



OPC UA Field Level Communications Initiative: Update & Roadmap

Milano/ Italy

October 29, 2019

Peter Lutz, Director FLC, OPC Foundation



OPC Foundation

<https://opcfoundation.org>

Vision

- Secure & reliable
- Vendor, platform, and domain agnostic
- interoperability from sensor to enterprise and beyond

Global Profile

- Non profit organization (founded 1995)
- Companies from Automation & IT
- Internationally Recognized: OPC UA is IEC62541

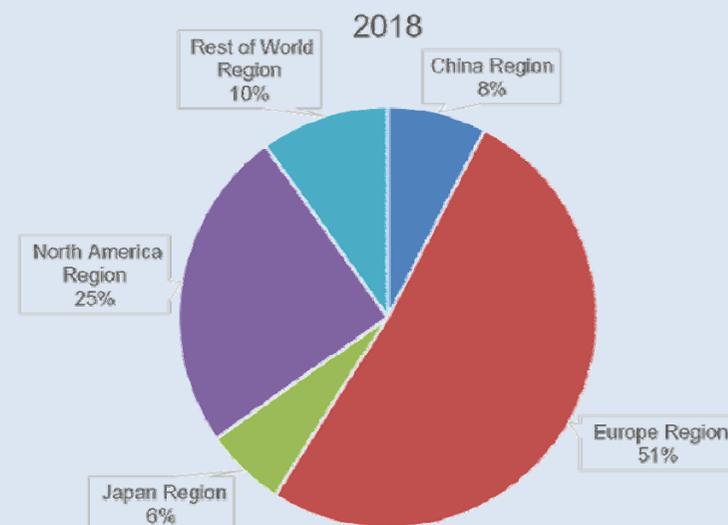
Deliverables

- Specifications: openly available
- Tools and code examples for faster, easier adoption (AnsiC/C++, C# .NET Standard, Java)
- Certification: OPC Labs open to everyone

Ecosystem with toolkits and education

Organizational Overview

Membership: 717 (Sept 25th, 2019)



2019 Board of Directors

Microsoft	Honeywell	Rockwell
SAP	Yokogawa	Schneider
Siemens	ICONICS	ABB
Beckhoff	Ascolab	

The Industrial Interoperability Standard

OPC UA: The industrial framework enabling secured, standardized data and interfaces

Interoperable

Vendor, Platform, Market and OS Independent

Scalable From Sensor to Cloud

Discoverable Services Oriented Architecture

Independent of transport protocol

Not-for-Profit (OPC Foundation)

Widely Adopted: >50M install base

Open Source on GitHub

Data Modelling

Graph Support, preserves source context

Vendor **extendable** data model via Companion Specifications

Relevant: Enables domain specific information models

- Discrete: Robotics, Machine Vision, ...
- Process: FDI, FDT, PA-DIM, MDIS, NOA..
- Energy: IEC61850, ..

Secure

Secure Design from group up

Based on open security standards

Auditing, Authentication & Encryption

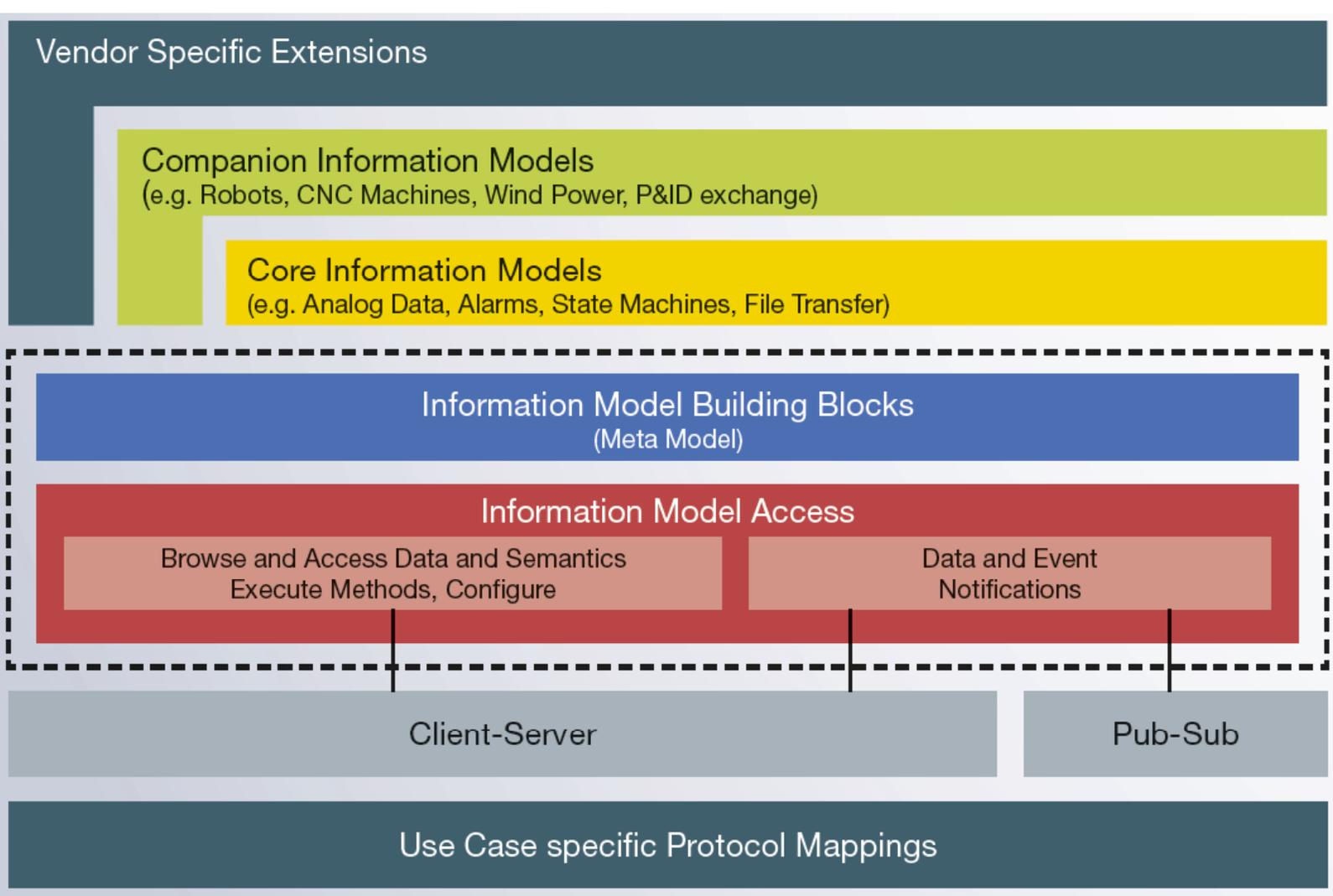
Future Proof: Evolves with security technologies

Vendors/Users can choose level of security

Accepted: Aligned with IT requirements

... today 50+ initiatives!

OPC UA Framework



Proprietary

Developed with / by partner organizations

OPC Foundation Responsibility

(OPC UA = IEC 62541)



Vendors will differentiate on features not interfaces...

Commercial printers

- Different vendors
- Standardized connectors
USB / Ethernet
- Support profiles “I am a printer”



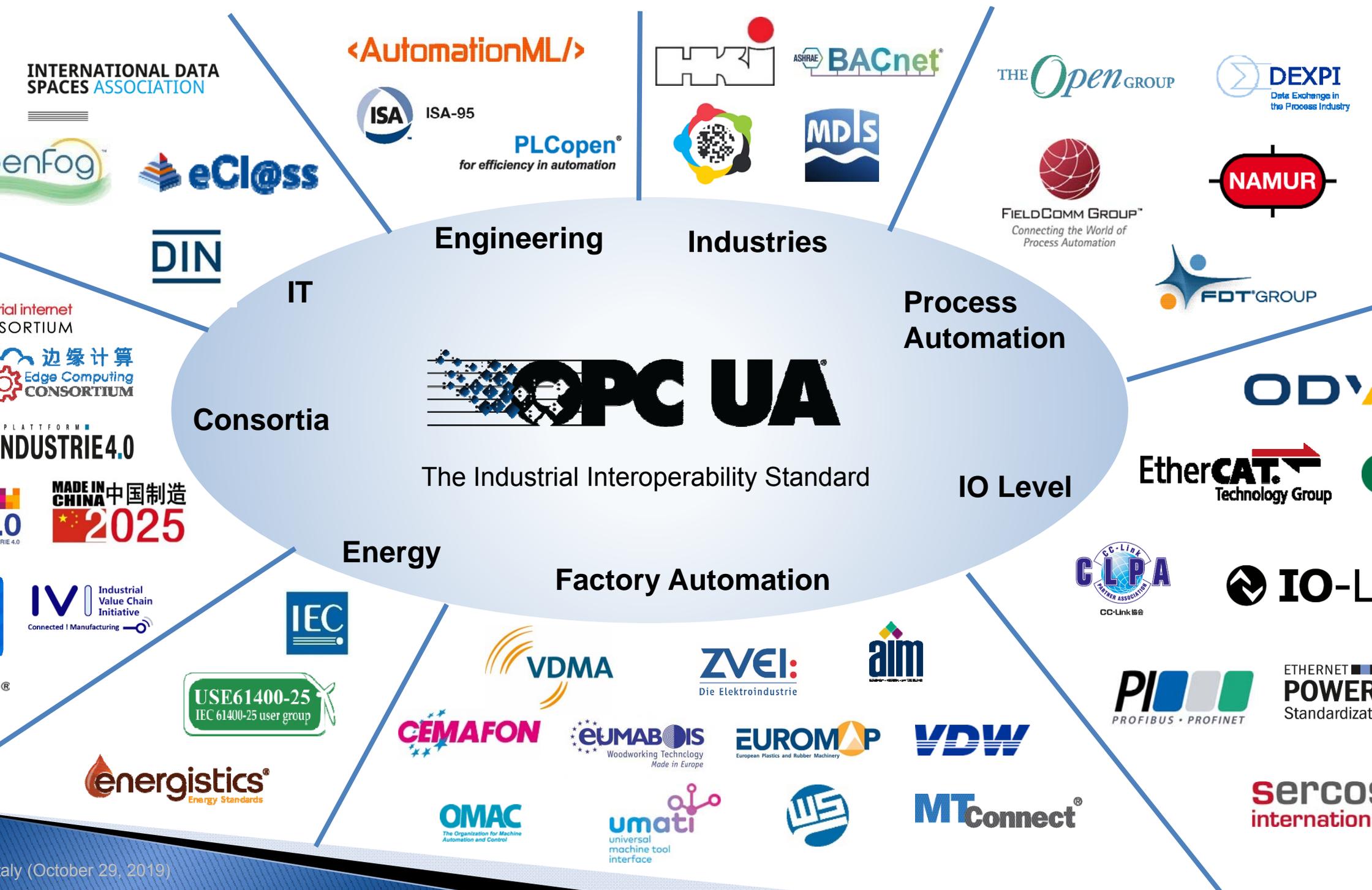
- Differentiate by functionality
 - All-in-once scan/fax/print?
 - Double side printing?
 - Colour? Combined or separate?
 - Print speed, cost, etc.
 - Ease of use
 -

Industrial devices / machines

- Different vendors
- Standardized connector: OPC UA
- Support profiles “I am an RFID reader”
- Built in security



- Differentiate by functionality
 - Reduce engineering costs
 - Support standards
 - Easy network integration
 - Costs
 - Throughput of machine
 -

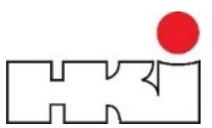


INTERNATIONAL DATA SPACES ASSOCIATION

<AutomationML/>



PLCopen®
for efficiency in automation



ASHRAE BACnet®

THE Open GROUP



eCloss



FIELD COMM GROUP™
Connecting the World of Process Automation



DIN

IT

Engineering

Industries

Process Automation



Industrial Internet Consortium

边缘计算
Edge Computing Consortium

INDUSTRIE 4.0

MADE IN CHINA 中国制造
2025

IVI Industrial Value Chain Initiative
Connected | Manufacturing



USE61400-25
IEC 61400-25 user group

energistics®
Energy Standards

The Industrial Interoperability Standard

IO Level

EtherCAT™
Technology Group

ODVA

Energy

Factory Automation



IO-LINK



ZVEI:
Die Elektroindustrie



CEMAFON

eUMABOIS
Woodworking Technology
Made in Europe

EUROMAP
European Plastics and Rubber Machinery

VDW

PI PROFIBUS • PROFINET

ETHERNET POWER
Standardization

OMAC
The Organization for Machine
Automation and Control

umati
universal
machine tool
interface



MT Connect®

SERCOS
international

INTERNATIONAL DATA SPACES ASSOCIATION



IT

Industrial Internet Consortium



INDUSTRIE 4.0

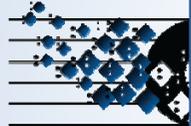


Consortia

Energy



Engineering



The Industry

Factory Automation



AutomationM



PL for efficiency

VDMA represents the breadth of the manufacturing industry VDMA has more than 3200 member companies

- » Agricultural Machinery
- » Air Conditioning and Ventilation
- » Air Pollution Control
- » Air-handling Technology
- » Building Control and Management
- » Cleaning Systems
- » Compressors, Compressed Air and Vacuum Technology
- » Construction Equipment and Building Material Machines
- » Drying Technology
- » Electrical Automation
- » Electronics, Micro and Nano Technologies
- » Engine Systems for Power and Heat Generation
- » Engines and Systems

- » Fire Fighting Equipment
- » Fluid Power
- » Food Processing Machinery and Packaging Machinery
- » Foundry Machinery
- » Gas Welding
- » Hydro Power
- » Integrated Assembly Solutions
- » Large Industrial Plant Manufacturing
- » Lifts and Escalators
- » Machine Tools and Manufacturing Systems
- » Machine Vision
- » Materials Handling and Intralogistics
- » Measuring and Testing Technology

- » Metallurgical Plants and Rolling Mills
- » Metallurgy
- » Micro Technologies
- » Mining
- » Plastics and Rubber Machinery
- » Power Systems
- » Power Transmission Engineering
- » Precision Tools
- » Printing and Paper Technology
- » Process Plant and Equipment
- » Productronic
- » Pumps + Systems
- » Refrigeration and Heat Pump Technology
- » Robotics

- » Robotic + Automation
- » Security Systems
- » Software and Digital
- » Surface Treatment Technology
- » Textile Care, Fabric Technology
- » Textile Machinery
- » Thermal Turbines Plants
- » Thermo Process T
- » Valves
- » Waste Treatment a
- » Wind Energy
- » Woodworking Ma
- » OPC UA CS Release
- » OPC UA CS under
- » Awareness e

VDMA | Dr. Reinhard Heister

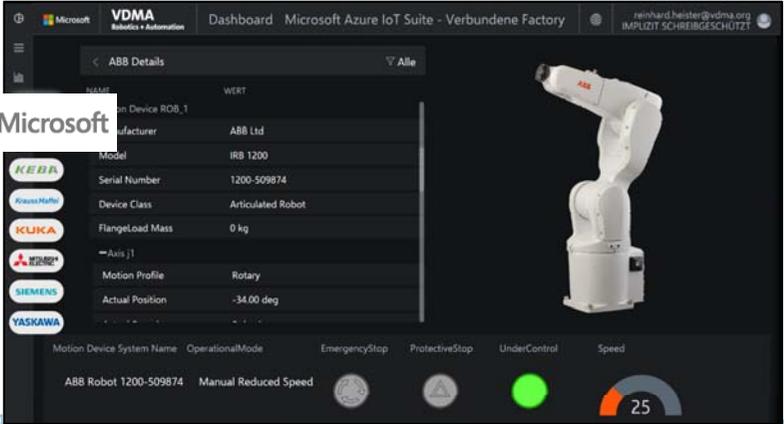


ETHERNET POWER Standardizat



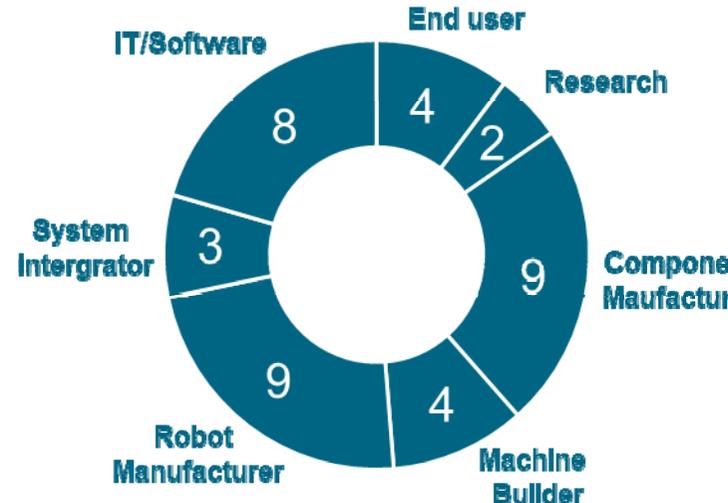
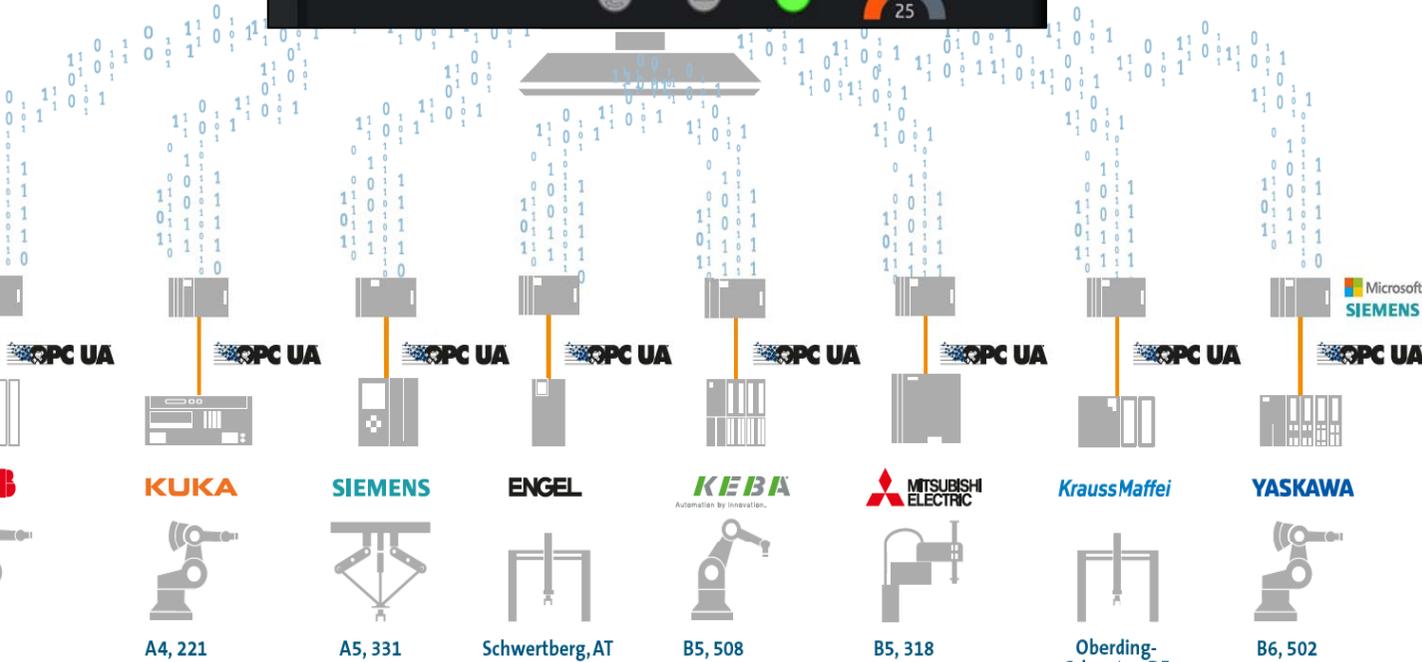
OPC UA Companion Specifications are implemented

- Demonstrator VDMA OPC Robotics Initiative



Applications of this demonstrator

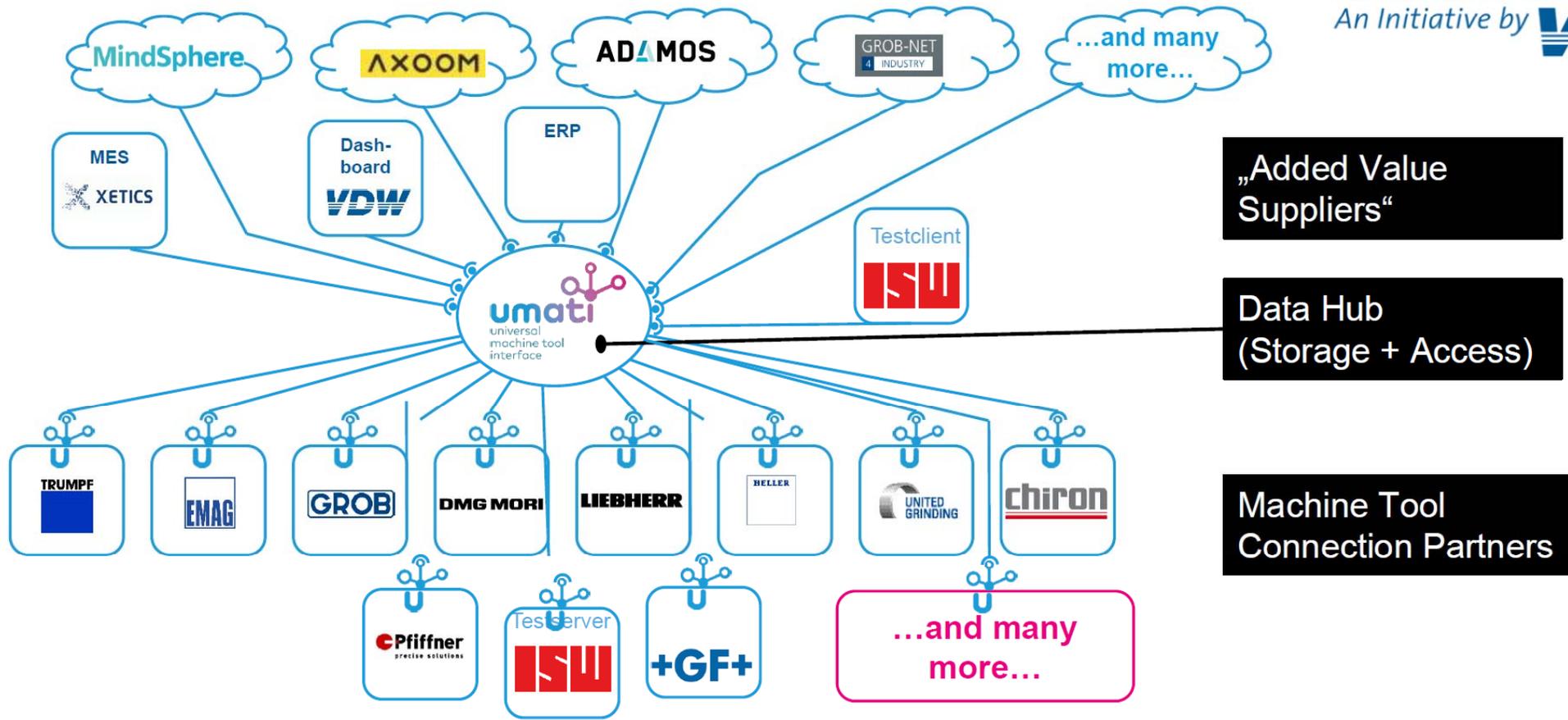
- » Asset management
- » Condition monitoring
- » Preventive Maintenance
- » Vertical integration
 - Information flow from shop floor to cloud
 - ERP, MES, SCADA



OPC UA Companion Specifications are implemented

umati EMO Connectivity Scheme

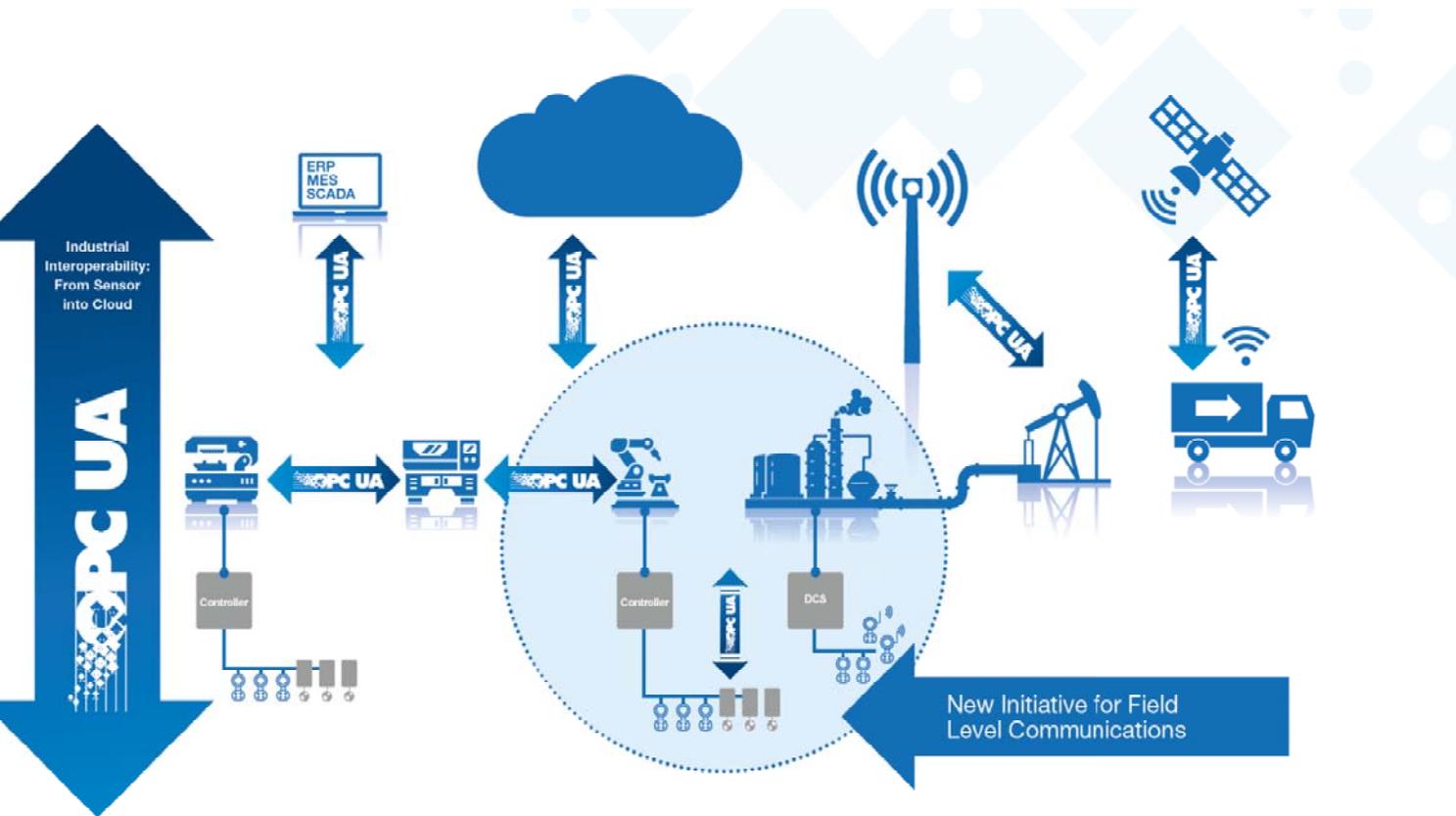

 Eine Initiative des
 An Initiative by 



source: Short Introduction to umati (VDW/Kon14.0)

OPC-F “Field Level Communications Initiative”

Extending OPC UA including TSN down to field level



OPCF Press Conference SPS 2018
Overcrowded!



OPCF Press Conference SPS 2018
ABB, Beckhoff, Mitsubishi,
Rockwell, Siemens, Schneider

DPCF Field Level Communications Initiative

Initial supporting Industry Players



BECKHOFF

rexroth
A Bosch Company



CISCO



HIRSCHMANN
A BELDEN BRAND



kalycito
creating a difference

KUK



molex

MOXA

OMRON



**Rockwell
Automation**

**Schneider
Electric**

SIEMENS
Ingenuity for life

TTTech
Ensuring Reliable Networks

WAGO



Vision for Field Level Communications Initiative

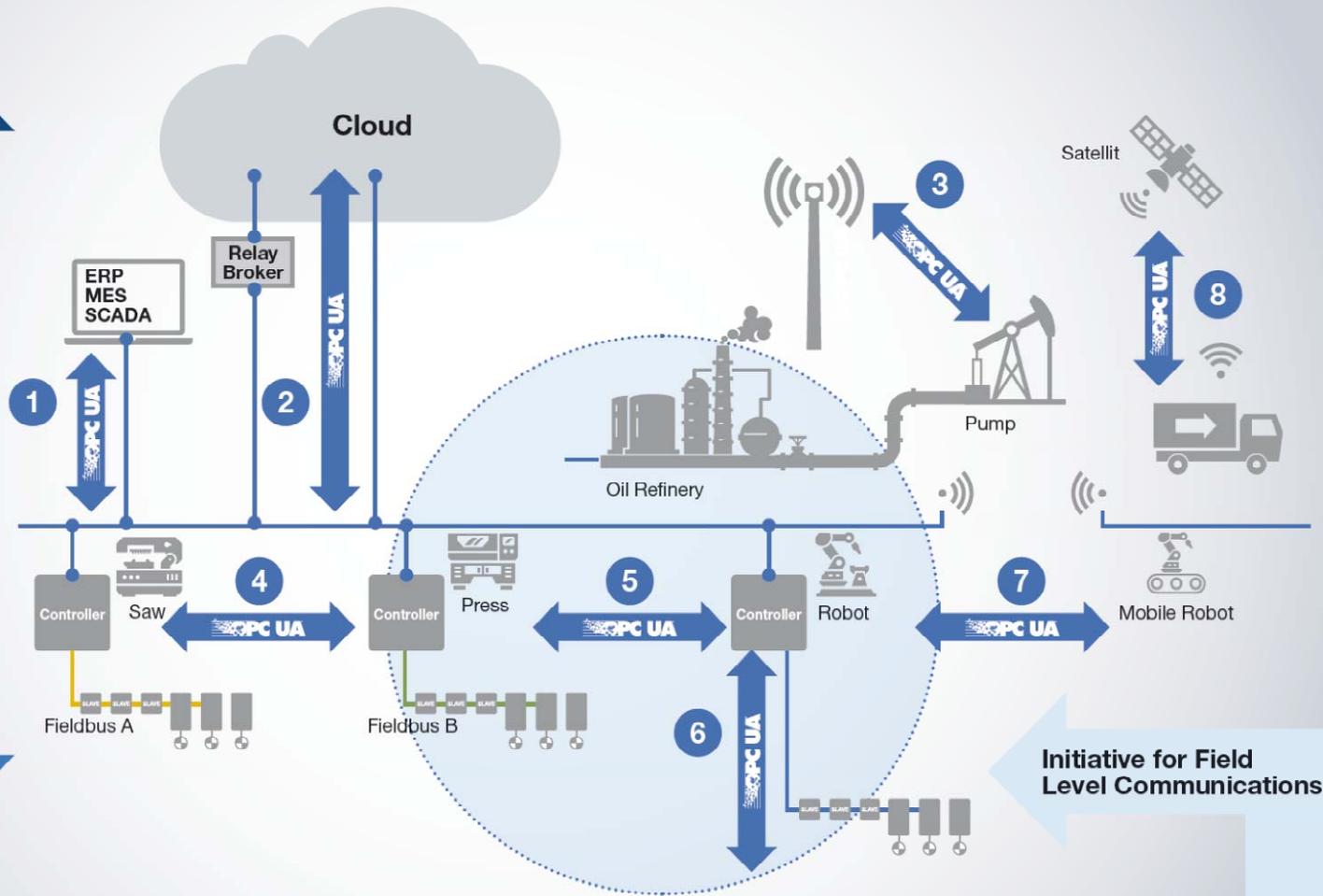
The vision of the initiative is...

...to aim for an open, unified, standards-based IIoT communication solution between sensors, actuators, controllers and cloud addressing all requirements of industrial automation

OPC UA Unified Architecture – from Sensor to Cloud

Industrial
Operability:
from Sensor
to Cloud

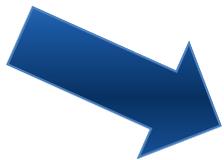
OPC UA



- 1 IT / OT Communication
- 2 Cloud Integration
- 3 Secure Remote Access
- 4 Local OT Communication
- 5 Controller to Controller
- 6 Controller to Field Device
- 7 Wireless Integration
- 8 Future Ready

Field Level Communications Initiative

Information Models
Semantic
Security
IT Connectivity

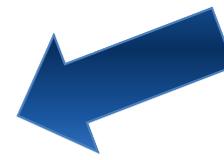


IEEE
802



TSN

Converged, real-time
capable Ethernet networks



Combine Strength



Major automation vendors in the
initiative add their long time field
level communications know-how

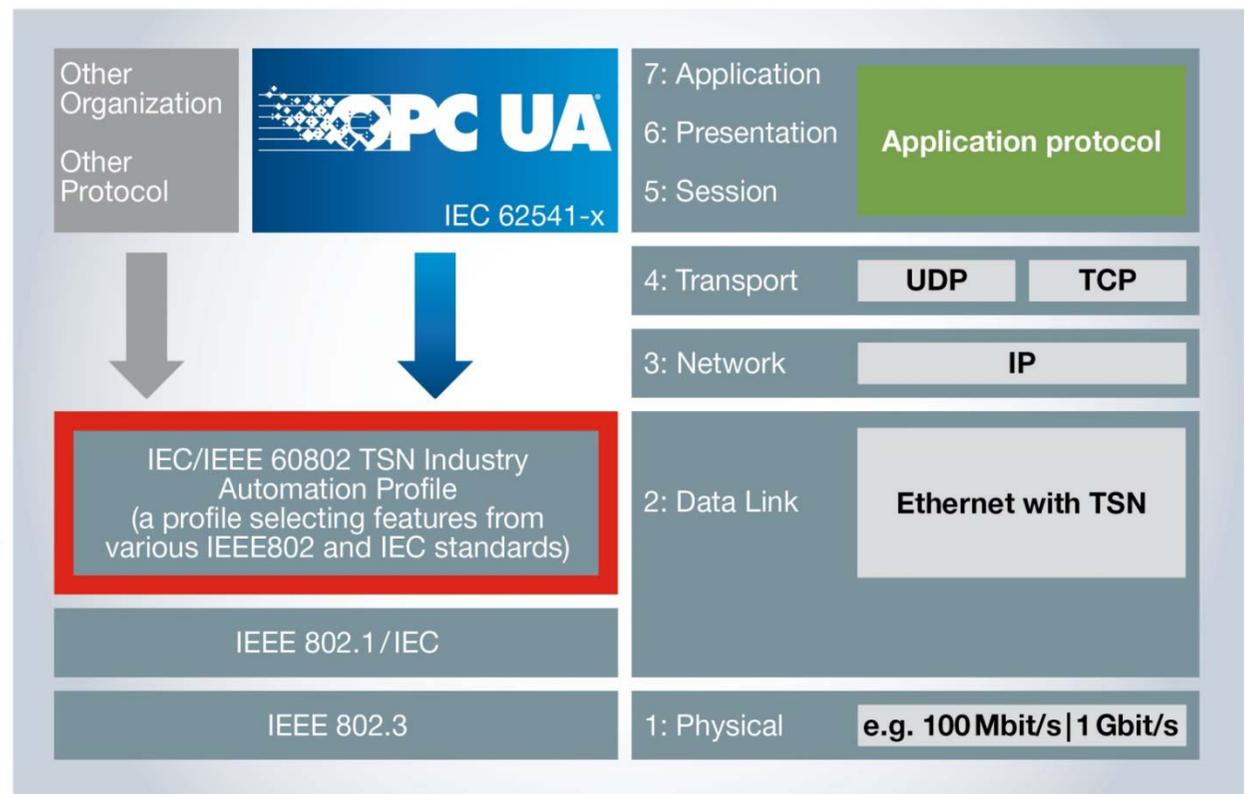


Technology base – collaboration with IEC and IEEE

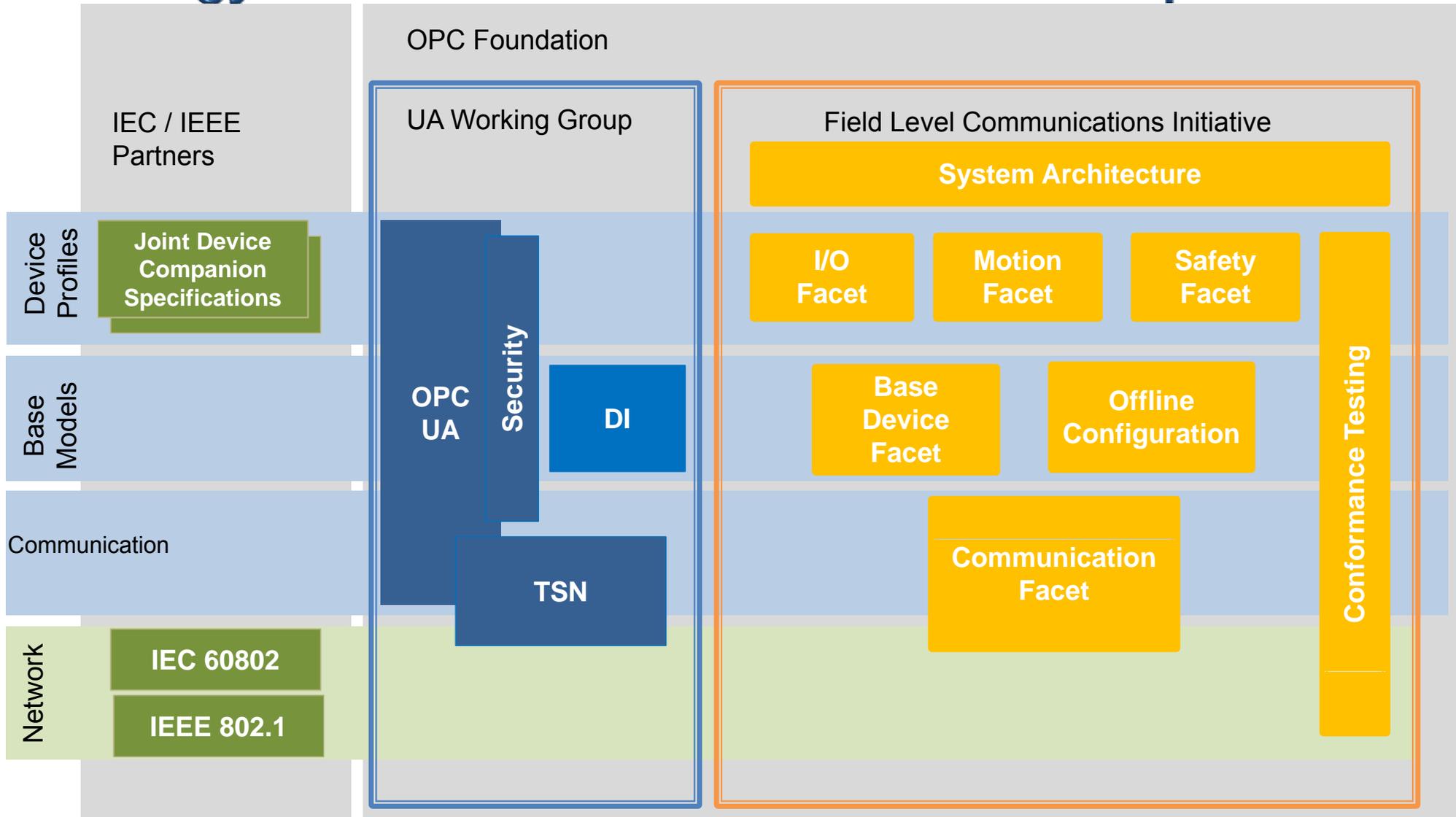
The working groups will closely align with the TSN Profile for Industrial Automation (TSN-IA-Profile) which will be standardized by the IEC/IEEE 60802 standardization group. This will help ensure that a single, converged TSN network approach is maintained so that OPC UA can share one common multi-vendor TSN network infrastructure together with other applications.

Goal of IEC/IEEE 60802

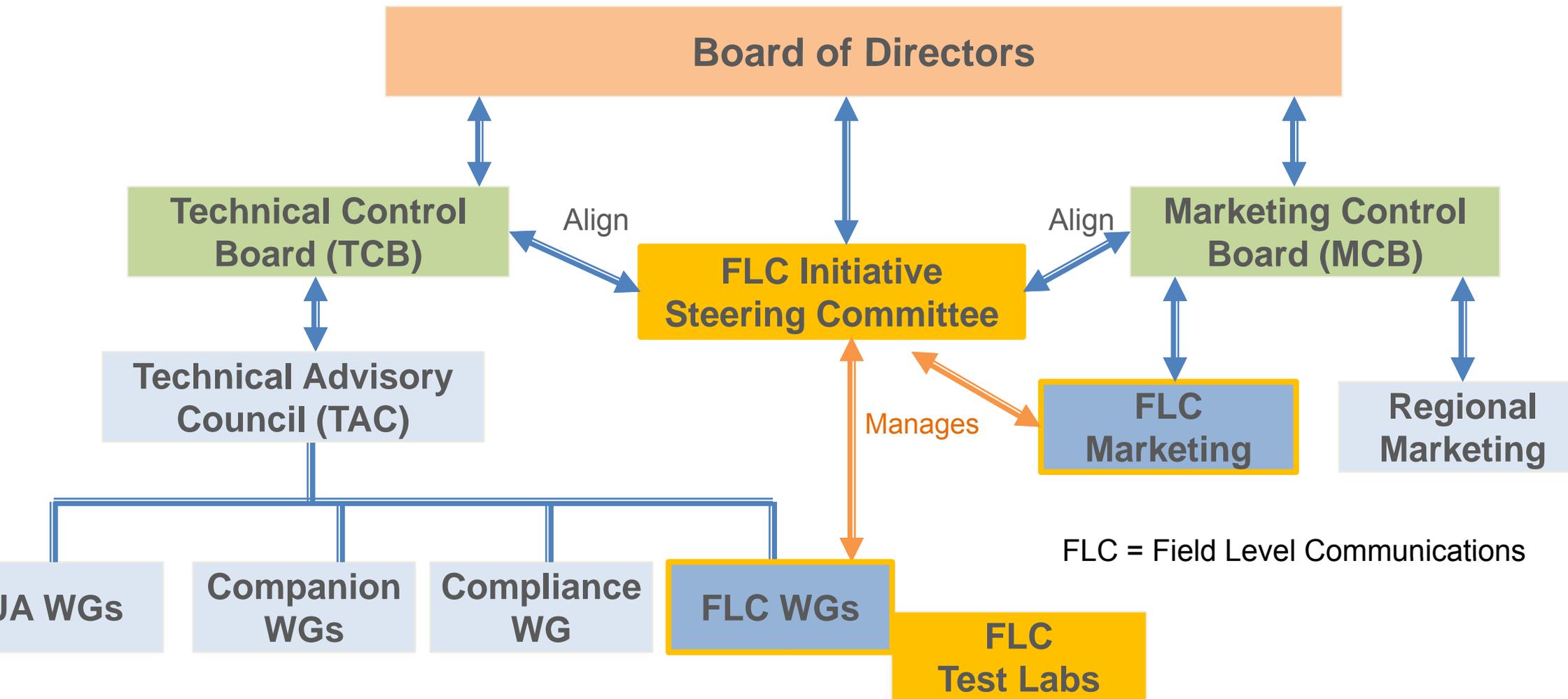
- Converged TSN network: different protocols can share the same TSN network infrastructure
- Use of common HW components



Technology overview – FLC work items and dependencies



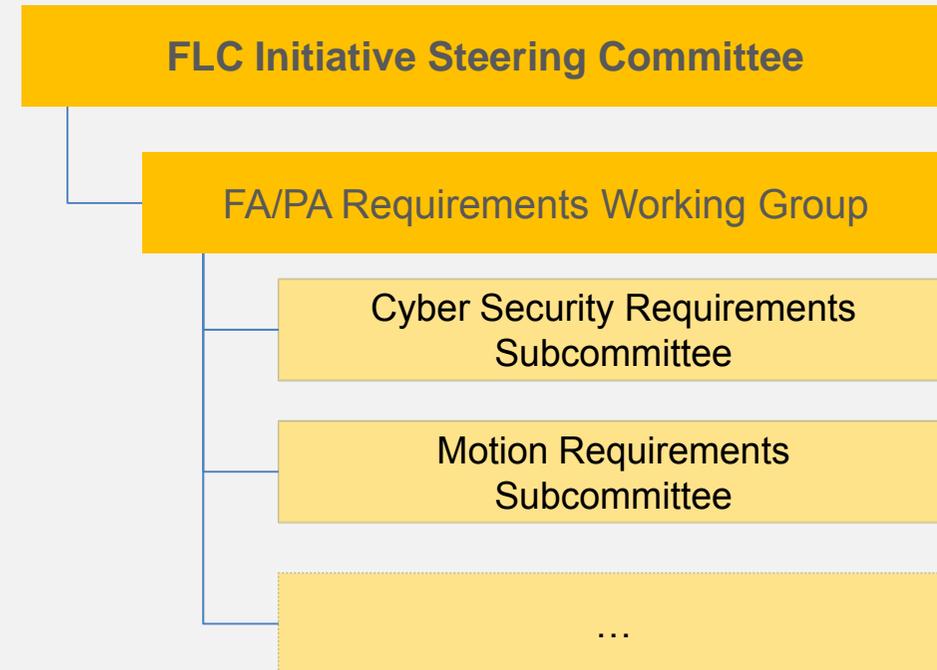
Integration of FLC Initiative into OPC Foundation



FLC = Field Level Communications

FA-PA Requirements working group (1)

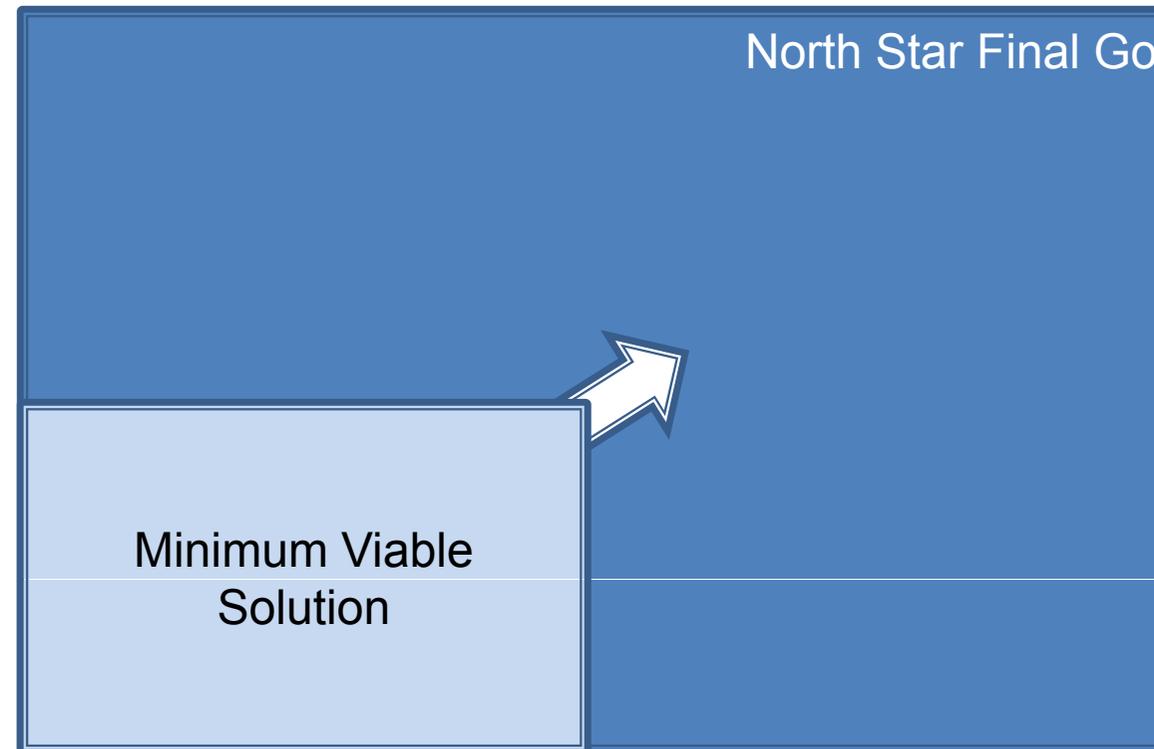
- ▶ FA/PA Requirements Working Group is responsible for defining the user requirements under the control of the FLC Initiative Steering Committee
- ▶ Participation is limited to members of the FLC Initiative



FA-PA Requirements working group (2)

Requirements are generated for:

- NorthStar vision (long term goal – no end date)
- MVS (Minimum Viable Solution)
- Work in progress –
creation of user stories /
derivation of formal requirement /
ongoing refinement /
define constraints & boundary conditions
(decided by the Steering Committee)

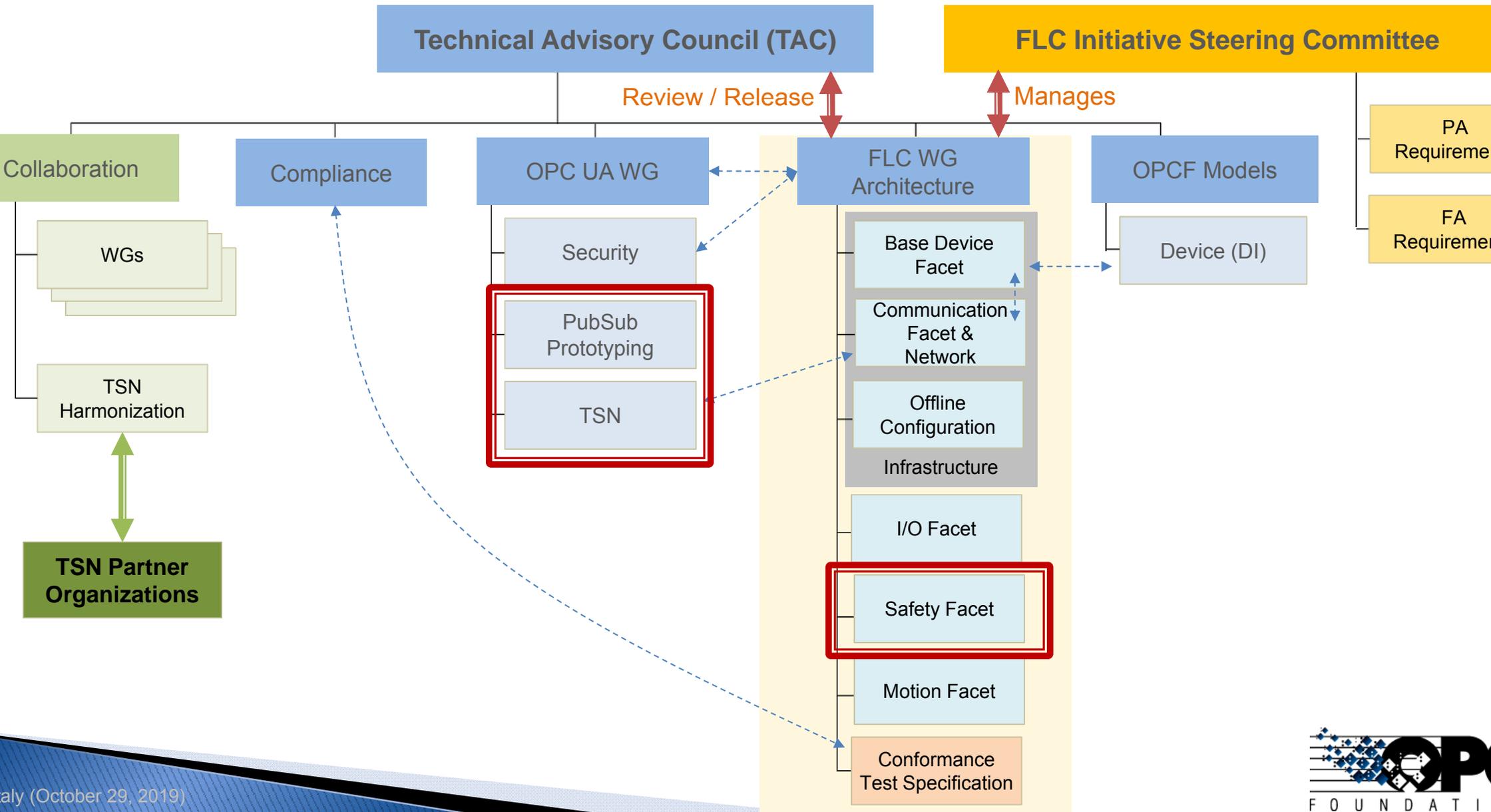


Field Level Communications Working Group (FLC-WG)

- ▶ FLC-WG has already 215 members from 45 companies
- ▶ January 8-10, 2019 Kick-Off
 - 90 participants from 38 companies
 - Presentation of planned working group setup and pre-work used as input
 - Brainstorming sessions for initial work and setup
- ▶ Election of chairman and editor of architecture working group
 - Chairman: Clark Case Rockwell Automation
 - Editor: Georg Biehler Siemens



FLC Initiative Working Groups



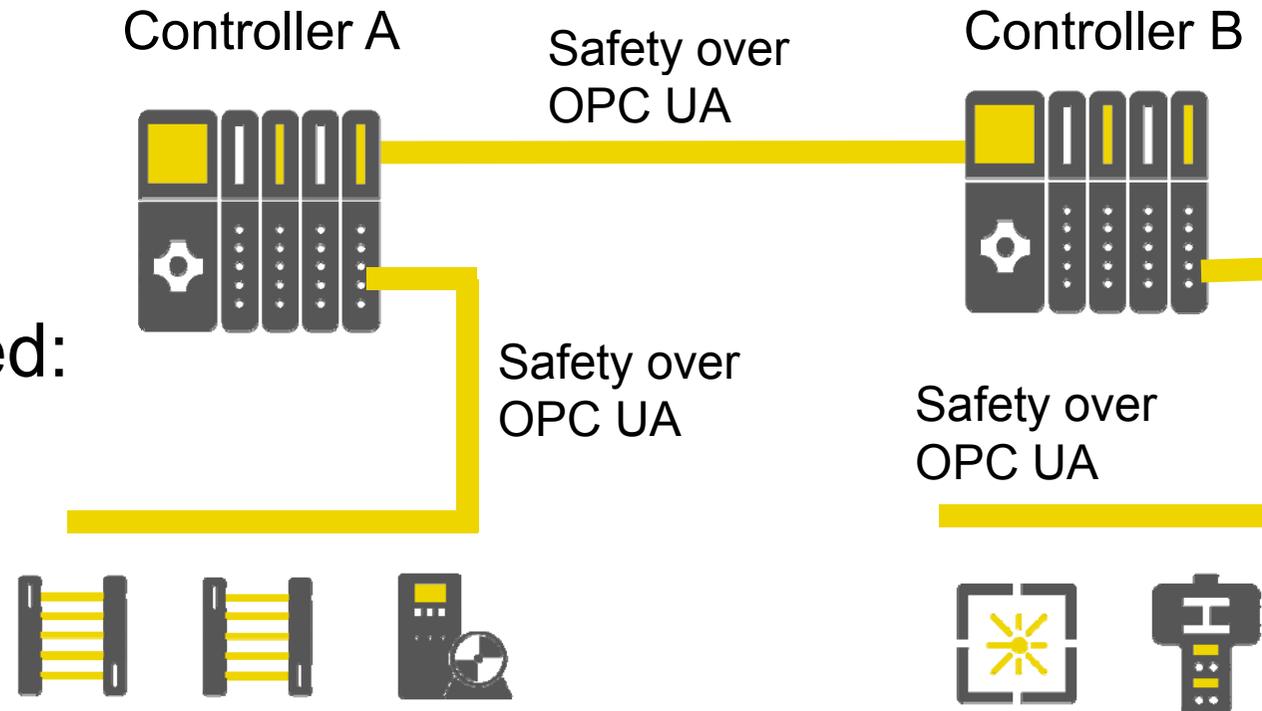


OPC UA Safety

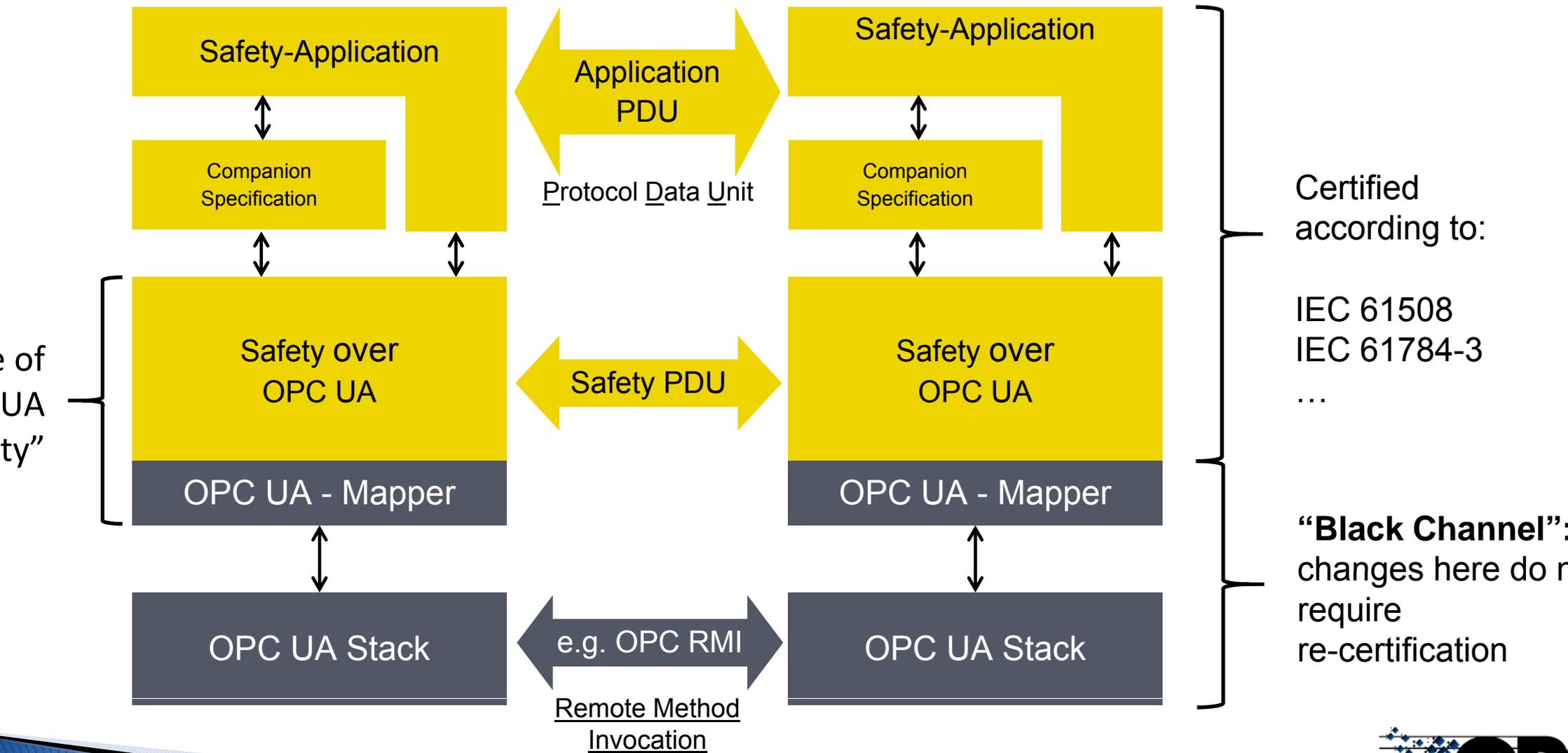
Scope of OPC UA Safety

- ▶ Original scope:
 - functional safety for communication **between controllers of different vendors**

- ▶ Since April 2019, the scope has been extended:
 - safety facet for field level communication (FLC) over OPC UA



Network layers of OPC UA Safety



Certified according to:

IEC 61508
IEC 61784-3

...

"Black Channel":
changes here do not
require
re-certification

OPC UA Safety – Status & Timeline

- ▶ OPC UA Safety – functional safe communication on all levels
- ▶ Key feature: dynamic establishment of connections during runtime

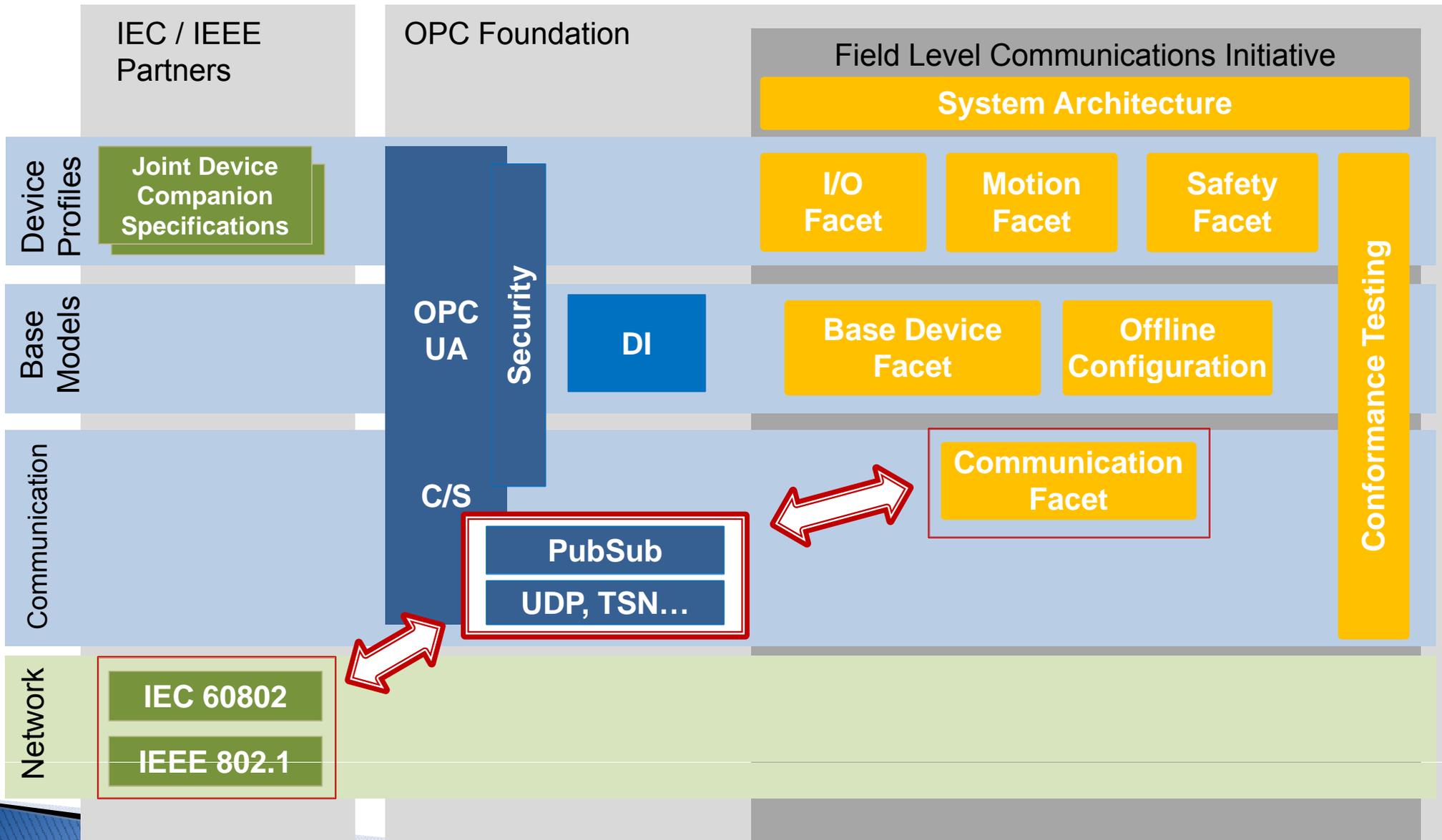
- ▶ V1.0 is currently under review, including
 - C2C-communication
 - OPC UA client/server
 - Run-time communication (no parametrization)

- ▶ Current & future work:
 - Mapper for PubSub (including TSN) – part of the black channel!
 - Test specification
 - Standardized parametrization

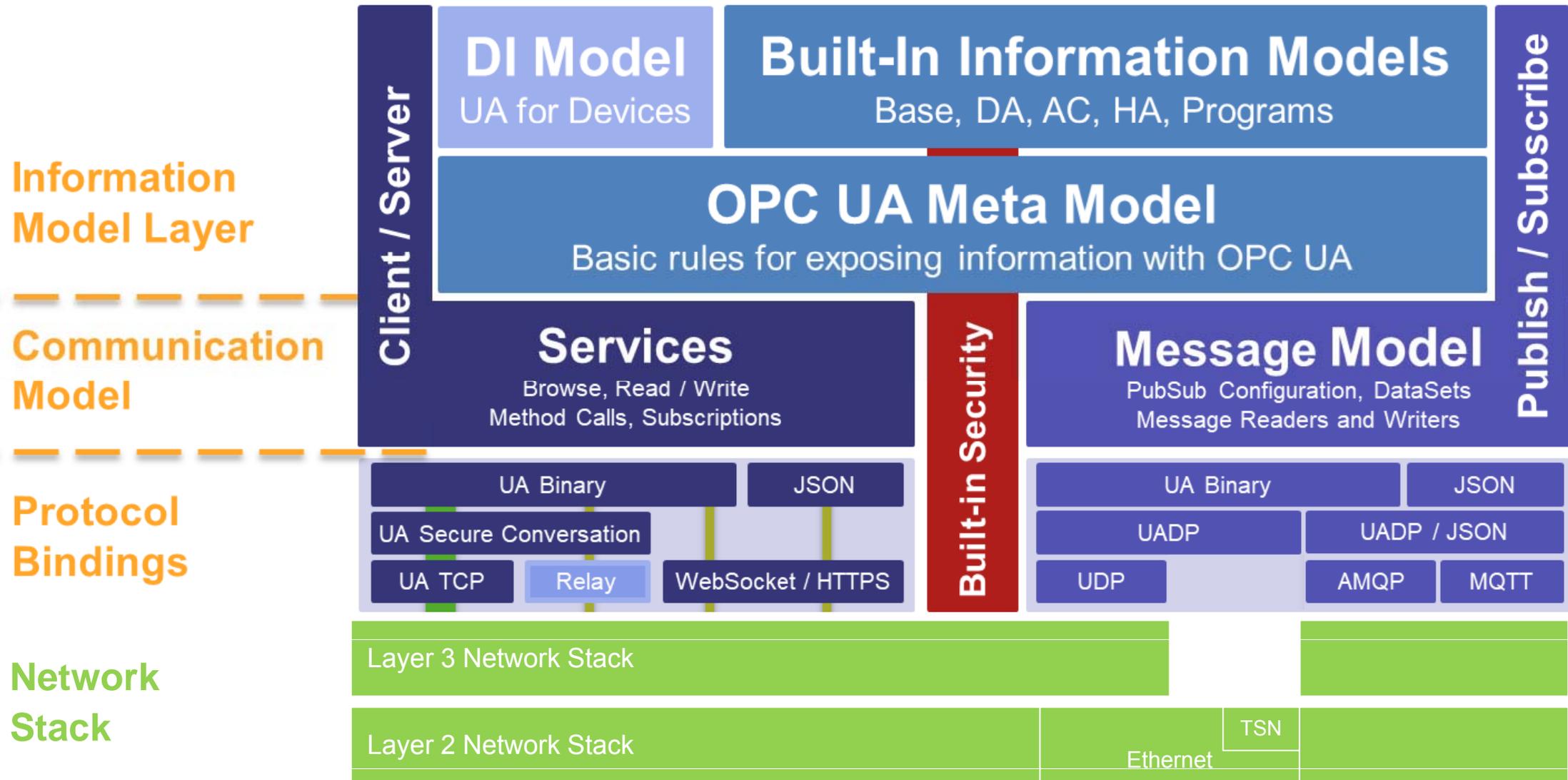


OPC UA PubSub TSN

Context of OPC UA TSN Sub-group



OPC UA Framework with PubSub TSN (1)



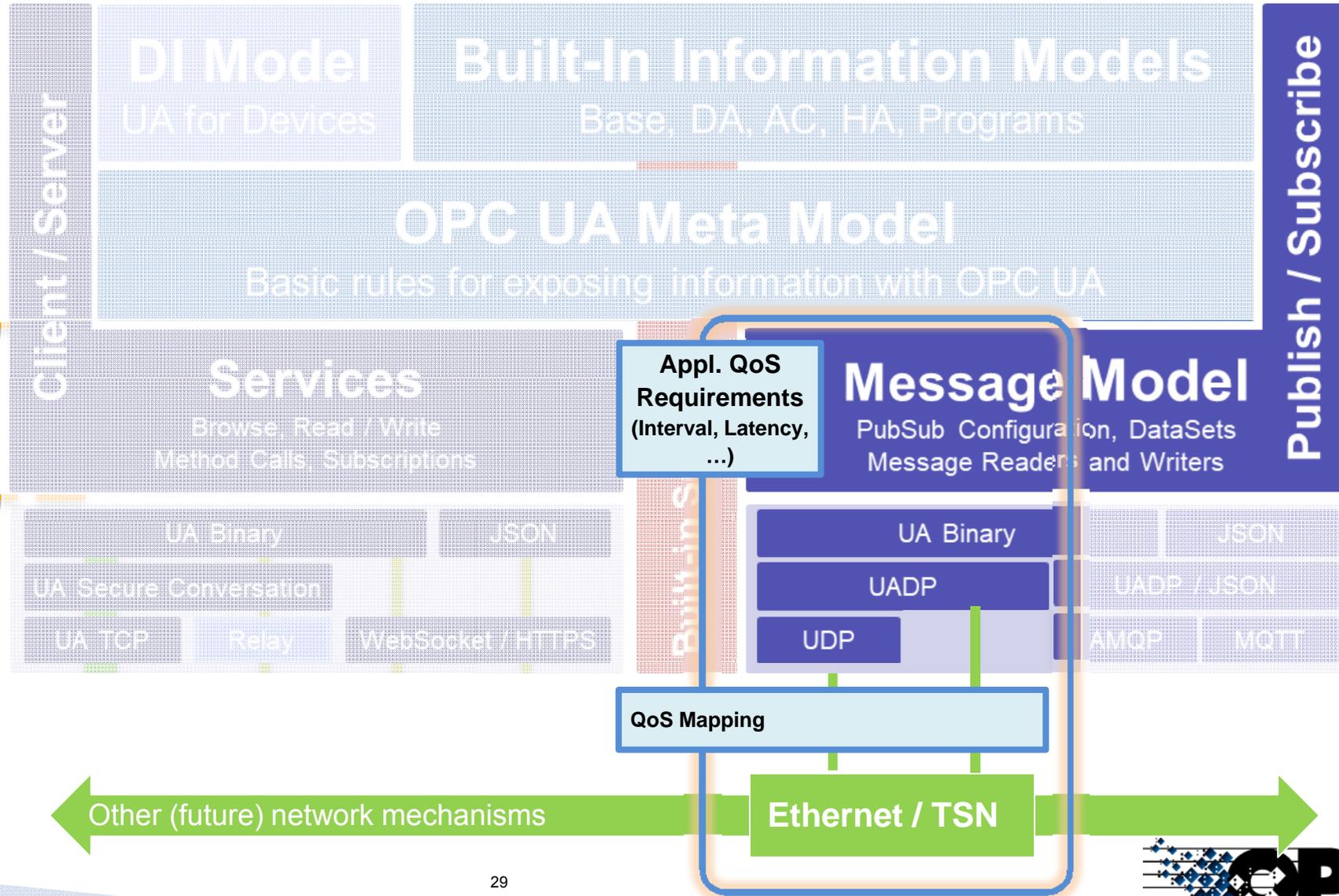
OPC UA Framework with PubSub TSN (2)

Information Model Layer

Communication Model

Protocol Bindings

Network Stack



OPC UA PubSub TSN – Status & Timeline

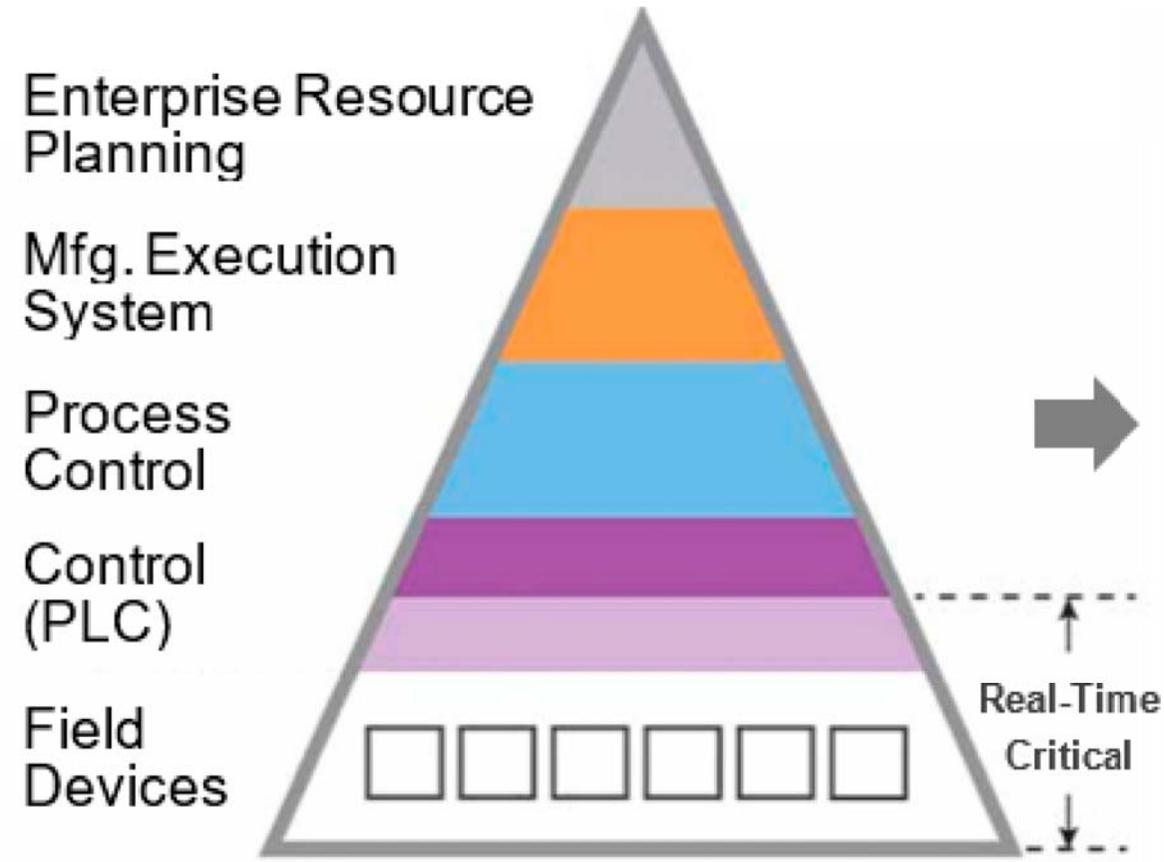
Status

- ▶ Working Draft for prototyping is available
- ▶ Prototyping started in July 2019

Next Steps

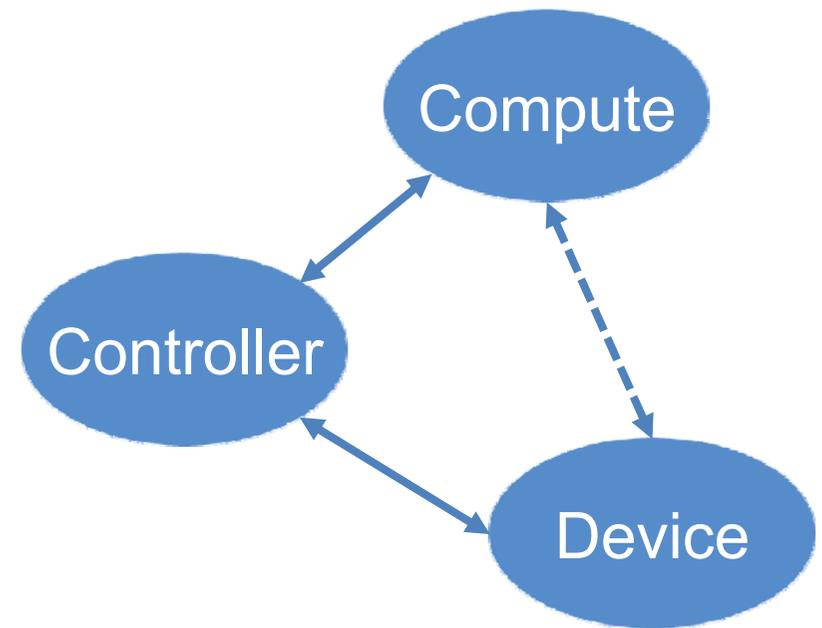
- ▶ Synchronization with FLC Architecture & Infrastructure WG and FLC TSN Expert Assessment Team (working assumption on future IA IEC/IEEE 60802 profile)
- ▶ Continuing PubSub prototyping
 - Integrate TSN Config Protocols in PubSub Devices
 - Interop Tests between different vendors
 - If successful: handover to TSN Testbeds (IIC TSN Testbed Stuttgart, LNI 4.0 TSN Testbed Augsburg)

Automation Pyramid



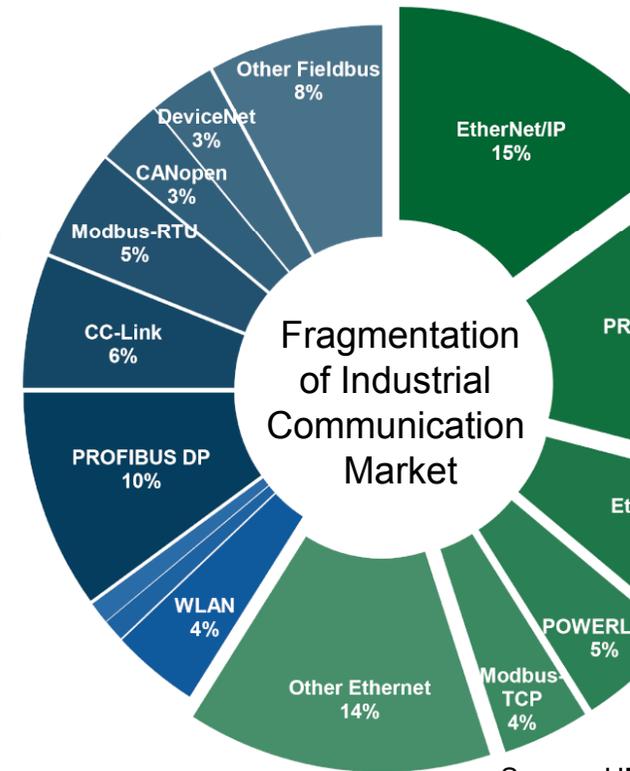
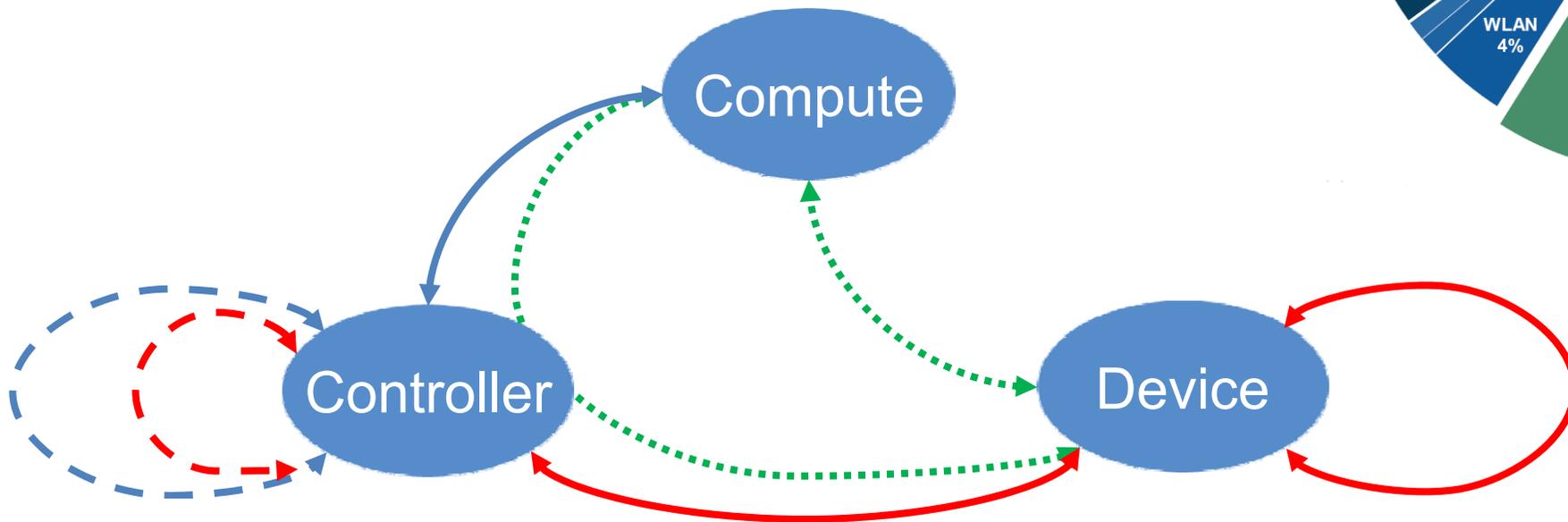
Automation Pyramid

Interactions Model (Abstraction)



Interactions Model (conventional)

- ▶ Controller to Compute (gateway, software, cloud) via OPC UA
- ▶ Controller to Controller (via OPC UA, no real-time & no semantics or via **Fieldbuses & Real-Time Ethernet solutions**)
- ▶ Controller to Device (**Fieldbuses & Real-Time Ethernet solutions**)
- ▶ Device to Device (**Fieldbuses & Real-Time Ethernet solutions**)
- ▶ Device to Compute (only via controller or via separate interface)

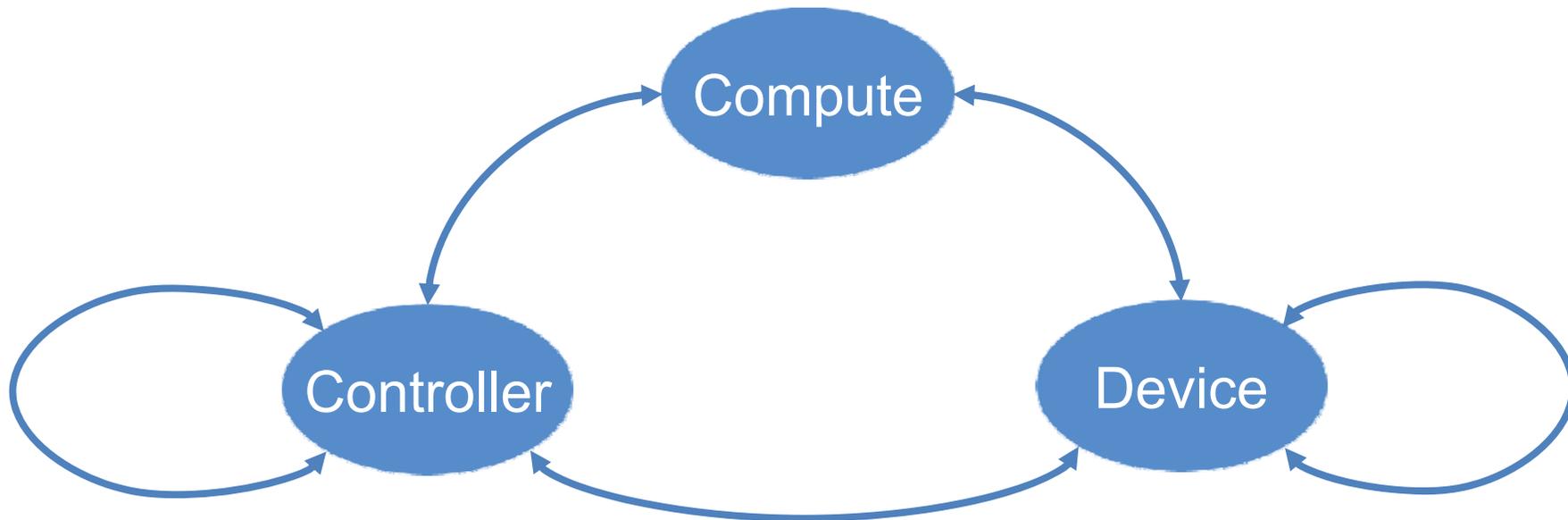


Source: H...

Interactions Model (with OPC UA FLC)

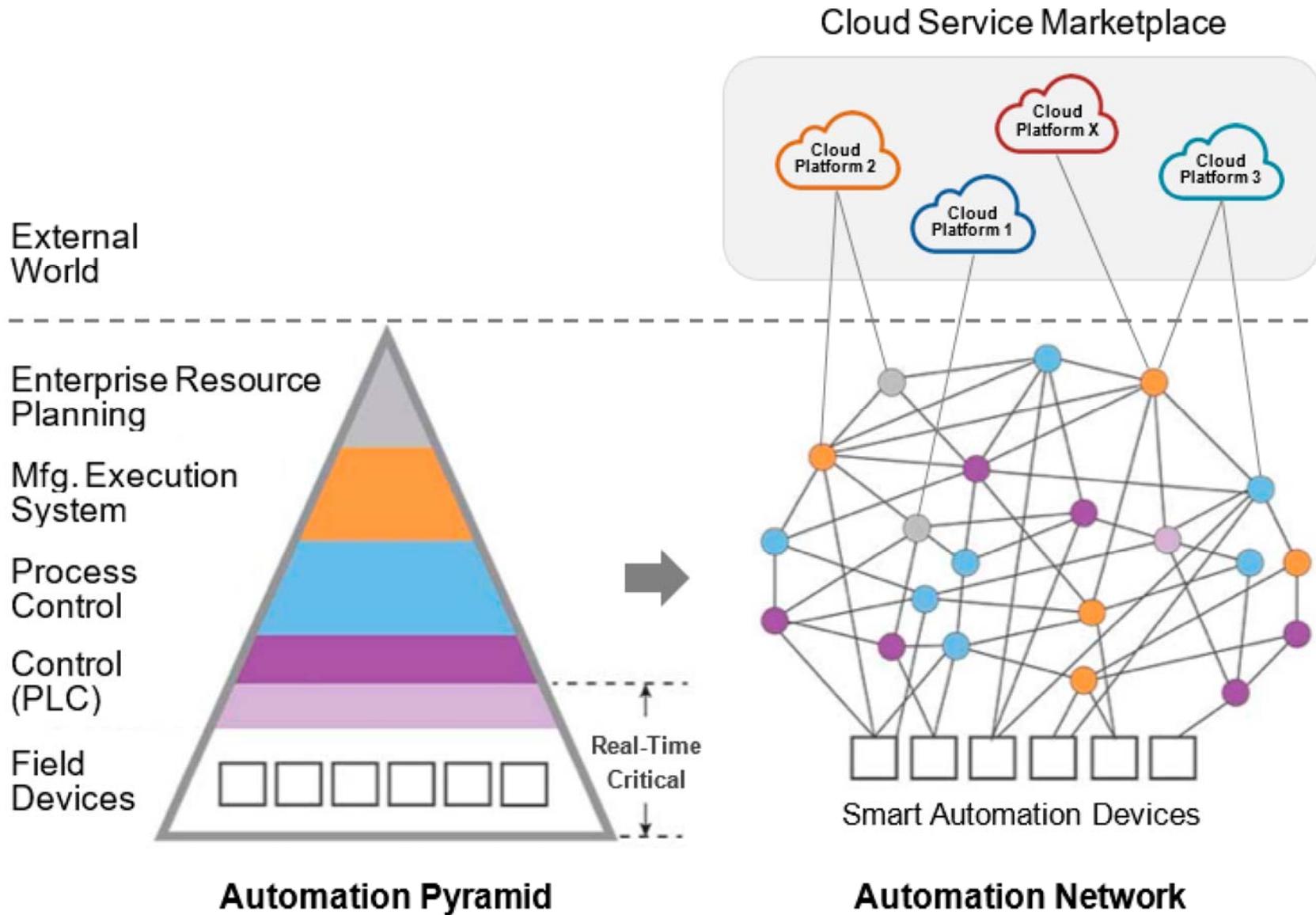
- ▶ Controller to Device
- ▶ Controller to Compute (gateway, software, cloud)
- ▶ Device to Compute
- ▶ Controller to Controller
- ▶ Device to Device

} via OPC UA



From Automation Pyramid to Automation Network

Source: VDI (2013), MDPI (2019)



Initial Supporters Field Level Communications Initiative



OPC-F “Field Level Communications Initiative”: Information

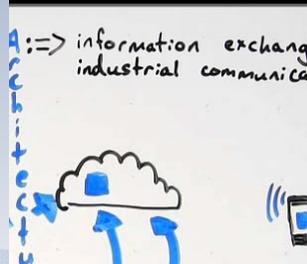


Brochure available from OPC-F Website:

<https://opcfoundation.org/flc-pdf>

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PETER LUTZ

Field Level Communications Director
OPC Foundation

Phone: +49 171 - 404 1028

Peter.Lutz@opcfoundation.org

www.opcfoundation.org

