

Solution Brief

5G Edge Servers for the Open RAN

EXECUTIVE SUMMARY

The imminent arrival of 5G has put virtual Radio Access Networks (vRAN) on mobile network operators' (MNO) radar screen. The benefits of an **open, programmable and disaggregated mobile network** are numerous starting by CAPEX and OPEX reduction. The case of avoiding vendor lock-in over a scale-out infrastructure that extends the cloud to the network edge strongly resonates among service providers that look at the RAN as the next candidate in their virtualization journey. And they are not alone in this journey. Openness and intelligence are main O-RAN ALLIANCE drivers, an operator led and industry supported initiative that works to build future access networks based on virtualized elements, white-box hardware and standardized interfaces.

vRAN opens the telecom edge to innovation, enabling new **Internet of Things (IoT) and cloud partnerships and private network services** that will allow operators to monetize 5G investment. But many uncertainties remain unsolved in the way to develop the RAN of the future. With network disaggregation, white-box hardware has become a key concern not only in terms of performance but also regarding critical aspects such as energy consumption, environmental and mechanical constrains, platform maintainability and serviceability. **Advantech 5G Edge Servers** enrich operators' white box base station hardware choice by providing them with an enhanced range of high performance servers that have been optimized for vRAN and the telecom edge to meet high availability and carrier-grade network needs.

BUILDING THE BACKBONE OF THE NEW AIoT ECONOMY

The **Artificial Intelligence of Things (AIoT)** is transforming businesses across all industries. We are approaching a hyper-connected era with 5G as a fundamental pillar to enable the new AIoT economy. Corporations look at IoT as the next industrial revolution and are increasingly bringing more intelligence into their operations, building smart factories, smart hospitals, smart campuses, smart stadiums, smart cities, smart grids and in general, smart enterprises. These require advanced communication services that guarantee **data security, real time operations and broad device connectivity**. 5G New Radio (5G NR) is the air interface being developed to support these new use cases in three main categories: Ultra-reliable and Low-latency Communications (uRLLC), Enhanced Mobile Broadband (eMBB) and Massive Machine Type Communications (mMTC). These standards will allow MNOs to create new opportunities and generate new revenue streams in fast-growing markets such as Industrial IoT (IIoT), 4K/8K live streaming, smart mobility and iHealth.

The development of a disaggregated and agile mobile network that supports a massive number of connected devices, broadband speeds, network slicing, and edge intelligence is the result of a number of technologies that form **the 5G vision**. vRAN and its O-RAN implementation are key foundational blocks to realize this vision and therefore next in operators' roadmap, which are also evaluating technologies such as Multi-access Edge Computing (MEC) and Cloud RAN (C-RAN) to unlock the full potential of a web-scale 5G network.

5G vRAN WHITE-BOX HARDWARE CHALLENGES

vRAN and O-RAN are disrupting how mobile networks are deployed for the first time since early analog cellular days. As it happened to other industries before, virtualization and open interfaces **lower entry barriers and stimulate the creation of a competitive ecosystem** that moves away from monolithic architectures. Building a multi-vendor and disaggregated infrastructure does not only transform the network but also traditional customer-supplier relationships. The O-RAN ecosystem takes a partnership approach to collectively address the challenges of deploying 5G, reshaping operators, system integrators, software and hardware vendors' roles.

Since its foundation in 2018, operators have led the O-RAN specification initiative, working closely with industry partners to define vRAN software and underlying virtual infrastructure requirements. On the hardware side, the O-RAN ALLIANCE promotes the use of **commercial-off-the-shelf (COTS) white boxes** to reduce 5G costs. This does not mean that standard IT servers can be used to run vRAN functions, but that Open RAN hardware is by definition software vendor agnostic and that hardware from different vendors can be swapped supporting second sourcing strategies to help operators mitigate supply chain risks.

But decoupling software from hardware poses several challenges especially in the baseband space where ecosystem efforts go to develop white-box servers able to run virtual Distributed Unit software (vDU or O-DU if referring to O-RAN Distributed Unit). Advantech embraces white-box models and works closely with service provider, software and hardware partners to design **white-box vDU servers ready for 5G**. The SKY-8000 Series of 5G Edge Servers based on Intel architecture are the result of these collaborations and integrate lessons learnt from over 20 years of experience designing carrier-grade hardware for leading telecom equipment manufacturers globally. Some of these include:

- **Performance per watt:** white-box servers based on Intel Xeon processors balance x86 economy of scale with CPU performance to fit vRAN deployments from small to macro cells. Advantech SKY-8000 servers for vDU provide a wide choice of white-box carrier-grade platforms that scale from ultra-short-depth single 3rd Gen Intel Xeon Scalable processor pole-mount configurations supporting extended operating temperature range, all the way up to dual socket based designs that can be deployed as micro data centers at the edge or in virtual Central Offices (vCO). Advantech 5G Edge Servers have been designed for high density PCIe card payload to integrate the required vRAN acceleration, I/O and time synchronization technology while optimizing vDU performance per watt. This becomes essential to support compute-intensive **5G NR outdoor macrocell** use cases, increasing bandwidths, hardware consolidation strategies and advanced antenna systems.
- **Telecom edge:** there is no blueprint when deploying the future RAN. Distributed Unit (DU) and Central Unit (CU) functions can be combined or split and deployed at the radio site or in centralized locations depending on density, services, transport network speeds and distance between sites. While some of these cases will allow certain vRAN functions to be hosted in the data center, the majority of these will need to be deployed closer to subscribers in radio sites or telecom points of presence (PoPs). Advantech 5G Edge Servers integrate field-proven carrier-grade features that **minimize costly downtime**, service interruptions and onsite interventions when deploying high computing power in remote network locations. These include advanced thermal and electrical design, NEBS Level 3 compliance, dust filter and DC support, redundant and field-replaceable power supply units and fans supporting single failure of these critical components, redundant BIOS and firmware images and fail-safe remote upgrades. All this in a compact design that allows for short depth 300mm or 600mm telecom rack use.

BASE STATION HARDWARE SELECTION GUIDE

Advantech commercial-off-the-shelf SKY-8000 servers can be deployed to run baseband **vDU function as well as vCU, User Plane Function (UPF) or MEC** services in cell sites, points of presence or central offices.

Advantech **SKY-8000 Series of 5G Edge Servers** are highly configurable platforms designed to balance Intel Xeon Scalable processor performance with high acceleration and throughput density in compact NEBS-3 compliant platforms. The systems are cost effective, highly available and optimized to run vRAN workloads. They are of special interest in **high-density 5G NR architectures** where there is a need for acceleration and more intelligence is moved to the edge.

Operators looking to build next-generation 5G NR RAN can chose the right SKY-8000 configuration to fit their deployment needs based on performance, throughput and environmental requirements. These include 1U and 2U, single and dual socket models featuring up to 36-core network-optimized 3rd Gen Intel Xeon Scalable processors which deliver on average **62% more performance** on a range of broadly-deployed network and 5G workloads over the prior generation. A selection is included below.

	
SKY-8132S-11 11" 5G Edge Server	SKY-8132S 20" 5G Edge Server
1x 3rd Gen Intel Xeon Scalable processor	1x 3rd Gen Intel Xeon Scalable processor
3x PCIe Gen 4.0 x16 slots	4x PCIe Gen 4.0 x16 slots
Intel ACC100 eASIC vRAN acceleration card and other 3rd party	
Ultra-short depth 11" (280mm)	Short depth 20.4" (520mm)
Extreme wide operating temperature range from -40°C (-40°F) to 65°C (149°F)	Wide operating temperature range from -30°C (-22°F) to 55°C (131°F)
Front accessible storage, I/O and power	
Redundant BIOS and FW images for fast recovery and fail-safe remote updates	
Onboard BMC (IPMIv2.0 compliant) with Web Interface, KVM and Redfish	
IP65 pole-mount cabinet option	



SKY-8232D
20" 5G Edge Server

2x 3rd Gen Intel Xeon Scalable processors
Up to 8x PCIe Gen 4.0 slots
Intel ACC100 eASIC vRAN acceleration card and other 3rd party
Short depth 20.4" (520mm)
Wide operating temperature range from -5°C (23°F) to 55°C (131°F)
Redundant BIOS and FW images for fast recovery and fail-safe remote updates
Onboard BMC (IPMIv2.0 compliant) with Web Interface, KVM and Redfish
IP65 pole-mount cabinet option

Advantech's broad range of telecom edge servers also include previous generation Intel Xeon Scalable processor based platforms and can be customized to meet specific application needs. In addition, we are continuously working with operator and industry partners to develop highly efficient platforms integrating state-of-the-art processing, acceleration and networking technologies. For more information on our products and latest developments, please contact us at cloud.iot@advantech.com.

THE CARRIER-GRADE ADVANTAGE

Advantech has been providing mission critical hardware to the world's leading service providers and telecom equipment manufacturers for **over 20 years**. Whether it is wired or wireless, virtual or physical nodes at the core or the edge of the network, Advantech's products are embedded in the telecommunications infrastructure that the world depends upon.

Advantech SKY-8000 5G Edge Servers

<p>Reliability </p> <ul style="list-style-type: none">• Redundant BIOS & FW• Redundant PSU & cooling<ul style="list-style-type: none">• High ESD immunity• EMC class-B barebone design (selected models)<ul style="list-style-type: none">• Dust filter support (selected models)		<p>Performance </p> <ul style="list-style-type: none">• Intel Xeon Scalable processors• NUMA balanced design• High I/O and acceleration density• Workload-optimized Intel Select Solutions configurations• In-house electrical, mechanical and thermal designs
<p>Serviceability </p> <ul style="list-style-type: none">• Fail-safe BIOS & FW updates via Advantech IPMI Core• Platform Health Diagnostics (Advantech Server iManager: running on CPU)<ul style="list-style-type: none">• Advantech BMC WebUI (Node Explorer)• Redfish compliant OEM options		<p>Longevity </p> <ul style="list-style-type: none">• 7-15 years product life cycle plus extended product warranty• Fixed BOM for customized product P/N
<p>Embedded Background </p> <ul style="list-style-type: none">• Product change notifications on key components for FW and HW• Customization options		<p>Environmental </p> <ul style="list-style-type: none">• Wide operating temperature range• NEBS-3 compliant designs• IP65 outdoor cabinet configurations• Chassis mechanical twist strength• 11 ~ 31.5 inch depth chassis

Deployed Globally in Telecom and Industrial Business and Mission Critical Applications

Platform Differentiation: DESIGN

More than CPU Performance

Unlike IT servers, SKY servers are designed from the ground up to optimize throughput and offload required by communication workloads. The systems not only combine powerful CPUs with support for high thermal design power (TDP) PCIe cards but also carefully balance I/O between multiple processor sockets (NUMA balanced). These performance and density advantages maximize system throughput in energy efficient, smaller footprint deployments which reduces total cost of ownership (TCO).

Robustness

SKY servers have been designed to withstand high shock and vibration levels and provide unique thermal properties. They can operate at high temperatures in both clean and dusty environments. With short depth models starting at 11" (280 mm), SKY-8000 servers can easily be deployed in telecom racks and outdoor cabinets. Their service friendly design and its front to rear airflow combined with our integration service ease product development reducing technical and schedule risks.

Base Design	Optimized for five 9's availability & carrier grade use cases
PCI Express	Balanced between sockets and PCIe slots (Gen3, Gen4, and coming Gen5)
Thermal design	No shading between CPU sockets, memories and IO cards
Thermal Spec	NEBS performance at max. configuration

Platform Differentiation: RELIABILITY

High Availability

In business and mission critical applications, service interruptions result in the loss of valuable data, revenue and customers. To minimize system downtime, our servers do more than just use the reliability features of the processor platform: Advantech's advanced design yields higher margins and lower component stress for improved platform reliability. The servers support single failures of critical components such as power supply modules and fans. In addition, redundant BIOS and FW images not only provide a safe way to recover from component failures but also offer remote fail-safe update capabilities via

Advantech's IPMI which reduces MTTR and costly on-site services.

Secure & Serviceable

All SKY-8000 Series serviceable items are Field Replaceable Units (FRUs) accessible from the front or rear of the chassis. While optimizing MTTR, this also enables advanced physical security via intrusion detection sensors. Security-optimized BIOS and IPMI firmware, Trusted Platform Module (TPM) support, and the option to leverage internal SSDs as boot and application drives allow for a clear separation between user and manufacturer privileges.

Thermal design	Optimized design yields lower component stress / better MTBF
Redundant BIOS	Yes
Redundant firmware	Yes
Remote update	BIOS and firmware
Failsafe upgrade	Yes
Serviceability	All FRU-able components are front/rear swappable

Platform Differentiation: LIFE CYCLE MANAGEMENT

Integration, Customization & Design

Advantech takes a complete platform approach with the SKY server line to help solution providers offload the complex system integration and validation services of PCIe cards from Advantech and third parties. We integrate, test and deliver fully integrated systems. Solution providers can also leverage our Customized COTS framework for semi-custom electronic or mechanical design as well as full product branding including artwork, packaging and BIOS firmware strings or IDs. As we design and manufacture all our sub-assemblies we are able to modify and optimize any element in the system to suit a specific market or customer need.

Full Life Cycle Support & Global Services

Advantech operates a totally integrated value chain starting from in-house R&D and self-owned factories to global logistics and integration centers as well as local field support engineers. That allows us to apply strict Bill-of-Materials (BOM) control and to provide a “No Surprises” policy to our customers across the full product life span. Our products are supported by a global service network that enables worldwide operations. Our Regional Service Centers help give quick responses to changing business needs with ready to go packages including extended warranty, advance replacement, pick-up, fast repair and on-site services.

Design IP	Full Ownership
Manufacturing	Self-owned factories (designed, developed, and built in Taiwan)
Life cycle & warranty	5 + 2 years life cycle. Extended warranty up to 5 years
Design freeze	Full BOM freeze including (customized) BIOS and FW
Product Change Notice	Advance notice for all proposed changes
BIOS/Firmware/Software	Clear release policy with advance notice; tailored SLA available
Global Services	4 logistic hubs, 14 service centers and branch offices in 26 countries

Platform Differentiation: ECOSYSTEM COLLABORATION

Advantech works closely with leading silicon, virtualization, software, system integration, service provider and enterprise partners to jointly address the challenges of **open and disaggregated networks** bringing to market optimized solutions that have been verified to perform well together. Selected SKY-8000 server configurations verified as Intel Select Solutions for NFVI can be used by communication service providers to build a coherent virtual infrastructure for seamless access, central office and core network transformation toward cloud native 5G architectures. Verified platforms are capable of **sustained optimized data and control plane processing** for workloads spanning the 4G and 5G wireless functions found in vRAN, vEPC, 5GC and UPF, as well as in the wireline network gateway functions vBRAS, vBNG and vCMTS. This pre-validated, pre-optimized solutions accelerate deployment and time to revenue, while reducing integration risk for communication service providers.

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