Optimization of Process Integration: Using EtherNet/IP for Integration of Field Devices with a Process Automation System

October 14, 2015 2:00 PM – 3:45 PM

Welcome, Background, and History

Shannon R. Foos, P.E.

ODVA Strategic Marketing Requirements Team, Leader

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Terry Minns

ODVA Strategic Marketing Requirements Team

Terry.Minns@Schneider-electric.com

Welcome

2:00 – 2:10 Background and History of Optimization of Process Integration (OPI)

2:10 – 2:15 Reference Architecture for OPI

2:15 – 2:30 Developments by ODVA's Special Interest Group for EtherNet/IP in the Process Industries

2:30 - 3:30 Adjacent Technical Developments Important to the Realization of OPI in Field Devices

- A New Perspective on Integration of Field Devices: Using the FDT Standard with EtherNet/IP
- Physical Layer – Overview and Demonstration of New Physical Layer Concepts for Industrial Ethernet and EtherNet/IP in Process Field Devices

3:30 – 3:45 Panel Session: Industry Perspectives on EtherNet/IP for the Process Industries

The Process Initiative

SMRt Participants

Cisco Systems
René Pluis

Endress+Hauser
Olivier Wolff

Rockwell Automation
Shannon Foos

Schneider Electric
Terry Minns

ODVA Katherine Voss

White Paper

Work Plan

Next steps: 12-18 months

- Finalizing EtherNet/IP Input Assembly structure including device diagnostics
- Finalizing HART mapping on EtherNet/IP
- Define PoE adaptation for EtherNet/IP
- Additional EtherNet/IP work plan topics

2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | Future

SIG - 19 members, 10 different vendors

Active Participants:
Cisco Systems (René Pluis)
Rosemount (Eric Rotvold)
Endress+Hauser (*Mirko Brcic*, Martin Hönicke)
Krohne (Christian Brehm, Christoph Spiegel)
Rockwell Automation (Carl Schumaker)
Schneider Electric (Stephane Hernu, Terry Minns, Mark Rossi)

Achievements

- Defined EtherNet/IP Reference Architecture for Process Industries
- Draft of EtherNet/IP Input Assembly structure including Process Diagnostic
- Draft of HART mapping on EtherNet/IP

Reference Architecture

Olivier Wolff

ODVA Strategic Marketing Requirements Team

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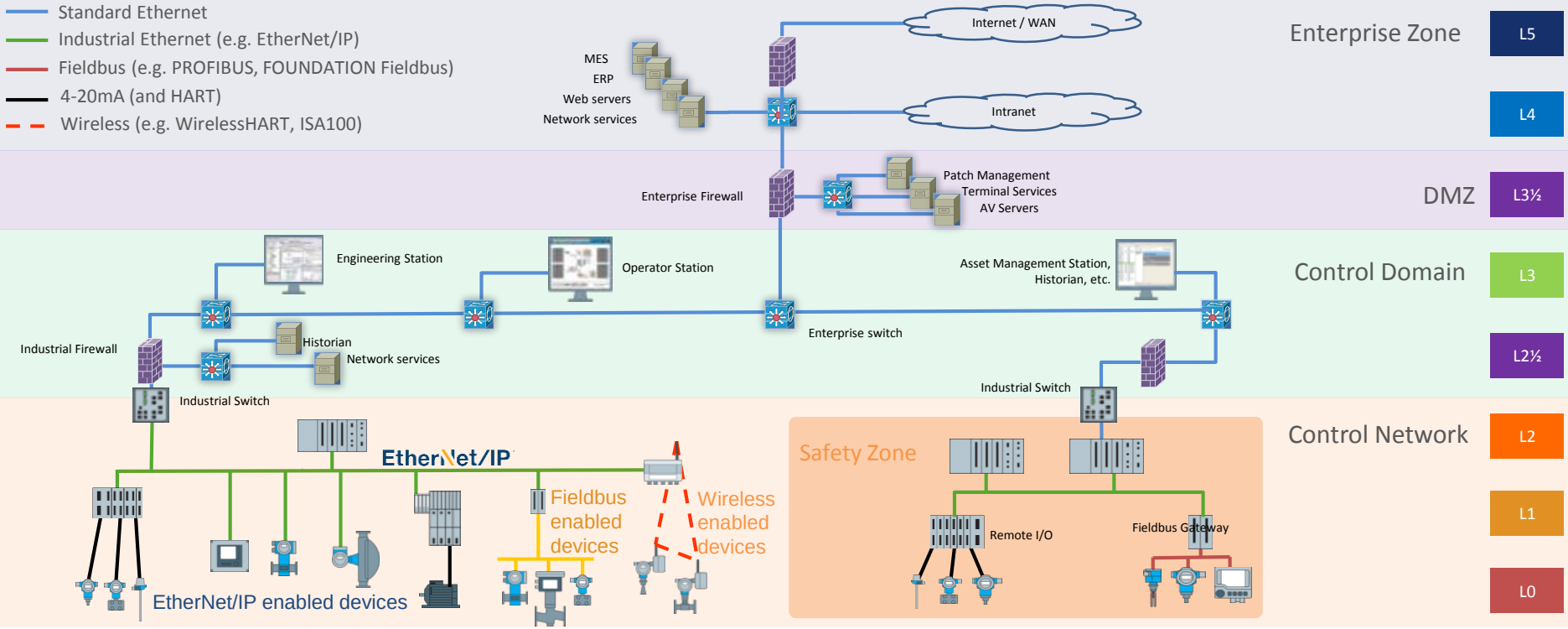
Rene Pluis

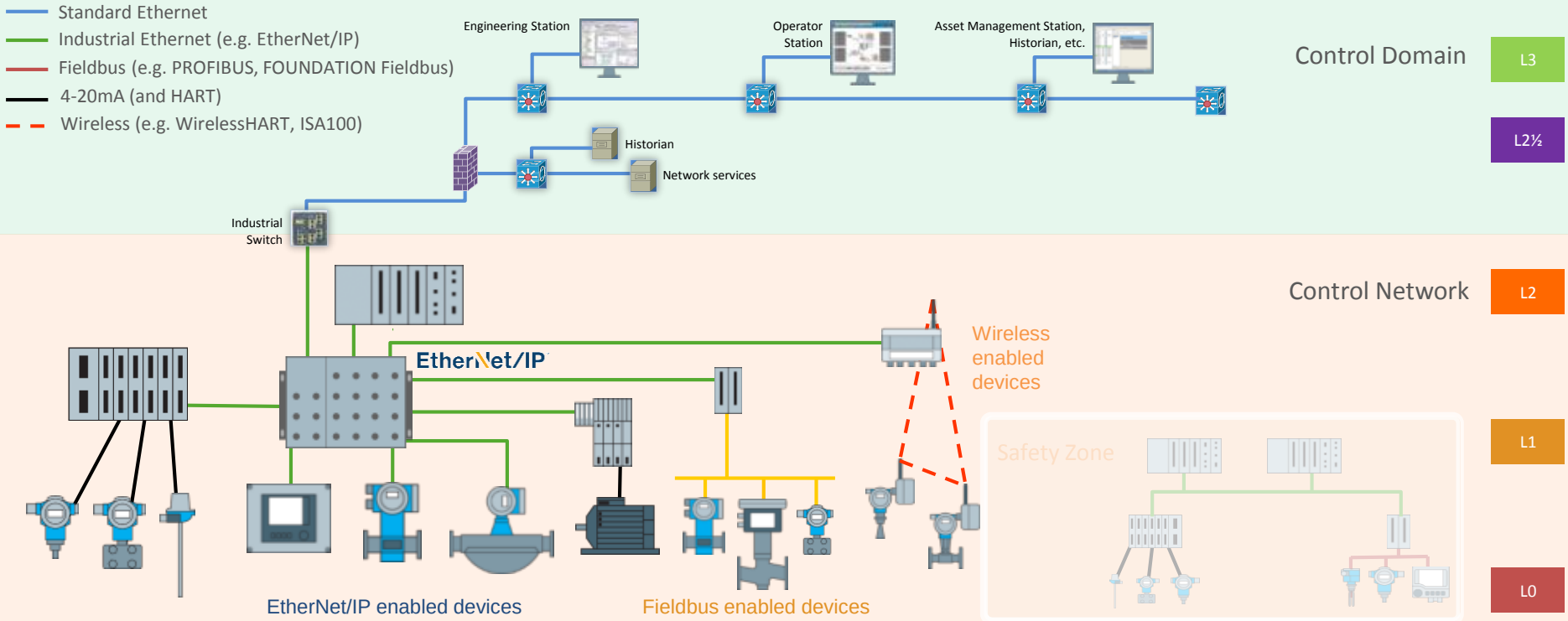
ODVA Strategic Marketing Requirements Team

RePluis@Cisco.com

Logical Network Reference Architecture



Logical Network Reference Architecture



The Technical Working Group

Mirko Brcic

ODVA Special Interest Group, Leader

Mirko.Brcic@solutions.endress.com

New ODVA Special Interest Group (SIG) Formed April 2015

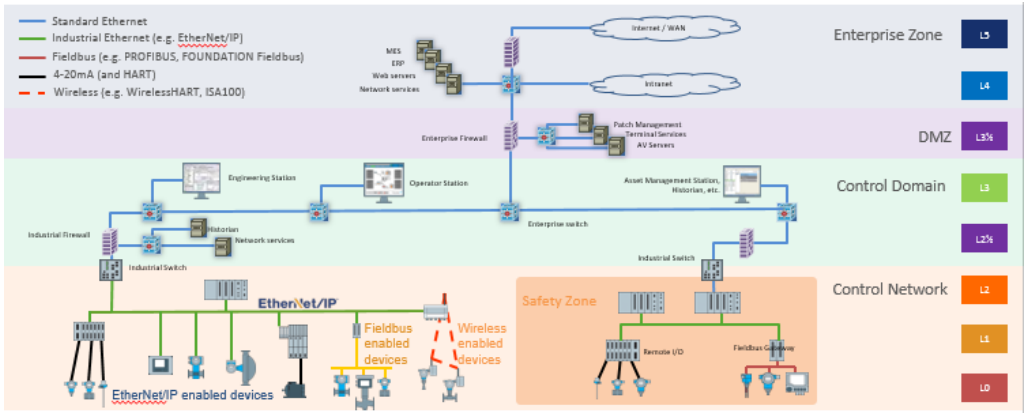
- EtherNet/IP in the Process Industries SIG

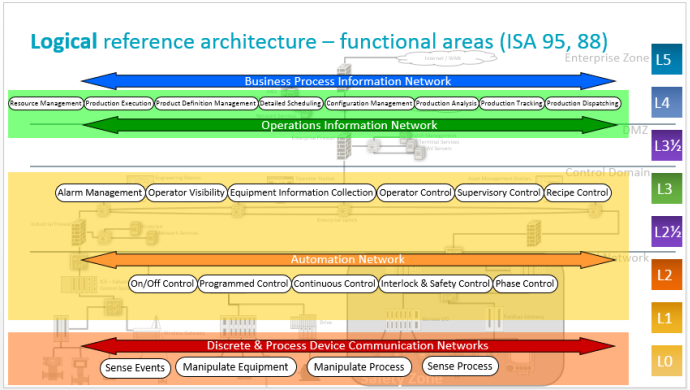
- Accomplishments and Activities in Progress
  - Defined Reference Architecture for Process Industries
  - Draft of Input Assembly structure including Process Diagnostic
  - Initiated HART mapping on EtherNet/IP
  - Evaluation of PoE adaptation for EtherNet/IP

- Plans for next 12-18 Months

Accomplishments and Activities in Progress

- Defined Reference Architecture for Process Industries
  - The **logical architecture** gives an overview of the functionality and segmentation between the several Purdue levels including Process Networks (FOUNDATION Fieldbus, PROFIBUS, HART and Wireless Networks)



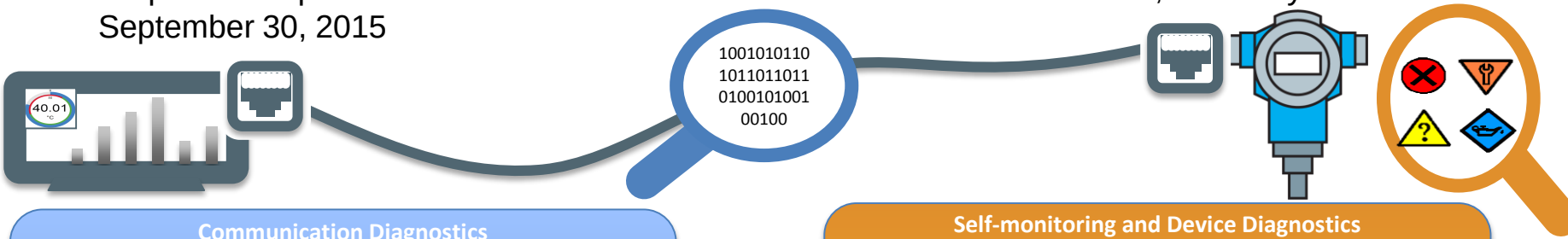


- A physical implementation / realization of the logical architecture can ‘collapse’ Purdue levels in one physical devices, as long as the associated logical function(s) are realized.

Accomplishments and Activities in Progress

Draft of Input Assembly structure including Process Diagnostic

- Standardized access to process data from EtherNet/IP devices
- Self-monitoring and Device Diagnostics according to NAMUR NE107
- Proposal was presented at the ODVA EtherNet/IP Roundtable in Raunheim, Germany on September 30, 2015



Communication Diagnostics

Focus of ODVA Diagnostics Working Group

- Quick and effective identification and resolution of communication problems
- Vision: Conduct regular analysis of the network using network statistics

Self-monitoring and Device Diagnostics

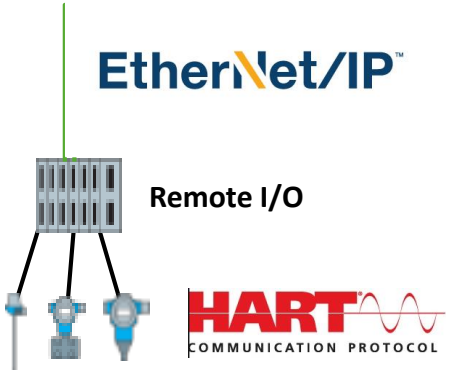
Focus of ODVA Process SIG

- Quick and effective identification and resolution of problems
- Vision: Conduct predictive maintenance to reduce downtime and to protect the investment

Accomplishments and Activities in Progress

– Initiated HART mapping on EtherNet/IP

- Update of internal Rockwell object review process
- Presentation of technical aspects of object
- Discussion of future work effort



Accomplishments and Activities in Progress

Evaluation of PoE adaptation for EtherNet/IP

- First evaluation of PoE adaptation for EtherNet/IP
  - The current standards for PoE (Power over Ethernet), being IEEE 802.af (for max 15W) and IEE 802.at (for max 30W), can be deployed for Ethernet/IP in Process environments
    - Using 4 or 8 wires CAT 5 or above cables
  - There are several developments to increase the total available power budgets to 60 – 90W or even above as well as integration with IEEE 802.3az (EEE – Energy-Efficient Ethernet)
  - For those industrial areas which need compliance to ‘intrinsically safe’ standards, the used maximum voltage of PoE needs to be lowered to 12V (instead of the standard used 48V)

Proposal for next 12-18 months

- Follow-up Reference Architecture for Process Industries
  - Provide implementation examples of the '*X in the cloud*' or '***as a service'*** developments, e.g. SCADA implementation in the cloud (either public or private) based on the logical architecture.

- Finalizing EtherNet/IP Input Assembly structure including device diagnostics
  - Standardized access to process data from EtherNet/IP devices including device diagnostics
  - Definition of device diagnostics for native EtherNet/IP devices that are compliant with NAMUR NE-107

- Finalizing HART mapping on EtherNet/IP
  - Standardized CIP object structure to get access to HART

- Define PoE adaptation for EtherNet/IP

Next ODVA Annual Conference

Reference Architecture

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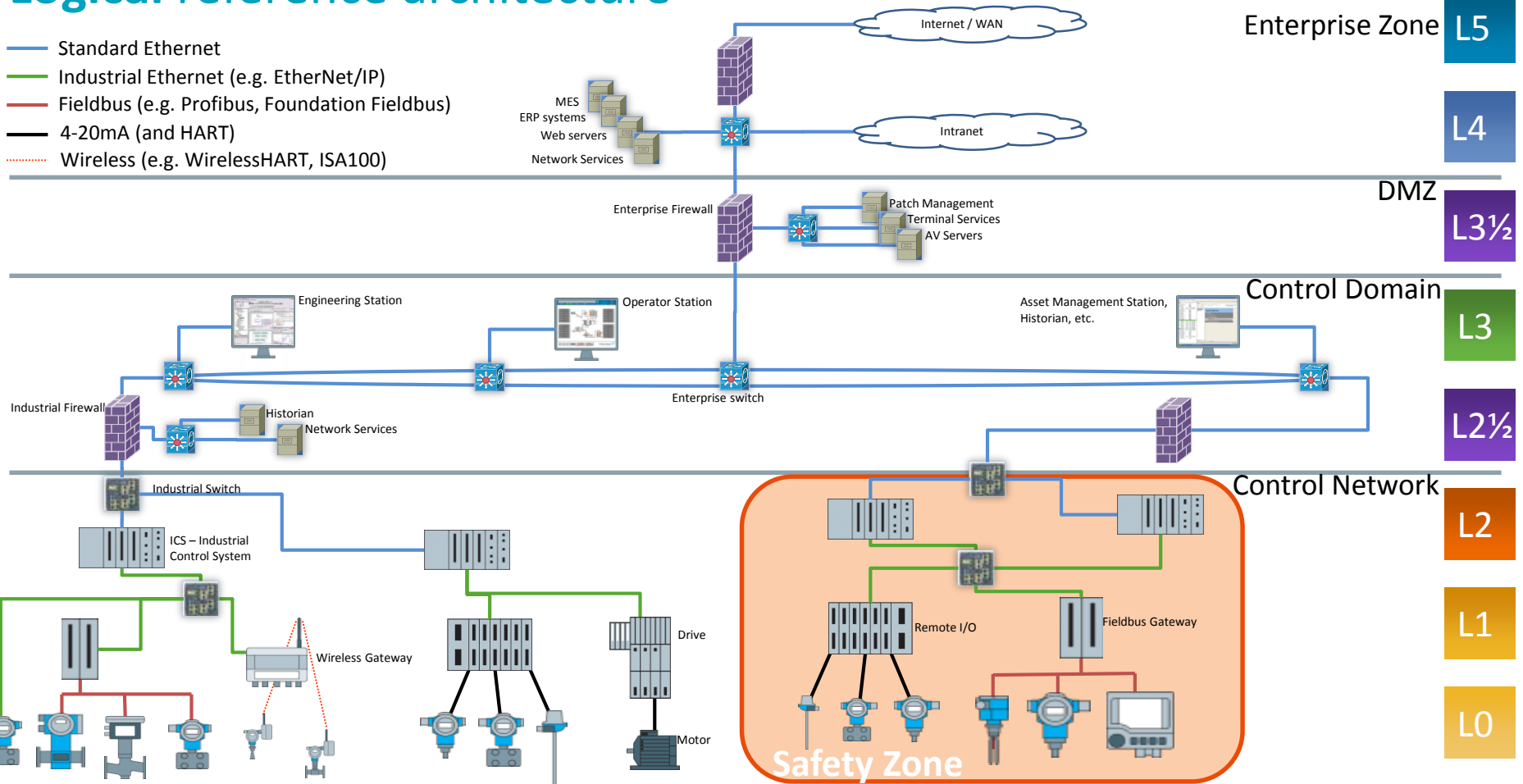
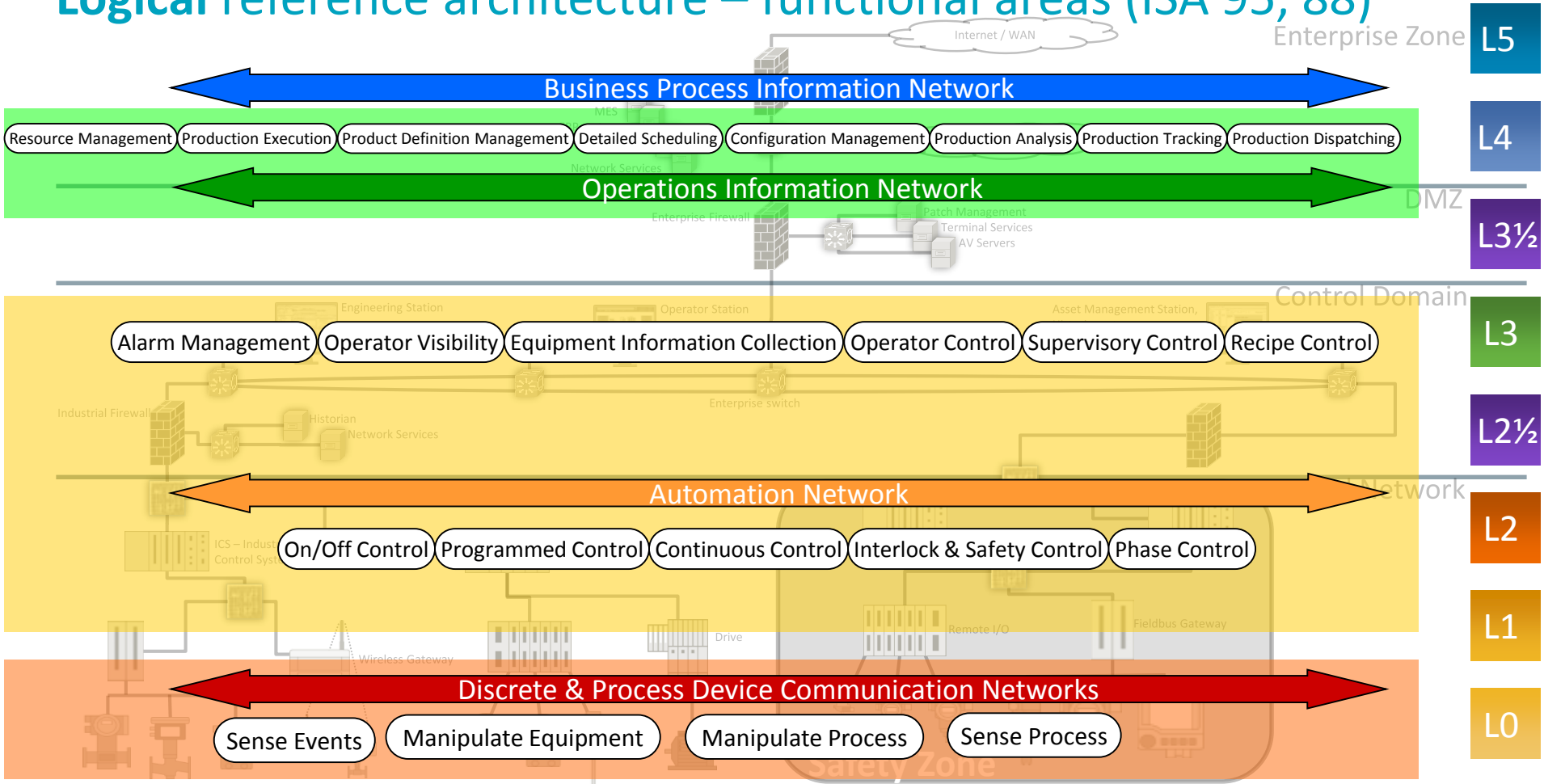
Logical reference architecture



Logical reference architecture – functional areas (ISA 95, 88)



Observations and remarks Logical reference architecture

The logical architecture gives an overview of the functionality and segmentation between the several Purdue levels.

A physical implementation / realization of the logical architecture can ‘collapse’ Purdue levels in one physical devices, as long as the associated logical function(s) are realized.

A point of further study will be the incorporation of the ‘*X in the cloud*’ or ‘*as a service’* developments, e.g. SCADA implementation in the cloud (either public or private) into this logical architecture.

HART Mapping on CIP

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Hart Mapping on CIP

HART Mapping on CIP

- Update of internal Rockwell object review process
- Present technical aspects of object
- Discuss future work effort

PoE in the Process Industries

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PoE

The current standards for PoE (Power over Ethernet), being IEEE 802.af (for max 15W) and IEE 802.at (for max 30W), can be deployed for Ethernet/IP in Process environments (using 4 or 8 wires CAT 5 or above cables).

There are several developments to increase the total available power budgets to 60 – 90W or even above as well as integration with IEEE 802.3az (EEE – Energy-Efficient Ethernet).

For those industrial areas which need compliance to 'intrinsically safe' standards, the used maximum voltage of PoE needs to be lowered to 12V (instead of the standard used 48V).

Diagnostics – Status Quo

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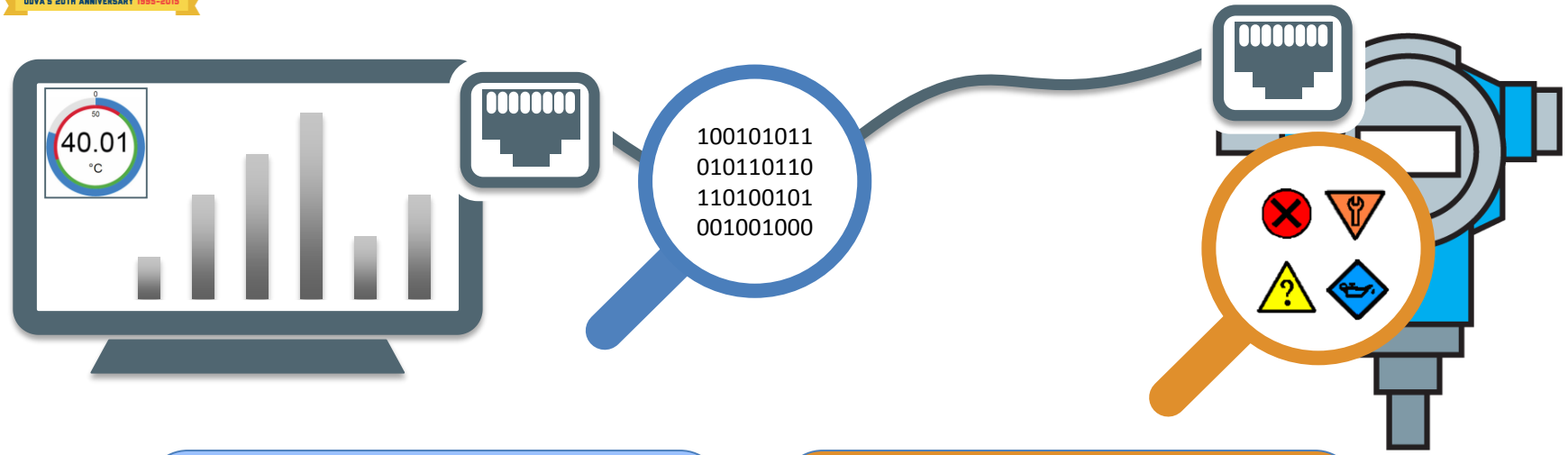
Types of Diagnostic



Communication Diagnostics

-

Focus of ODVA Diagnostics Working Group

Self-monitoring and Device Diagnostics

-

Focus of ODVA Process SIG

How diagnostics can be used

Communication Diagnostics

- Short term: Quick and effective identification and resolution of communication problems
- Mid term: Conduct regular analysis of the network using network statistics

Self monitoring and Device Diagnostics

- Mid-term: Conduct predictive maintenance to reduce downtime and to protect the investment
- Short term: Quick and effective identification and resolution of problems

Device Diagnostics

- Modern sensors and actuators are able to do self-monitoring and provide diagnostic information
- In addition to the “Big 12”, this can also be used to prevent downtime
- Therefore Device diagnostics were regarded in the Process SIG work plan

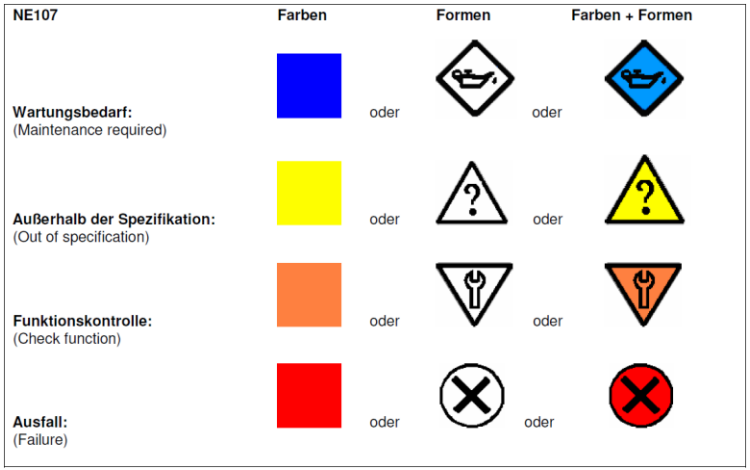
“In particular, the SIG will seek to define device diagnostics for native EtherNet/IP devices that are compliant with **NAMUR NE-107**”

NAMUR

- ***NAMUR is an international association of process automation end users***
- ***NEs are recommendations to help end users and to guide suppliers as well as industry foundations on future technology and product development***
- ***~300 active members in ~40 working groups***
- ***Members: e.g. Novartis, BASF, Bayer, Evonik, Shell, Clariant, …***

NE107 – “Self-Monitoring and Diagnosis of Field Devices”

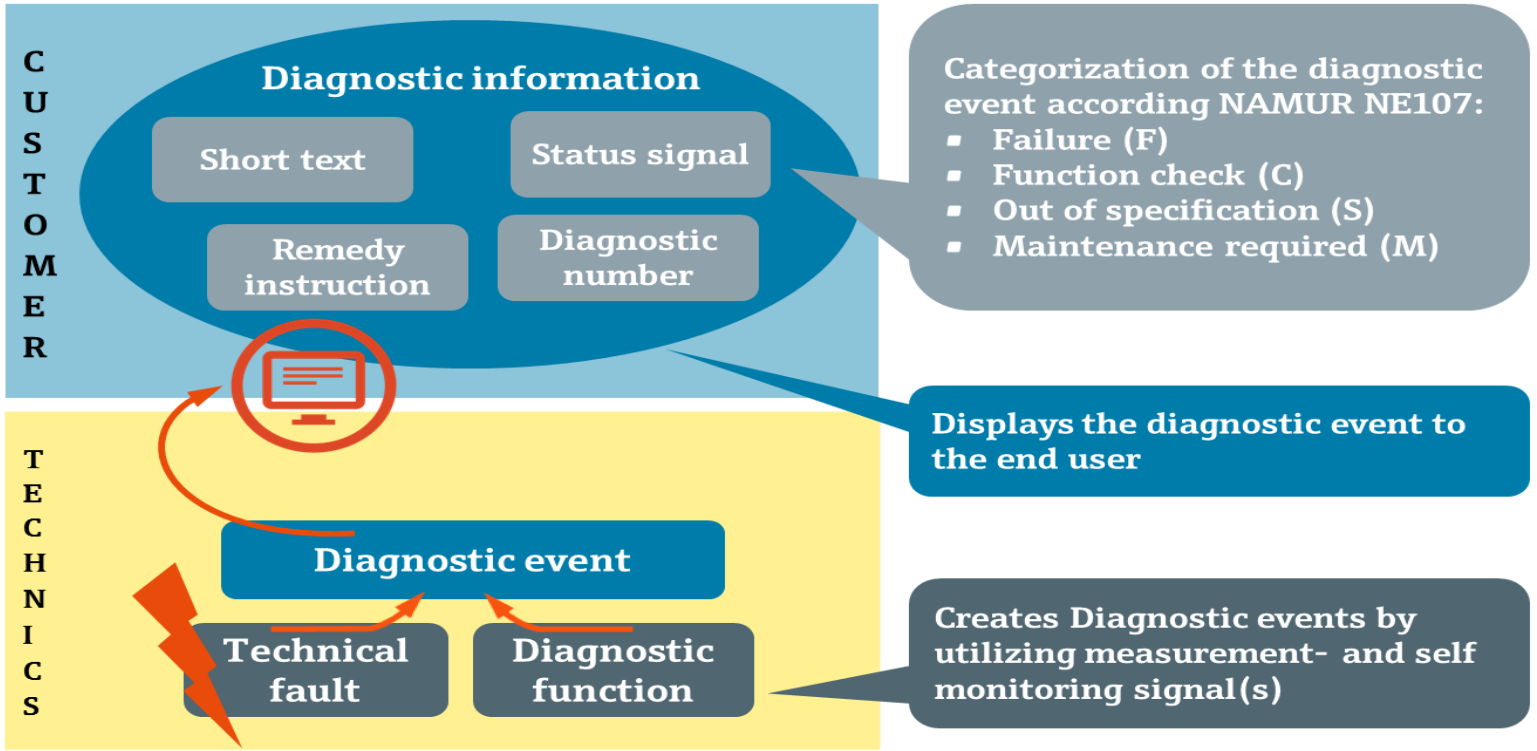
Colors and Symbols



Possible sources of error

– E.g. electronics, sensor or actuator element, installation, putting into operation, non-compliance with specified operating conditions, connecting to the process

NE107 – Information Flow



Accessing Device Diagnostics with EIP

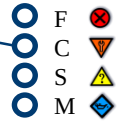
PLC/Tool

Input Assembly
(work in progress)

NE107-Device

Status	Diagnostic Code
	NE 107 status signal
	channel
Data(i)	Value
	Status
	(Padding)?
	Engineering unit
Data(i+1)	…

Grouping by source (sensor, electronics,...)



Source of status signal (for multichannel devices)

Good, bad, (uncertain)?

+simulation flag?
+active flag?

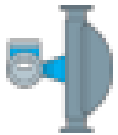
Adjacent Technology Developments

Three Use Cases in Optimization of Process Integration:

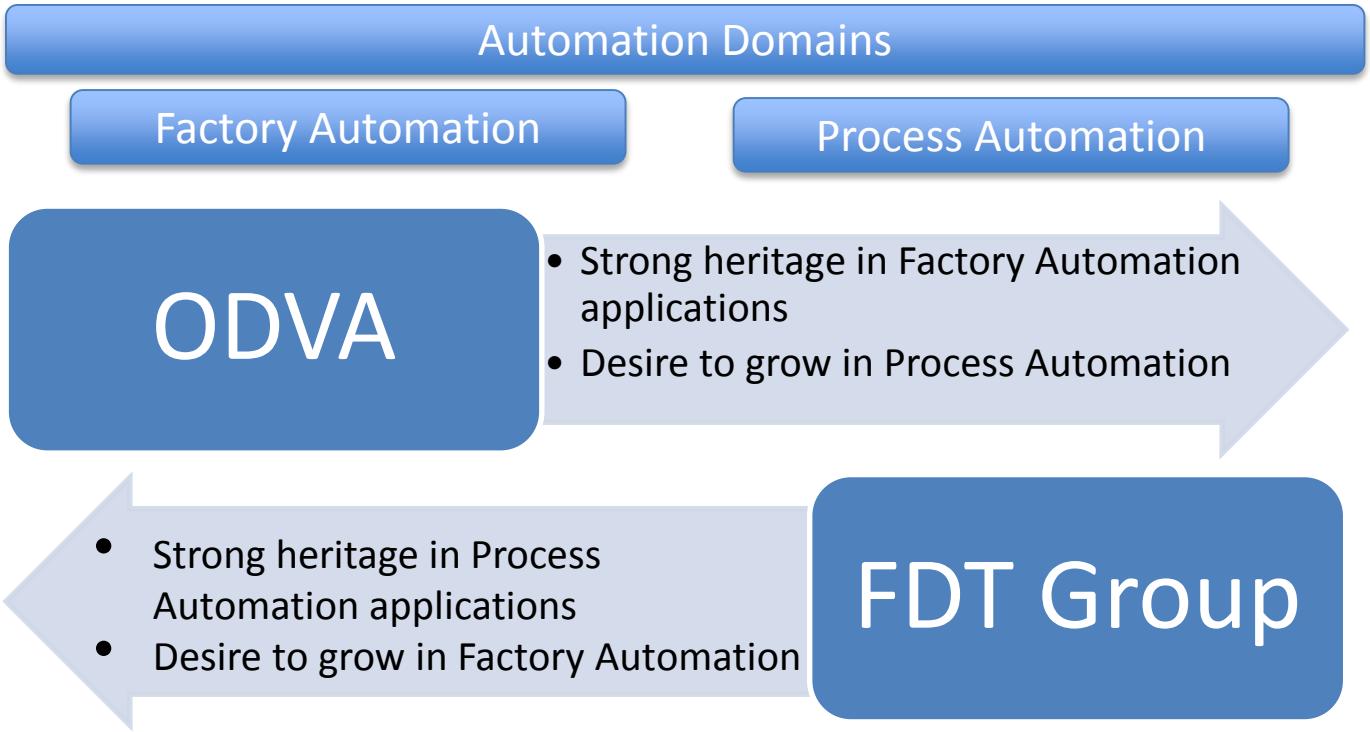
Field Device to Industrial Control System Integration

Field Device to Plant Asset Management

Holistic Field to Enterprise Architecture



Adjacent Technology Developments



A NEW PERSPECTIVE ON INTEGRATION OF FIELD DEVICES: USING THE FDT STANDARD WITH ETHERNET/IP

GLENN B. SCHULZ
MANAGING DIRECTOR
Glenn.Schulz@fdtgroup.org

FDT –Ideal for EtherNet/IP in Process

The FDT standard is the standard for the Process Industry

- Commissioning applications
- Asset Management applications

Most large HART and FF installations use the FDT standard

- Including HART Plant of the Year winners
- Written into procurement requirements

10+ year track record

- Millions of devices shipped
- Tens of thousands of hosts installed
- Supported by more than 90 companies

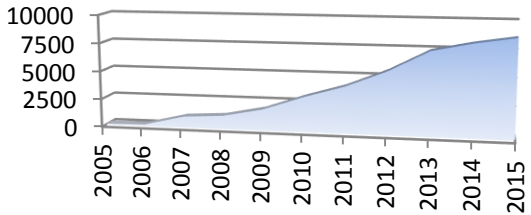
There is no charge to use the FDT standard

- Truly open and free

A large FDT EcoSystem to support vendors

- Services, toolkits, consulting

Devices Supported by Certified DTMs

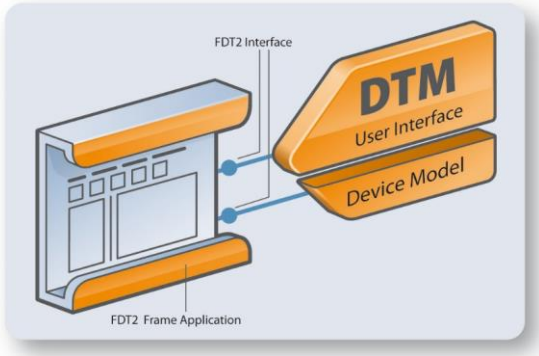


The FDT Standard

Allows any compliant device to be integrated into a host system (Frame)

Device vendor supplies a DTM (Device Type Manager)

– A software representation of the device
  - Configuration (wizards, smart guides, etc.)
  - Diagnostics
  - Troubleshooting
  - Manuals



Host system can "host" any number of DTMs

– Any device type, any vendor,
any mix of industry buses

Key Features of the FDT Standard

Extensible to any new industry bus

– Simple “annex” process - e.g. ISA-100 recently added

Transparently tunnel (route) through all networks to talk with end device

Client server or standalone architectures

Layered security model

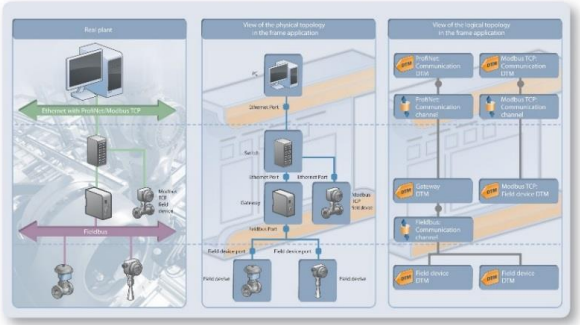
Latest version fully .NET

– Backward compatible

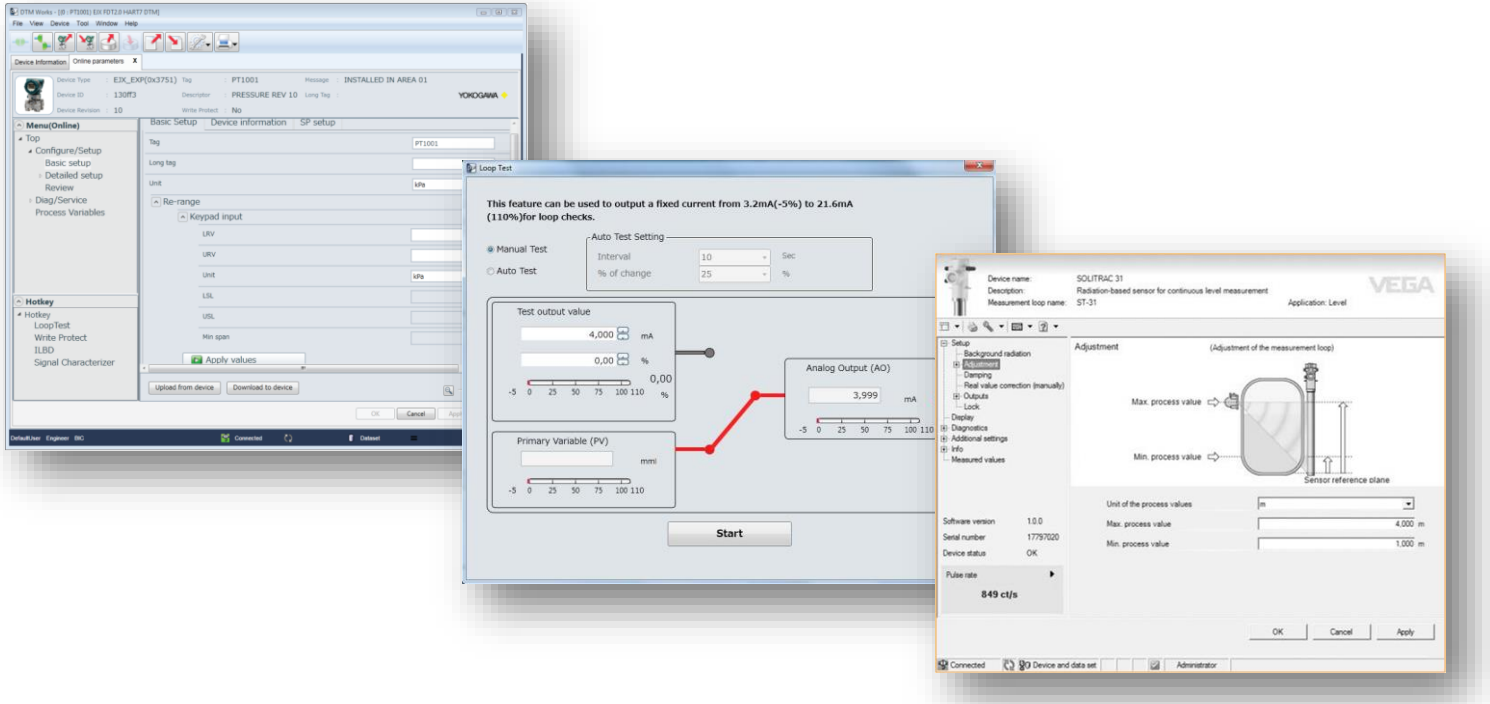
Recognized world-wide

– IEC 62453 / ANSI ISA 103 / China GBT 29618

No licensing or royalties to use the standard



DTM Examples – Configuration



DTM Examples –Diagnostics

Three Types of DTMs

Device DTM

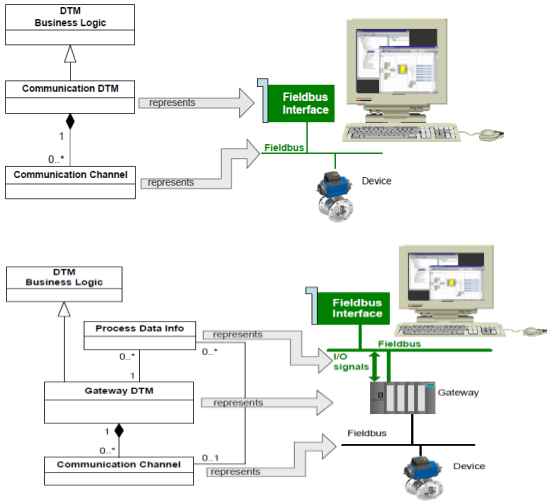
Represents an “end” device e.g. a drive, prox, etc.

Communications DTM

Provide communication channels which provide the services to access the fieldbus

Gateway DTM

DTM representing a device that connects different fieldbus segments

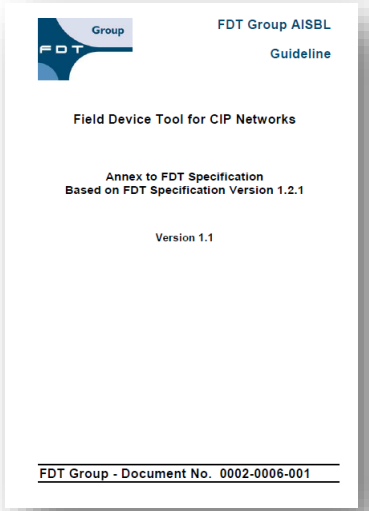


Protocol Annex

- Written by technical experts for the protocol
- Maps protocol specific requirements and features into the FDT standard
  - No changes to the FDT standard or the Frame applications
- Provides derived classes and extended base arguments for methods to support the protocol specific requirements
- Defines required device DTM behavior, for example:
  - IO signals provided by the DTM
  - Mapping protocol specific data types to FDT data types
  - Support of scanning method
  - Handling of communication anomalies
- Deliverables include test cases for FDT conformance testing

CIP Annex Status

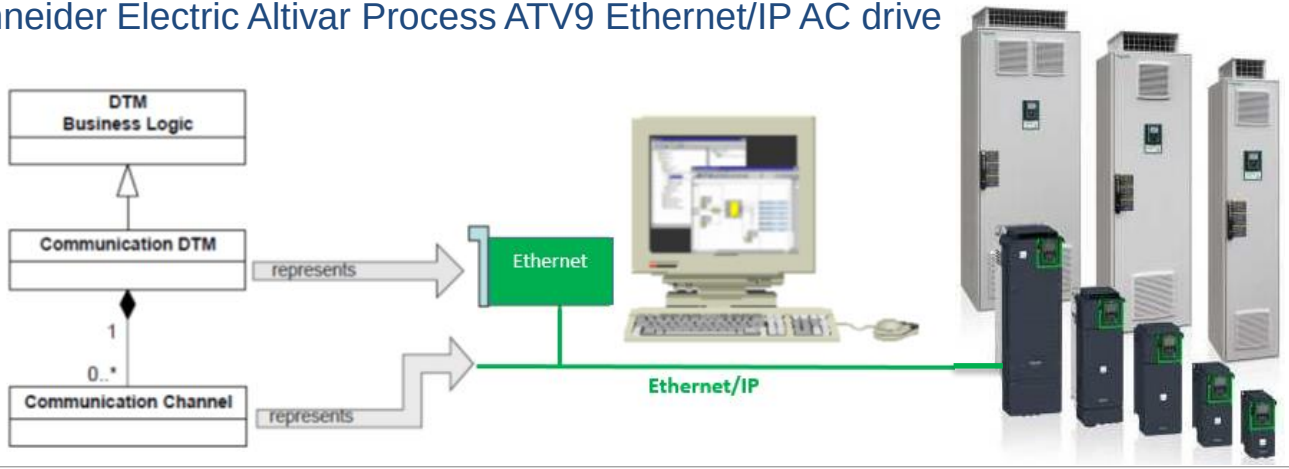
- FDT 1.2.x annex released in 2008
- FDT2 annex under development
  - David Comeau is the project leader
  - First TRB review this week
  - Expected release 1st Qtr 2016



EtherNet/IP Demo

An off the shelf demo

- A free, downloaded FDT Frame
- An Ethernet/IP communications DTM
- An ATV9xx family device DTM
- A Schneider Electric Altivar Process ATV9 Ethernet/IP AC drive



Core process industries

What are the characteristics of a chemical plant?

- Big foot print
- Long term running (~20-30 years)
- No plant shut down “button”
- Continuous processes without downtime
- Hazardous areas

EtherNet/IP in the field of core process industries


Chemicals


Oil & Gas


Power & Energy


Primaries & Metals

"Clear requirements for use of EtherNet/IP in the field have to be fulfilled in core process industries"

Core requirements to be fulfilled

- Information and energy on a single cable
- Employable in hazardous areas
- Long distances communication between assets
- Easy handling
- High availability

EtherNet/IP in the field of core process industries

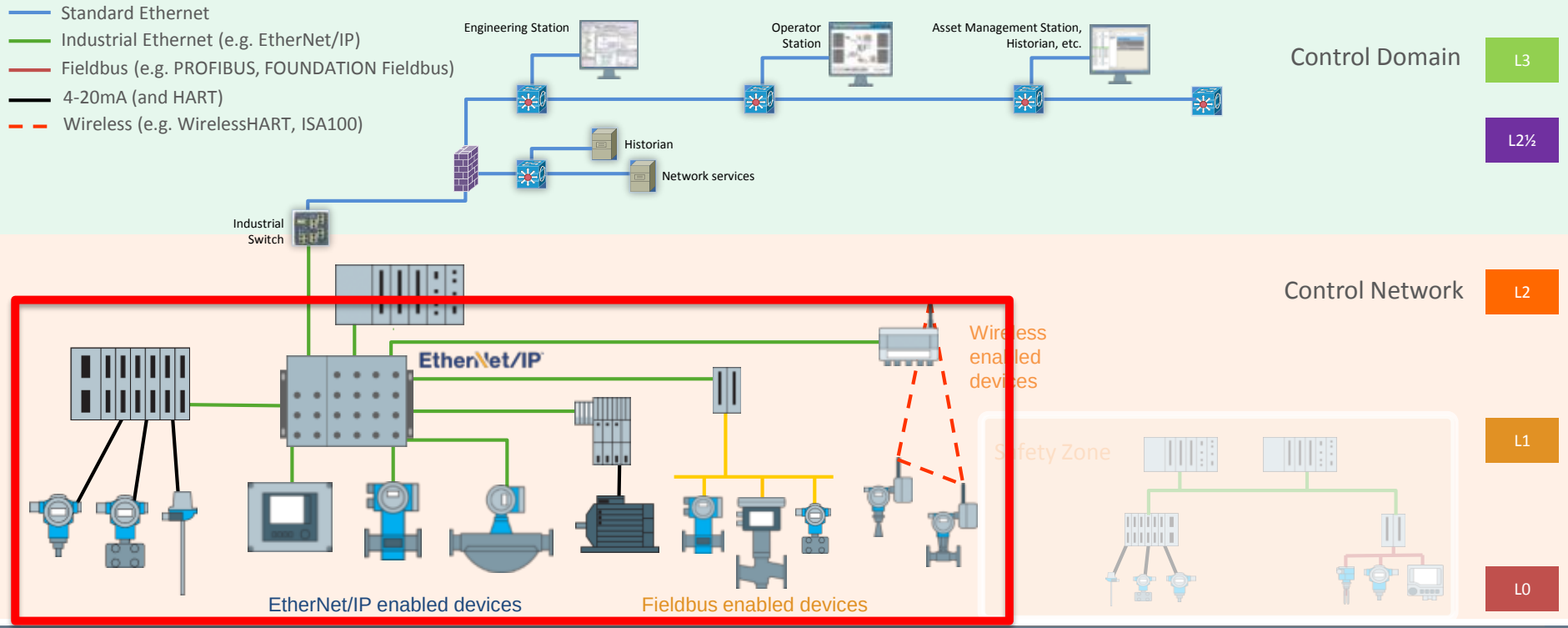
Physical Layer – Overview and Demonstration of New Physical Layer Concepts for Industrial Ethernet and EtherNet/IP in Process Field Devices

Jens Schmidt, Pepperl+Fuchs

Agenda

- Application area
- Requirements
- Technical concept
- Live demonstration
- Outlook

Application area



Requirements 1

Cable length Control Room - Field Junction Box (Trunk)	1000 m / 3280 feet	
Cable length Field Junction box - Field Device (Spur)	200 m / 565 feet	
Connection method (Trunk and spur)	Copper, 2-wire for power + data	
Increased EMC immunity	NA 21	
Intrinsically safe option	Required	
Cable	Today used cable	
Connectors	Robust industrial-grade connectors	

Requirements 2

Number of Field Devices per Trunk	more than 40
IO data update time	100ms (50 Byte IO) for 32 field devices
Communication performance for webserver, DTMs etc.	Fluent / adequate
Implementation	Open solution with long time support
Cost aspect	Same order of magnitude than today
Power requirements	Low power to simplify implementation and allow higher number of devices

Result of Evaluation

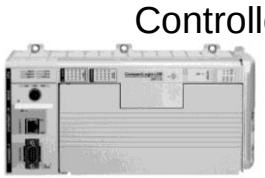
After evaluation of the technologies available today Pepperl+Fuchs realized that they don't fulfill the requirements for process automation field installations

As an outcome of the evaluation Pepperl+Fuchs decided to design a new physical layer for Ethernet communication fulfilling the requirements of Process Automation field installations.

Concept structure

Switch

PactWare
FDI-i-DTM, Plant PAx



Controller

WLAN
Router

Up to 1000 m

iPad
Web-Browser

Control room switch

- Separate powered
- Switched technology
- Converts Ethernet (e.g. 4-wire, 100 Mbit/s) to two wire powered Ethernet

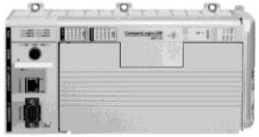
Ethernet

Powered, 2-wire, Ethernet communication

Concept structure

Switch

PactWare
FDI-i-DTM, Plant PAx

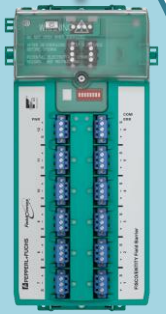


Controller

WLAN
Router

iPad
Web-Browser

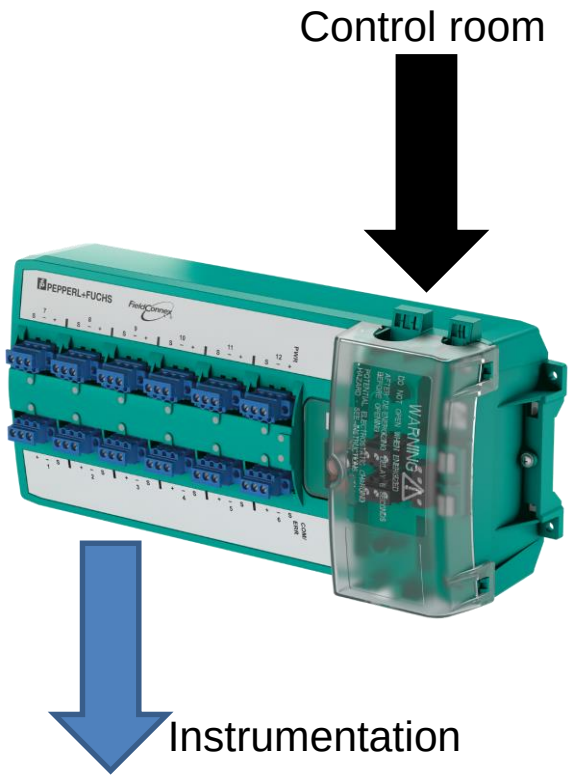
Up to 1000 m



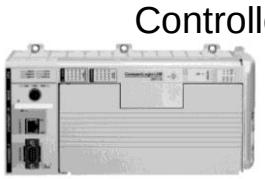
Field-Switch
Zone 1

Field-Switch

- Switched connections for instruments
- Switch and instrument powered over data line
- Intrinsically safe instrument connection
- Robust industrial-grade connectors



Concept structure



PEPPERL+FUCHS

PactWare
FDI-i-DTM, Plant PAx

iPad
Web-Browser

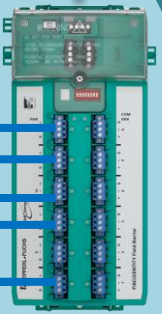
Switch

Up to 1000 m

Zone 0

Up to 200 m

Zone 2



Field-Switch
Zone 1

Key figures 1

- 2-wire system for power and data
- Number of devices per trunk: > 60
- Usage of IEC-61158 Type A fieldbus cable
- Provides all benefits of switch network according to IEEE 802.1
- Intrinsically safe option for use in hazardous area Zone 2/Div 2, Zone 1/Div 1 and Zone 0
- Low power consumption supports cost efficient Field Device implementation (below 100mW)
- More power for advanced device functions
- Open implementation based on mass market components (No ASICs)
- Redundancy for cable and infrastructure components supported

Key figures 2

Communication speed

- 10 MBit/s up to 500m / 1640 feet
- 2 MBit/s up to 1000 m / 3280 feet

Auto negotiation and dynamic baud rate switching supported

Requirement: 100ms (50 Byte IO) for 32 field devices

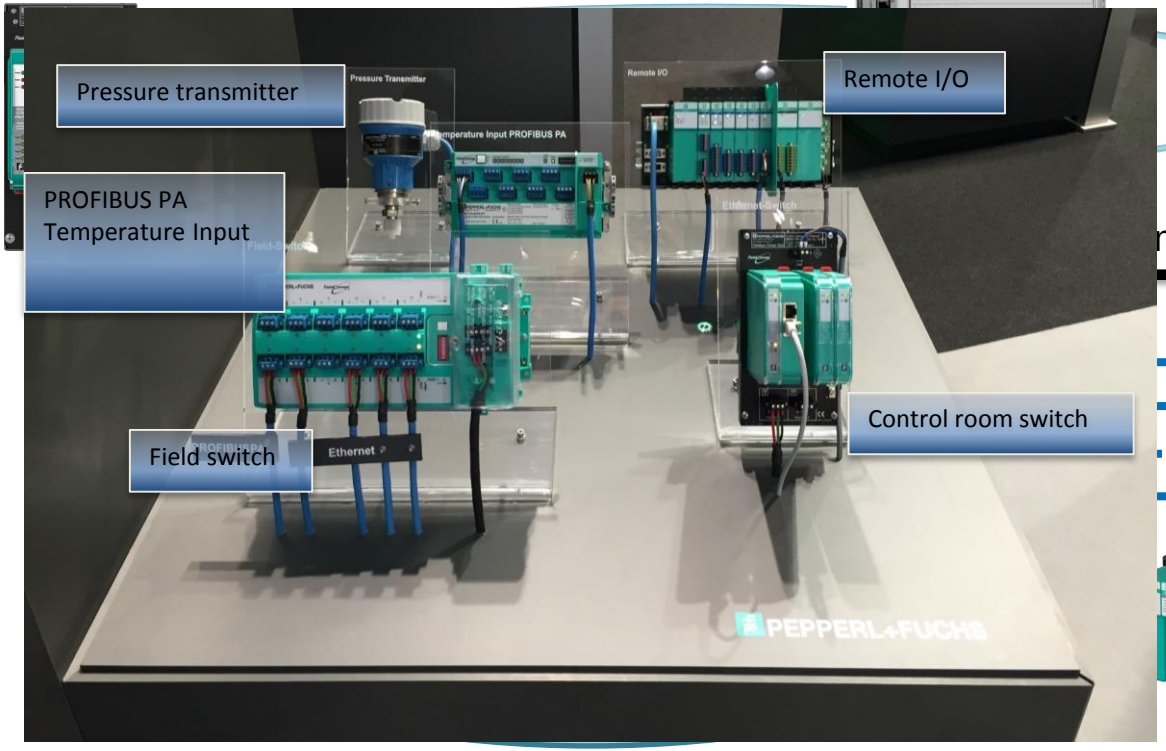
Trunk bandwidth usage of this IO data:

- 2 MBit/s: 28%
- 10 MBit/s: 5%

Live Demo

Controller

PEPPERL+FUCHS



Live demo - highlights

- Ethernet network fulfilling field installation requirements for process automation
- Multi vendor demo proves feasibility of concept
- Integration of complex and simple devices into one homogeneous network
- Major step in communication speed enables upcoming IIoT use cases
- Compatibility to existing technologies FF, PA and HART offers migration path
- First presentation of field device prototypes utilizing the new physical layer to provide EtherNet/IP communication

Outlook

- The concept shows what is possible today using available technology
- Switched technology and build in auto negotiation support future speed upgrades when technology evolves
- Basically it‘s only a physical layer. The concept shows a reasonable utilization for process automation installations but other usage is also possible.

- Pepperl+Fuchs works with many process automation suppliers to create an international and open standard

Demo availability

The demo will be available for more detailed questions and presentation at the Magnolia room tomorrow and on request

Industry Perspectives on EtherNet/IP for the Process Industries

- Mirko Brcic, ODVA Chairperson for Process SIG
- Shannon Foos, Rockwell Automation
- Terry Minns, Schneider Electric
- Rene Pluis, Cisco Systems
- Jens Schmidt, Pepperl+Fuchs
- Glenn Schulz, FDT Group
- Olivier Wolff, Endress+Hauser


ODVA
2015
INDUSTRY CONFERENCE
AND 17TH ANNUAL MEETING
ODVA'S 20TH ANNIVERSARY 1995–2015

THANK YOU

Links To Referenced Documents

[White Paper Press Release]


ODVA

Press Release

NEW WHITE PAPER OUTLINES VISION FOR PROCESS INTEGRATION

ODVA helps process industries migrate towards a unified communication solution using EtherNet/IP

Ann Arbor, Mich., USA, Feb. 10, 2014 – ODVA announces the availability of a new white paper, Optimization of Process Integration, which outlines a strategic vision for manufacturers looking to maintain cost-effective, sustainable production capacity in the process industries. The white paper is designed to help business and technical leaders in these industries define their future network architecture and plan for the efficient integration of their plant's network infrastructure into existing business applications.

ODVA envisions an approach to the optimization of process integration that is convergent, compatible, scalable and open for users and their suppliers. The approach will simplify the exchange of configuration, diagnostic and production data between field devices and higher-level systems, such as supervisory control and data acquisition systems.

The approach also will enable plant asset management (PAM) and secure remote access of field installations. This, together with the proven benefits and cost advantages of commercially available, off-the-shelf Ethernet and Internet technologies, will help businesses improve productivity and competiveness.

"In ARC's vision for the plant of the future, Ethernet is integrated into process automation systems," said Dick Hill, vice president and general manager, ARC Advisory Group. "The application of Ethernet technology to process automation promises to collapse these systems into a paradoxically simpler structure, while providing a solid basis for distributed intelligence with the elimination of artificial barriers to data and information."

Katherine Voss, president and executive director, ODVA, agrees that industry will see a continued expansion of Ethernet and IP technologies in automation systems used in process industries. "The Optimization of Process Integration leverages the prevailing trend of convergence in information and communication technologies used in industry and in business applications. As EtherNet/IP is proven in hybrid and discrete industries, it is an ideal technology to provide process industries with a unified communication solution from the field to the enterprise."

In this white paper, ODVA describes the opportunity for the optimization of process integration (OPI) and an overview of its vision for a comprehensive approach including:

- OPI in the industrial ecosystem;
- ODVA's vision of OPI in the production domain;
- Industrial use cases for OPI;
- ODVA's technical approach to OPI; and
- OPI in practice.

[SIG Formation Press Release]


ODVA

Press Room

ODVA Announces Formation of Special Interest Group for EtherNet/IP™ in the Process Industries

Download the press release: English | German

Ann Arbor, Michigan, USA — November 17, 2014 — ODVA announced today that it will form a new special interest group for EtherNet/IP in the process industries. The SIG will leverage the inherent strengths of EtherNet/IP to develop enhancements to The EtherNet/IP Specification to address three key use cases for automation applications in the process industries: (1) field device-to-industrial control system (ICS) integration; (2) field device-to-plant asset management (PAM) integration; and (3) a holistic field-to-enterprise communication architecture.

The formation of this SIG is one outgrowth of ODVA's process initiative, which is aimed at the optimization of process integration (OPI™). The SIG's scope of work is founded on the overarching vision to proliferate adoption of EtherNet/IP in the process industries, and will focus initially on the integration of field devices with industrial control systems and related diagnostic services. The work of the SIG will result in a unified communication approach to process applications, enhancing the ability of users to exchange information to and from the field. The work of the SIG is expected to be completed in phases generally aligned with the key use cases.

"ODVA's SIG for EtherNet/IP in the process industries will provide ODVA's members with a venue to concentrate on technical requirements often unique to process applications," said Katherine Voss, president and executive director of ODVA. "The result will provide users in all production domains of industrial automation – discrete, hybrid and process – with a feature rich and future proof solution using EtherNet/IP."

ODVA will issue its call for SIG participants in December 2014 with an organizational meeting of the SIG to be held in the first quarter of 2015. Participants in the SIG are expected to include individuals from ODVA's principal members – Cisco Systems, Endress+Hauser, Rockwell Automation and Schneider Electric – in additional to other participants from ODVA's 300+ member companies. ODVA will be providing more information on OPI, as it relates to the scope of work to be addressed by the SIG, at its media briefing to be held on November 25, 2014 in conjunction with the SPS IPC Drives Show in Nuremberg, Germany.

[White Paper]


Optimization of Process Integration

ODVA's Vision of a Unified Communication Solution for the Process Industries

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[Work Plan (Accessible by ODVA Members)]


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Work Plan for
Special Interest Group
EtherNet/IP™ in the Process Industries

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