

**OPC DAY** FINLAND 2017

WEDNESDAY, OCTOBER 11TH 2017 @MESSUKESKUS HELSINKI

# OPC UA Enables Smart Manufacturing



FINNISH SOCIETY OF AUTOMATION  
SUOMEN AUTOMAATIOSEURA RY

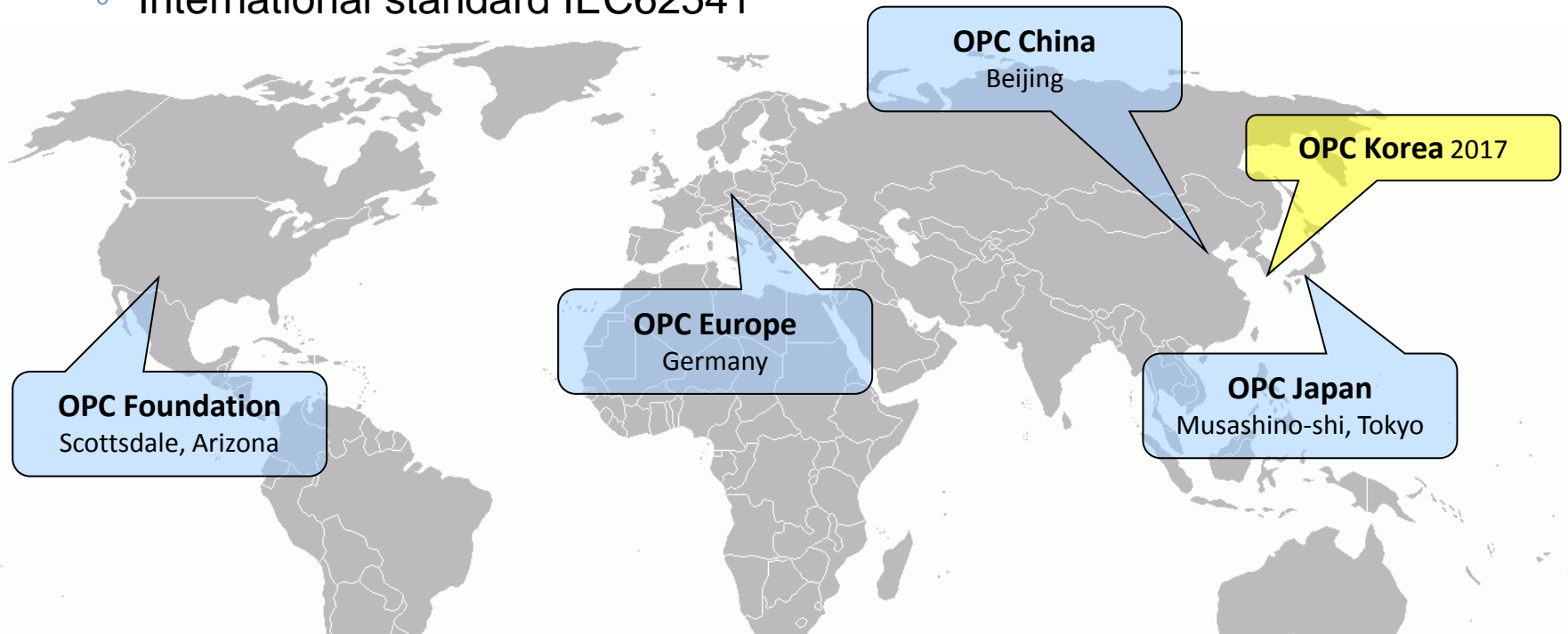
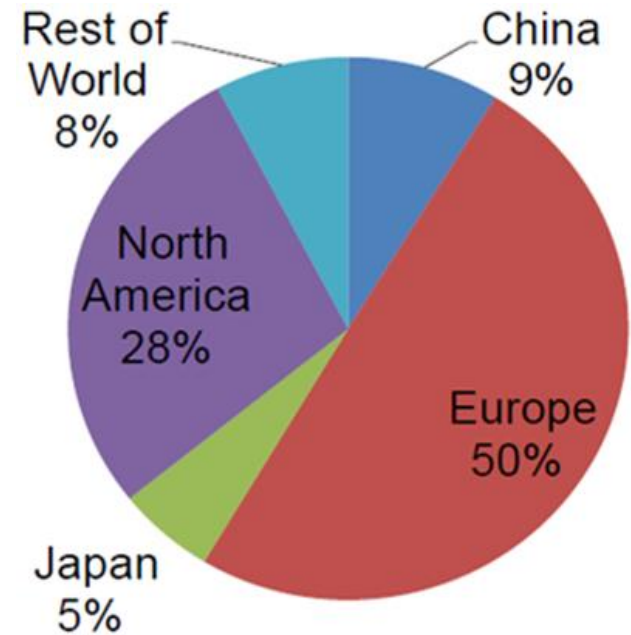


Jouni Aro  
CTO, Prosys OPC  
Chairman, OPC Committee  
Evangelist, OPC Foundation



# OPC Foundation

- ▶ Vision  
secure, reliable, multi-vendor,  
multi-platform, multi domain  
interoperability from sensor to enterprise
- ▶ International
  - 500+ Companies from Automation & IT
  - International standard IEC62541



# OPC Foundation: Board of Directors

- ▶ International board – democratic elections by members every year
  - Companies from Automation & IT
  - All over the world

## North America



## Japan

YOKOGAWA ◆

## Europe



# OPC Foundation: Key Persons

- ▶ President: Thomas Burke



- ▶ Vice President: Stefan Hoppe





# OPC Foundation: Class A members

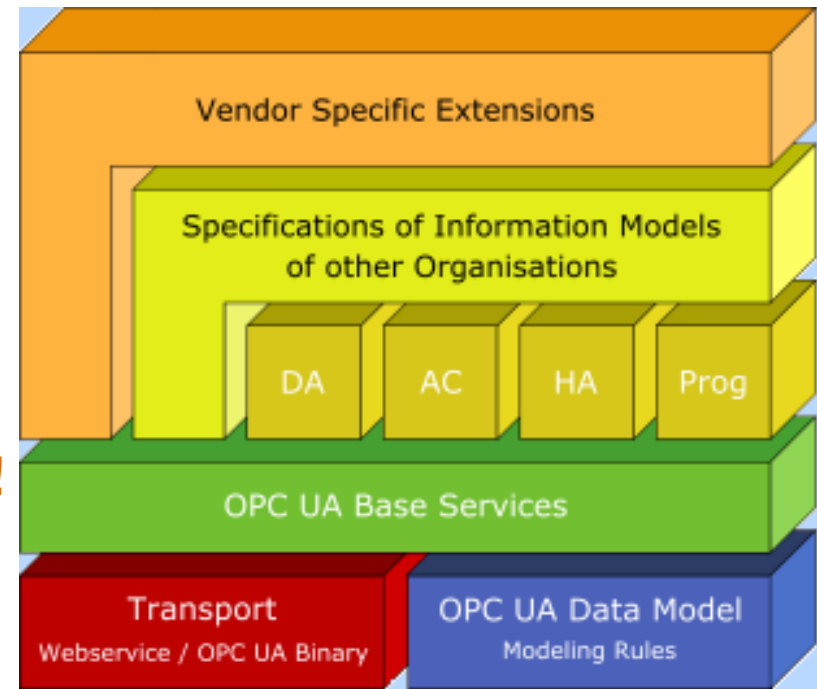


# World's Largest Ecosystem for Interoperability

- ▶ OPC Statistics
- ▶ ARC analysis (Status 2016)
  - ▶ 35.000+ OPC Products
  - ▶ 4.200+ suppliers of OPC Products
  - ▶ 47 million+ OPC installations
- ▶ Projected for 2018
  - ▶ 52.000+ OPC Products
  - ▶ 6.000+ suppliers of OPC Products
  - ▶ 120 million OPC installations

# OPC Unified Architecture (UA)

- ▶ OPC is de facto communication protocol in industrial systems since 1995 (OPC Classic)
  - Originally: OLE for Process Control → OPC
  - Microsoft DCOM based
  - Separate protocols
    - Data Access (DA)
    - Alarms & Events (AE)
    - Historical Data Access (HDA)
- ▶ OPC UA 1.0 released 2009
  - Unified Architecture: DA, AC, HA, etc.
  - Platform independent
  - Built-in security
  - Information modeling
- ▶ IEC 62541 release 2010-2011
- **Enables Secure Industrial Internet!**
  - **Smart Manufacturing**
  - **Smart Cities**
  - **Etc.**



# OPC UA in the world



IIC



Industry 4.0



MII 3.0



Made in China 2025





# North America: Industrial Internet Consortium (IIC)

**Industrial Internet Reference Architecture (IIRA), Connectivity Framework**  
[https://www.iiconsortium.org/pdf/IIC\\_PUB\\_G5\\_V1.0\\_PB\\_20170228.pdf](https://www.iiconsortium.org/pdf/IIC_PUB_G5_V1.0_PB_20170228.pdf)

**Published on 28.02.2017**

**OPC UA listed with IoT's details**

**Today 3 testbeds with integrated OPC UA**

- **OPC UA + TSN in Manufacturing**
- **OPC UA Sensor in Brownfield environment**
- **OPC UA and AutomationML for factory**

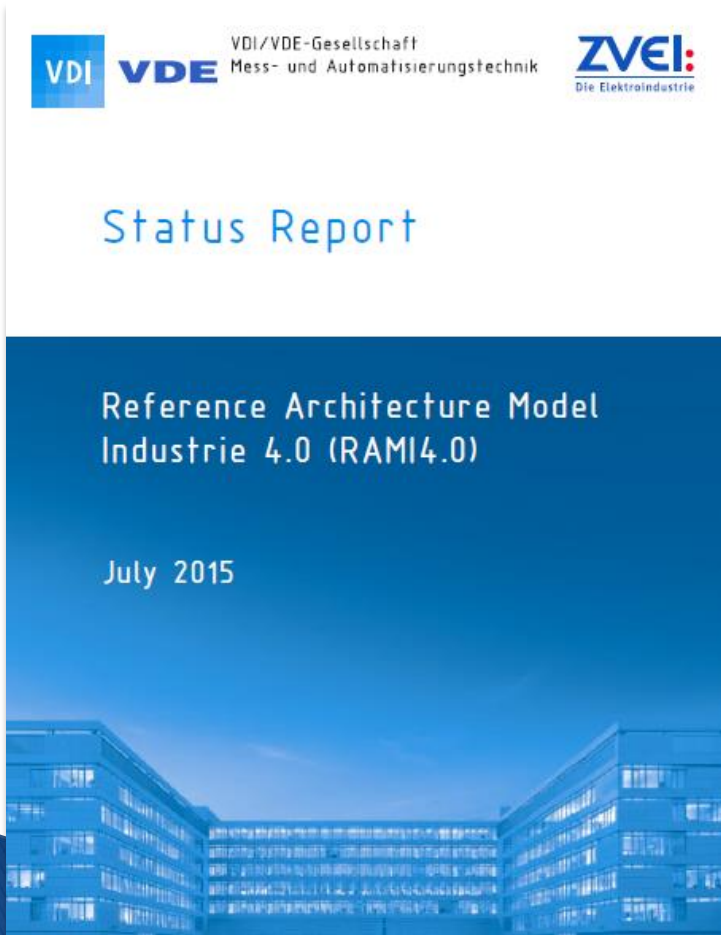


**The Industrial Internet of Things  
Volume G5: Connectivity Framework**

IIC-PUB:G5:V1.0:PB:20170228

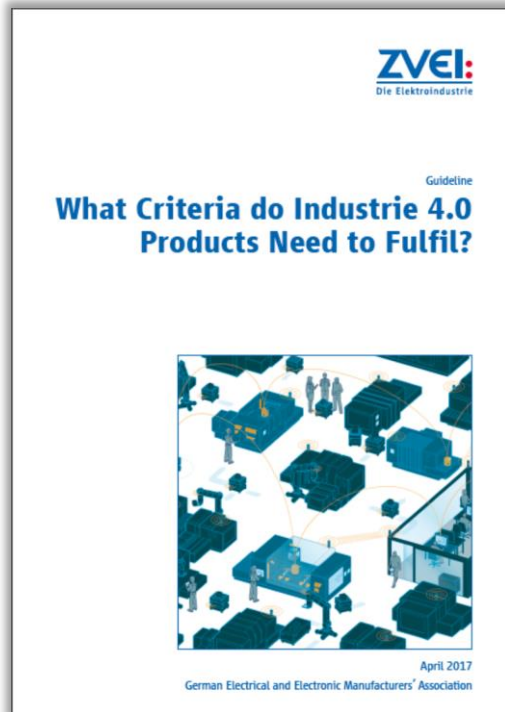
# German Industrie 4.0 recommends OPC UA

[http://www.zvei.org/Downloads/Automation/5305 Publikation GMA Status Report ZVEI Reference Architecture Model.pdf](http://www.zvei.org/Downloads/Automation/5305_Publikation_GMA_Status_Report_ZVEI_Reference_Architecture_Model.pdf)



- Approach for implementation of a Communication Layer
  - OPC UA: Basis IEC 62541
- Approach for implementation of an Information Layer
  - IEC Common Data Dictionary (IEC 61360 Series/ISO13584-42)
  - Characteristics, classification and tools to eCl@ss
  - Electronic Device Description (EDD)
  - Field Device Tool (FDT)
- Approach for implementation of a Functional and Information Layer
  - Field Device Integration (FDI) as integration technology
- Approach for end-to-end engineering
  - AutomationML
  - ProSTEP iViP
  - eCl@ss (characteristics)

# German Industrie 4.0 requires OPC UA



## Industrie 4.0 Full

Target: standards, norms and research, > 5 years

Definition of full Industrie 4.0 properties incl. strategic outlook

## Industrie 4.0 Ready

Target: manufacturers, < 5 years

What are the minimum properties that products must have in order to participate in the Industrie 4.0 network?

## Industrie 4.0 Basic

Target: customers, today

Which products are currently well prepared for Industrie 4.0?

Source: ZVEI

- There are 3 levels to reach: Basic / Ready / Full
- Industrie 4.0 Basic → 7 criteria – 2 of them are OPC UA

|    |                                       |  |   |   |   |
|----|---------------------------------------|--|---|---|---|
| 2. | Industrie 4.0 communication           | Transfer of product data and data files for interpretation or simulation, for example; product data in standardised form<br>The product can be addressed via the network, supplies and accepts data, Plug & Produce via Industrie 4.0-compliant services | T | M | Manufacturer makes data that is relevant for the customer available/accessible online with the aid of identification, e.g. PDF via http(s)  |
|    |                                       |  | I | M | Product addressable online via TCP/UDP&IP with at least the information model from OPC-UA   |
| 5. | Industrie 4.0 services and conditions | Definition still open (service system)<br>General interface for loadable services and messages regarding statuses Essential basic services that an Industrie 4.0 product must support and provide  | T | O | Description of the device interface available digitally   |
|    |                                       |  | I | O | Information such as statuses, error messages, warnings, etc. available via OPC-UA information model in accordance with an industry standard |

# VDMA: Modeling based on OPC UA



Industrie 4.0  
Kommunikation mit OPC UA  
Leitfaden zur Einführung in den Mittelstand



**VDMA (Verband Deutscher Maschinen- und Anlagenbau, Mechanical Engineering Industry Association) represents more than 3,200 mostly medium-sized companies in the capital goods industry, making it the largest industry association in Europe.**

New guideline

**„Industrie 4.0 Communication with OPC UA“**

Available at Hanover Messe April 24th

ISBN 978-3-8163-0709-9

English translation will follow

Adressing end users and integrators:

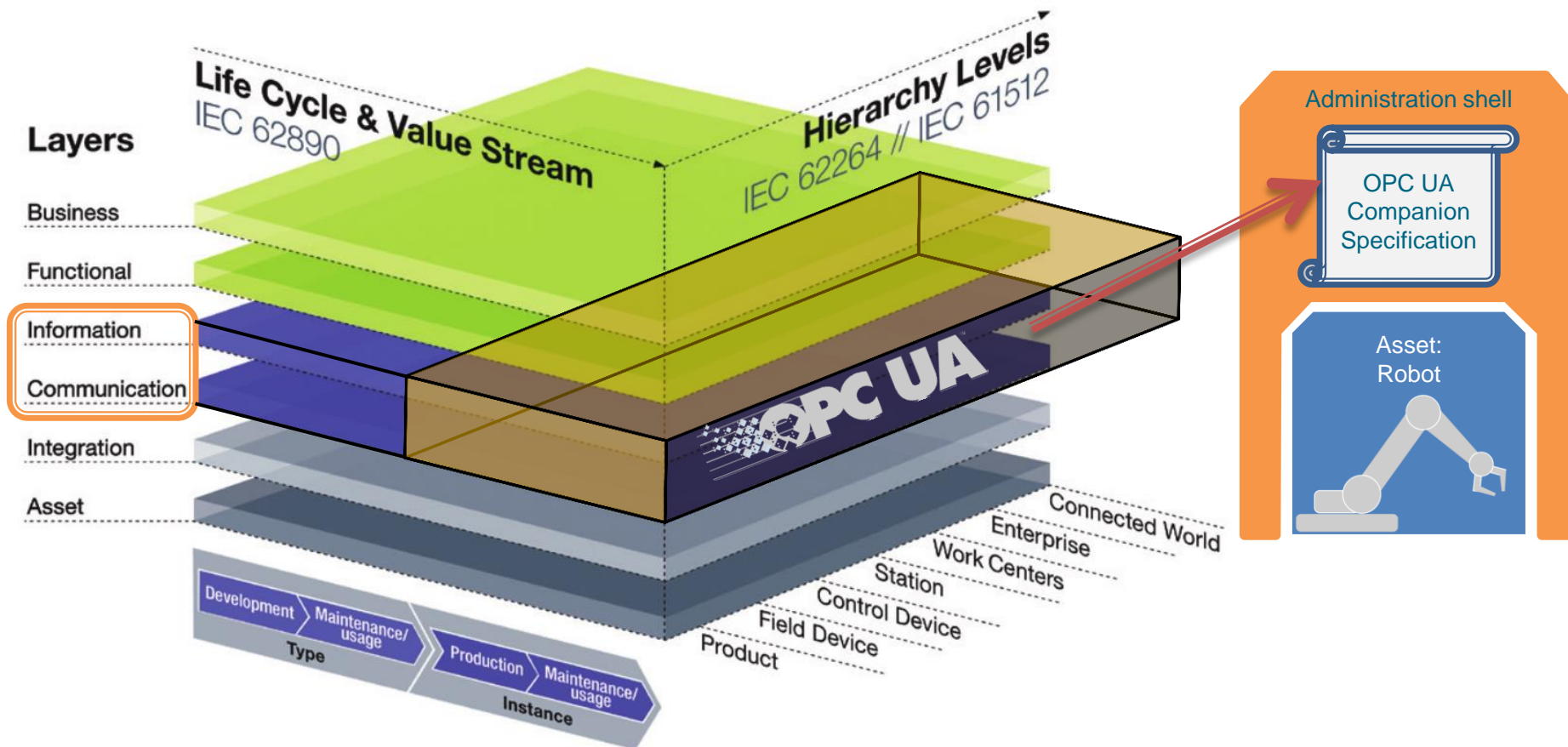
- Benefits of using OPC UA
- Example use cases
- Migration steps

In Kooperation mit





# OPC UA fits into Industrie 4.0



(Dr. Reinhard Heister)



# OPC Korea

## Manufacturing Industry Innovation 3.0



Smart factory based on 'Manufacturing Industry Innovation 3.0 (MII3.0)' in response to the paradigm shift of the 4th Industrial Revolution.

MII3.0 is aiming for 3 achievements:

- |                        |                     |                            |
|------------------------|---------------------|----------------------------|
| 1) High productivity   | 2) High flexibility | 3) High resource awareness |
| through 3 technologies |                     |                            |
| 1) Automation          | 2) Production       | 3) ICT                     |

By 2020, it is working as a practical goal to spread smart factory technology to 10,000 enterprises in cooperation with major domestic and foreign companies.

**Especially, OPC UA will be used as an industrial standard to connect between OT (Operational Technology) and IT (Information Technology).**

# OPC Korea

SPS-IPC Drives 2016: Sign MoU with OPC Korea, Company KETI  
[opckorea@opcfoundation.org](mailto:opckorea@opcfoundation.org)

Ceremony on March 30<sup>th</sup> 2017 in Seoul



# OPC China – National Standard

- ▶ TC124 started October 2016, working on the national standard
- ▶ Formal release ceremony held
  - Parts 1 - 8 have been completed and are released
  - Parts 9 - 12 will be completed later in 2017
- ▶ Government official speech's
  - OPC UA is critical for factory automation “Made in China 2025”
- ▶ Ceremony was attended by 120 people





# China National Standard



» In 2015, ITEI undertook 7 Intelligent Manufacturing Projects issued from MIIT, in which basic and common standards regarding to intelligent manufacturing body will be set. One project is "Industrial control networks standard research and verification platform", and one task of this project is to draft a national standard named "OPC UA-based unified architecture for interconnected networks in digital plant", which will provide a unified solution for interconnecting the networks among device level, control and management level in digital plant. This standard will promote, that the device manufacturers should provide OPC UA servers for their produced devices directly, and the software vendors should better to embed OPC UA clients. Therefore, for the device manufacturers and the software vendors, it is only needed to invest and develop once, while for the manufacturing enterprises and the system integrators, it will avoid case-by-case solutions, which will decrease integrating costs and cycles greatly.

**Jinsong Ouyang,**  
President, Instrumentation Technology & Economy Institute, P.R.China (ITEI)  
Vice chairman of the committee, National TC124 On Industrial Process Measurement, Control And Automation Of Sac



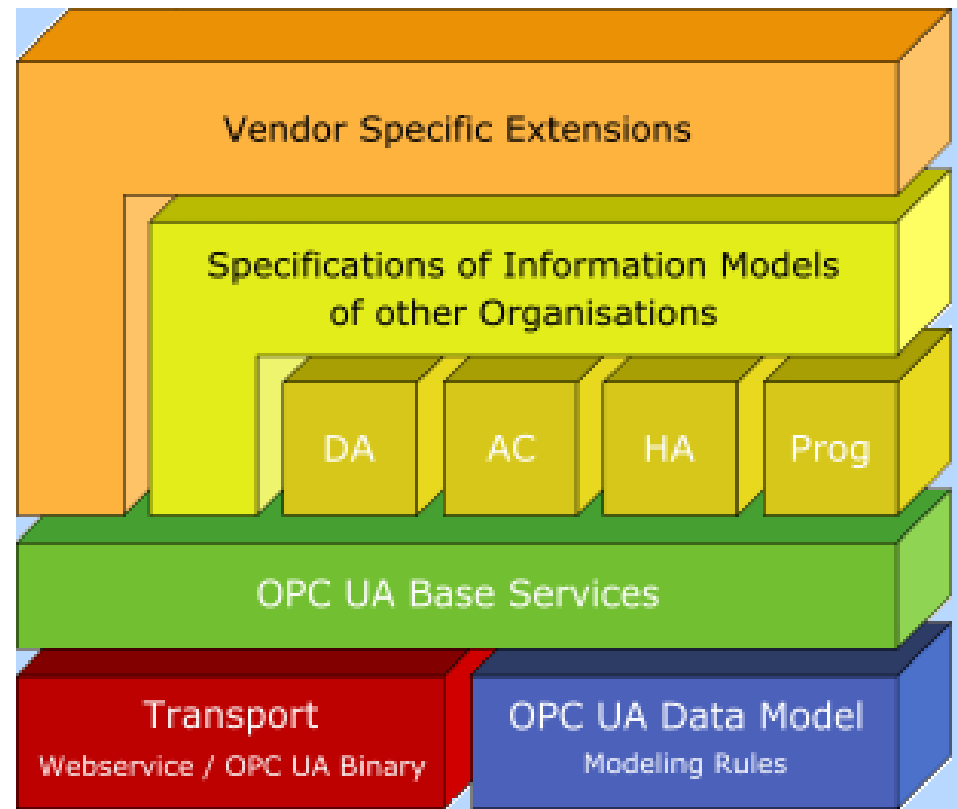
» Industrial IoT can be viewed as the convergence of ICT and OT in the various industrial verticals. The resulting technology innovation has created an inflection point that will change how we think of, participate in and benefit from the industrial sector. In response to this inflection point, there is an emerging ecosystem that includes standards, best practices and reference architectures. This ecosystem includes both industry stakeholders and government initiatives across geographies and verticals.

OPC Foundation is an essential part of that emerging ecosystem. It defines OPC UA, a standard that is fundamental to linking the ICT and OT environments in a way that is both secure and forward looking, this enabling new innovations such as real time manufacturing, digital manufacturing and low latency/time sensitive industrial systems.

**Wael William Diab,**  
Senior Director, Huawei Technologies Co., Ltd.

# OPC Unified Architecture

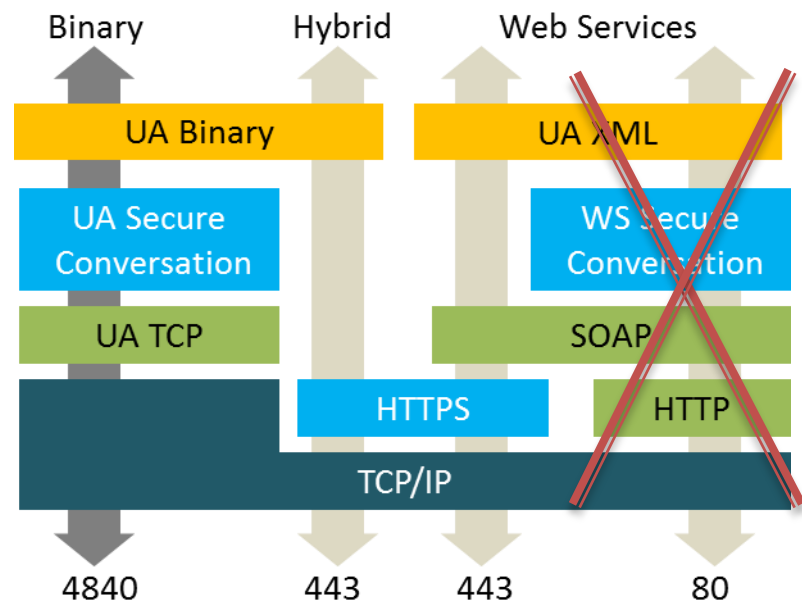
- ▶ Platform Independent
- ▶ Standard Communication Protocols
- ▶ Built in Security
- ▶ Information Modeling
- ▶ Collaboration Platform





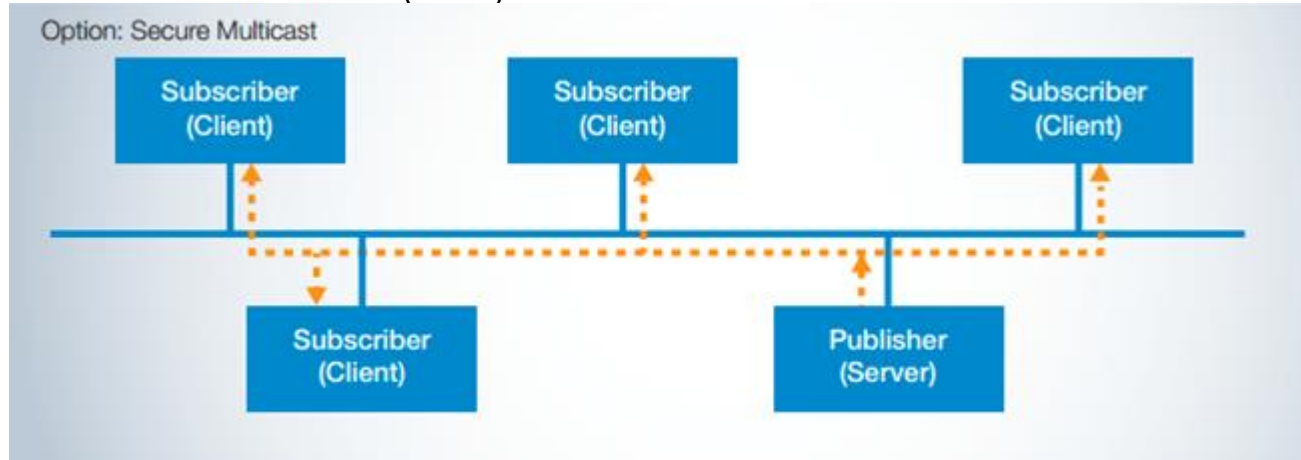
# Communication Protocol

- ▶ OPC UA is based on TCP/IP
  - Client/Server-protocol
  - Session-based
- ▶ Alternative transport protocols
  - UA TCP
  - HTTPS
  - SOAP
  - **Next: WebSocket (v1.04/2018)**
- ▶ Full security
  - UA Secure Conversation
  - TLS (inside HTTPS)
  - (WS Secure Conversation: deprecated in OPC UA v1.03/2015)
- ▶ All parts flexible to accommodate changes as necessary!

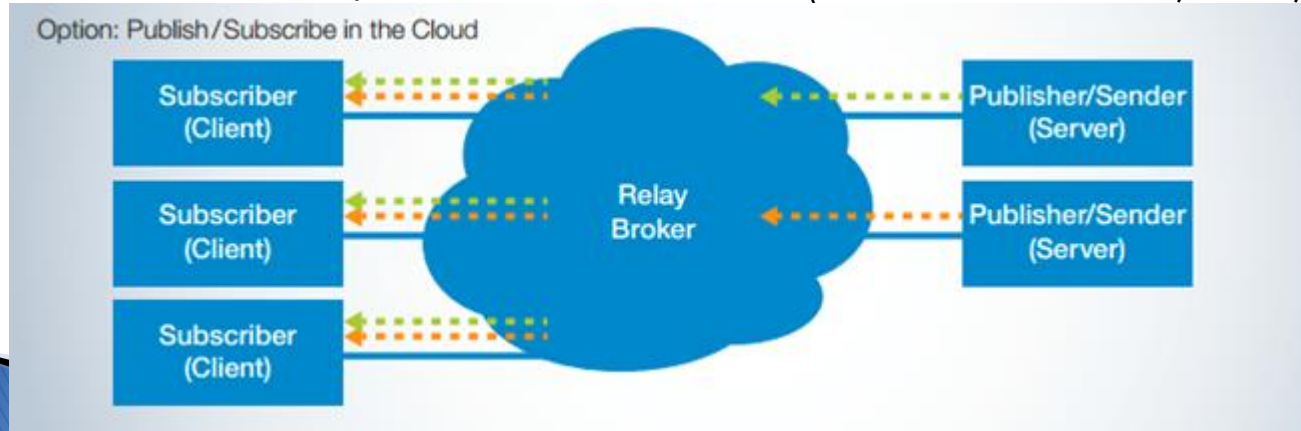


# New: Publisher/Subscriber

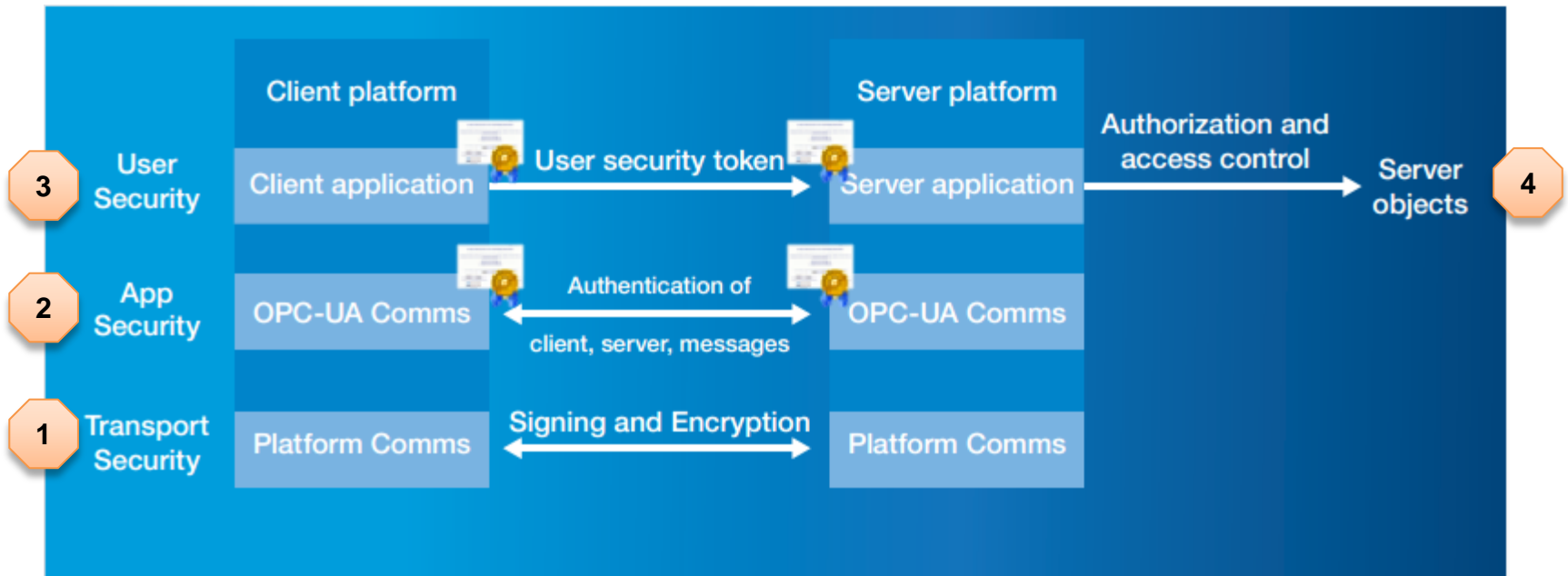
- To be released in OPC UA v1.04/2018
  1. Secure Multicast (UDP): towards hard real-time with TSN Ethernet extension



2. Secure Publish/Subscribe in the Cloud (AMQP first – MQTT, XMPP, etc. later)



# Security Concept



1. Optional Message Signing and Encryption (AES-128/256)
2. Applications authenticated with Application Instance Certificates (X.509)
3. Users authenticated with user name & password or X.509 certificates
4. Authorization on application level

# OPC UA Security Analysis

**Who:** Federal Office for Information Security (German Government BSI)

**Why:** Because of relevance of OPC UA for German Industry

**What:** Security Evaluation of OPC-UA – Finalized March 2016

- Analysis of Specification / Analysis of Reference Implementation

**Result:** Available on BSI web and OPC web

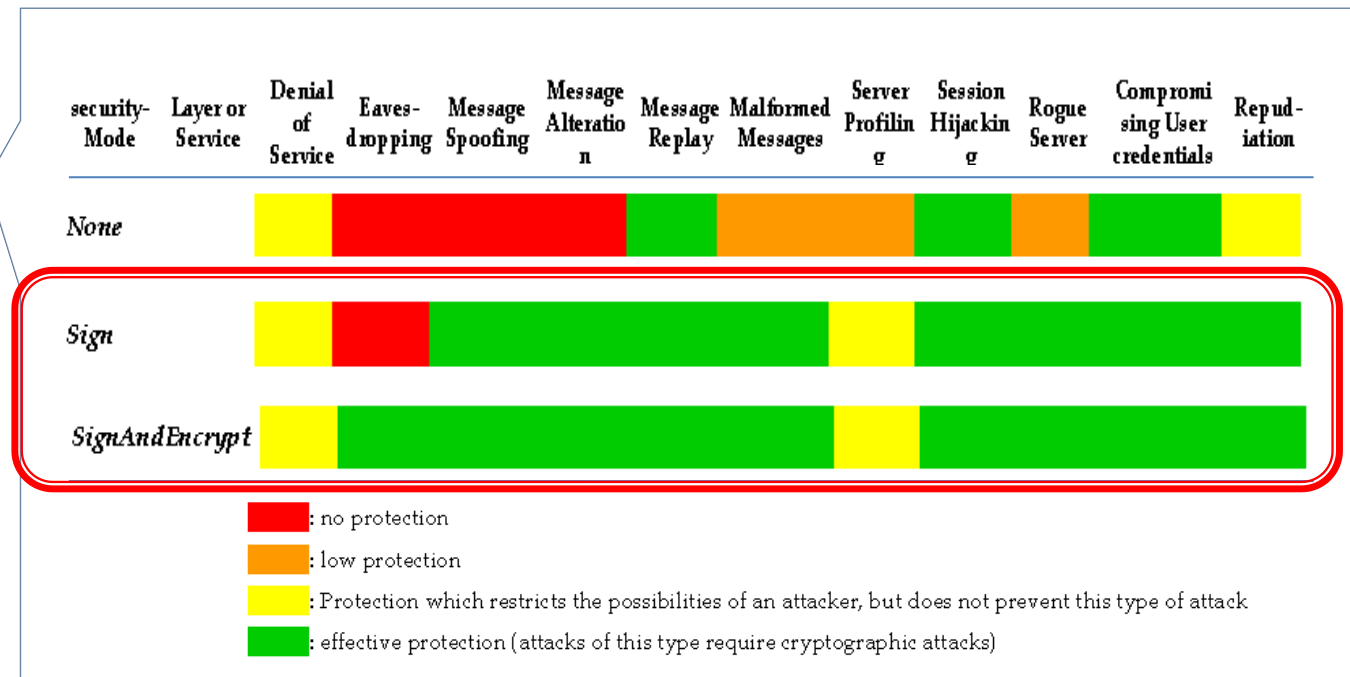
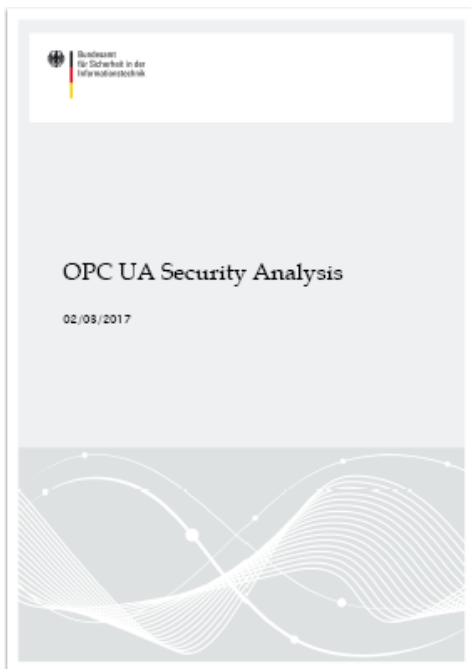


Commented version available  
(English + German)

[www.opcfoundation.org/security](http://www.opcfoundation.org/security)



# OPC UA Security Analysis

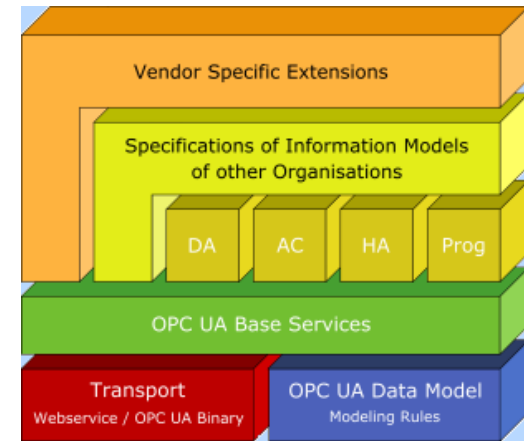
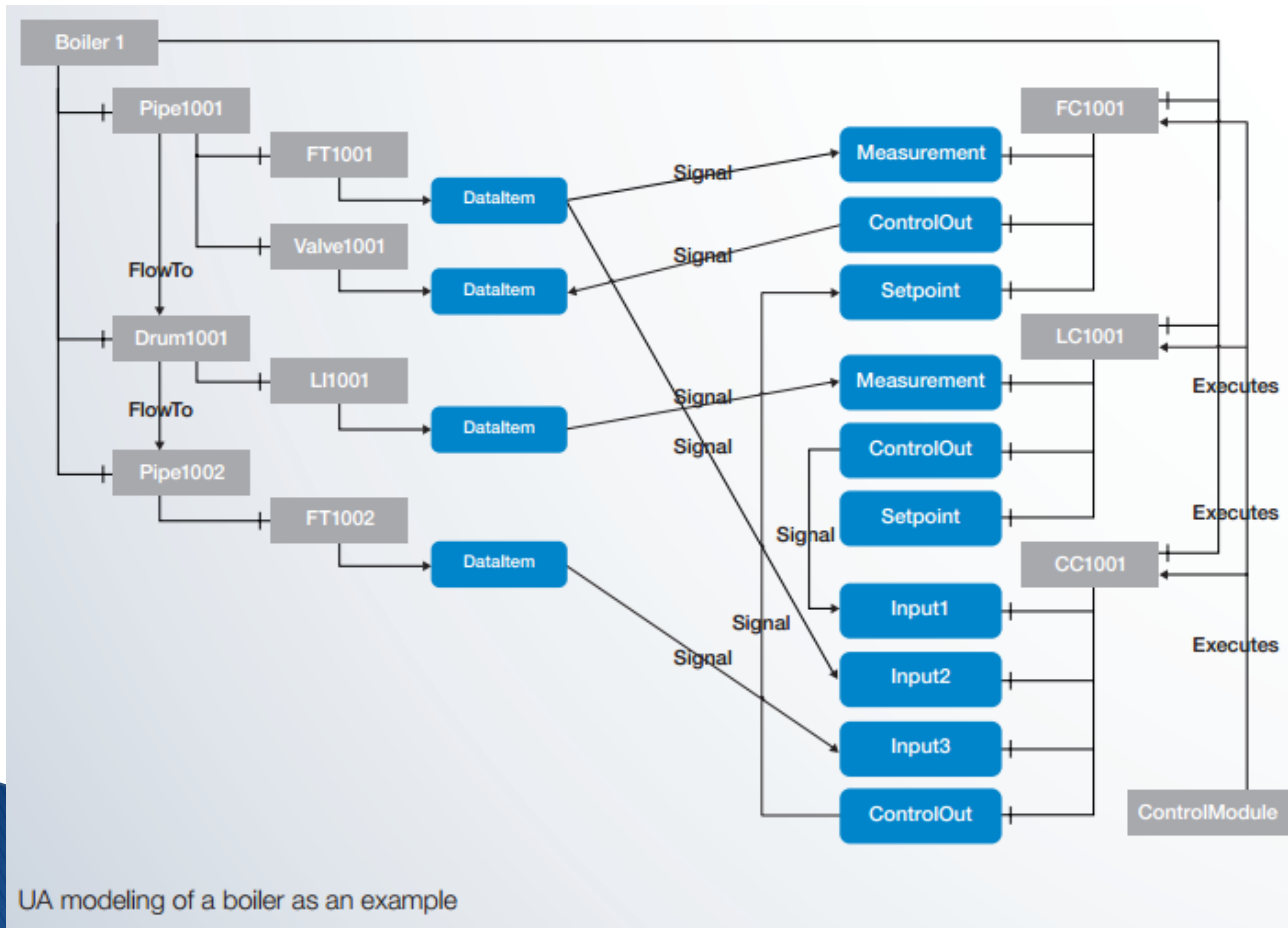


► Recommendation: Use Security

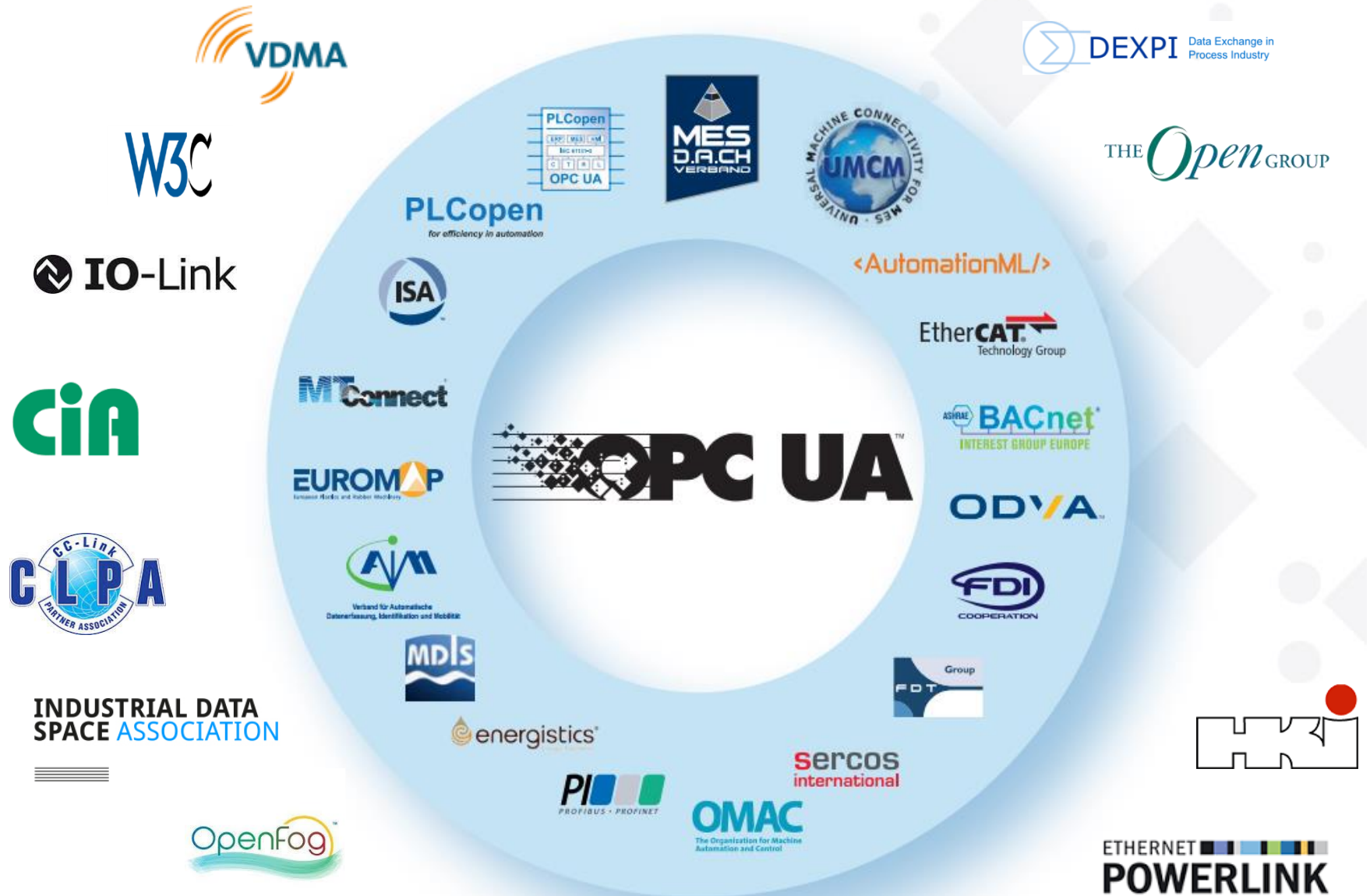


# Information Modeling

- Enable exchange of semantic information
  - Standard information models (ISA95, PLCopen, etc.)
  - Custom models

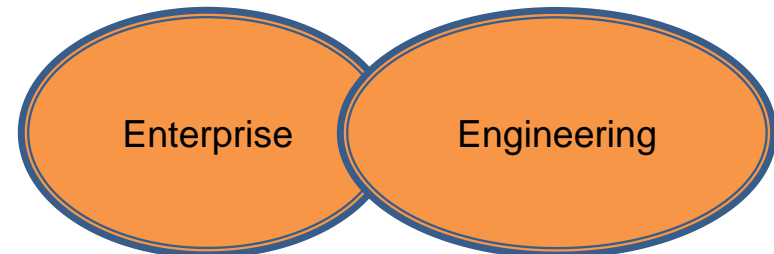
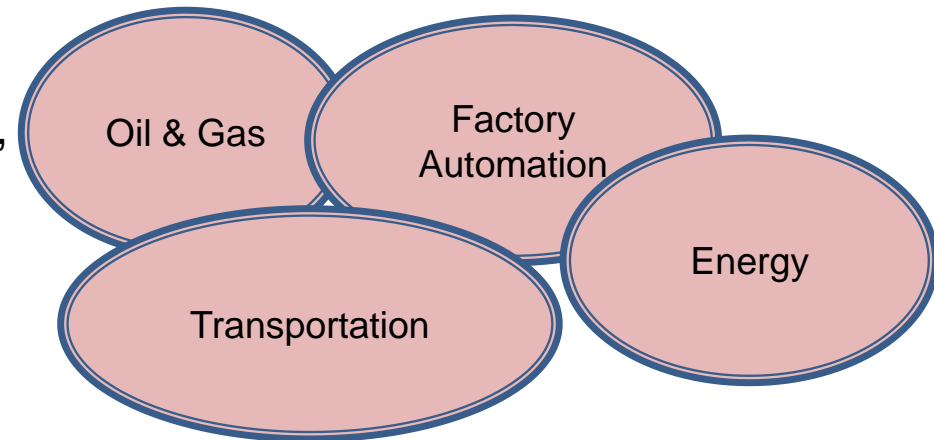
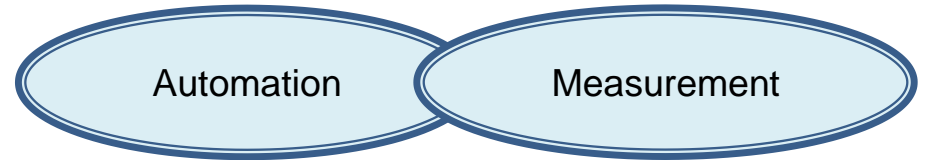


# Collaboration



# Collaboration: Information Models

- ▶ Lower level modeling
  - Profibus/NET, SERCOS, EtherCAT, CLPA , CAN, Powerlink, IO-Link, ...
- ▶ Verticals
  - MDIS, WITSML, PackML, IEC61850, MTConnect, VDMA (38 different!), ...
- ▶ Enterprise levels
  - ISA-95, MIMOSA, OpenFog, ...
- ▶ Engineering
  - PLCopen, AutomationML, DEXPI, ...



# VDMA Collaboration: Target Fields of Industry

- 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
- Robotics + Automation
- Security Systems
- Software
- Surface Treatment Technology
- Textile Care, Fabric and Leather Technology
- Textile Machinery
- Thermal Turbines and Power Plants
- Thermo Process Technology
- Valves
- Waste Treatment and Recycling
- Wind Energy
- Woodworking Machinery

**OPC UA CS under development**

**Awareness exists**

# New!

## OPC Product Certification Labs

- ▶ “OPC Foundation Europe Certification Lab” started 2017 Jan 2<sup>nd</sup>
- ▶ “OPC Foundation China Certification Lab” started 2017 Sept 1<sup>st</sup>
- ▶ New non-member test options (“Certification as a service”)
- ▶ OPC UA certification plus Companion Spec certifications
  - Certification of products
  - Script extensions of CTT for companion specs

**First device in Europe Lab  
Siemens RFID reader**

Tom Burke (OPC), Jörg Allmendinger





# New!

## UA Logo Membership

### **Assumption:**

- Worldwide OPC UA products are based on
  - minority provided by OPC members
  - majority provided by non OPC members using a toolkit

### **Till now:**

- OPC UA logo is only available for OPC members and their products

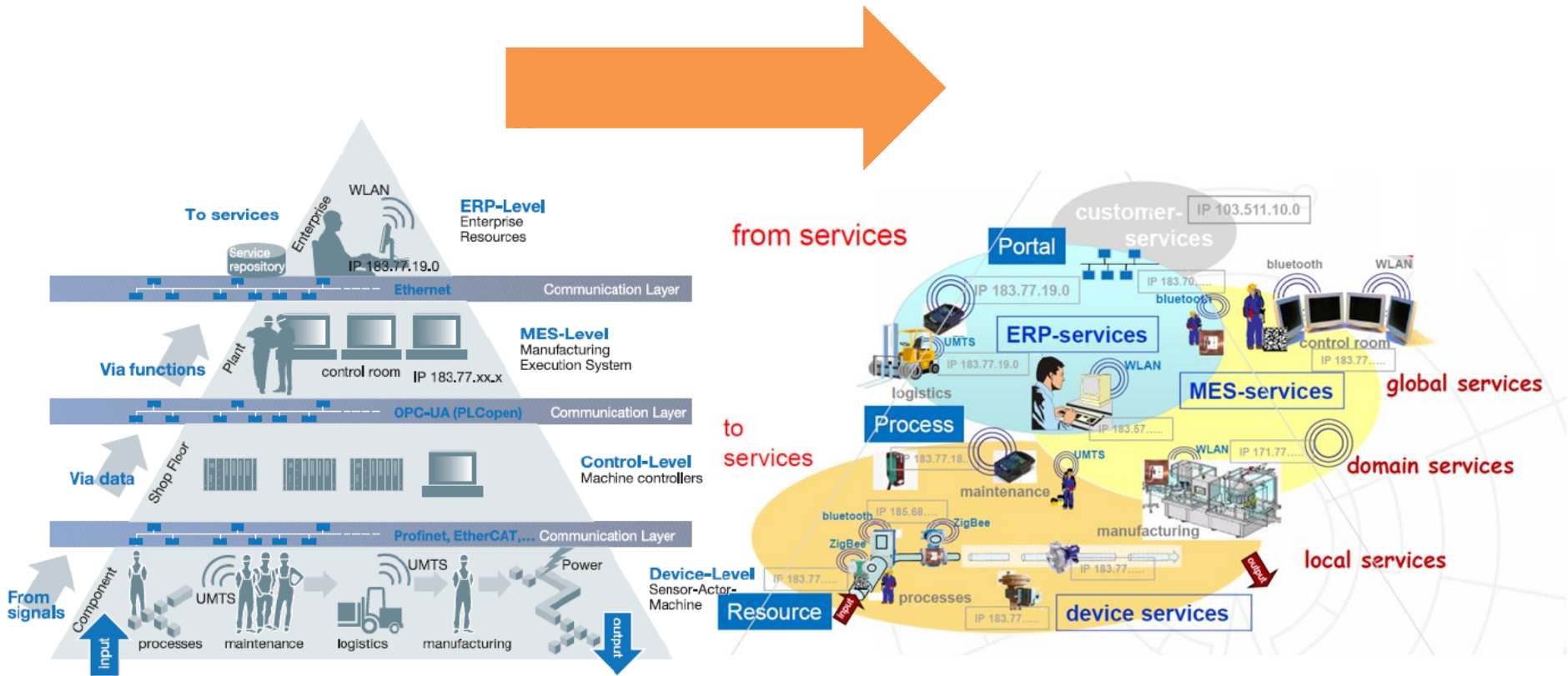
### **Goal:**

- Increase visibility of worldwide available OPC UA products
- Get in contact with non OPC members

Goal to offer paid services:

- Certification as a (paid) service
- Get them into full membership level

# Trend: OPC UA between Services

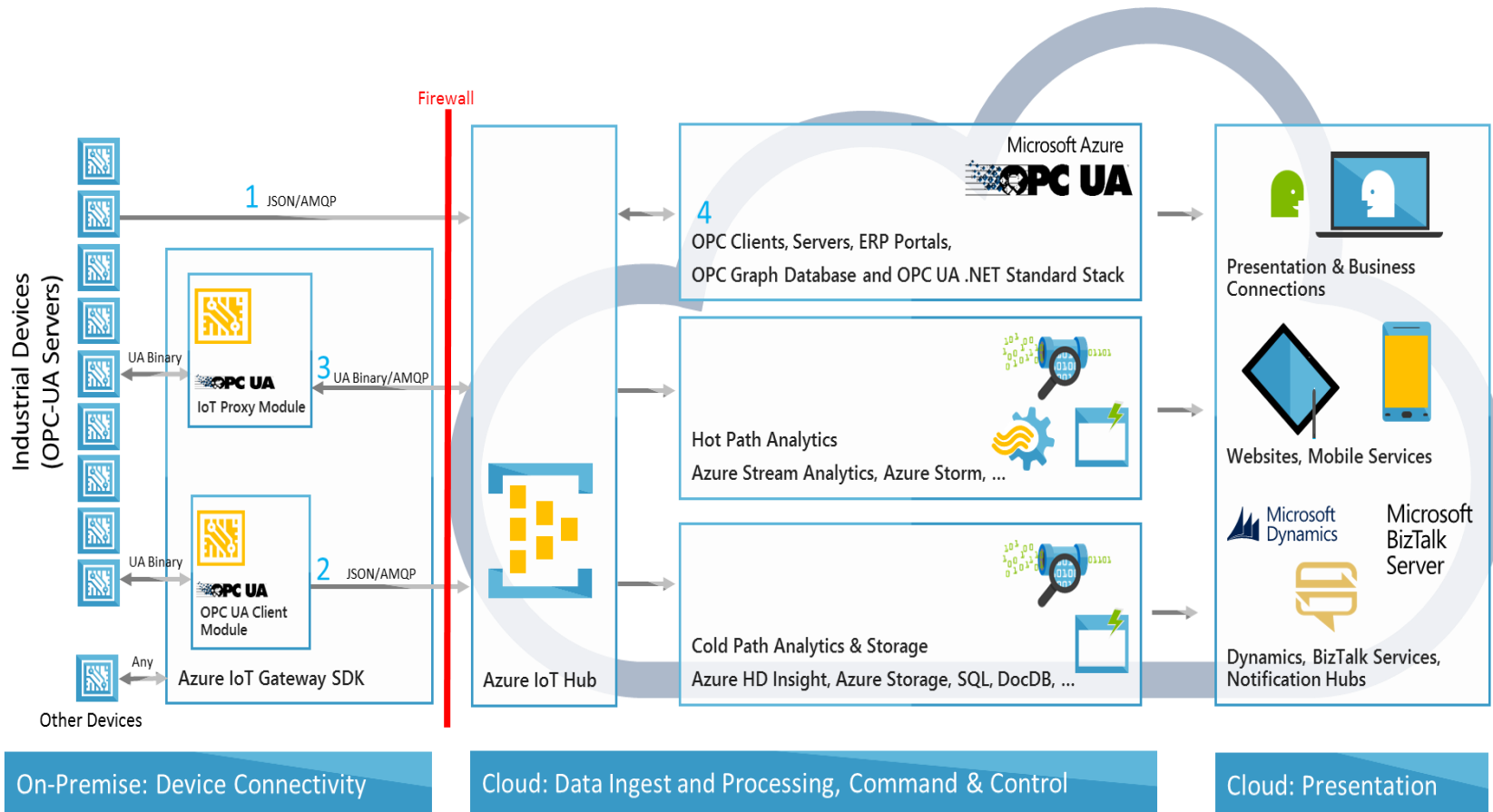


Graphics: Prof. Zühlke, DFKI

# Trend: OPC UA in Cloud



## ► Azure IoT Hub



# Trend: OPC UA on Chip Level

- ▶ 2016: Commercial product with OPC UA on chip



- Intelligent multiprotocol module for field devices
- IoT communication via OPC UA and MQTT bypassing the PLC

- Central „build process“ with intelligent engineering tool
- Protocol independent object interface to the application
- Customized device description file & source code for integration into the application



(Hilscher)

# OPC UA Videos



- ▶ Basics
  - ▶ OPC UA Vision, Thomas Burke  
<https://youtu.be/7mUmfq0M29U>
  - ▶ OPC UA Technical Introduction, Uwe Steinkrauss  
<https://youtu.be/nYMbQiRqK74>
  - ▶ OPC UA Security, Darek Kominek  
<https://youtu.be/NFQfZeU90Kw>
- ▶ Companion specs
  - ▶ AutomationML, Dr. Miriam Schleipen  
OPC UA and AutomationML, [https://youtu.be/i\\_simQ5Gu6c](https://youtu.be/i_simQ5Gu6c)  
OPC UA and AutomationML in 1 Minute <https://youtu.be/Nrzd-3Kbr9Q>
  - ▶ AutoID (RFID, etc.), Olaf Wilmsmeier  
Result OPCF & AIM WG <https://youtu.be/C9q13sVRPA8>
  - ▶ etc.



# Thank you - Questions?



**Jouni Aro**  
**CTO, Prosys OPC**  
**Chairman, OPC Committee**  
**Evangelist, OPC Foundation**  
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## OPC DAY FINLAND 2017

11.10.2017 #OPCUA #OPCDAYFINLAND #AUTOMATION #OPCDAY

