

Field Communications Overview: What We Have, How to Use it and How to Configure with External Devices

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Field communications is an advanced technology that replaces centralized networks with distributed control levels. Fieldbus serves as an upgrade of point-to-point links, providing various field communication products for multiple purposes and sites.

Modern field communication devices offer two-way, multi-drop links between isolated intelligent devices, including [power and temperature controllers \(/en/products/controllers\)](/en/products/controllers), [thermocouples \(/en/products/sensors/thermocouples\)](/en/products/sensors/thermocouples) and other heating products. In some cases, these connections involve single master/multiple slave systems, where a master device links and controls multi-slave devices to and from a centralized communications hub.

Types of field communications products

Modbus® TCP

Modbus® is a popular communication protocol applied across various industries. The Modbus® TCP is an upgrade of its previous RTU settings, providing users with Ethernet (TCP/IP) functionalities compared to limited serial communication settings.

Modbus® TCP incorporates seamlessly with current infrastructures via RJ45 wiring, enabling easy scalability and fast data transfer speed. Users can conveniently set up a Modbus® TCP system within hours through driver configurations. Engineers developed the Modbus® TCP in 1979 as an updated communication solution (via LAN infrastructures) between programmable controls and sensors. The improved Modbus® technology significantly increased the limit of connected devices from an estimated 240 (RTU capabilities) up to over 16 million.

In terms of disadvantages, the Modbus® TCP features discrete data pulls. Additionally, the device depends on requested data (without reports by exception) and a continuous connection.

DeviceNet™

Founded in 1999, DeviceNet™ runs as an application layer on top of a CAN chip through twisted-pair wiring. DeviceNet™ manages implicit and explicit messages at an affordable cost, and the device receives wide usage across various industries with high reliability. DeviceNet's low cost and simplicity make it a viable option for facilities that eliminate costly hard-wiring processes while providing accurate diagnostics on a device-level.

DeviceNet™ also enables users to configure multiple devices across a network in real-time and record the configurations for future use.

On the downside, DeviceNet™ has limited bandwidth and message size, which restricts use to smaller communication systems. Additionally, DeviceNet™ functions with a limited cable length, making it unsuitable for more complex facility set-ups that span across a wide area. Some users report errors related to incorrect EDS (electronic data sheet) files, leading to technical issues.

EtherNet/IP™

EtherNet/IP™ is the commonly applied standard for most PLC (programmable logic controller) devices. ControlNet founded the technology in collaboration with ODVA in the 2000s and remains a widely accepted field communication choice. EtherNet/IP™ offers a certifiable standard to ensure that field devices meet industry consistencies and quality.

One of the standout features of EtherNet/IP™ involves its transport control protocol (TCP), which helps users organize disparate but connected devices for convenient access via a shared control hub. Additionally, EtherNet/IP™ functions with a fast cycle rate, optimizing I/O data transfers up to 1 ms cycles.

In terms of disadvantages, the EtherNet/IP™ functions with limited bandwidths (at a maximum size of 500 bytes per data packet). EtherNet/IP™ lacks general diagnostic features, which reduces the effectiveness of troubleshooting.

Profibus DP

Profibus DP (decentralized periphery) is one of the most widely used fieldbus standards across production industries. Founded in 1989 by BMBF (German department of education and research), Profibus functions with high speed and reliability, and is commonly applied in industries across Europe. Engineers and OEMs often use Profibus DP to operate various peripherals (i.e., actuators and sensors) from a centralized hub with an easy plug-and-play feature.

There are about 13 million nodes of Profibus installed worldwide, with 2.1 million coming from the process industries, possibly as a result of the support received from controller suppliers.

The disadvantages of the Profibus DP include low data bandwidth limits (at 244 bytes per node) and costly installation fees, including the price of cable and distance extenders.

ProfiNet®

Siemens® designed the ProfiNet as an industrial variant of the Profibus DP. The technology provides a wide range of advantages, including high-speed performance, implicit messaging functions and enhanced reliability due to its deterministic protocols. ProfiNet also comes equipped with energy-saving features that turn off unused devices and production units.

Additionally, ProfiNet's ultra-speed capabilities enable users to communicate via field devices in real-time to achieve synchronized motion and improved efficiency. The device also provides high-availability installation, either through external switches or integrated programs.

ProfiNet's real-time capabilities enable users to power multiple protocols across single paralleled networks. On the downside, ProfiNet is incompatible with some PCs/PLCs in the industry, requiring users to seek alternate solutions.

CAN Bus

CAN (controller area network) Bus provides users with master-to-master communication and requires minimal wiring set-up costs. Additionally, the device is highly flexible and easily incorporated into various project sites. CAN Bus significantly reduces the complex wired systems found across multiple industries (i.e., automotive, heating, etc.) and provides users with an auto retransmission of messages with lost attribution values during a system fault.

In terms of cons, CAN Bus has a limited wired length of 40 meters and is highly sensitive to voltage changes. Additionally, CAN Bus software management and processes may lead to high expenditure. The system also does not enable users to remove nodes without termination resistors.

EtherCat®

EtherCAT® (Ethernet for control automation technology) is an upgrade of the Modbus® RTU, improving communication quality between programmable controls and sensors, specifically for industrial automation operations. In addition to physical Ethernet advantages, EtherCAT® uses a unique set of protocols, where the master device is the only node authorized to deliver a frame, which significantly fine-tunes real-time operability while reducing bandwidth demands.

Establishing the right communication

Ultimately, all field communication options feature their pros and cons. OEMs and design engineers can discover the most suitable device by considering their specific project needs alongside factors like industry type, topology (system layout), number of connected devices and data speed.

Watlow is a trusted international supplier of quality heating products. Our comprehensive inventory of products includes [power and temperature controllers \(/en/products/controllers/\)](/en/products/controllers/), [PID controllers \(/en/products/controllers/temperature-and-process-controllers/\)](/en/products/controllers/temperature-and-process-controllers/), [thermocouples \(/en/products/sensors/thermocouples/\)](/en/products/sensors/thermocouples/) and other optimized field communications devices. We believe in providing leading technology for a future powered by possibility.