

Ethernet for Process Automation

A Concept Study



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 **PEPPERL+FUCHS**

Bringing Ethernet to the Process Industry – our Contribution to Industry 4.0

The one thing necessary for Industry 4.0 is an open digital network that connects all intelligent devices to create the “Industrial Internet of Things” (IIOT). Ethernet for process automation brings this vision to process industries: the data communication infrastructure from system levels down to the field devices.

The Status quo

In traditional automation architectures, devices are connected directly through various communication technologies to control systems. The control systems are connected to business networks to exchange non-process-critical information. More and more devices such as sensors and actuators that support IP communication allow you to send information directly to IT-based applications. These applications support the life cycle management of devices and installations.

IP communication technology uses various Ethernet physical layer standards. But all too often, today's Ethernet physical layers are unsuitable for use in process automation. It does not meet basic process requirements such as support for long cable lengths and robust cabling with power on the line, and use in hazardous areas. Fast-moving innovation cycles common to standard IT-based technologies tend not to fit the long development cycles of industry suppliers and the long lifetime of process installations.

Main technical characteristics

- 2-wire infrastructure, communication and power over one pair of wires
- Maximum cable length of 1200 m between the control room and field devices
- Use of standard PROFIBUS PA/FOUNDATION fieldbus cable
- High communication bandwidth up to 10 Mbit/s
- Use in hazardous areas, support of intrinsic safety, intrinsically safe concept similar to FISCO

Future requirements

Based on a concept study on the limits of today's Ethernet technologies, Pepperl+Fuchs has performed a new physical layer that maintains the advantages of standard IT Ethernet communication and industrial protocols such as EtherNet/IP and PROFINET in field devices.

As a result of this concept study, the setup shows some of the benefits of seamless IP-communication to the field level.

The device description and product documentation is stored directly in the field devices. Access to the information is possible through web services with standard mobile IT infrastructure. Device tools like PACTware upload FDI packages that you can use to instantly access device information.

Given the long life cycles of process installations, classical and IP-based technologies can coexist for a long time. Integration and migration of dominant digital networks such as 4 – 20 mA HART, PROFIBUS PA, and FOUNDATION fieldbus is an important aspect to consider. The solution features the direct integration of classical fieldbus devices into the new IP-based communication infrastructure.



Key Benefits

One unifying Ethernet communication network infrastructure throughout all system levels

- Integration of devices with different bandwidth requirements into one homogeneous Ethernet network (remote I/O, analyzers, pressure, flow, temperature, etc.)
- No more configuration of gateways or proxies between different network solutions
- Compatible with all Ethernet protocols like PROFINET, EtherNet/IP, HART over IP, HTTP, TCP, etc.
- Low power consumption leads to simple, cost-effective field device implementation
- More power for field devices enables the design of new 2-wire device functions

High communication bandwidth

- Device description (e.g., FDI packages) and documentation can be stored directly in the devices
- Faster commissioning, e.g., parameter upload and download
- Web-browser-based configuration
- Higher process data update rates

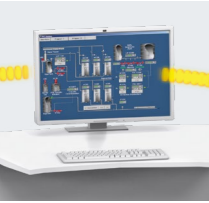
Reliability/availability

- Intrinsically safe for use in hazardous areas Zone 2/Div. 2, Zone 1/Div. 1, and Zone 0
- Fault tolerant due to switched topology, field devices are electrically decoupled
- Live maintenance at the field device without affecting availability
- Redundancy for cable and infrastructure components

Easy migration from digital networks to the new Ethernet-based system

- Compatible with PROFIBUS PA and the FOUNDATION fieldbus physical layer
- Integration of 4 – 20 mA HART devices into the Ethernet network
- Existing cable infrastructure can be reused
- Topology capabilities are identical – only the infrastructure components need to be changed

The Demonstrator Network Infrastructure



PC

PACTware, the open and manufacturer-independent device configuration tool, in combination with iDTM-FDI from the company CodeWrights, allows you to scan the topology and automatically upload the FDI-packages stored in the individual devices. The FDI packages allow efficient and economical device integration into host systems.



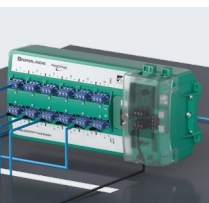
Tablet

The Tablet, connected via a wireless access point to the Ethernet backbone, allows access to the web servers integrated in the field devices and switches. The web servers provide documentation such as manuals, data sheets, hazardous area approvals, calibration certificates, and FDI packages. Additionally, device information, process data, and diagnostics are available.



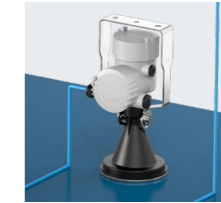
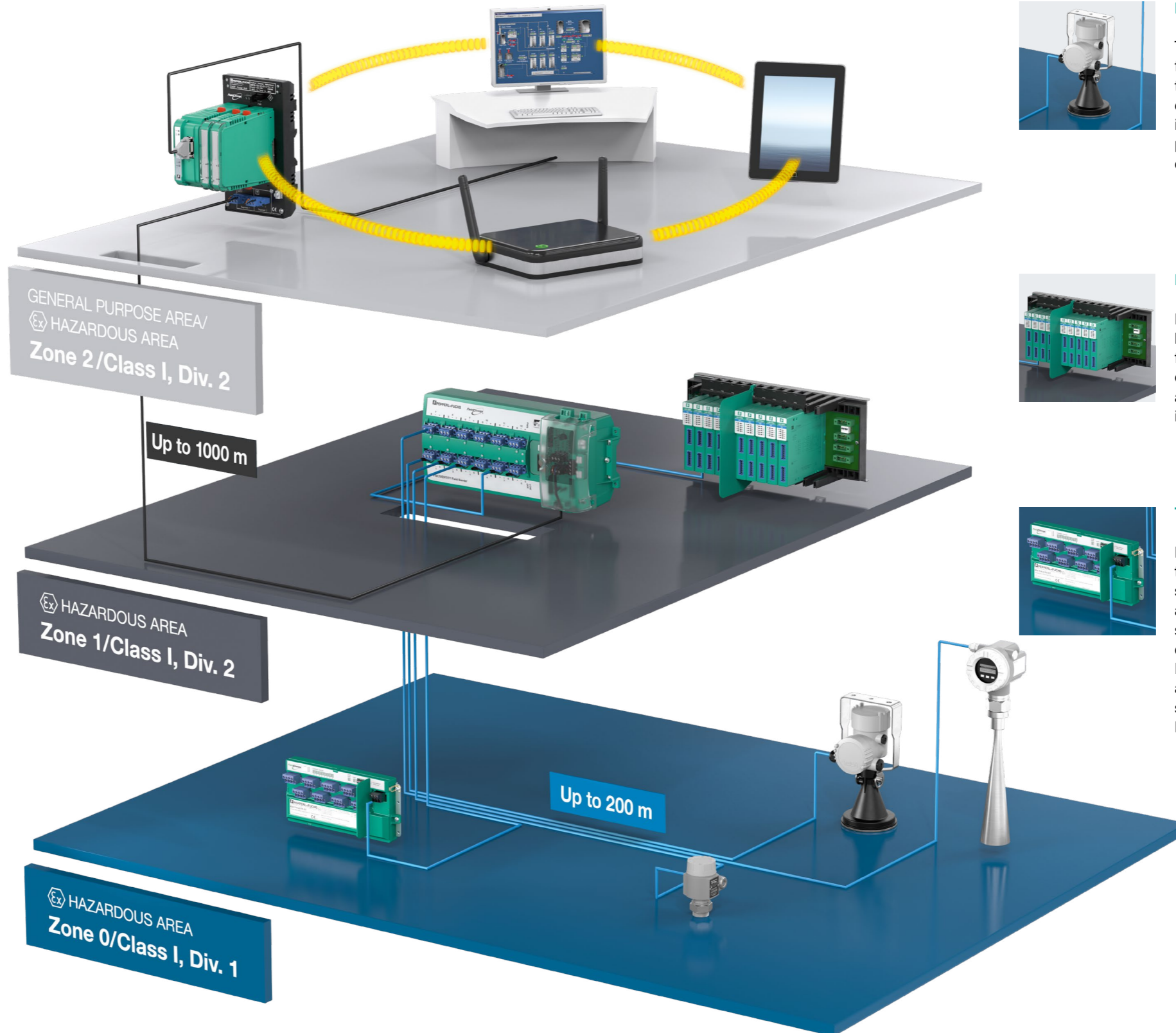
Ethernet switch

An Ethernet switch provides connectivity to all standard Ethernet networks. The switch includes power supplies that provide power for field switches and connected field devices. Optionally, the switch and power supply can be redundant.



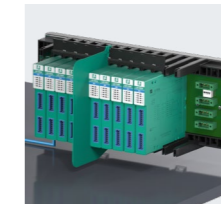
Field switch

The field switch provides intrinsically safe power (up to 1.1 W per port) and connectivity for the field devices. Each port is physically isolated so that faults on one port do not influence adjacent ports. The field switch is loop powered by the Ethernet switch.



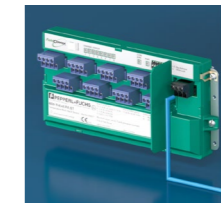
Field device

The economical design of simple process field devices like pressure and temperature transmitters is supported. Even if the communication bandwidth of the devices is increased to up to 10 MBits/s, the power requirement is less compared to currently used fieldbus devices.



Remote I/O

Devices that require higher power and bandwidth can be connected to the field switch. Simple devices and complex devices such as remote I/O systems, analyzers or cameras can be integrated into one homogeneous network.



Temperature multiplexer, PROFIBUS PA

For easy migration from today's fieldbuses to the Ethernet-based system, the field switch supports new IP-based devices as well as PROFIBUS PA devices at the same port. The switch detects automatically the type of device connected to it. In the case of a PROFIBUS PA device, an internal proxy is activated which represents the PROFIBUS PA device as a PROFINET device on the Ethernet level.

The topology of the demonstrator

The "Ethernet for Process Automation" network can be connected to any Ethernet IEEE 802.3 based network by using a switch. This switch provides 2-wire ports with integrated power feeding having communication and power over the same pair of wires. Standard fieldbus cable connected to the 2-wire ports will lead into the hazardous area, where field switches are connected to. The field

switches provide intrinsically safe 2-wire connection for IP-based process field devices such as simple temperature transmitter or remote I/O systems. The same ports are also supporting the direct connection of standard fieldbus devices. The entire infrastructure is loop powered requiring no external power.

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Explosion Protection

- Intrinsically Safe Barriers
- Signal Conditioners
- Fieldbus Infrastructure
- Remote I/O Systems
- HART Interface Solutions
- Wireless Solutions
- Level Measurement
- Purge and Pressurization Systems
- Industrial Monitors and HMI Solutions
- Electrical Explosion Protection Equipment
- Solutions for Explosion Protection

Industrial Sensors

- Proximity Sensors
- Photoelectric Sensors
- Industrial Vision
- Ultrasonic Sensors
- Rotary Encoders
- Positioning Systems
- Inclination and Acceleration Sensors
- AS-Interface
- Identification Systems
- Logic Control Units