN	Serving GPRS Support Node
GPRS	General Packet Radio Service	SGW	Serving Gateway
GSA	Global mobile Suppliers Association	SMS	Short Message Service
HD	high-definition	SR OS	Alcatel-Lucent Service Router Operating System
HLR	Home Location Register	TCO	total cost of ownership
HSS	Home Subscriber Server	UE	User Equipment
IP	Internet Protocol	vEPC	Virtualized EPC
IPsec	IP Security protocol suite	VoIP	Voice over IP
IT	information technology	VoLTE	Voice over LTE
LAN	local area network	VPN	virtual private network
LTE	Long Term Evolution	WLAN	wireless LAN

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