Power and Energy Success Case Collection

- Intelligent Connectivity
- Industrial Automation
- Edge Computing
- Virtualization

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The Digital Transformation of Power

The power generation market is continually evolving worldwide, primarily due to the emergence of renewables and other distributed energy resources. Traditional generation relies on relatively few large centralized facilities, but today this is shifting to many small and widely-dispersed assets.

The old model for power generation was simple: build big baseload facilities, primarily fossil-fueled, with large-scale hydro in areas where it was possible to build huge dams. Today's new reality still requires utilization of some baseload facilities, but these are increasingly being supplemented or replaced by renewables.

Electrical substations are the nerve center for transmission and distribution operations, providing required real-time monitoring and control, along with coordination between generation facilities and points of use. Automated processes and future-proofed infrastructure upgrades help reduce risks and achieve a cost-effective, resilient electrical grid.

Advantech provides industrial solutions for monitoring and controlling distributed energy resources, substations, and more. These energy solutions support necessary protocols for communication with field devices, additional generation sites, substations, and centralized dispatch centers. Here, we have collected a range of real-life use cases to show these solutions in action.

Substation Operation:

Upgrading Substation Power Equipment with Automation Computers

With new technological innovations in the field of power equipment, traditional substations are rapidly applying information technology for enhancing operation management efficiency. To implement a SCADA system to replace traditional manual operation management, the system needs to process massive amounts of information.

System Requirements

A leading system integrator specializing in power monitoring solutions for substations needed to overhaul its power equipment operations and maintenance management system. The company used SCADA software

developed by Brazil's Elipse Software to implement a distributed control and centralized management system. To ensure the system did not lag from overloading, the company proposed the following hardware requirements:

1. A sturdy and durable industrial computer complying with the IEC 61850-3 power standard.
2. Sufficient computing performance for a range of SCADA functions.
3. A variety of I/O interfaces and flexible expansion options to connect with base-layer equipment and devices.
4. An RTU capable of carrying out data collection and control for non-networked devices.

System Description

The solutions provided by Advantech—the ECU-4784, an IEC 61850-3 certified power automation computer, and the ADAM-3600, a multi-channel intelligent remote terminal unit—integrated with Elipse SCADA software and met the hardware requirements.

Substations consisted of two categories: those that supported IEC 61850 network signals and those that did not. Advantech obtained information by connecting devices that did not support the protocol through the ECU-4784 network port to the monitoring center.

The ADAM-3600, installed on-site, collected device information—which did not provide network interfaces—and converted the data into DNP3.0 communication network signals before uploading to the ECU-4784.

The ECU-4784, installed with Elipse SCADA software, collects data and performs system administration. When an abnormal incident occurs, the IED automatically shuts down and the ECU-4784 receives a signal, helping users implement rapid emergency response. To dispatch power during peak periods, users can issue start and stop commands directly from power equipment and devices through the ECU-4784.

ECU-4784

IEC 61850-3 Certified Power Automation Computer

- Intel 6th/8th/9th Core and Xeon Processors
- Isolated 8 x LAN, 10 x Serial Port Communication Interfaces, 2 x I/O Expansion Slots
- Fan-less operation for optimal reliability
- Programmable LEDs
- Intelligent Connectivity Diagnosis Management
- Remote Management

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ADAM-3600

Wireless Intelligent RTU

- Domain Focused Onboard IO -8AI / 8DI / 4DO
- High I/O Flexibility with 4-slot I/O Expansion
- Modbus & DNP3 Protocol
- IEC 61131-3 & C Programming Language

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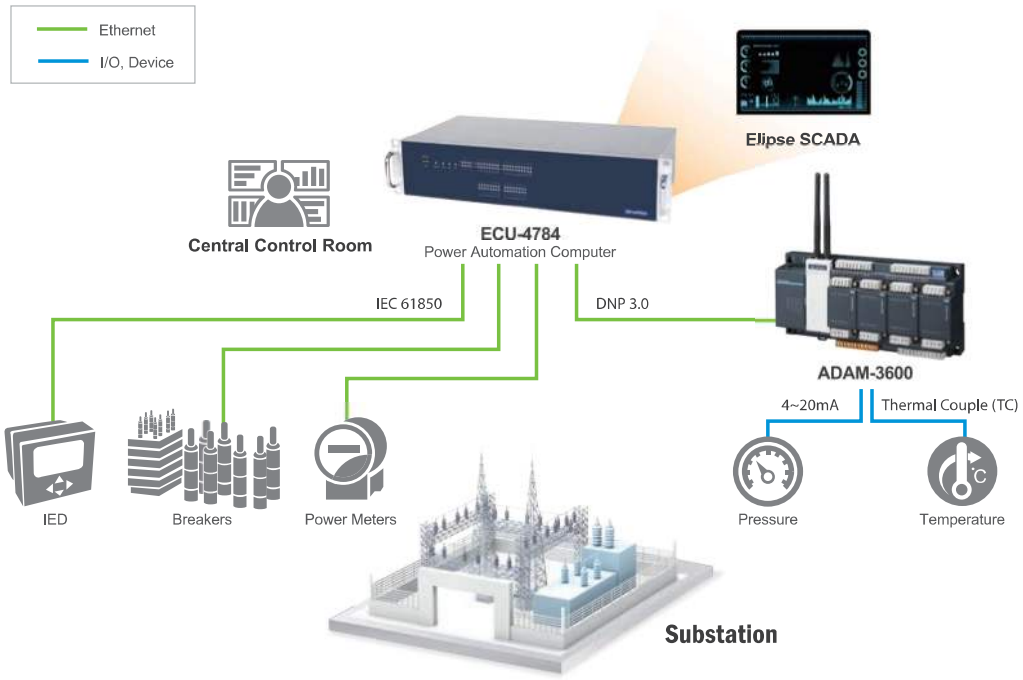
System Diagram



Remote Devices:

Intelligent Power Distribution Cabinet Solution Optimizes Remote Management

Low-voltage power distribution cabinets are the basic equipment in power transmission and distribution projects. Unexpected shutdown or abnormal operation may result in huge economic losses.

For power distribution devices located in remote areas, maintenance and usage safety cannot be effectively guaranteed. Intelligent control is the only way to maintain operational integrity for critical operating equipment, enabling users to quickly understand usage statuses and efficiently manage equipment lifecycles.

System Requirements

A leading company in the low-voltage electrical industry, Zhejiang Tengen Electric Co., LTD. is committed to offering customers intelligent solutions. In recent years, Tengen saw market demand change from a previous emphasis on pure products into a growing need for overall solutions. The solutions often required additional integration for large amounts of equipment, which were not easily connected.

The cost for the digitalization of power distribution cabinets was high, making it difficult to gain popularity. In the process of upgrading and connecting the products to the network, Tengen required industrial-grade wireless gateways that could coexist with MQTT, a popular IoT protocol, and power standard protocols.

System Description

Advantech's technical team developed a system plan: first, install an ECU-1251 edge industrial communication gateway on each low-voltage power distribution cabinet. The next step was utilizing the communication interface of ECU-1251 to collect data on the operating status data of the cabinet.

Then, it directly transmits data to the cloud via built-in wireless LTE communication. Finally, the solution gathers collected data into a report for users to see real-time statuses and predict potential abnormalities.

ECU-1251

RISC-based Industrial Communication Gateway

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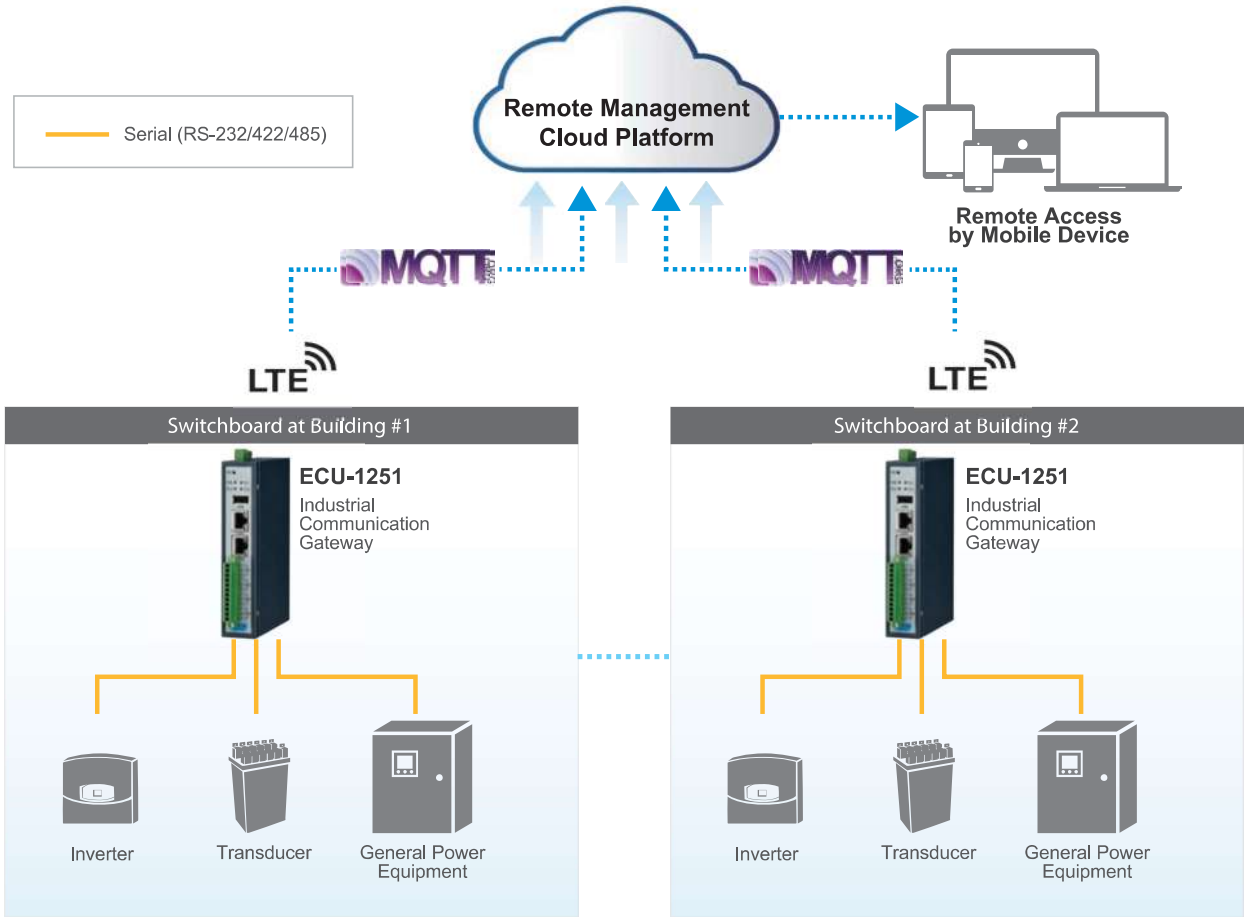
The ECU-1251 is a RISC-based edge intelligent gateway that supports Ethernet communication, Wi-Fi, and GPRS/3G/4G wireless communications. Each serial port has isolation measures to ensure stable and accurate data. Support for communication protocol, IEC 60870, and IoT-specific lightweight MQTT, allows the ECU-1251 edge intelligent gateway to collect deployed switchboard *and* equipment operation data.

Advantech's intelligent power distribution cabinet solution reduces manual detection errors, allowing end customers to understand and monitor equipment statuses during use.

System Diagram



Smart Substations:

Flexible Platforms Help Improve Reliable Smart Substation Automation

Massive smart grid plans in China aim to improve existing electricity grid efficiency, manage power demands to avoid outages and overloads, expand to provide electricity to rural areas, and connect power-generating facilities to more heavily populated areas. Its traditional substation system was unable to meet control and monitoring requirements for a smart grid system. In order to improve efficiency and ensure secure operation, a new intelligent system with robust computing platforms is critical in maximizing performance of existing assets and making the grid resilient against disruptions.

System Requirements

For the new smart substation, the system integrator implemented the Advantech ECU-4784 series that is TUV IEC 61850-3 and IEEE 1613 certified for high reliability and stability in global power automation. With a fan-less and robust design, flexible expansion, rich communication interfaces, and intelligent functions, the ECU-4784 industrial computer is are ideal for smart substation applications.

Additionally, the EKI-9226G managed Ethernet switch is designed for power substation automation and also meets IEC 61850-3 and IEEE 1613 certifications. The EKI-9226G series contains dual power inputs to ensure system stability and two relay outputs for greater flexibility.

ECU-4784

IEC 61850-3 Certified Power Automation Computer

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EKI-9226G-20FOI

IEC61850-3 20G SFP + 6GE Managed Ethernet Switch

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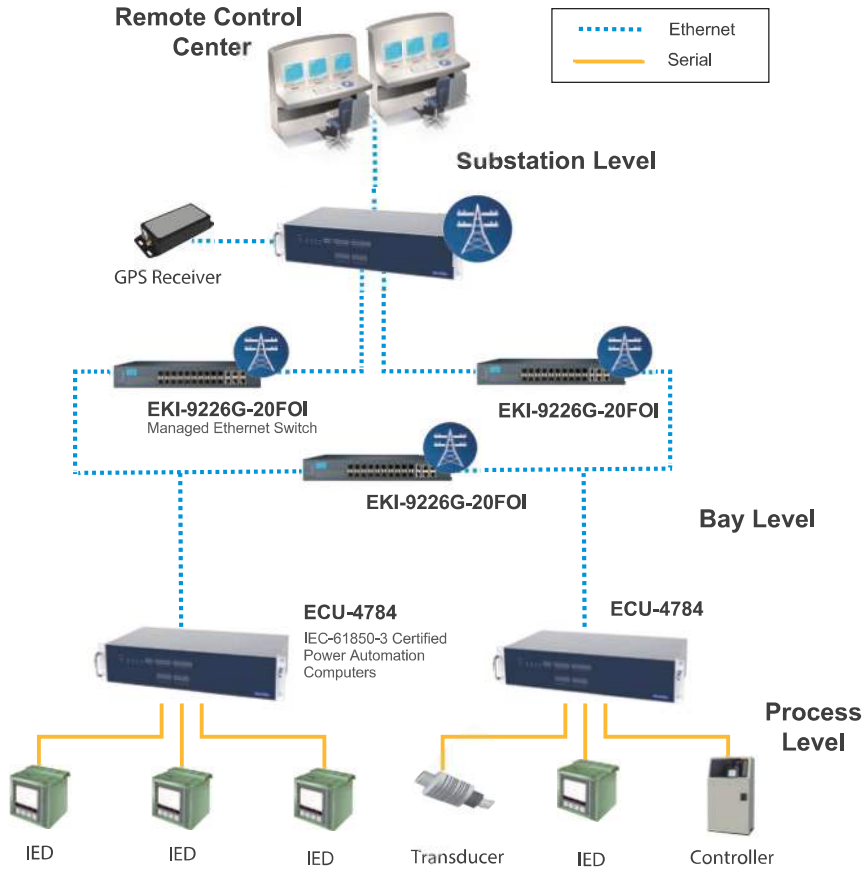
System Diagram



Substation Virtualization:

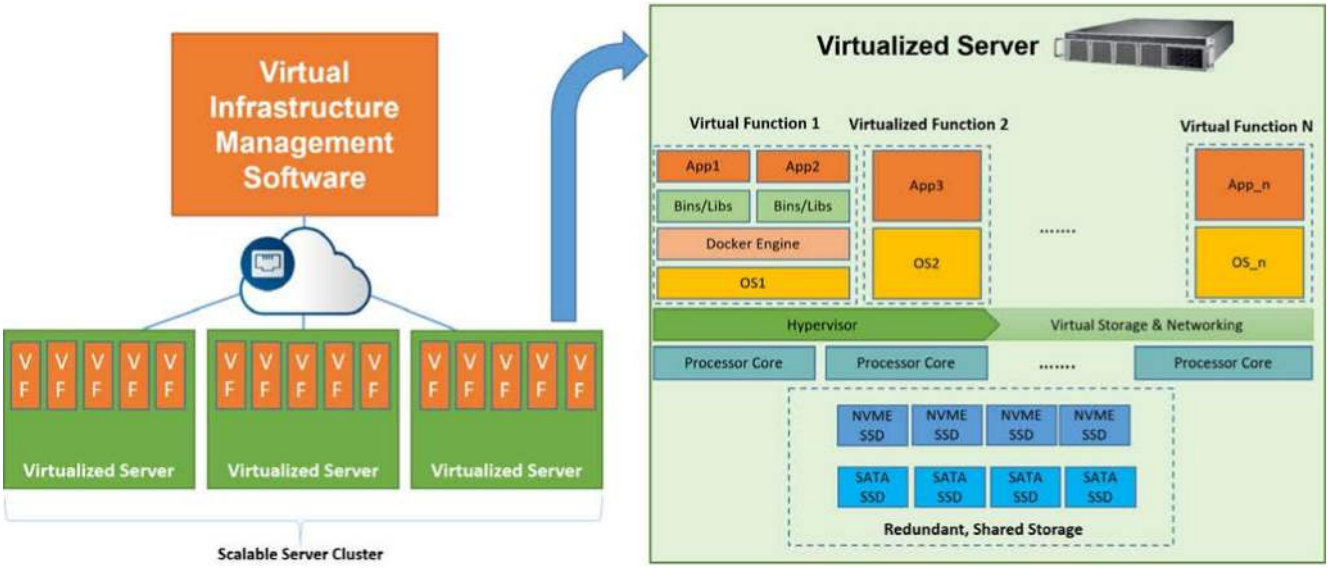
Reduce OPEX by Improving Security, Agility, and Manageability with Virtualization

Mission critical grid equipment, as well as supporting infrastructure, is becoming more digitized, utilizing modern servers and communications networks. Like the enterprise before them, substations are primed for a virtualization transformation. Virtualization adds a layer of software enabling functions encapsulated in virtual machines (VMs) or "containers" (e.g. Docker). This allows applications to securely share a server and flexibly migrate between servers organized in variable size groups, called clusters.

A substation may dedicate redundant server clusters to critical, real-time applications, such as protection relays, to pool less-demanding, general support applications on their own cluster. Storage shared between servers helps enable application migration within a cluster. The virtualization layer, typically residing in hypervisor software, enhances security by isolating applications and controlling access to hardware resources. By scaling this model to a full private, edge cloud, the substation owner can coordinate operation of an entire grid.

With increasing cyber-attack risks and growing power flow complexities, virtualization offers a compelling business case. Benefits include saving control room space by sharing servers between applications; reducing maintenance costs through automation and remote management; and adding agility to flexibly allocate resources to different tasks as workloads change. To solve substations requirements for real-time control, active-active redundancy, and environmental certification, Advantech designed a purpose-built, scalable server for substation virtualization, the ECU-579.

Software-Defined Substation



System Requirements

A utility customer implementing substation virtualization needed an automation server platform that allowed for the combination of virtual communication and virtual automation. The solution also needed to be extensible and scalable to accommodate growth of substation size and adding future functionality. Advantech suggested its scalable ECU-579 automation server, a substation-certified computer capable of handling all virtualized applications in a substation (in both Windows and Linux) including real-time appli-cations. With TUV IEC 61850-3 certification, the ECU-579 provides high reliability and stability for substation protection and control systems.

Additionally, end users can remotely manage software upgrades for large numbers of substa¬tions while maintaining availability through redundancy implemented with hot-swappable components. Overall, the upgraded system benefits from economies of scale, modularity, and greater efficiency. It also allows for easy replication of the virtual architecture in new substations added to the grid.

ECU-579

IEC-61850-3 Certified Power Automation Server

- 2U rack mount server with an wide operating temperature
- Intel® Xeon® Processor Scalable Family
- Scalable CPU 24/20/14/8 Core (150W/125W/85W/70W)
- 12 x DIMM sockets support up to 768GB DDR4 1600/1866/2133/2400/2666MHz SDRAM (ECC/RDIMM/LRDIMM)
- Up to 2 x hot-swappable PSU and 4 x hot-swappable fan for redun-dancy

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Distributed Energy Sources:

Performance and Reliability for Power Distribution Centers in Harsh Environments

Intelligent control is an ideal method to manage equip-ment life cycles and reduce manual detection errors dur-ing the flow of power. Robust connectivity technology, designed and built for harsh locations, ensures reliable power distribution, balanced loading, and network com-munication.

In the case of power distribution centers, a variety of en-vironments and applications must be supported, includ-ing in locations with harsh environmental conditions. They also can be installed on many different structures to house electrical equipment for power distribution. However, numerous consumption variables can lead to undesirable unbalanced power distribution. A balanced loading of the electrical grid is critical to reduce technical losses and improve efficiency of energy resources.

System Requirements

A recent customer needed to ensure reliable operation and performance for power distribution centers in remote, harsh environments. Power uptime was especially important, driving a need for high reliability in critical applications. Productivity, effective cost management, and safety were main customer concerns. With industrial hardware from

Advantech, the customer can ensure performance and reliability of its PDC.

For electricity-related applications that require a total wireless and Ethernet communication solution, Advantech suggested its ECU-1251, a RISC-based industrial communication gateway. Additionally, an ICR-3241 LTE gateway was deployed to connect IP and/or serial devices to a cellular network. With LTE Cat.4 upload speeds of up to 50 Mbps, and download speeds of up to 150 Mbps, the router provides ample bandwidth for high data demands.

ICR-3241 LTE Gateway

- 4G LTE Cat.4 VPN Gateway for Industrial IoT applications
- LTE B2, B4, B5, B12, B13, B14, B66, B71
- Carriers support; Verizon, AT&T, T-Mobile, FirstNet (Public Safety)
- Powerful CPU with 1.3 GB storage to host customer SW applications

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ECU-1251

RISC-based Industrial Communication Gateway

- TI Cortex A8, 800MHz
- 4 x RS-232/485 isolated serial ports
- 2 x 10/100 Base-T Ethernet ports
- 4G LTE Cat.4 VPN Gateway for Industrial IoT applications
- Supports web service for remote monitoring
- Supports SD card & on-line firmware updates
- Supports Modbus, IEC-60870-101/104 protocol
- Supports data logger on SD card

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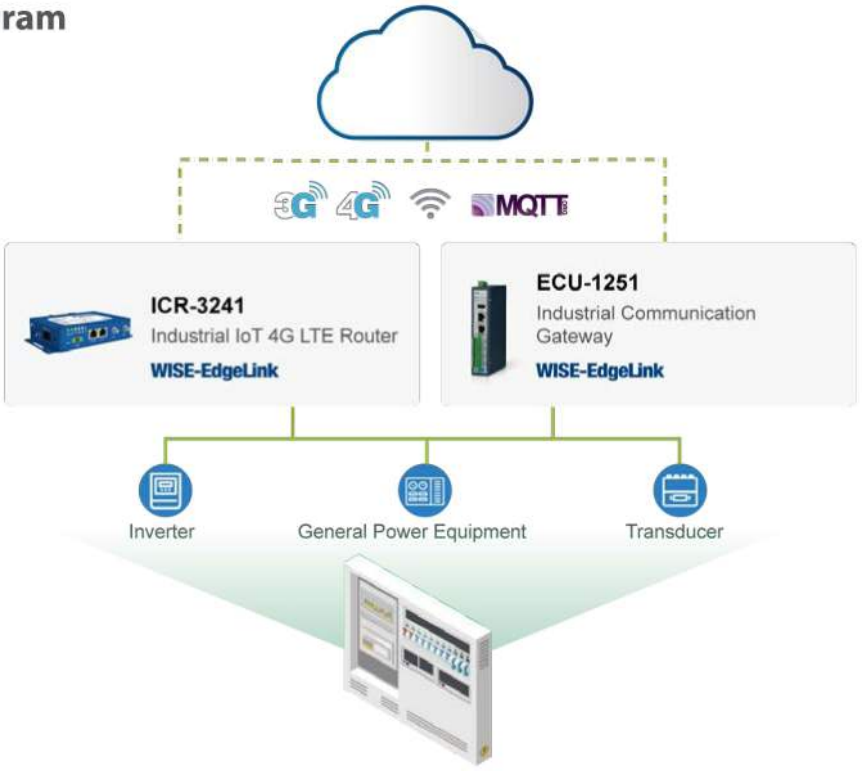
System Diagram



Further Reading

- Virtual Protection Relay System for Substation Transformation and Modernization
- Electric Grid Modernization Challenges: The Importance of Implementing Edge Intelligence for Active Grid Management
- White Paper: Modernized Grids Require Substation Virtualization
- Data Collection at the Edge—a Full-Circle Approach to Digital Transformation
- Connecting Remote I/O Devices Over Any Distance with Cellular

Contact Us to Learn More

Want to talk to us about Power and Energy product solutions and application support?
E-mail us at Energy@Advantech.com and our team will be happy to help.

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