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Pegatron 5G Debuts Smart Factory Private 5G with Intel Technology

Pegatron 5G delivers family of private 5G solutions for manufacturing based on Intel® Xeon® Scalable processors; company has used this technology to streamline factory operations in Vietnam



Smart factories are ushering in the use of a wide range of innovative technologies including artificial intelligence (AI) / machine learning (ML), automation, IoT, and digital twins to improve production output, improve quality, and lower costs. For smart factories to leverage these technologies effectively they need to have their factory floor be wirelessly interconnected.

Many factory floors use wired Ethernet for networking which offers bandwidth and low latency but doesn't offer mobility and often requires expensive fiber-optic cabling. Wi-Fi technology also offers high bandwidth, and adds mobility, but may lack the required quality of service (QoS) guarantees due to signal interference that can take place because Wi-Fi uses an unlicensed frequency band. Limited signal coverage may also result in complicated network designs with lots of access points for factory-wide coverage.

PEGATRON 5G

Private 5G is an ideal connectivity technology for smart factory applications. Private 5G takes network elements engineered for service provider deployments and adapts them for enterprise and manufacturing applications. Private 5G networks use virtualized Open RAN technologies enabling scalable, lower-cost systems that can run on an Intel® architecture server (see Figure 1).

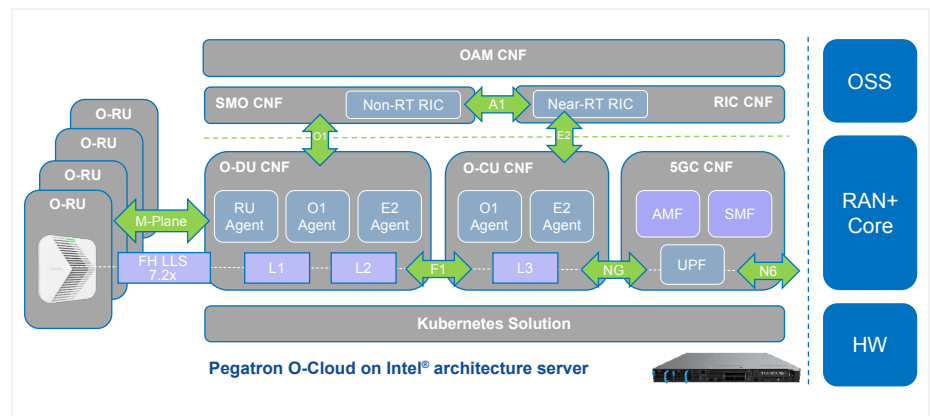


Figure 1. 5G vRAN solution framework.

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Another enabler of this technology is the availability of spectrum. Many countries have set aside dedicated spectrum for private 5G uses. In countries without a spectrum band set aside, it can be possible to license the required spectrum from mobile network operators.

The connectivity provided by private 5G overcomes the following challenges in smart factories:

- **Slow deployment** – Factory equipment is frequently moved to accommodate expansion or to retool a factory. Moving the network cables along with the equipment adds complications and delays to deployments.
- **Assembly errors** – Wireless connectivity means better supervision of manual assembly lines, improving accuracy and supervision speed.
- **Quality assurance** – Private 5G enables automated inspections of manufacturing lines resulting in better quality with lower operating expenses.
- **Automated inventory** – Private 5G networks enable autonomous vehicles to move parts around the warehouse and to customers, reducing operating expenses.
- **Improved manufacturing efficiency** – Private 5G can reduce production times and reduce operating expenses by using AI/ML and AR/VR technologies.
- **Real-time reliable communication** – Reliable and secure transport of data on time is one of the key requirements of industrial communication technology. With real-time communication, the machines on the shop floor can collaborate in an efficient way to improve productivity.

Pegatron 5G Offers Complete 5G Solution

Intel® Network Builders ecosystem member Pegatron 5G has developed a private 5G network solution to provide ultimate connectivity for smart factories.

Pegatron 5G’s Integrated 5G Solution consists of a family of virtualized Open RAN-based systems that can deliver complete 5G connectivity in manufacturing and warehousing environments. Thanks to open interface standards that are a part of Open RAN, Pegatron 5G has been able to build a solution using Intel® Xeon® Scalable processor-based servers and Intel® Ethernet 800 Series Network Adapters for cost-effective and flexible deployments.

Pegatron 5G has also developed its own RAN software including centralized units (CU) and distributed units (DU) network elements providing complete baseband functionality. The system also includes full-featured operations, administration, and maintenance (OAM) to help operate and manage the network.

Pegatron 5G has matched up this software with two server systems to build two products designed for manufacturing applications:

The Scaled Version (see Figure 2) is a rack-mounted solution offering the ability to add additional servers to support a large number of users. The rack offers flexible deployment of additional DU or CU functionality as well as other network functions such as AI/ML compute, top-of-rack switching, backhaul switching, and MEC compute. The system can scale up to support 12 RRU’s and 1,500 devices across a 10,000 m² space.



Figure 2. Pegatron 5G Scaled Version private 5G solution.

The Lite Version (see Figure 3) can be used in factories for rapid deployment. It also has some portability features including satellite backhaul options that enable it to be rapidly deployed to deliver high-throughput communications for first responders during natural disasters. The Lite Version is an all-in-one server that runs the 5G core, CU, DU, and OAM. It can support two radio units, and 256 device connections with a 2,000 m² signal range. In a factory application, this system can handle a single manufacturing line.

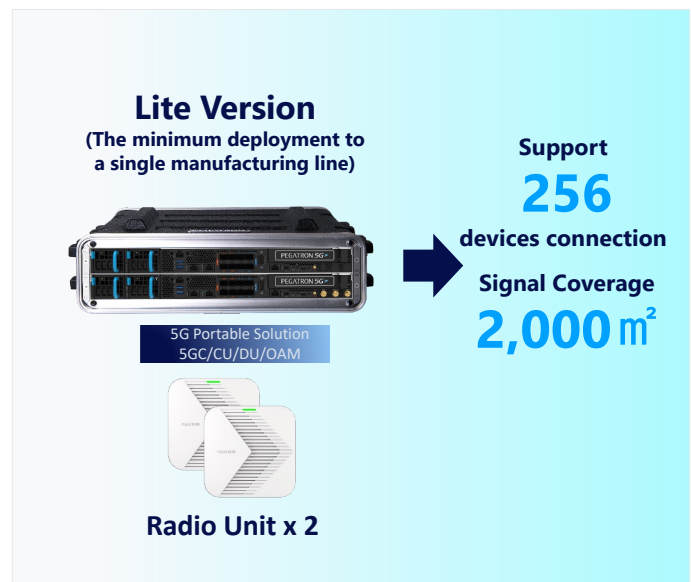


Figure 3. Pegatron 5G Lite Version private 5G solution.

The company offers several 5G core options to address various deployment and market needs. All of these solutions can run either on a server or in the cloud.

For radio connectivity, Pegatron 5G has developed two indoor 5G RRUs that operate in sub 6GHz frequency bands with 100MHz of bandwidth. The indoor model supports 3GPP Release 15 offering a multiple input- multiple output (MIMO) with 4T4R capacity. The outdoor RRU supports 3GPP Release 16 and delivers 4T4R MIMO.

The company has also developed a line of 5G devices, including a dongle that can be used to attach devices to the network and a 5G ultra-high definition (UHD) camera that supports both 5G and Wi-Fi connections to the network.

Powered by Intel Technologies

Pegatron 5G's RAN solutions are powered by Intel® architecture technologies including:

Intel® Xeon® Scalable processors

The edge network servers for the solution are based on Intel Xeon Scalable processors. These processors are the foundation for powerful servers that deliver compute agility and scalability. These CPUs benefit from decades of innovation for the most in-demand workload requirements and are part of a complete set of edge technology from Intel.

Intel Xeon Scalable processors feature a balanced architecture that supports AI and Open RAN with built-in acceleration and hardware-based security features. Other features for modern 5G network workloads target low latency, high throughput, deterministic performance, and high performance per watt.

Intel® Ethernet 800 Series Network Adapters

This solution requires a network interface card with precision timing synchronization. Pegatron selected the Intel Ethernet Network Adapter E810-XXVDA4T that offers support for both IEEE 1588 Precision Time Protocol (PTP) and Synchronous Ethernet (SyncE) methods. The E810-XXVDA4T's onboard high-precision oscillator maintains accuracy when the synchronization source is not available, providing up to four hours with less than +/- 1.5 microsecond of phase error.

OpenVINO™

OpenVINO is an open-source toolkit for optimizing and deploying AI inference. The toolkit boosts deep learning performance in computer vision, automatic speech recognition, natural language processing, and other common tasks. It is optimized for Intel architecture CPUs and can use models trained with popular frameworks like TensorFlow, PyTorch, and others.

Intel® vRAN Dedicated Accelerator ACC100

This accelerator card speeds up forward error correction (FEC) a mechanism designed to resolve data transmission errors over unreliable or noisy communication channels. FEC workloads are compute intensive so this accelerator can boost total system throughput in a significant way.

FlexRAN™ Reference Software

FlexRAN is a vRAN reference implementation that is used to efficiently implement wireless access workloads powered by Intel Xeon Scalable processors. FlexRAN is comprised of several modular, virtualized control functions with well-defined interfaces that allow flexible and programmable control of the layer 1 wireless infrastructure.

Intel® Arria® 10 FPGA

The performance needed for several of Pegatron's indoor RRUs comes from the Intel Arria 10 FPGA. These FPGAs deliver optimal performance, power efficiency and small form factor and are ideal for a broad array of midrange applications in communications, data center, military, broadcast, automotive, and other use cases.

Intel® QuickAssist Technology (Intel® QAT)

Intel® QAT provides hardware acceleration to assist with performance demands of applications such as 5G UPF, IPsec or TLS networking. Intel® QAT provides a vital accelerator of the cryptography needed for 5G networks. The technology also provides compression/decompression for storage, cloud, enterprise, database, or machine learning, while reducing storage footprint and reserving processor cycles for application and control.

Pegatron 5G Deploys 5G in Vietnam Factory

Pegatron 5G demonstrated the power of its private 5G solution in a deployment at one of its factories in Vietnam. The company worked with Vietnam's largest telecom company to build Pegatron 5G's first overseas all 5G smart factory in Hai Phong, Vietnam.

The network gave the factory broad-based connectivity to provide flexibility and mobility, high throughput, and low latency. It provides connectivity for a large number of devices and implements zero-trust security.

The network enabled the following applications:

Rapid deployment: Pegatron 5G values the ability to retool its factory for new product launches, remote site planning, production line optimization, and capacity expansions. The blanket connectivity provided by the network provides scalable expansion, minimal reconfiguration, and improved utilization. Pegatron5G also implemented a digital twin of the network to provide quick setup.

Vision AI: The network supports a number of video security functions including forbidden area detection, object detection, flame / smoke detection, and others. The 5G network provided the throughput needed to customize the wireless service for these applications.

Assembly monitoring: The network supports assembly procedure correctness detection, AI-based visual inspection, and next procedure guidance.

Augmented reality (AR) collaboration: The network supports the use of AR for real-time management for production line maintenance, inventory management, employee education, and handling emergency safety situations.

Future network applications include expanded edge computing infrastructure to support digital twinning for robots, expanded intelligent autonomous mobile robots (AMRs) as well as expanded connection capacity for added devices including CCD recognition, and more AI applications.

Specific benefits are shown in Table 1:

Use Cases	Features	Applications	Benefits
Rapid deployment — Dynamic production planning and execution	<ul style="list-style-type: none"> ▪ 5G wireless connectivity ▪ Quick setup by digital twins ▪ Scalable expansion ▪ Minimizing re-config time & ▪ Maximizing equipment utilization ▪ Big data collection, analysis, and ▪ Abnormal alert 	<ul style="list-style-type: none"> ▪ New product launch ▪ Remote site planning ▪ Production line optimization ▪ Capacity expansion 	<ul style="list-style-type: none"> ▪ Deployment cost saving — 50% ▪ Utilization improvement — 10%
Vision AI — Fast AI landing	<ul style="list-style-type: none"> ▪ Easy to setup ▪ Various AI integrated ▪ Reinforce pretrained AI models ▪ Customize your own service 	<ul style="list-style-type: none"> ▪ Forbidden area detection ▪ Face recognition ▪ Abnormal behavior detection (pose estimation) ▪ Object detection (safety obedience checking / flame detection / smoke detection) 	<ul style="list-style-type: none"> ▪ Labor cost saving — 50%
Assembly monitoring — Driving efficiency with AI	<ul style="list-style-type: none"> ▪ Assembly SOP correctness detection ▪ AI visual inspection of the product ▪ Next-procedure guidance 	<ul style="list-style-type: none"> ▪ Barcode / label auto-detection / inspection ▪ Component inspection (soldering / placement etc) 	
AR collaboration — Real-time management	<ul style="list-style-type: none"> ▪ AR dynamics 365 ▪ Assistance & collaboration anywhere ▪ Real-time monitoring & control ▪ Efficient troubleshooting and maintenance 	<ul style="list-style-type: none"> ▪ Production line maintenance and repair ▪ Inventory and logistics management ▪ Employee education and training ▪ Emergency safety situation handling 	<ul style="list-style-type: none"> ▪ Travel expense saving — 30% (via remote collaboration)

Table 1. Results of 5G deployment at Pegatron 5G factory in Vietnam.

Conclusion

As factories become digitized, many aspects of manufacturing, from production to product quality to maintenance and worker safety, can be revolutionized. Using private 5G networks that are based on Open RAN technology provides networks that deliver the throughput, low latency, and data security needed to power smart factories. Pegatron 5G's complete solution is Open RAN compliant and based on Intel technology which provides high performance and scale to meet the needs of a growing factory. The company has put this technology to use in a significant deployment at its factory in Hai Phong, Vietnam.

Learn More

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[Intel® Network Builders](#)

[Portable 5G Private Network Solution: Digital Resilience](#)

[Intel® Ethernet 800 Series Network Adapters](#)



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