Ethernet to the Field of Process Plants

Ethernet-APL: Smart, Fast, Digital

The Data Highway for endless Possibilities

CINI4.0 Conference Day
16/06/2022, Gent

Endress+Hauser
People for Process Automation

Presenter

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Endress+Hauser Digital Solutions

Reinach, Switzerland

Marketing Manager Industrial Communication

Agenda

1. **Why do we need a new technology for the field level?**
2. Details about Ethernet-APL
3. Added value with Ethernet-APL
4. Endress+Hauser activities

Trends in Automation Industries

Digitalization

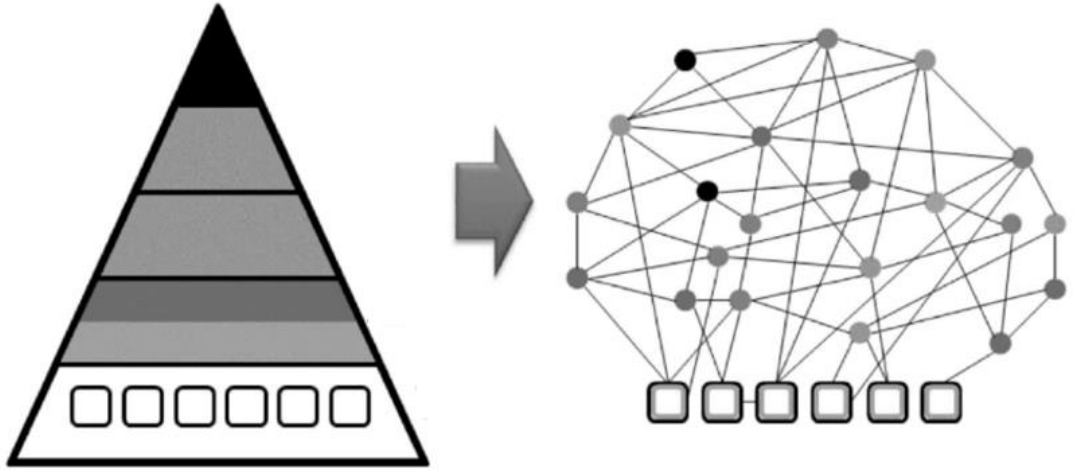
Industry 4.0

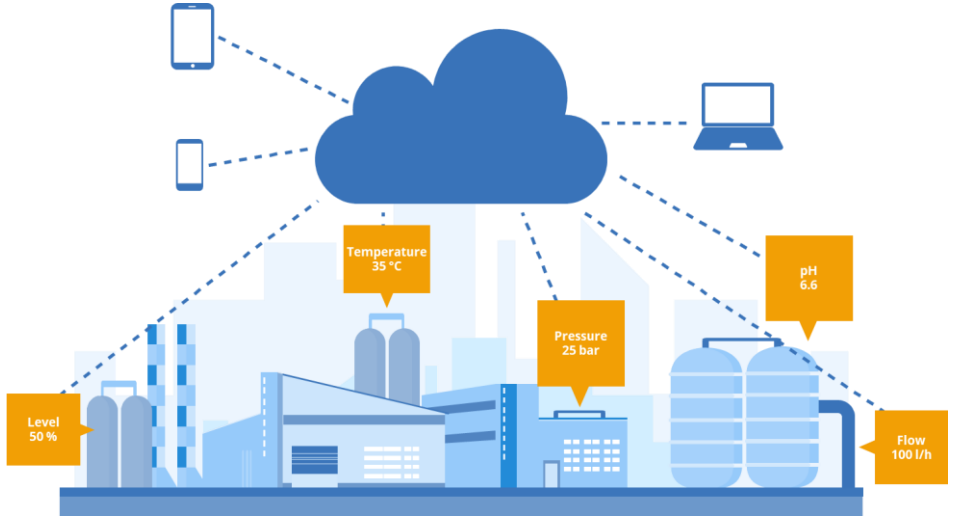
IIoT

NAMUR Open Architecture

Data-driven decisions

2nd channel





It’s all about seamless data access to the field level!

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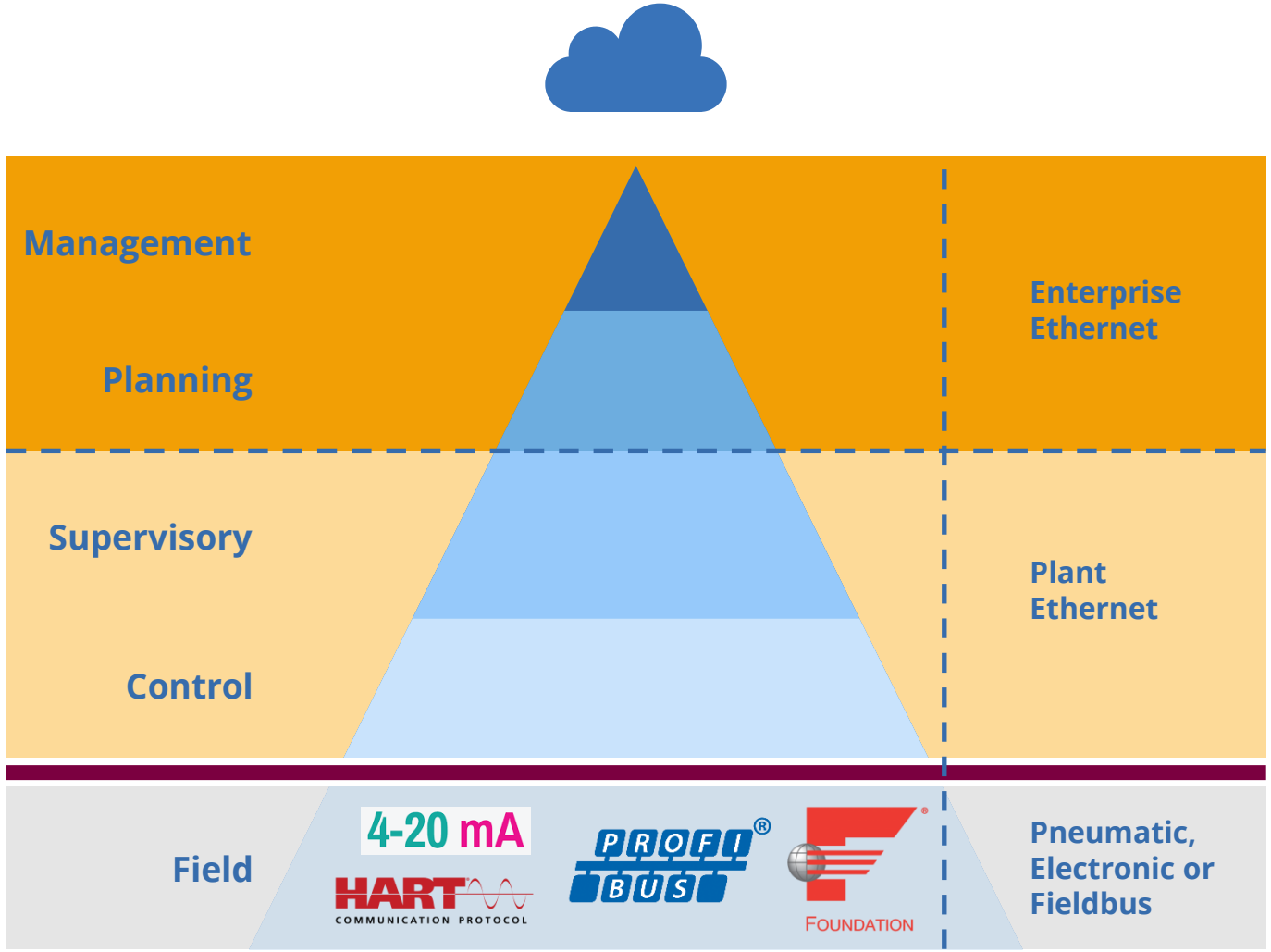
Ethernet gap in the field of process industries



Current technologies in the field level have limitations:

- Complex engineering / troubleshooting
- Protocol conversion required
- Low speed
- No seamless data access
- Device driver handling

For digitization and data-driven applications, one single network technology is required

Ethernet-APL in a nutshell

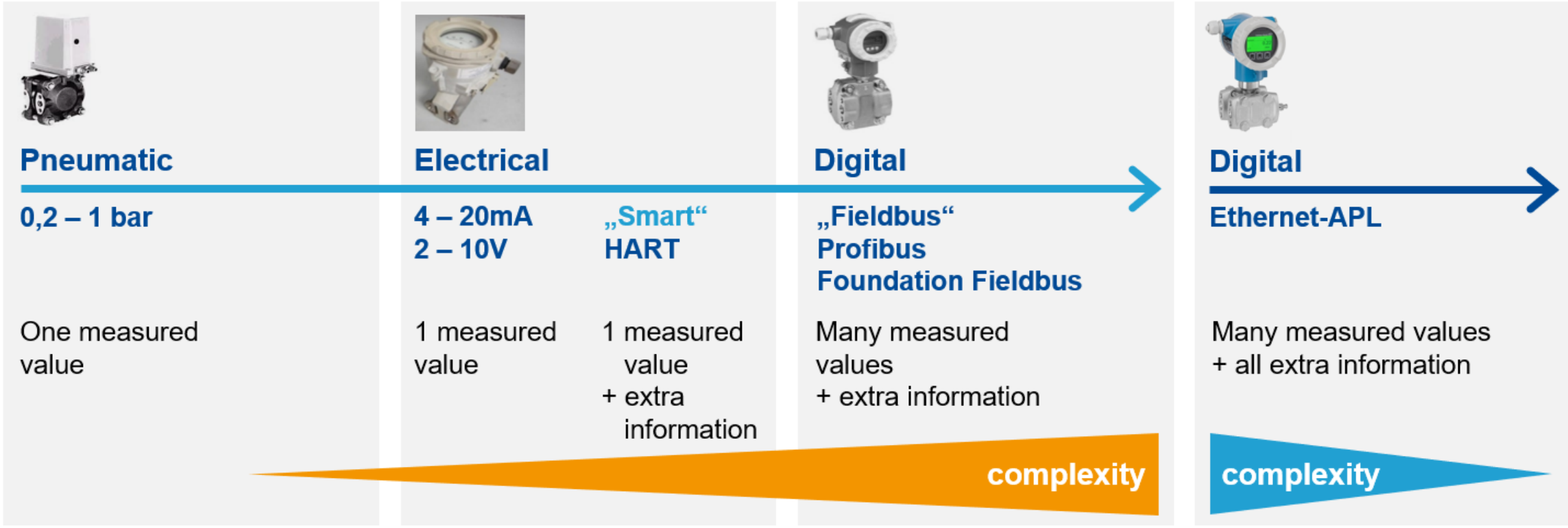
Organization Ethernet-APL Project

- Cooperation of standard organizations and industry partners
- All specifications and guidelines finalized
- Technology launch in 2021

Key characteristics of Ethernet-APL

- Power and data via 2-wire cable
- Ethernet speed with 10Mbit/s full-duplex
- Hazardous area protection including Ex ia
- Open for any industrial Ethernet protocol

Evolution of Technologies in the field level



Source: Seintsch / Pelz (NAMUR)

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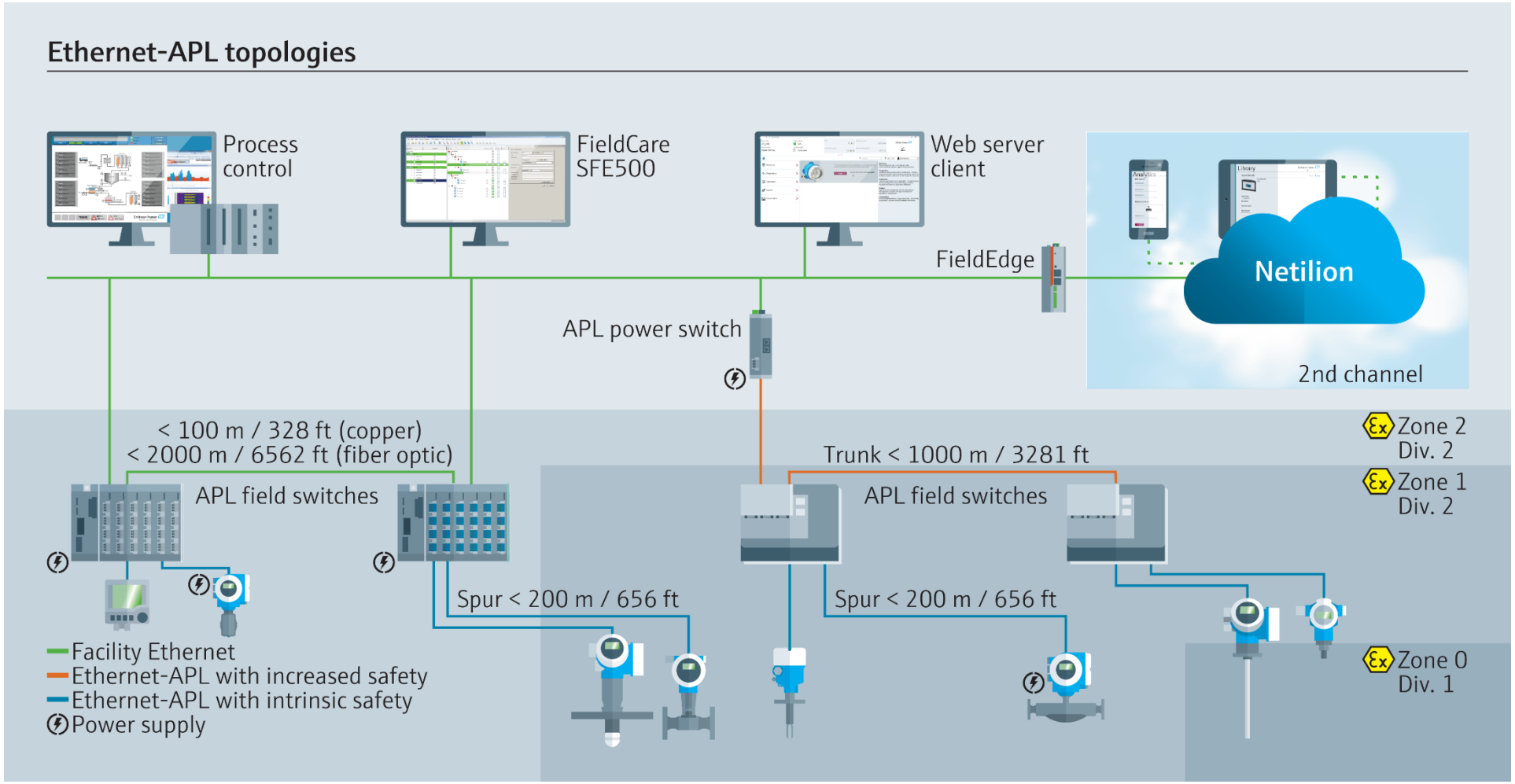
Topologies with Ethernet-APL



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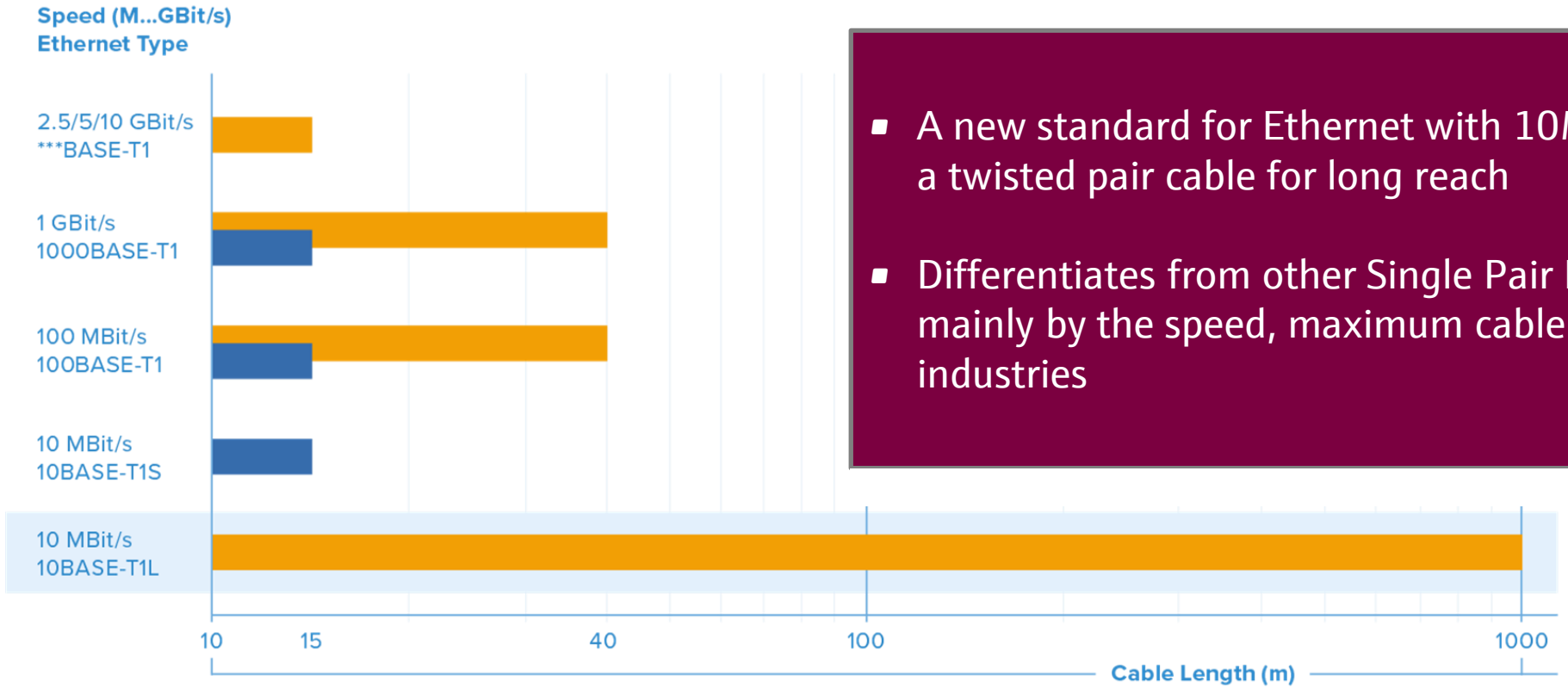
Overview of relevant specifications and guidelines

IEEE 802.3cg-2019 10BASE-T1L	IEC TS 60079-47 2-WISE	Ethernet-APL Port Profiles	Ethernet-APL Engineering Guideline	Ethernet-APL Conformance Tests



- A new standard for Ethernet with 10Mbit/s full-duplex over a twisted pair cable for long reach
- Differentiates from other Single Pair Ethernet standards mainly by the speed, maximum cable distance and target industries

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IEEE 802.3cg-2019 10BASE-T1L	IEC TS 60079-47 2-WISE	Ethernet-APL Port Profiles	Ethernet-APL Engineering Guideline	Ethernet-APL Conformance Tests

- 2-WISE = 2-wire Intrinsically Safe Ethernet
- Electrical parameters are derived from well-known FISCO (Fieldbus Intrinsically Safe Concept)
- Simple validation without calculations by observing
  - Only connect 2-WISE ports to each other
  - Observe requirements for cable parameters
  - Observe maximum cable lengths

Overview of relevant specifications and guidelines

IEEE 802.3cg-2019 10BASE-T1L | IEC TS 60079-47 2-WISE | **Ethernet-APL Port Profiles** | Ethernet-APL Engineering Guideline | Ethernet-APL Conformance Tests

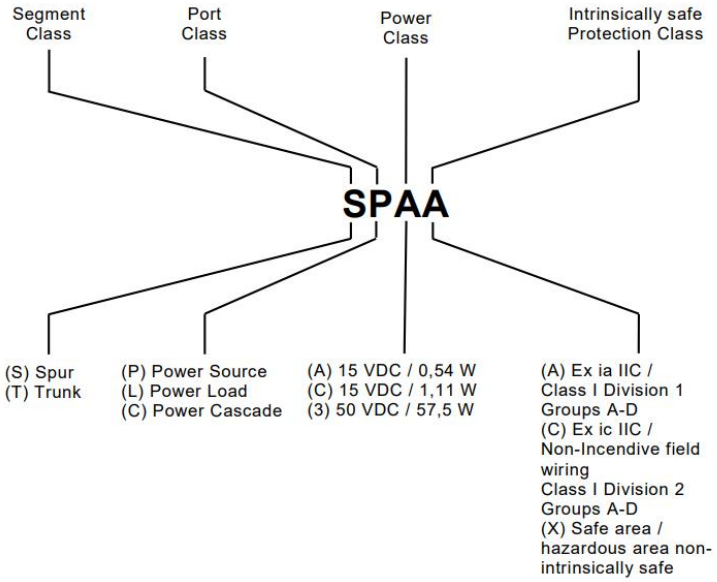

Table 5 – Power classes

Source Power class	Maximum voltage / minimum output power	Permitted segment classes	Permitted port classes	Permitted load power classes
A	15 VDC / 0,54 W	S	P, L	A
C	15 VDC / 1,11 W	S	P, L	A, C
3	50 VDC / 57,5 W	T	P, L, C	3

NOTE 1 Other combination of classes than given in Table 5 are prohibited.

NOTE 2 The permitted combinations of port classes do not imply that every combination is also permitted from an intrinsically safe viewpoint.

NOTE 3 A load port may be specified for more than one load power class.

NOTE 4 Cascade (C) ports may only be connected to a power source port having equal or lower maximum output values (voltage, current and power) than the input values specified for the cascade port.

Table 6 – Electrical characteristics of power classes

Power Class	15 VDC / 0,54 W	15 VDC / 1,1 W	50 VDC / 57,5 W
	A	C	3
$U_{PS(max)}$ (VDC)	15 [5]	15 [5]	50 [3]
$U_{PS(min)}$ (VDC)	9,6	11,61	46 [6]
$I_{PS(min)}$ (mA)	55,56	95	1250 [8]
$P_{PS(min)}$ (W)	0,54	1,1	57,5 [6]
$U_{PL(min)}$ (VDC)	9,0 [1]	10,6 [1]	28,8 [2]
$P_{PL(min)}$ (W)	0,5 [1]	1,0 [1]	36 [2, 7]
$I_{PL(min)}$ (mA)	20		40 [4]
$I_{PL(max)}$ (mA)	See footnote [9]		
$I_{PL(reverse)}$ (mA)	n.a.		≤ 10 [8]

[1] $U_{PL(min)}$ and $P_{PL(min)}$ are determined by cable losses due to the wire resistance of AWG 18 cable with a length of 200 m at an ambient temperature of +70 °C (equivalent to 10,6 Ω loop resistance) at maximum load.

[2] Calculation is required, considering load condition and the cable resistance at the maximum ambient temperature, to guarantee $U_{PL(min)}$ and $P_{PL(min)}$.

[3] $U_{PS(max)}$ shall be overvoltage protected to less than 60 VDC.

[4] For power class 3 the minimum specified current consumption $I_{PL(min)}$ is only required if a diode function, as e.g. a reverse polarity protection, within the signal path of a load port is used.

[5] Safety voltage limits of power classes A and C are defined in IEC TS 60079-47.

[6] For cascade power ports $U_{PS(min)}$, $I_{PS(min)}$, and $P_{PS(min)}$ may be lower than the specified values.

[7] For cascade load ports $P_{PL(min)}$ may be lower than the specified value.

[8] Only for polarity sensitive ports.

[9] If the voltage at the load port drops below $U_{PL(min)}$, a load port shall under no circumstance draw more current than the minimum supply current $I_{PS(min)}$ of the power source port, the load port is designed for.

NOTE 1 $U_{PD(max)}$ and $U_{PD(min)}$ are specified for steady state operation without communication voltage.

NOTE 2 All parameters in Table 6 reflect the electrical DC characteristics. The communication signal is added as an additional signal source to the DC electrical parameters.

To be transferred to an IEC standard

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Overview of relevant specifications and guidelines

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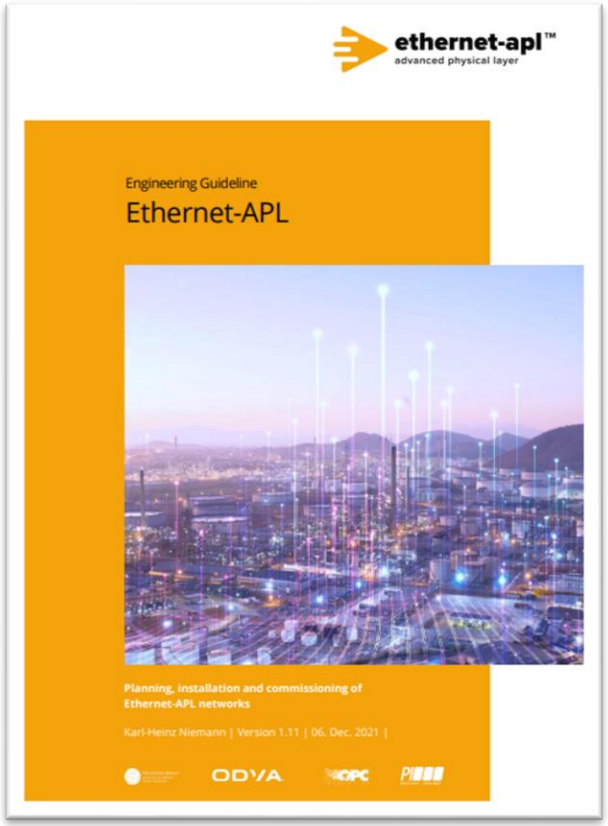


- Detailed information for planning, installation, commissioning
- Explanation for components (switches, cables, field devices)
- Example applications and topologies
- Power considerations
- Grounding and shielding

Overview of relevant specifications and guidelines

IEEE 802.3cg-2019 10BASE-T1L	IEC TS 60079-47 2-WISE	Ethernet-APL Port Profiles	Ethernet-APL Engineering Guideline	Ethernet-APL Conformance Tests

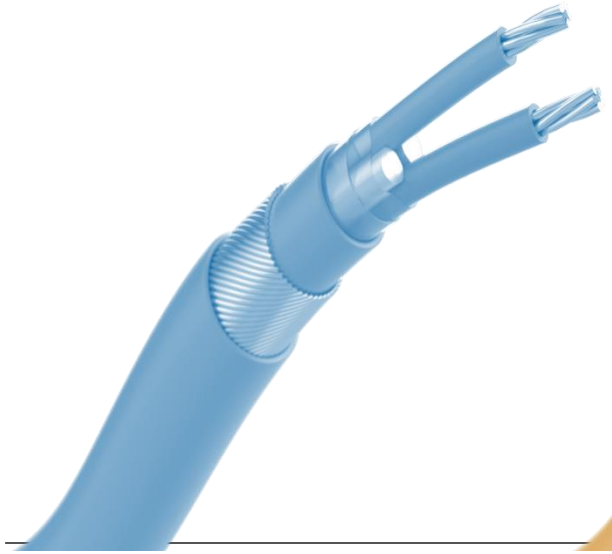
- Mandatory for all Ethernet-APL devices
- Derived from IEEE and IEC standards
- A single form of physical layer testing for all Ethernet protocols
- Each organization offers testing of their supported protocols.
- One Ethernet-APL following the same requirements

Cables and Connections for Ethernet-APL segments

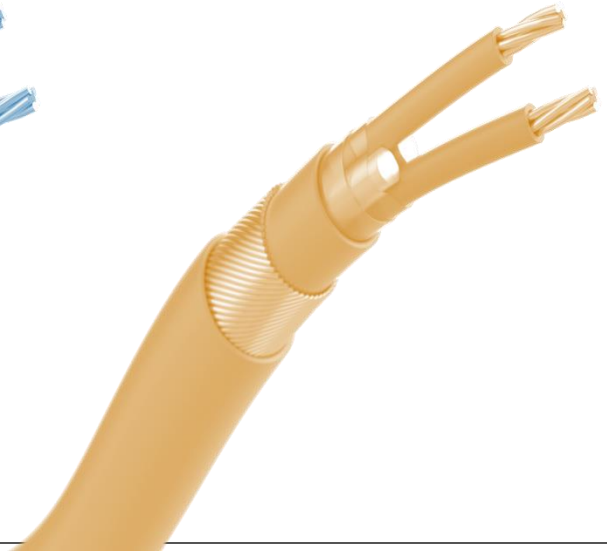
Cables

- Reference cable: IEC 61158-2 Type A
- Shielded, twisted pair, AWG 26…14 / 0.14…2.5 mm²

Fieldbus Type A cable with (optional) light blue sheath for intrinsically safe APL segments



Fieldbus Type A cable with any other color sheath (e. g. black, orange, yellow) for all other APL segments



Connection technology

Screw or push-in terminals

M8 and M12 connectors

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Technologies for the Field of Process Plants

Attribute	4-20mA + HART	Fieldbus	Ethernet 100BASE-TX	Ethernet-APL 10BASE-T1L
Single Pair Cable	✓	✓	✗	✓
Data rate	1.2 kbit/s half duplex	31.25 kbit/s half duplex	100 Mbit/s full duplex	10 Mbit/s full duplex
Reference Cable	n/a	Type ‘A’	CAT 5 / 6	Type ‘A’
Trunk Length	n/a	typ. 700 m	100 m	1000 m
Spur Length	n/a	120 m	n/a	200 m
Screw Type Connector	✓	✓	(✓)	✓
Polarity independence	✗	✓	n/a	✓
Intrinsic safety option	✓	✓	(✓)	✓
One network technology from field to enterprise	✗	✗	✓	✓

Ethernet-APL combines benefits of simple and robust 2-wire technology with benefits of Ethernet, enabling top-performance and seamless data access in the field of process plants.

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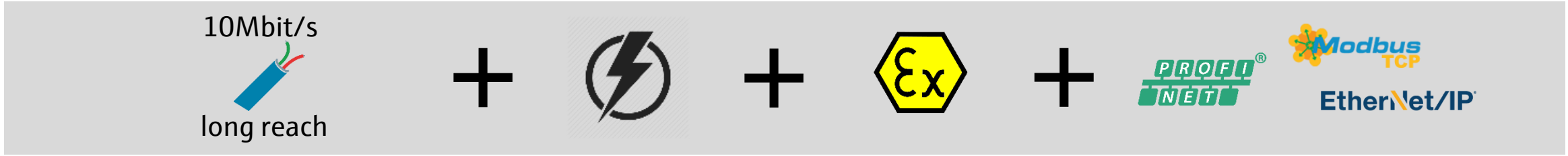
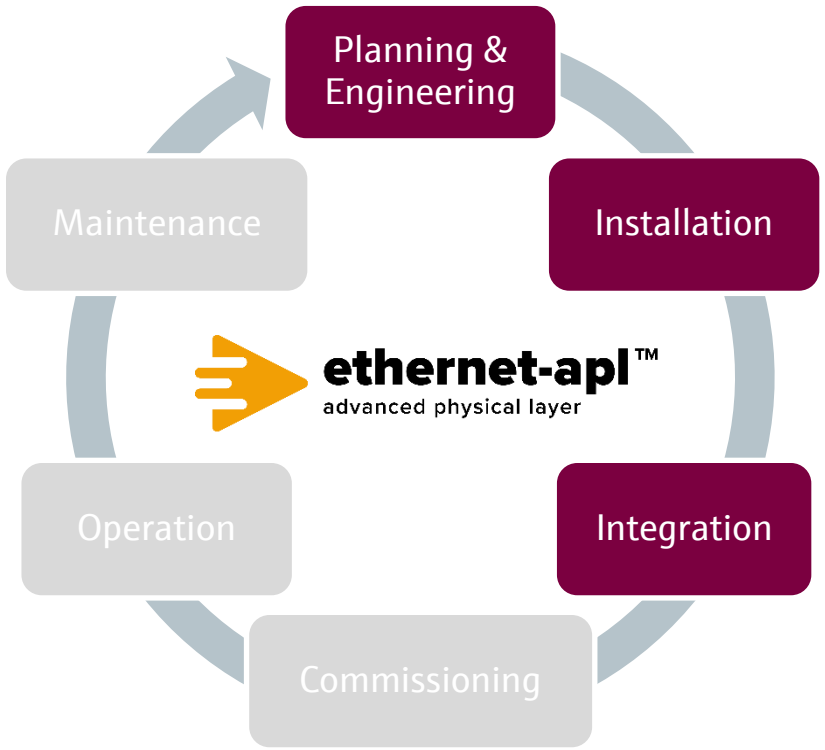
2. Details about Ethernet-APL
3. **Added value with Ethernet-APL**
4. Endress+Hauser activities

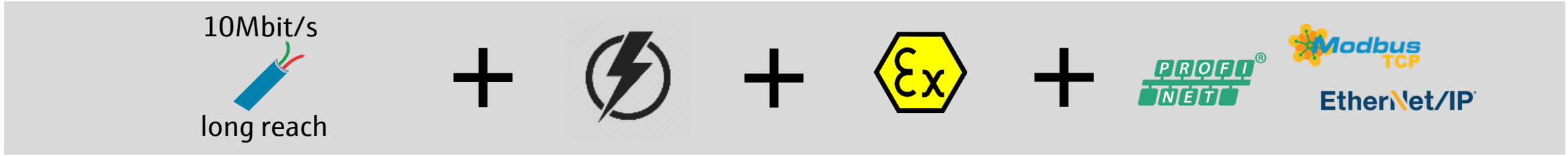
Advantages throughout all Life Cycle phases

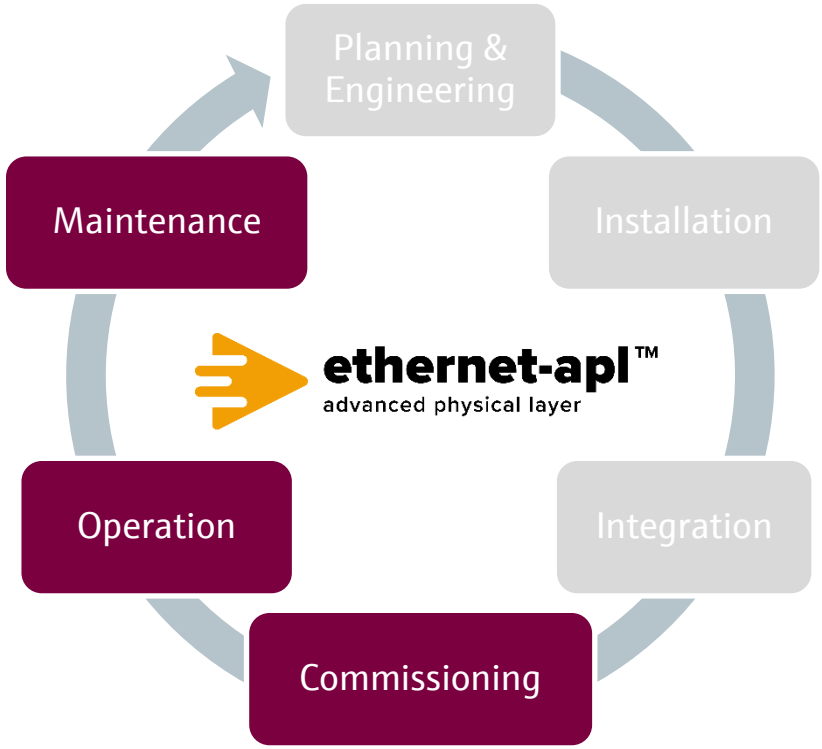




- Designed for process and hybrid industries
- Flexible and scalable network topology design
- No need for hazardous area calculations (2-WISE)
- High availability by variety of redundancy mechanisms
- Easy and error-free installation (2-wire, polarity independence)
- Simplified DCS integration (automatic discovery, no scaling)

Advantages throughout all Life Cycle phases





- Increased output and quality by accurate digital process values
- Simple remote access to field devices and infrastructure
- High performance for maintenance use cases
- Optimized reliability by continuous diagnostics, remote verification and monitoring (Heartbeat Technology)
- Efficient troubleshooting on Ethernet network and field devices
- Seamless data access by homogeneous network for 2nd channel and Industrial Internet of Things (IIoT)

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Endress+Hauser Ethernet-APL Portfolio 2022/2023

Flow

Promass 300/500
Coriolis flowmeter

Promag 300/500
Electromagnetic flowmeter

Prowirl 200
Vortex flowmeter

Level

Micropilot FMR6xB
80GHz radar

Liquiphant FTL51B/6x
Point level switch

Gammapilot FMG50
Radiometric level and density

Pressure

Cerabar PMxxxB
Pressure transmitter

Deltabar PMD7xB
Differential pressure

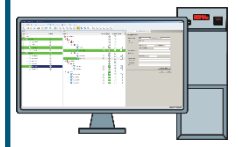
Temperature

iTEMP TMT86
Head transmitter

iTHERM ModuLine
Modular thermometer

Ecosystem

FieldCare
Universal device configuration



Field Xpert
Universal tablet PC

to be continued (more device types, more Ethernet protocols)

Endress+Hauser Ethernet-APL Portfolio: device details

Feature	Benefit
PROFINET S2 System Redundancy	High availability of process plant
PROFINET Dynamic Reconfiguration	Flexibility in plant operation
PROFINET PA Profile 4	Easy device replacement and harmonized integration / diagnostics
Embedded web server	Remote access for easy and fast parametrization and troubleshooting
Heartbeat Technology	Permanent diagnostics, monitoring and verification for preventive and predictive maintenance
FDI Package	Easy and state-of-the-art device integration incl. PA-DIM Mapping

Use PROFIBUS PA as fallback solution for device types without Ethernet-APL

ethernet-apl™ advanced physical layer

PROFINET®

Promass

Promag

Prowirl

Micropilot

Cerabar

Deltabar

iTEMP TMT

iTHERM ModuLine

PROFIBUS®

Prosonic Flow

Liquiline

t-mass

Liquiphant

Deltapilot

Levelflex

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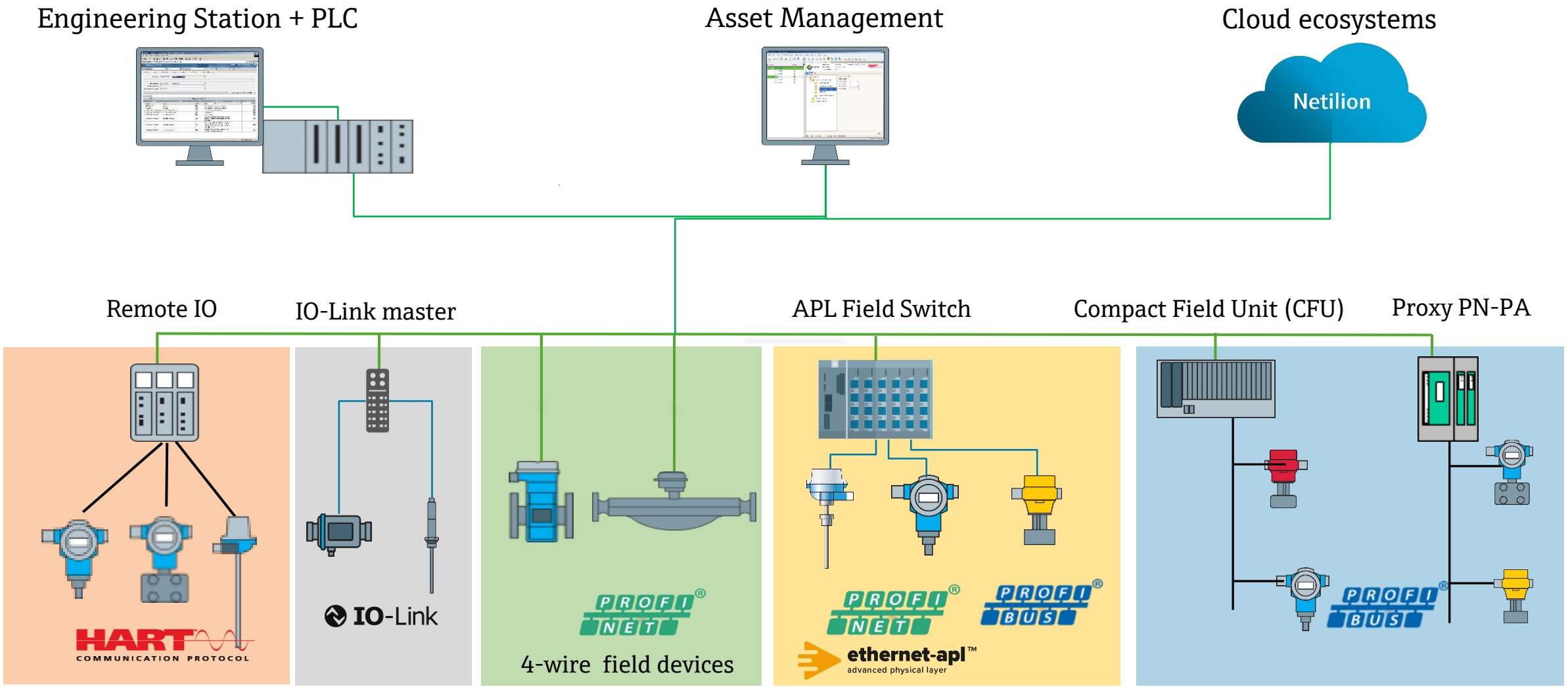
Mixed technologies in the same network



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Adoption of Ethernet-APL

Greenfield

- Ethernet-APL can be adopted easily
- Sufficient APL instruments will be available (switches, sensors, actuators)
- Solutions available to integrate devices which don’t support Ethernet-APL yet

Brownfield

- No simple migration possible
- Depending on technologies which are in use
- General changes
  - APL field switches
  - APL field instruments
  - Shielded cables
  - Ethernet capable PLC / DCS

To be checked individually, e.g. during

- Plant modernization
- Plant extension
- Device phase out

Status customer discussions

Customers in heavy and hybrid industries

Requirements

Digital communication down to the field level, even in **explosion hazardous** areas

Robust technology which ensures high **availability** of the process plant

Simplicity in engineering, commissioning and maintenance

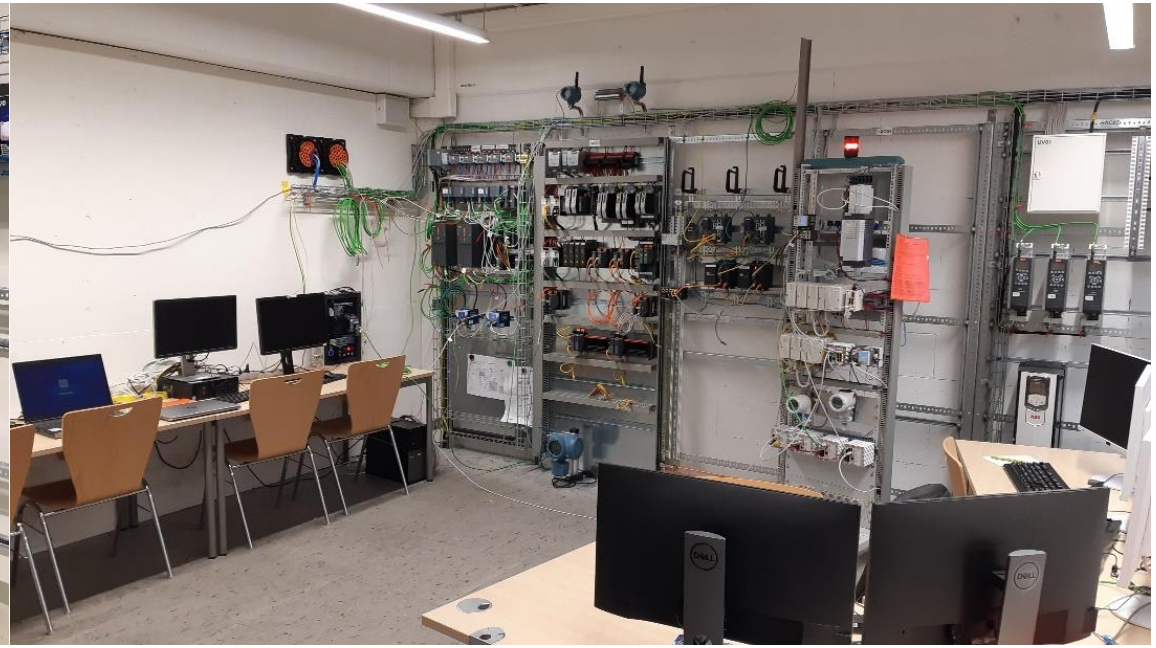
Data export in parallel to DCS for any kind of **Industry 4.0 application**

Solution

ethernet-apl™
advanced physical layer

Ethernet-APL @ BASF

Ethernet-APL Evaluation Project



→ BASF is convinced that Ethernet-APL is THE technology for future plants
→ First real projects are in planning

Questions & Answers

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The Data Highway for endless Possibilities

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