ADVANTECH Networks & Communications
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White Paper

NFV Everywhere: A Micro-datacenter-in-a-box for the Network Edge

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Overview

It was only three years ago that the European Telecommunications Standards Institute (ETSI) Network Functions Virtualisation (NFV) industry specification group (ISG), comprised of thirteen tier-1 network operators first published their prominent white paper on software-defined networking (SDN) and OpenFlow. Faced with the threat from more agile over-the-top (OTT) web-scale corporations and cloud service providers of being relegated to the role of simple access provider, they set out to define the benefits, enablers and challenges for NFV and outlined the justification for international collaboration to accelerate development and deployment of interoperable solutions based on industry standard servers.

Inspired by technologies already widely deployed in datacenters and public cloud to facilitate the roll out of new services and manage connectivity, the group produced several more in-depth documents, including a number of use cases that act as references for those considering implementing NFV.

After two years of proof-of-concept (PoC) testing where operators and vendors put the use cases to the test on commercial-off-the-shelf (COTS) servers, vendors have since productized SDN and NFV software in field trials with several commercial deployments now underway.

This pioneering NFV initiative has dramatically increased innovation in the networking business and has spawned a broad ecosystem of equipment manufacturers, integrators, software vendors and communication service providers (CSPs) all co-working to find new ways to transform and simplify the network. However as CSPs seek to accelerate the delivery of new services and handle exponential growth in the number of subscribers accessing their new services, it is vital that they optimize infrastructure for density and cost, not just in the telco data center but also at the network edge.

In the radio access network, the increasingly dynamic nature of mobile traffic, in addition to new concepts such as the introduction of latency sensitive mobile user apps and the potential of computational offload from mobile devices make it difficult to forecast wireless access network resource requirements. Because of this, datacenter elasticity and proximity will be key when it comes to deploying services that improve user experience and extend battery life. In addition, recent research indicates that lower end-to-end latency between a mobile device and its cloud services significantly increases handset performance and improves energy consumption.

The impact of IoT on the network also needs to be carefully considered. The amount of IoT data captured from sensors and transmitted to the cloud today is estimated as being insignificant compared to what it will be 5 years from now. Incoming video data from fixed and mobile surveillance cameras, smart phones and cars coupled with increasing densities of high-data-rate sensors will require a more scalable approach to data collection. A decentralized architecture using cloudlets or micro-data-centers-in-a-box at the edge of the network provides an intermediary processing stage to reduce the amount of data shipped back up to the cloud by executing algorithms for applications such as face recognition, local building and landmark labelling for augmented reality and cognitive assistance or even crowd-sourced video analytics.

This can be achieved through the presence of “micro-datacenters-in-a-box” situated closer to the user entity at strategic aggregation points connecting small cells, Wi-Fi access points and cellular base stations.

This paper describes such a micro-datacenter-in-a-box, built to improve subscriber quality of experience and enable more RAN-aware services with capabilities that optimize the hosting of latency-sensitive functions and applications at the mobile edge.

Paving the Way to 5G

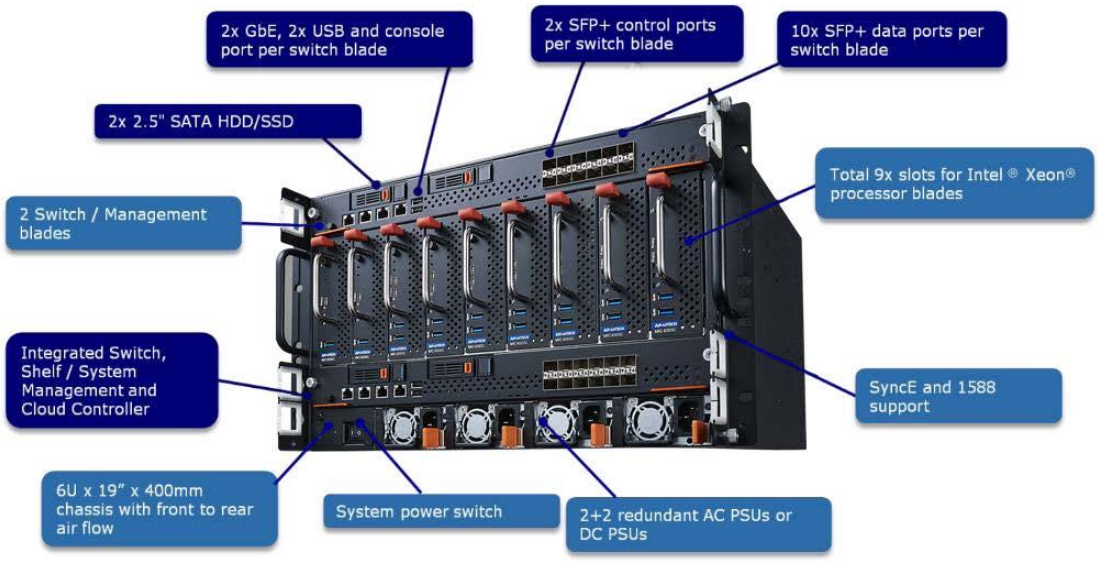
Advantech initially designed the Packetarium XLc for next generation carrier networks with a number of objectives in mind:

- Help integrators and operators to evolve from closed proprietary solutions to an agile and scalable software-driven architecture using virtualized network functions running on general-purpose Intel architecture processors.
- Ensure carrier-grade availability and conformity to standards such as NEBS in order to accelerate brown field deployment in central offices, telco rooms and baseband hotels at cell aggregation sites.
- Facilitate the deployment of vRAN andC-RAN by providing a platform which can be used to scale baseband pools with virtualized baseband units (vBBUs) and evolve the traditional BBU beyond C-RAN and hoteling.
- Enable greater NFV elasticity allowing operators to deploy just-in-time baseband resources to match increased network load rather than provisioning capacity to meet expected peak demand in each cell.
- Offer sufficient compute capacity to enhance 4G performance now and deploy 5G-ready services earlier.
- Provide the flexibility needed now to deploy the new applications and services described by the ETSI Mobile Edge Computing ISG, paving the way to 5G and the Internet of Things (IoT).
- Accelerate time to market and help operators generate more revenue sooner.

Meeting Carrier Grade Needs

The Packetarium XLc system has been carefully designed to meet carrier grade requirements including NEBS level 3 compliance and five 9's availability. For easy installation and operation in data centers, central offices and aggregation sites at the network edge the system was designed to fit in a shallow depth 400mm chassis with front to rear airflow and consume less than 400W per rack unit of power. The system provides a 2+2 redundant power supply (PSU) set-up supporting redundancy with -48VDC DC feeds or with 220V AC feeds. Support for 2+2 redundant AC power schemes simplifies the deployment in legacy environments that partially only supply two circuits per rack. Moreover, it provides for enhanced system availability compared to N+1 topologies as the interruption of one phase will not compromise the system's power integrity.

The system houses the highest density of compute available in a 6U high, 400mm deep carrier grade chassis with 288 Intel® Xeon® processor cores networked together over nine processor blades connected to redundant switch blades over a high speed packet switched backplane. The system routes traffic through two redundant switches that connect to the dual-star backplane creating an internal network with no single point of failure. These features essentially make the Packetarium XLc a carrier grade data-center-in-a-box ideal for deployment in a broad range of locations as previously mentioned.



Lightweight and Easy to Deploy in Existing Locations

Packetarium XLc is easily deployable in existing locations as well as new facilities. Supporting standard 19" 600mm rack infrastructure, AC and DC power supply options combined with modest power and thermal requirements, facilities do not have be re-modelled or specifically built to accommodate the high power gear deployed in non-standard,1200mm deep racks. In addition, the systems are lightweight and do not require special procedures for installation.

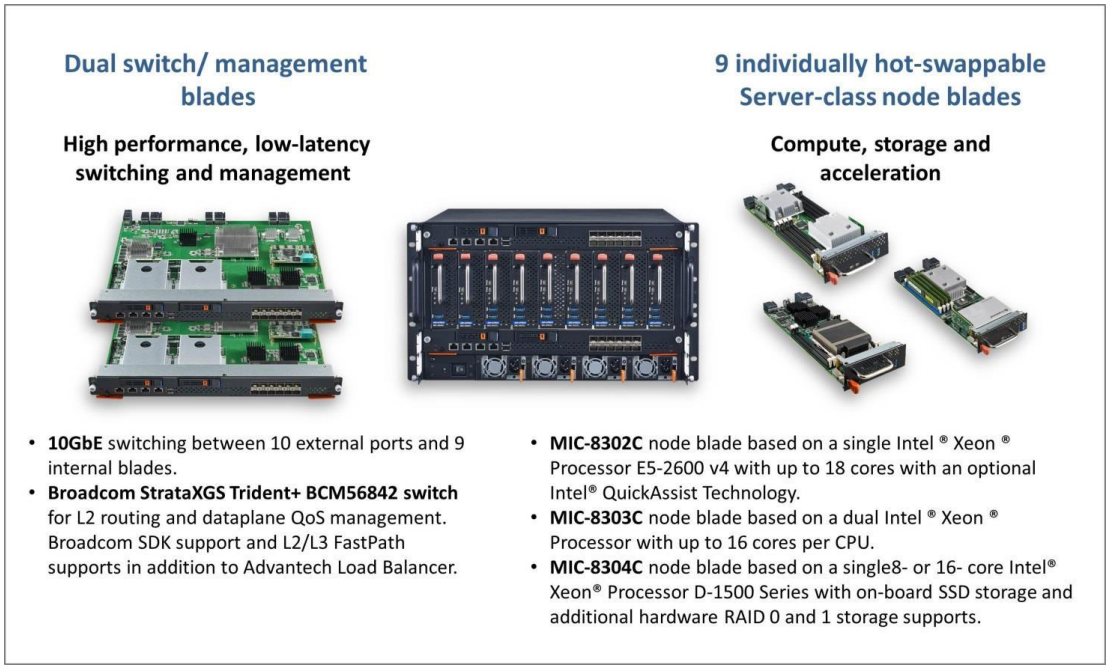
Having shared power infrastructure per chassis and integrated switch fabrics vastly reduces cabling effort which saves cost, installation time and is less prone to errors at higher reliability. Compared to stacked 1U servers, Packetarium XLc saves more than 180 cables per pack and saves 250kg of equipment weight.

Best-in-class Compute Density

The Packetarium XLc PAC-6009 chassis incorporates a highly versatile and modular design with 9 front slots to host 9 single or dual node Intel® Xeon® processor blades. Generic compute blades run application workloads (VNFs) while dedicated cloud control nodes provide orchestration and virtual infrastructure management functions. Cloud storage nodes for content caching and nodes optimized for mediaand image processing are in preparation.

Compute blades are available as single or dual node blades:

- MIC-8302C node blade Single Intel® Xeon® Processor E5-2600 v4 with up to 18 cores with an optional Intel® QuickAssist Technology.
- MIC-8304C node blade Single 8- or 16-core Intel® Xeon® Processor D-1500 series with on-board SSD storage and additional hardware RAID 0 and 1 storage supports.
- MIC-8303C dual node blade Equipped with 2x 8- or 16-core Intel® Xeon® Processor D-1500

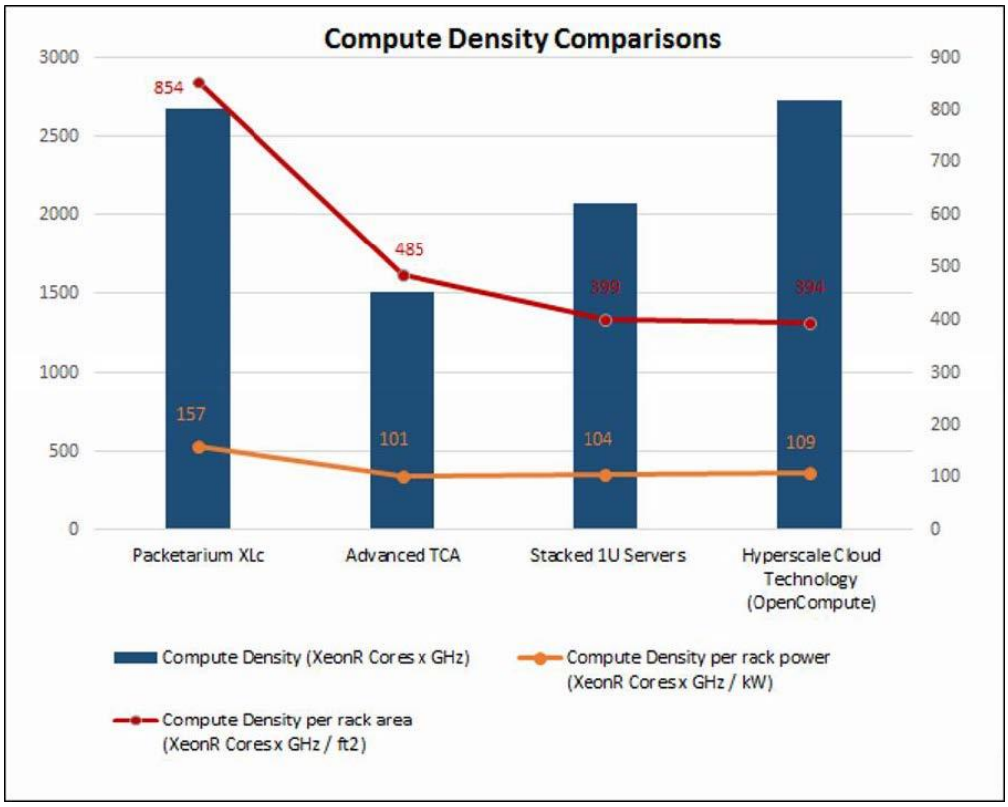


Up to 288 Intel® Xeon® cores

The Intel Xeon Processor D-1500 family offers new options for infrastructure optimization, by bringing the performance and advanced intelligence of Intel Xeon® processors into a dense, lower-powersystem-on-a-chip. The Intel Xeon processor D family is Intel's 3rd generation 64-bit System-on-a-Chip (SoC) and the first SoC based on Intel Xeon processor technology. It has been designed for deployment at the network edge and for a variety of workloads including wireless base stations, Cloud-RAN and vRAN, mobile edge computing, and the Internet of Things making it ideal for carrier grade blade server performance and high density compute at the network edge. Either when looking at a minimum deployment scenario or at a rack level, Packetarium XLc outperforms competing architectures by far.

As an example, when compared against stacking 1U servers as the “leanest” approach, such deployment would require 2 GbE Top-of-Rack Switches for control plane, two 10GbE Top-of-Rack Switches for data plane networking, two servers as cloud control nodes in addition to the compute nodes that would run the VNFs.

Just this basic system infrastructure requires a 6U rackspace and an estimated 1.8kW of power and cooling. A single Packetarium XLc system also occupies just 6U of rack space but can host up to 14 Intel® Xeon® processor nodes in addition to hosting the same system infrastructure at an overall power budget of less than 2.4kW.

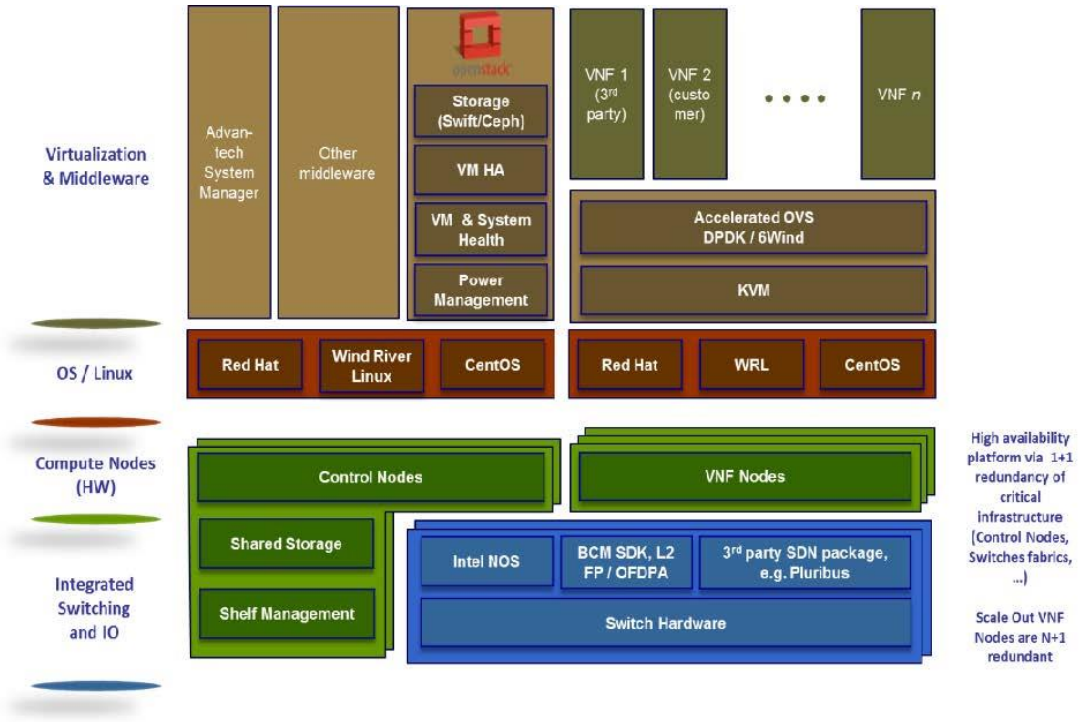


Software Framework

The system is enabled by a strong middleware partner ecosystem and provides a solid NFV Infrastructure (NFVI) to application developers and content providers enabling them with the cloud-computing capabilities and IT-style service environment they need at the edge of the mobile network.

Advantech is integrating leading NFV middleware and applications from the global ecosystem into the Packetarium XLc platform, turning the PAC-6009 into a fully-integrated, deployable NFVI.

As an active member of the Intel Network Builder Program, Advantech is closely aligning Packetarium XLc with major Intel platform initiatives and software frameworks such as Open Networking Platform (ONP Server) and Network Edge Virtualization (NEV).



Summary

To a large extent industry focus until now has been centered on the use of NFV in the network core and in the IP Multimedia Subsystem (IMS). However CSPs also stand to benefit immensely from a cloud and virtual RAN. Virtual machines can be spun up dynamically and released as required enabling greater elasticity for a more adaptable and efficient on-demand network.

By virtualizing network functions in the RAN using COTS platforms based on Intel architecture, such as Advantech's Packetarium XLc, the RAN becomes more open and flexible, easier to optimize for the hosting of both new and legacy functions. This is the enabler for the addition of new value-add services at the mobile edge that deliver a better user experience and generate new revenue streams for operators.

With 5G in sight, a decentralized architecture using C-RAN and data-centers-in-a-box at the edge of the network can reduce traffic bound for the cloud by pre-processing data and executing algorithms for applications locally.

Edge computing is set to bring improved quality of experience to subscribers and will enable more RAN-aware services with capabilities that optimize the hosting of latency-sensitive functions and applications at the mobile edge.

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