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White Paper

Next-Generation Platforms for Telecom Cloud Services

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Executive Summary

Telecom services are shifting to a cloud infrastructure, in which new services can be rapidly provisioned by deploying virtual network functions (VNFs) instead of physical boxes. This dramatically reduces the operating cost of carrier networks and allows carriers to invest in new infrastructure as revenue grows. To gain the full benefit of this new cloud infrastructure, carriers need to build a network of carrier-grade platforms that support network functions virtualization (NFV) from the data center and central office to remote base stations. This requires a new class of scalable platform that combines high-performance switching and server-class processing performance with five-nines availability, along with options that comply with the relevant equipment practice and power/thermal footprints of central offices and other telecom locations.

Traffic on mobile networks is expanding in both bandwidth and scope. LTE and LTE Advanced are becoming widely deployed with bandwidths of 10-100 Mbit/s today, growing to 1 Gbit/s or more in the future. This new capacity enables subscribers to view HD video on smart devices such as mobile phones and tablets but creates bandwidth bottlenecks between the mobile core and the application servers when many subscribers simultaneously view popular content. At the same time, we are seeing increased interest in the use of mobile networks to support low-bandwidth applications connecting household meters and other things to the Internet. The Internet of Things (IoT) places different constraints on the mobile infrastructure, requiring many low-speed connections and greater upstream traffic. Cloud infrastructures make it easier for carriers to support these developing applications.

NFV and software-defined networking (SDN) enable a virtualized infrastructure in which functions and resources are provisioned and reallocated to meet short-term requirements. Telecom services require some resources that are shared across the network and other resources that are very local to subscribers, such as the radio access network (RAN) and local caching to support video on demand (VoD) and other applications. The network needs to provide adequate backhaul from the RAN and high-speed networking between systems in the central office and data center as virtual environments can dramatically increase East-West traffic between servers.

The challenge in deploying telecom cloud services is to build a common software and hardware infrastructure that delivers the performance and flexibility required at different physical locations in the network. This can be best achieved using scalable solutions that have been developed specifically to support NFV and SDN in data centers, central offices and remote locations.

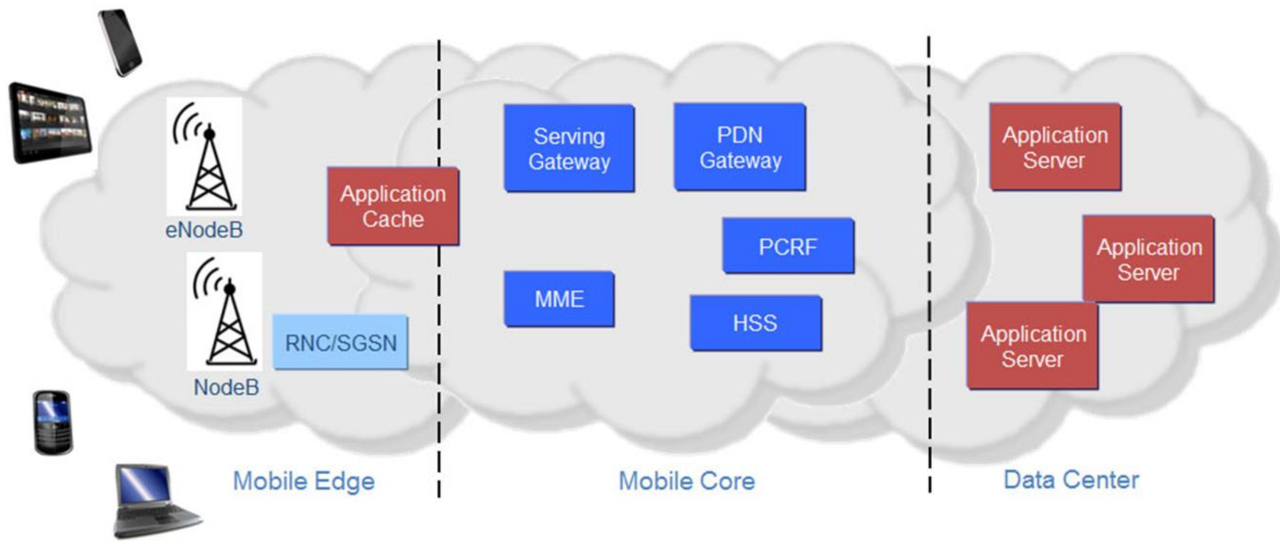
This white paper explores the benefits of deploying a telecom cloud infrastructure for both carriers and their customers and examines the changes in modular platform development required to meet the demands of virtualized environments. The paper goes on to review a new approach to this challenge from Advantech that uses a flexible processor module and software environment across multiple systems, including top-of-rack switches, enterprise appliance platforms and a carrier-grade appliance platform. This approach is intended to bring together the benefits of standard servers, high-speed switches and ATCA-like carrier-grade availability.

Telecom Cloud Infrastructure

The increasing use of smart devices, including mobile phones and tablets, and data-hungry services, such as remote storage and VoD, is driving data bandwidth and putting many more demands on the network. A key requirement is the distribution of content to the network edge and to subscriber devices. To meet these demands, carriers are moving to a virtualized cloud infrastructure that promises support for higher-value services, rapid provisioning and better ROI.

Traditional telecom infrastructure has been built using dedicated hardware, in which each system has a specific function. The telecom cloud infrastructure shown in **Figure 1** is a convergence of telecom and IT technologies, with virtual functions in the mobile edge, mobile core and data center running on standard server platforms, dedicated hardware or a combination, depending on the network topology.

Figure 1: Telecom Cloud Infrastructure



Source: Earlswood Marketing

The mobile edge consists of base stations and controllers that form the LTE (eNodeB) and 2G/3G (NodeB/RNC/SGSN) RAN. There is also a requirement in many networks to provide local application caches that store regularly accessed data such as popular video content, offloading the backhaul network. This approach is supported by the Mobile Edge Computing (MEC) Initiative within ETSI, which will allow operators and authorized third parties to deploy applications and services toward subscribers using local content and context.

The mobile core is built around the Evolved Packet Core (EPC) developed for LTE networks. The key functions here are the serving and PDN gateways, Mobility Management Entity (MME), Home Subscriber Server (HSS) and the Policy and Charging Rules Function (PCRF) that allows operators to dynamically control bandwidth, charging and other functions for each subscriber and application.

Mobile carrier data centers host application servers for the many services they provide their subscribers and applications that support the carriers themselves such as billing. The telecom cloud infrastructure also needs to support network services including IP Multimedia Subsystem (IMS) and Voice over LTE (VoLTE).

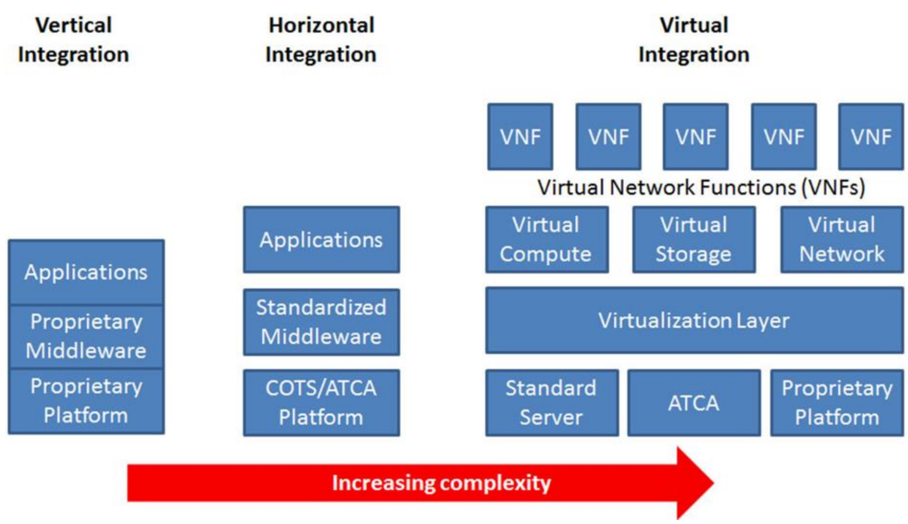
The telecom cloud infrastructure allows carriers to quickly provision new services and maximize the utilization of processing and network resources. The telecom cloud infrastructure also needs to support five-nines high availability and guarantee network and application performance from the data center through the mobile core to the mobile edge and subscriber handset.

The shift to a cloud infrastructure creates a new requirement for flexible platforms that combine high-performance virtual function processing, local storage and high-speed network interfaces. These platforms need to meet the different physical and environmental constraints at different locations in the telecom network, and the cloud infrastructure must be guaranteed to meet carrier-grade five-nines availability.

Modular Platforms & Virtualization

The shift to virtualized functions and cloud infrastructure based on NFV and SDN is the latest transition in how the telecom industry develops systems, as shown in **Figure 2**.

Figure 2: System Development Trends



Source: Earlswood Marketing

Until the early 2000s, most telecom companies had a vertically integrated model using proprietary platforms, and in many cases proprietary silicon and middleware, and then provisioning applications that were designed specifically to run on that hardware platform. By then, the industry had realized that developing a new platform from the ground up for each generation of applications was unaffordable in terms of time to market and engineering resources.

The industry then moved to a horizontal integration model, where commercial off-the-shelf (COTS) platforms, including ATCA, were developed to provide a common hardware platform. The industry also developed standardized middleware that would support the same applications running on different hardware platforms.

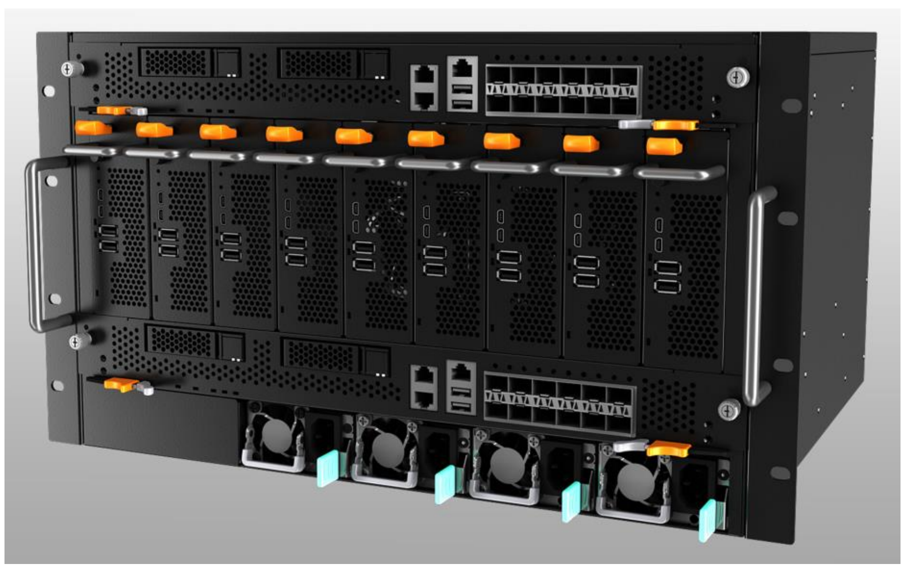
The industry is now moving to the third stage, with virtual integration and separate hardware and software modularity. NFV defines a framework in which VNFs support multiple applications. These VNFs have access to virtual resources including compute, storage and networking elements such as switches. These virtual resources are mapped through a virtualization layer to multiple hardware platforms that may include standard servers, ATCA, proprietary platforms or dedicated NFV platforms.

The catalyst behind this latest shift has been the desire of carriers to enable rapid service provisioning and much more flexible deployment models. The shift to virtualized solutions has some significant benefits but also increases complexity, which brings some significant development challenges. Rackmount servers, microservers and blade servers can be used for data center functions that do not support real-time applications. The telecom cloud and other networking applications require more advanced and flexible platforms that combine the benefits of standard servers with support for high-speed networking and ATCA-like high availability. These platforms need to be highly configurable to fit the different functions and locations across a telecom network, such as central offices and telecom rooms.

Packetarium XL

Advantech describes its Packetarium XL systems as highly configurable platforms optimized for next-generation enterprise and telecom applications, integrating high-speed switch fabrics, flexible I/O and up to 12 processor modules. The Packetarium XLc (**Figure 3**) supports carrier-grade availability and is optimized for the equipment practice, power and thermal footprint of telecom rooms and central offices.

Figure 3: Advantech Packetarium XLc

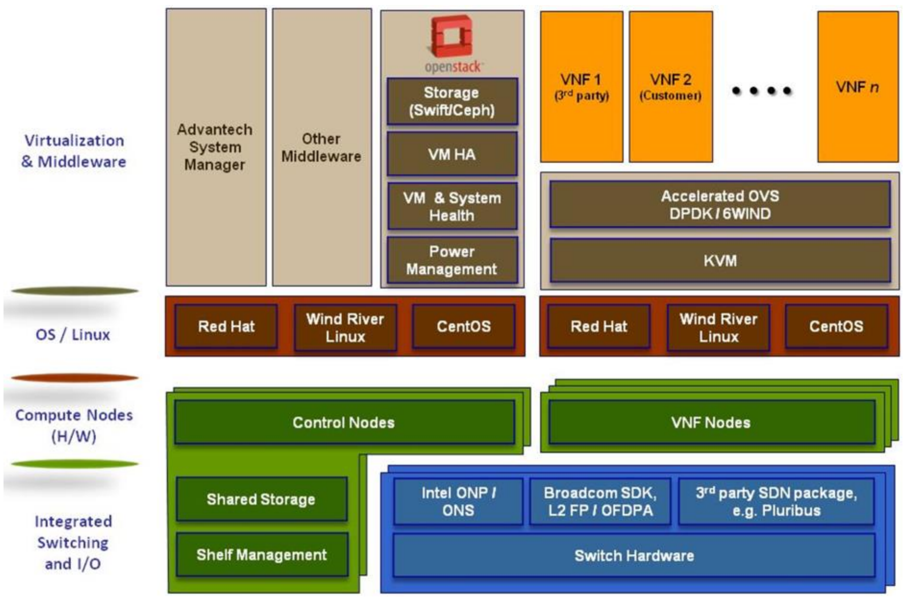


Source: Advantech

The 6U platform integrates up to nine hot-plug dual- or single-node blades; front-mounted, hot-swappable and redundant AC or DC power supply units (PSUs); and hot-swappable fan modules. It has dual-star data and control plane interconnects with redundant switch modules. Each switch module also integrates a control processor and Advantech Packetarium shelf manager. The shelf manager is based on the Advantech ATCA shelf manager with IPMI v2.0 support, enabling the Packetarium XLc to deliver carrier-grade five-nines availability.

Figure 4 shows the Advantech Packetarium NFV software solution. Applications are supported by the VNFs. The software platform supports accelerated packet processing and Open vSwitch (OVS) with integrated Intel DPDK offload. The Packetarium XL hardware platform includes shelf management, storage and control processors as well as up to 12 processor modules and one or two switch fabrics.

Figure 4: Advantech Packetarium NFV Software



Source: Advantech

The Advantech Packetarium XLe shown in **Figure 5** is optimized for compute and I/O density to meet the growing need for throughput in a platform that overcomes the bottlenecks present in legacy systems such as ATCA.

Figure 5: Advantech Packetarium XLe

Source: Advantech

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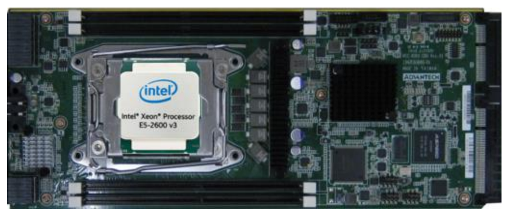
The 4U platform integrates 12 hot-swappable blades and six PHY Mezzanine Modules (PMMs), each with 120Gbit/s bandwidth to the internal switch fabric. PMMs are available with a range of different networking interfaces, including 10, 40 and 100 Gigabit Ethernet ports, supporting up to 720 Gbit/s of flexible I/O per Packetarium XLe platform.

Flexible Building Blocks

The latest Advantech Packetarium XL platforms designed for NFV are built around flexible building blocks including server, storage, backplane, I/O and front panel modules. The Advantech MIC-8301 server module, shown in **Figure 6**, integrates a single Intel Xeon E5 with Intel PCH chipset and DDR4 DRAM.

Figure 6: Advantech MIC-8301 Server Module



Source: Advantech

Figure 7 shows the Advantech MIC-8301 Server Module connected to backplane interface and faceplates for the Advantech Packetarium XLe system. Each Packetarium XLe system will support up to 12 MIC-8301 Server Modules.

Figure 7: Advantech MIC-8301 Server Module Application

Source: Advantech

Advantech is also developing a Versatile Server Module (VSM) that will be available with the Intel® Xeon® Processor D Product Family and Intel® Atom™ Processor C2000 Series. The VSM, in contrast to existing computer-on-module standards, has been designed to support server and virtualized workloads in communication networks. With this networking- and server-centric feature set, VSMs can be easily embedded into access, edge equipment such as small cells, demarcation boxes and base stations to add NFV capabilities, or into enterprise equipment such as gateways or top-of-rack switches to enable software-defined control plane features. The versatile design concept also allows the integration of VSMs as a factory-installable add-on card, or as a field-replaceable, hot-swappable server node.

In deployment scenarios such as ETSI's Mobile Edge Computing (MEC), VSMs not only provide MEC server capabilities but also provide NFV elasticity. NFV elasticity helps to avoid cumbersome cell site-to-cell site traffic when excess service capacity is required in a given cell. It does this by running the same VNFs on systems such as Packetarium XLc installed at aggregation points, or even deeper in the core network, instead of routing traffic to adjacent cells.

Conclusions

The shift to a telecom cloud infrastructure is changing both carrier system strategies and system development approaches. The lines between telecom and IT infrastructure are being removed, and carriers need to deploy a common software and hardware infrastructure from the data center and central office to remote base stations. NFV and SDN bring many benefits, but also many challenges.

Telecom cloud services require a new class of scalable platform that combines high-performance server processing, high-throughput switching and carrier-grade availability. Telecom NFV/SDx equipment that needs to be close to the customer premises or be placed in existing locations such as central offices and telecom rooms, instead of data centers, requires flexible platforms that supports NFV and work with the existing infrastructure.

Advantech says its Packetarium XL family provides scalable platforms for telecom cloud infrastructure applications from the data center and central office to the mobile edge. The use of flexible building blocks allows customization to meet many combinations of processing performance and network I/O. According to Advantech carriers can use the Packetarium XLe for high-bandwidth middle boxes linking the mobile packet core into the application servers and the Packetarium XLc with full NEBS-3 compatibility, with highly scalable processing and I/O capabilities for the cloud-based mobile core and edge. The Packetarium XL platforms support a range of high-speed network interfaces up to 100 Gigabit Ethernet and integrate switch fabrics supporting 120 Gbit/s per I/O module. The Advantech VSM is intended to add further flexibility as a server node that can be integrated with access/edge equipment to enable NFV and new services on legacy equipment.

The Advantech Packetarium XL platforms and VSM are the first in a new generation of flexible solutions that will be at the heart of the telecom cloud infrastructure. Although carriers can easily deploy new services by provisioning VNFs on their virtualized infrastructure, they must ensure that the underlying hardware has the required balance of processing power, storage and switching to meet customers' demands in the data center, mobile core and mobile edge.