

Solution Brief

Private 5G Networks for Industrial IoT

Executive Summary

The Internet of Things (IoT) is transforming businesses across all industries becoming one of the main drivers of the fourth industrial revolution. Corporations are looking forward to Industry 4.0 and are increasingly integrating intelligence into their operations for a competitive edge. Factories, warehouses, ports, airports, hospitals, grids, stadiums and cities around the world are adopting the “smart” prefix leveraging latest advances in big data, analytics, edge computing, cybersecurity, robotics, Augmented Reality, Virtual Reality (AR/VR), Artificial Intelligence (AI) and machine learning technology. At the core of the smart organization, the so-called **Industrial IoT (IIoT)** creates an autonomous network of smart sensors and machines that collaborate to improve productivity and services without the need of human intervention.

The realization of IIoT relies by definition on the underlying network. This has traditionally been implemented through a combination of wired and wireless technologies but the increasing number of connected devices, their mobile nature and rising security concerns are replacing these with private mobile networks. Latest 5G New Radio (5G NR) technology reinforces this alternative, as it has been specified to support reliable, low latency and broadband communications. The **Advantech Private 5G Network solution** combines industrial-grade hardware with full-stack radio access and core software in a fully integrated platform that provides enhanced data security, broadband speeds, deterministic behavior, real time response and cost efficiencies to enterprises deploying on-premises mission and business critical applications, building the backbone for the **smart enterprise** of the future.

Industrial IoT Opportunities and Challenges

Since first information technology (IT) systems entered the enterprise and where interconnected, corporations are going through a continuous digital transformation that accelerates business, improves flexibility and optimizes operations. In the past few years, the cloud has led this digital transformation enabling software-as-a-service models that have democratized enterprise applications. However, Industry 4.0 and **the Artificial Intelligence of Things (AIoT)** are **pushing the network to its limits**. Increasing security, responsiveness and reliability concerns open the door to hybrid architectures where business and mission critical applications can be deployed on premises.

Some Industrial IoT applications that can benefit from onsite secure, low latency and high bandwidth wireless communications include:

- **Industry 4.0:** visual inspection, predictive maintenance and fully autonomous or remote controlled machines are leading the fourth industrial revolution heavily relying on real-time data and ultra-high definition (UHD) video-based AR/VR and AI to build smart factories
- **Smart warehousing:** asset location and tracking combined with the use of unmanned vehicles enables warehouse goods to be received, organized and shipped automatically minimizing turnaround times and improving capacity
- **Oil and gas:** from production to consumption, real-time decision making based on vast data gathering and analysis is essential to minimize security risks and optimize production in an industry driven by accuracy and efficiency

Container ports



Oil refineries



Manufacturing



Construction



Mines



Warehouses



Wind farms



Oil rigs



- **iHealthcare:** real-time management of critical medical resources, flexible equipment mobility and enhanced patient services are some of the highlights of future smart hospitals
- **Smart stadiums:** live viewers able to upgrade their experience with enhanced 4K/8K video streaming to each individual seat of the venue, which can also leverage 5G connectivity to improve stadium security, broadcasting services and onsite purchases
- **Smart city:** local authorities around the world are working towards greener metropolitan areas being smart mobility the focus of their efforts to address urban transportation challenges

Private 5G Networks can replace wired local area networks in industrial deployments where a fixed communication infrastructure is not feasible due to physical constraints or increasing number and mobility nature of connected users or devices. **5G New Radio** offers a combination of essential security, reliability and performance enhancements over other wireless technologies as it has been designed from the ground up to meet business and mission critical applications needs in three main categories: Ultra-reliable and Low-latency Communications (uRLLC), Enhanced Mobile Broadband (eMBB) and Massive Machine Type Communications (mMTC). In addition, network functions virtualization (NFV) and software-defined networking (SDN) technologies are **democratizing mobile technology** enabling stand-alone, low-footprint solutions that are viable for enterprise use.

Private 5G Networks can meet IIoT communication needs including:

- **Data security:** private network end-to-end security based on strict access control through advanced user and device authentication and network isolation protecting sensitive data and devices
- **High availability:** full network ownership, carefully selected industrial-grade components, custom network planning and self-managed maintenance are some of the factors that help achieve virtually zero downtime ensuring service continuity
- **Low latency:** latest 3GPP Release 16 focuses on 5G NR uRLLC and IIoT use cases providing up to 99.999% reliability with millisecond-level latency
- **High throughput:** heavy-duty intelligent video-based applications including 4K/8K UHD live streaming can leverage private 5G greater and dedicated bandwidth for higher upload and download speeds over 1 gigabit per second
- **Cost efficiency:** private network solutions based on NFV, SDN and open standards allow for lighter, flexible and future proven communication infrastructure solutions that can be managed as another enterprise IT system

Private 5G Networks for Industrial IoT

The Advantech Private 5G Network solution provides enterprises with an integrated connectivity platform tailored for IIoT. It creates a wireless local area network delivering onsite **secure, reliable and performant** communication services to smart devices. Advantech private 5G solution uses virtualized and open standard networking software that can scale performance for indoor and outdoor deployments, from small to macro cells. In addition, the platform can be leveraged to deploy large scale private mobile wide area networks that provide 5G connectivity to remote sites and is centrally managed from headquarters.

Advantech private network solution is based on **SKY-8000 Series of 5G Edge Servers**. These are highly configurable ruggedized platforms designed to balance Intel® Xeon® processor performance across high density PCI Express card payloads in a compact form factor. The systems are cost effective, highly available and have been workload-optimized for the network functions virtualization infrastructure (NFVI).

The solution integrates software from **leading ecosystem partners** to provide all functions required to build a 5G IIoT network. On the radio side, the open and virtual Radio Access Network (vRAN) provides 5G NR air connectivity to smart sensors, devices and machines. Its virtualized nature allows for additional Mobile Edge Computing (MEC) and software defined WAN (SD-WAN) applications to be deployed on the same server enabling enhanced IoT and enterprise communication services while consolidating hardware resources. The solution can be deployed stand-alone (SA) or non-stand-alone (NSA) through different packet core software options including a 4G virtual Evolved Packet Core (vEPC) or a low-footprint 5G Core (5GC) supporting network slicing.

Advantech Private 5G Network Solution Tailored for Industrial IoT



Advantech streamlines solution evaluation and deployment by providing enterprises with a fully integrated **small cell demonstrator** that can be easily deployed on premises delivering all required elements to run private 5G IIoT networks in a ruggedized rack. The demonstrator can be configured to meet different performance and functionality needs in indoor or outdoor scenarios.

Advantech Private 5G Network Demonstrator based on Intel® Select Solutions for NFVI



Ruggedized rack including pre-integrated radio access network, packet core software, industrial-grade servers and radio unit

Sample configuration:

- 1x vRAN via SKY-8201L
 - Powered by dual socket 2nd Gen Intel Xeon Scalable processor
 - O-RAN based including distributed and central unit functions and supporting 5G NR and MEC
- 1x Packet Core via SKY-8201L
 - Powered by dual socket 2nd Gen Intel Xeon Scalable processor
 - NSA or SA through 4G vEPC or 5GC
- Top-of-the-rack switch
- Radio unit


Advantech Private 5G Networks can be deployed in collaboration with system integrator and service provider partners for additional wide area, roaming, spectrum, planning, installation, operation, and maintenance services. Enterprises can also apply for 5G spectrum in countries where authorities have allocated parts of it for industrial use.


As an active 5G and IIoT ecosystem player, Advantech is continuously working with hardware, software, system integrator and service provider partners to deliver advanced private network solutions integrating state-of-the-art computing and networking technologies. For more information on our 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 communication 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


- Reliability** 
- Redundant BIOS & FW
 - Redundant PSU & cooling
 - High ESD immunity
 - EMC class-B barebone design
 - Dust filter support


- Serviceability** 
- Fail-safe updates via Advantech IPMI Core
 - Platform Health Diagnostics (Advantech Server iManager: running on CPU)
 - Advantech BMC WebUI (Node Explorer)

- Embedded Background** 
- Product change notifications on key components for FW and HW
 - Customization options



- Performance** 
- Intel Xeon CPUs
 - NUMA balanced
 - High I/O and acceleration density
 - Workload-optimized Intel Select Solutions for NFVI configurations
 - In house electrical, mechanical and thermal design

- Longevity** 
- 7-15 years product life cycle plus extended product warranty
 - Fixed BOM for customized product P/N

- Environmental** 
- Wide operating temperature range
 - Rugged design
 - Chassis mechanical twist strength
 - 11-27.5 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 telco 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
Power Supply	1400W PSU no configuration limitations

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 firmware 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 need.

Full Life Cycle Support

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.

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 3 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

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 and vUPF, 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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