



**IEEE 802.3cg (10SPE) – 10 Mb/s Single Pair Ethernet meeting
Industrial Automation objectives**

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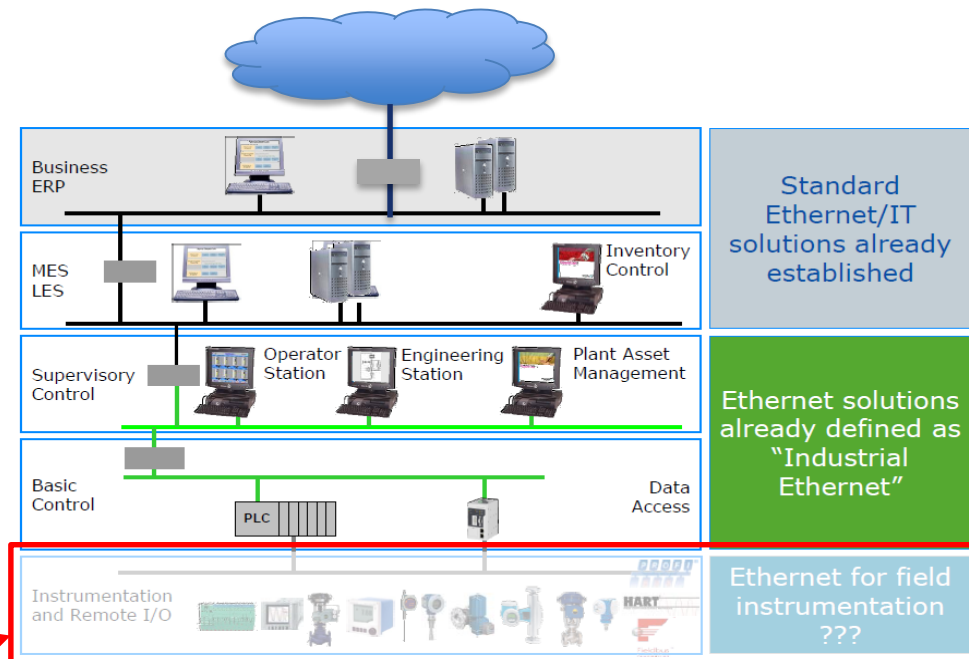
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- Single Network (Ethernet) Vision
 - Added lifecycle cost of a fragmented network
 - Partial Migration to Industrial Ethernet
 - Existing Ethernet gaps at the edge
- Industrial demands
 - Process Automation demand
 - Automotive demand
- IEEE 802.3cg (10SPE)
 - 10SPE emerges to fill Ethernet edge gaps
 - Abbreviated IEEE process and 10SPE status
 - Simplified 10SPE Objectives
 - Implications and suggestions for ODVA
- Summary

Single network (Ethernet) vision

- One vision is that of a single network paradigm from the Cloud to the field devices
- Industrial Ethernet can bridge IT and OT, being appropriate for MES, most controllers and user interfaces, and many field applications



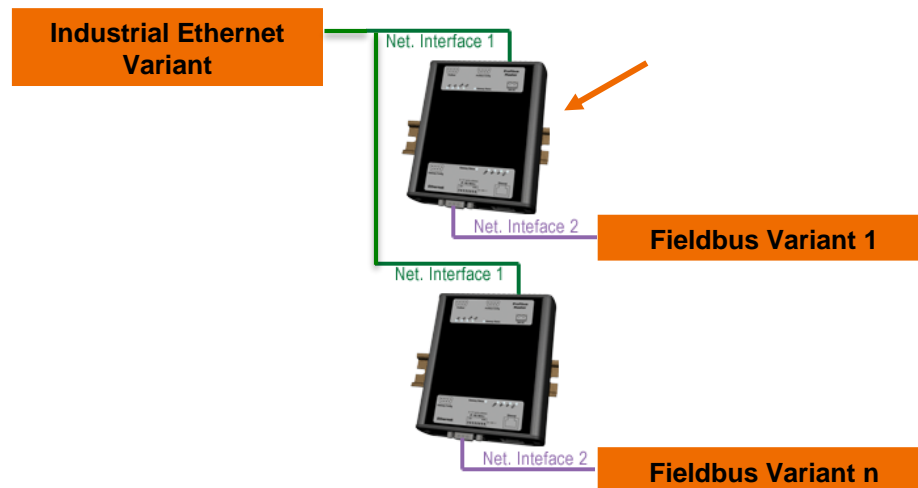
Ethernet Gaps at the 'Edge'

Adapted from: Dr. Raimund Sommer, Endress+Hauser, ODVA Industry Conference, Oct. 2014.

Added lifecycle cost of a fragmented network

- A variety of non-Ethernet solutions (typically buses or point to point links) augment Ethernet for a complete solution
- Lifecycle costs:
 - Sourcing appropriately qualified labor
 - Design complexity
 - Installation complexity
 - Maintenance complexity
 - Interoperability issues and feature loss
 - More standards
 - Certification complexity
 - Complex IP-convergence for IIoT and related usage

The gap at the edge is commonly filled by application-specific Gateways



Partial migration to Industrial Ethernet

- Since the turn of the century, Industrial Automation has seen an ever increasing adoption of Ethernet-based networking and the associated IP stack
- HMS Industrial Networks, Inc. reports (2016)
 - Entire market is growing
 - Fieldbus share = 58%
 - 7% growth
 - Ethernet share = 38%
 - 20% growth

Fieldbus Variants	
FOUNDATION H1	PROFIBUS DP
PROFIBUS PA	DeviceNet
HART	CANOpen
IO-Link	Modbus
CompoNet	CC-Link
AS-Interface	INTERBUS

Only
Partial
Migration



Industrial Ethernet Variant
EtherNet/IP
PROFINET
FOUNDATION HSE
Modbus TCP/IP
HART-IP
CC-Link IE

Partial lists...

Existing Ethernet gaps at the edge

- A variety of practical concerns limit the utilization of Ethernet at the field edge
- The Ethernet “family” could be extended within IEEE 802.3 to overcome these gaps
- Limited distance of 100 m for wires (fiber has additional challenges)
- Special environment requirements such as intrinsic safety (Process Automation)
- Power distribution concerns
- Operation over legacy cables and connectors
- High implementation cost relative to the smallest components

Process Automation user demand

- Process Automation users are demanding Ethernet edge solutions
- NAMUR: User Association of Automation Technology in Process Industries
 - <http://www.namur.net/en/home.html>
 - Member companies: 135
 - Experts in member companies: 2000
- “Position paper An Ethernet communication system for the process industry”
 - http://www.namur.net/fileadmin/media_www/Dokumente/Anforderung_Ethernet-NAMUR_2016-02-25_EN.pdf

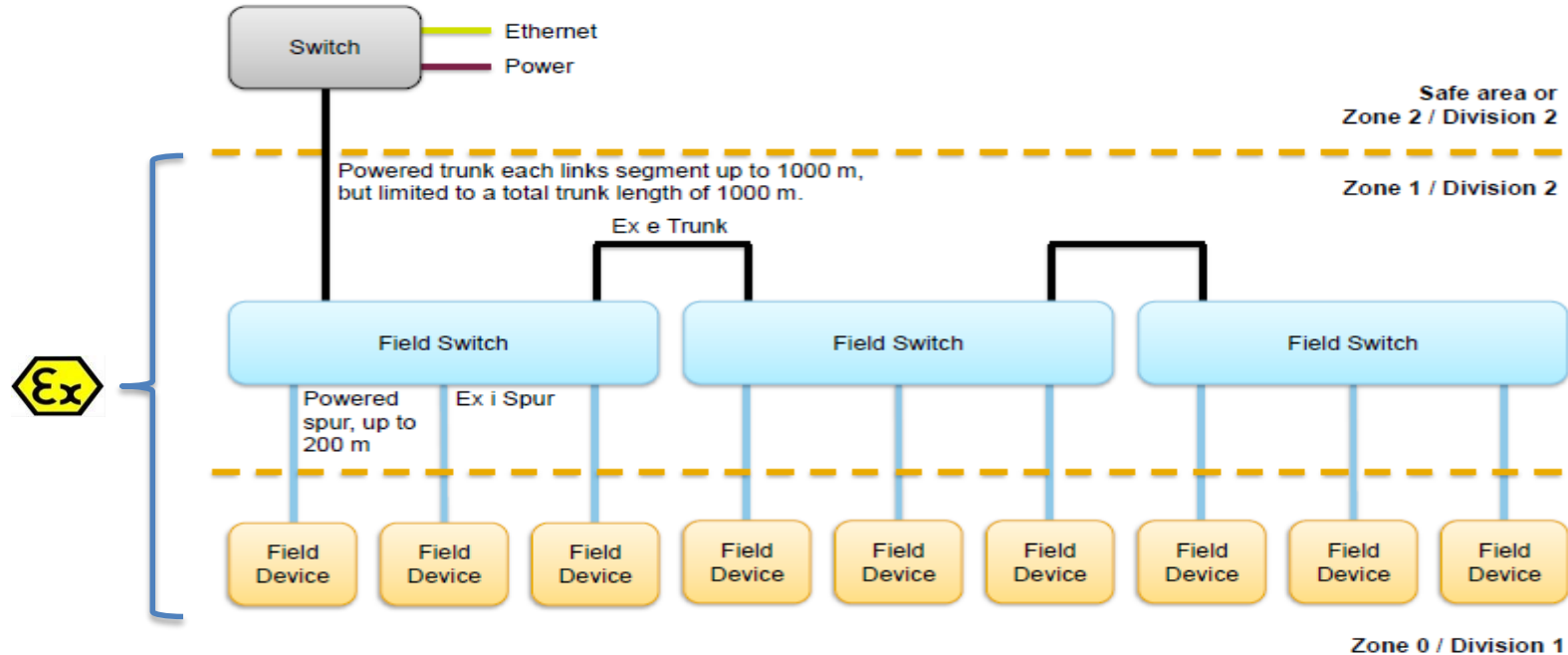
- Ethernet to the instruments (edge) means filling many gaps



- Long distance > 1000 m
- Intrinsic Safety requirement
- Legacy single pair cables
- Communication + power

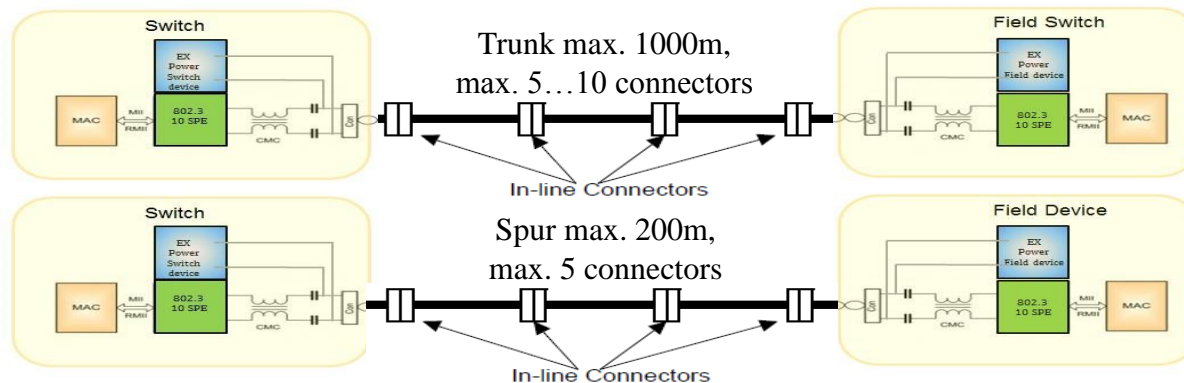


Process Automation topology



Process Automation requirements

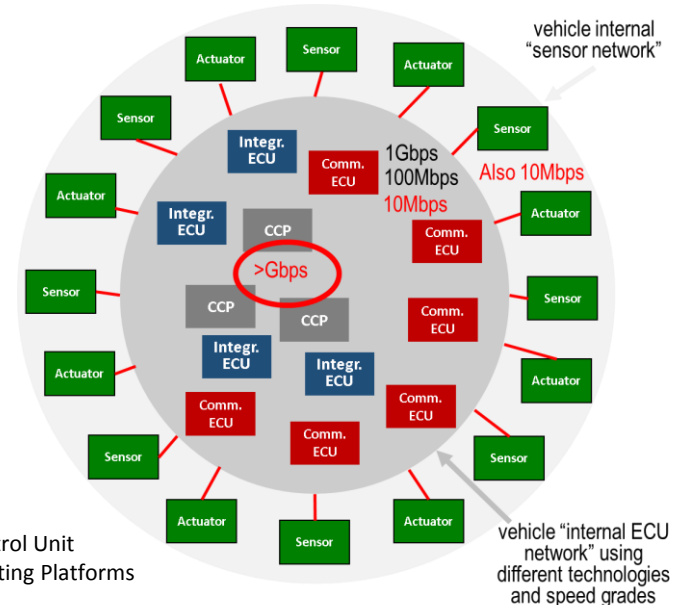
- **IEC61158 type A fieldbus cable with shield**
 - Single pair communication + power
- **Intrinsically Safe communication and device power**
 - Low and high power devices 500mW up to 5 W
- **PHY: 10 Mb/s, full-duplex, Auto-Negotiation** (support for future extension of transmission speed 100 Mb/s)
- **Extended reach: Cable length 1000 m for Trunk with max. 5..10 connectors, 200 m for Spur with max. 5 connectors**



- Automotive is demanding Ethernet edge solutions
- A transition to Ethernet is underway
 - 1000BASE-T1
 - 100BASE-T1
- A converged network is desired
 - Independence of physical and logical network
 - Reduction in number of In-Vehicle Network (IVN) technologies
 - MOST / FlexRay / LIN / ...
 - Reduction of multiple gateways

Automotive demand

- Target is 50% of 100BASE-T1 system cost, addressing another gap



ECU: Electronic Control Unit
CCP: Central Computing Platforms

10SPE emerges to fill Ethernet edge gaps

- In July 2016, the IEEE 802.3 authorized the “10 Mb/s Single Twisted Pair Ethernet Study Group” (informally known as “10SPE”), kicking off the development of a set of Ethernet enhancements aimed at closing the gaps for edge devices
- Participating industries:
 - Industrial Automation
 - Automotive
 - Building Automation
 - Lighting

Abbreviated IEEE process and 10SPE status

- Call For Interest (CFI)
 - Complete in March-July, authorized a “Study Group”
 - “10 Mb/s Single Twisted Pair Ethernet”
 - http://www.ieee802.org/3/cfi/0716_1/CFI_01_0716.pdf
- Study Group (SG) progress
 - Named “10SPE” (10 Mb/s Single Pair Ethernet)
 - <http://www.ieee802.org/3/10SPE/index.html>
 - SG deliverables (complete in November):
 - Project Authorization Request (PAR)
 - Criteria for Standard Development (CSD)
 - Objectives (high level requirements)
- Task Force (TF) is the next step (IEEE P802.3cg)
 - Weekly teleconferences and face-to-face meetings
 - Draft amendments to the 802.3 standard

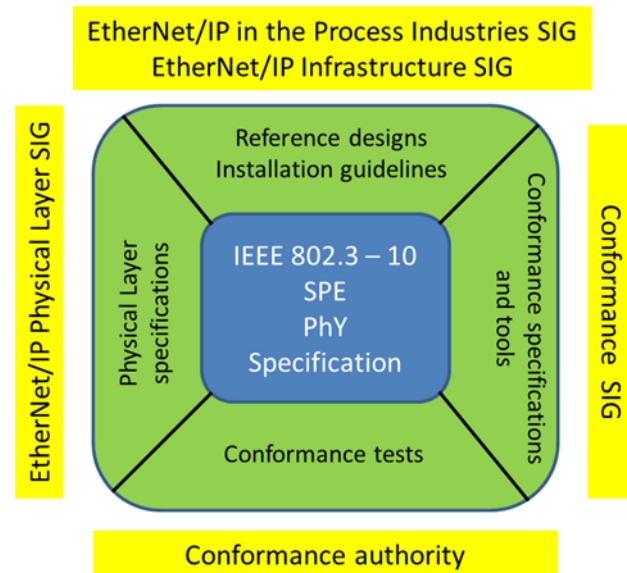


Simplified 10SPE objectives

- Up to 2 PHYs
 - One optimized for up to at least 1 km reach
 - Point-to-point
 - One optimized for up to at least 15 m reach
 - Expectation is a reduced system cost
 - Optional multi-drop was not excluded
- Operation in automotive and industrial environments (EMC, temperature)
- Existing MAC interface
- 10 Mb/s
- Optional Auto-Negotiation
- Single balanced twisted pair
- Optional power distribution over the single pair
- Fast startup (100 ms)
- Does not preclude intrinsic safety

Implications and suggestions for ODVA

- Affected areas:
 - Direct integration of Process Automation devices
 - Reduced overhead for in-cabinet and other constrained devices
- The IEEE PHY standard will set a foundation, but requires extension:
 - Front-end circuitry, interfacing from the PHY chip to the wire, including intrinsic safety
 - Power on the communication channel, including intrinsic safety
 - Connector and cable specification
 - Management objects
 - Potential multi-drop protocol enhancement
 - Conformance testing for multiple purposes
- Multiple SIGs are likely affected
- Leverage of other effort is possible



Summary

- Despite ongoing Ethernet migration across automation domains, the single network vision is thwarted by existing Ethernet limitations
- IEEE 802.3 – 10 SPE project - recently established – has released the objectives to specify and standardize a new Physical Layer to close the Ethernet gaps at the edge
- Paradigm change is likely, almost certainly in Process Automation and possibly for in-cabinet and other constrained components
- ODVA is encouraged to enhance their specifications based on the results in order to deliver on the single network vision and expand into the resulting new markets
- ODVA vendors are encouraged to participate in IEEE standard and ODVA specification development to realize the single network vision



THANK YOU