OPC UA is The Industrial Integration Technology

Status update November 2019

OPC Day Helsinki, Nov 6th, 2019

Stefan Hoppe
President & Executive Director OPC Foundation
Stefan.hoppe@opcfoundation.org

OPC Foundation

https://opcfoundation.org

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

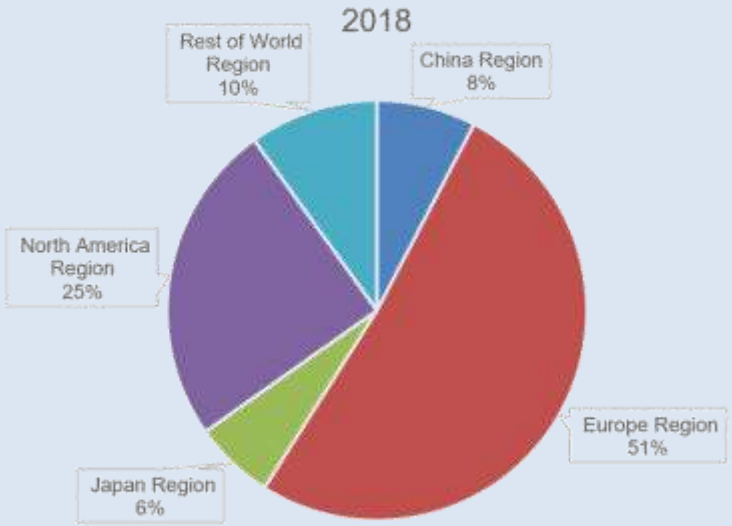
- Global Profile
  - Non-profit organization (founded 1995)
  - Companies from Automation & IT
  - Internationally recognized: OPC UA is IEC62541

- 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: 734 (Nov 5th, 2019)



2019 Board of Directors

Microsoft	Honeywell	Rockwell,
SAP	Yokogawa	Schneider,
Siemens	Mitsubishi	ABB
Beckhoff	Ascolab	

OPC UA 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

Non-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!

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OPC UA in the world

IIC

Industrie4.0

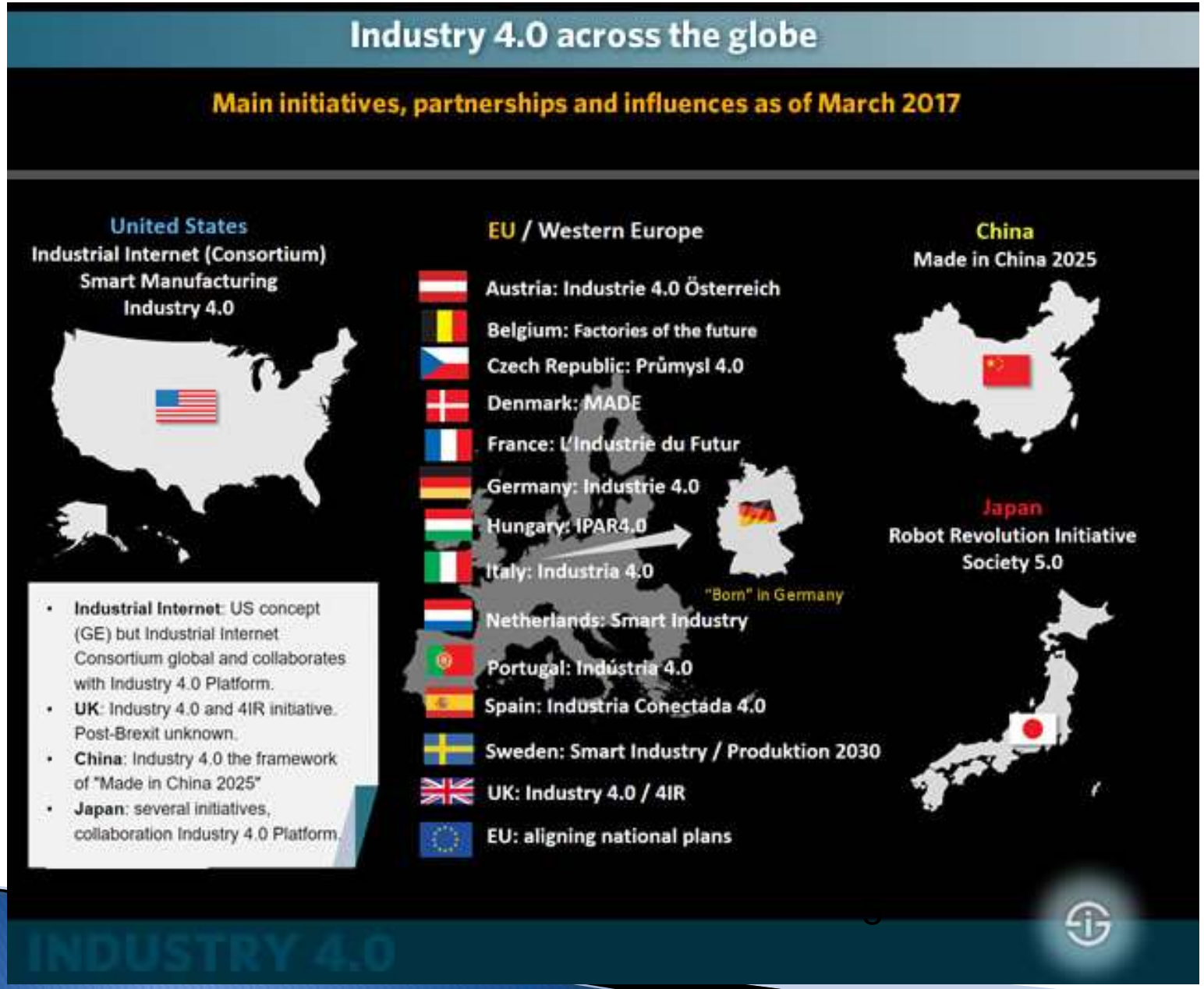
Made in China2025

Japan IVI

smart manufacturing korea 4.0

Manufacturing Renaissance
'Made in Korea'

OPC UA in the world: Industrie4.0 is the enabler across the globe



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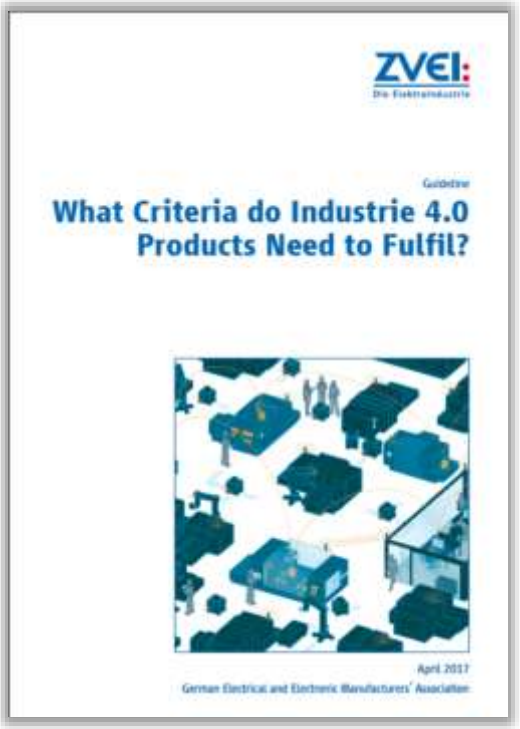
German Industrie 4.0 requires OPC UA



Source: ZVEI

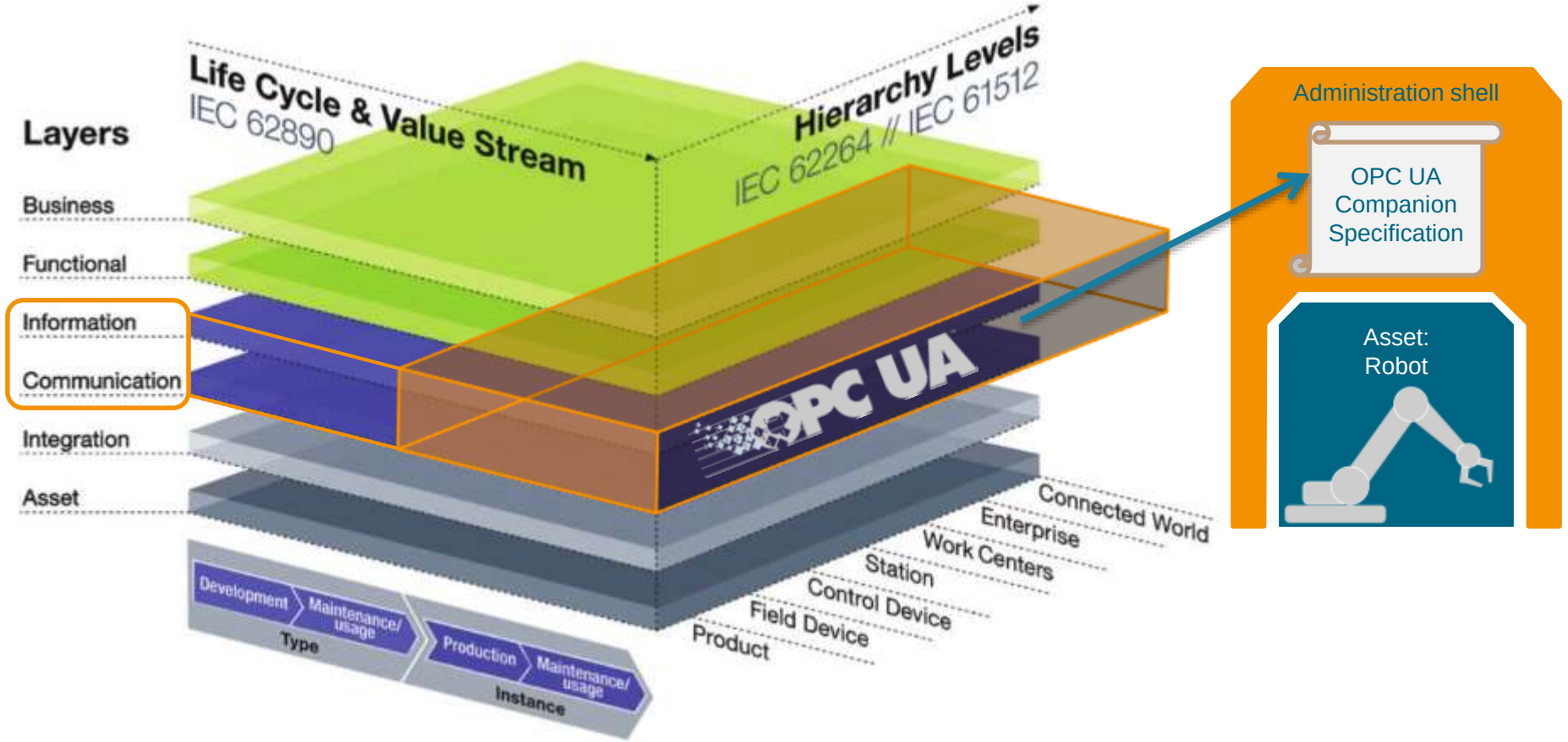
There are 3 levels to reach:

- Industrie 4.0 Full
- Industrie 4.0 Ready
- Industrie 4.0 Basic

Industrie 4.0 Basic list 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	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)
		The product can be addressed via the network, supplies and accepts data, Plug & Produce via Industrie 4.0-compliant services	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) 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

OPC UA fits into Industrie 4.0



Interoperability Conference - World

- **Host: Hannover Messe & OPCF & VDMA & FieldComm Group**
- **32 Organizations & groups presenting**
- **Information & registration www.opcfoundation.org/wic2019**

- **Agenda**

12:00 noon	Keynotes OPCF / VDMA / FCG
13:30 h	Thematic Round 1 (short talk Vision, Mission, Discussion)
14:15 h	Thematic Round 2 (short talk Vision, Mission, Discussion)
15:00 h	Thematic Round 3 (short talk Vision, Mission, Discussion)
15:30 h	End of the event

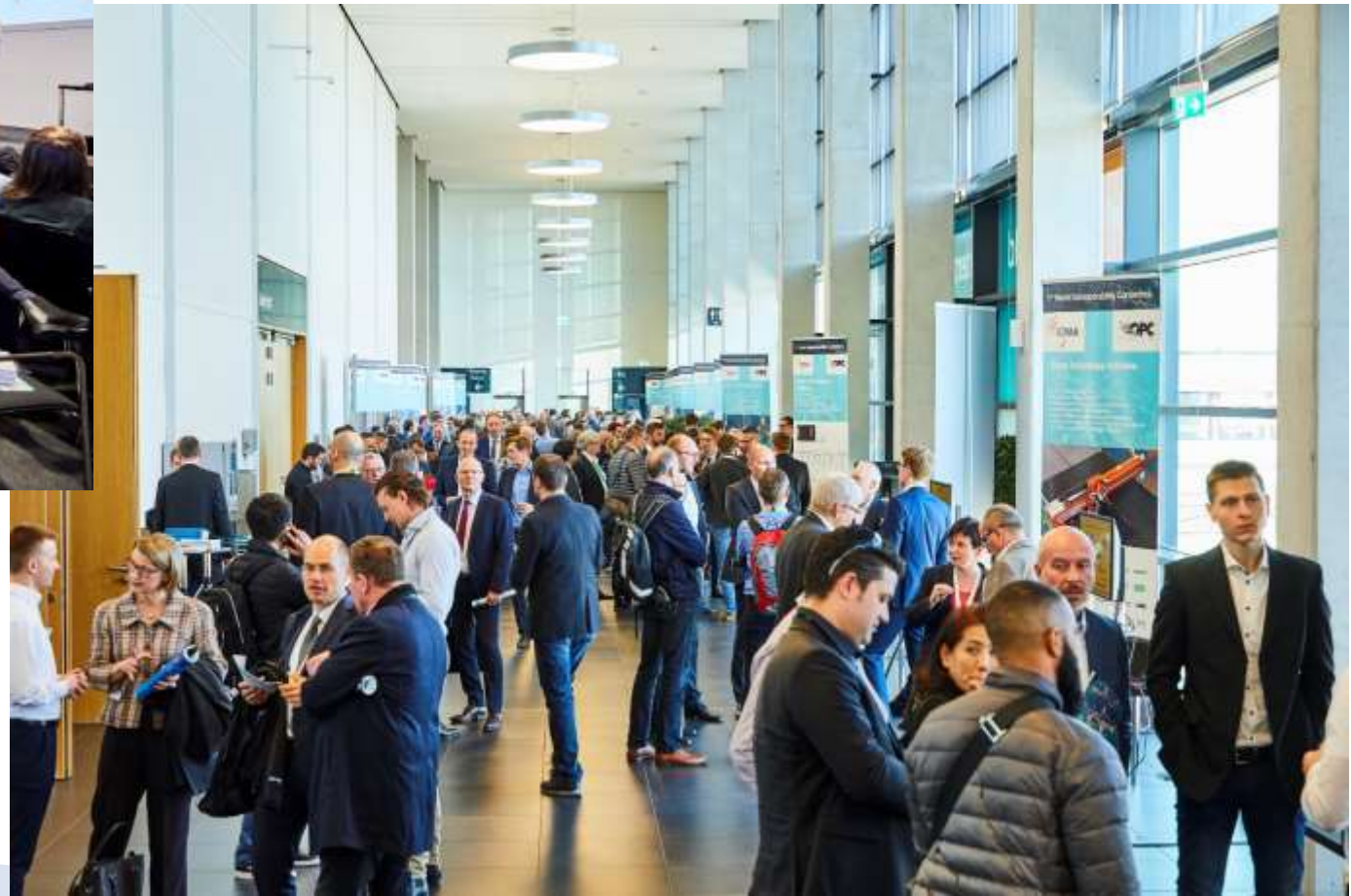
Presenting Organizations

1st Interoperability Conference - World

32 Groups

Very positive feedback

Conference No. 2: on Monday April 20th, 2020



OPC UA Day Automotive 23.05.2019

- **Organizers**
  - **AIDA: Audi, BMW, Daimler, Porsche, Volkswagen**
  - **OPC Foundation**
  - **VDMA**

377 registered attendees
306 participants

- **Host**
  - **Volkswagen in Wolfsburg**
  - **German speaking event**
    Plan to replicate in US and India

- **Notes**
  - **300+ attendees expected**
  - **Focus is adoption (not technical developer level)**
  - **Free of charge**

- **Information & Registration**
  https://opcfoundation.org/automotive-europe

OPC UA Day Automotive 23.05.2019

Marketplace with 19 sponsors

306 attendees voted most valuable speakers:
Uwe Steinkrauss & Alex Allmendinger

North America: Industrial Internet Consortium Listing OPC UA + other protocols / Testbeds

- **OPC UA listed**

9.2.2 SECURITY IN REQUEST-RESPONSE AND PUBLISH-SUBSCRIBE COMMUNICATIONS

Two common patterns in IIS communications are request-response and publish-subscribe. The request-response pattern is common in industrial systems. Examples of the implementation of this pattern include Java Remote Method Invocation (Java RMI) [6], Web Services/SOAP [7], RPC-over-DDS [8], RESTful Servers, OPC [9], Global Platform Secure Channel Protocol and Modbus [10]. As the protocols of this pattern vary in degrees of support for security, they should be independently and carefully evaluated with regard to confidentiality, integrity and availability requirements. As an example, Modbus, a popular application-level fieldbus protocol within industrial systems, lacks support for authentication and encryption, and does not provide message checksums, and lacks support for suppressing broadcast messages.

- **Today 3 testbeds with integrated OPC UA**
  - **OPC UA + TSN in Manufacturing**
  - **OPC UA Sensor in Brownfield environment**
  - **OPC UA and AutomationML for factory**

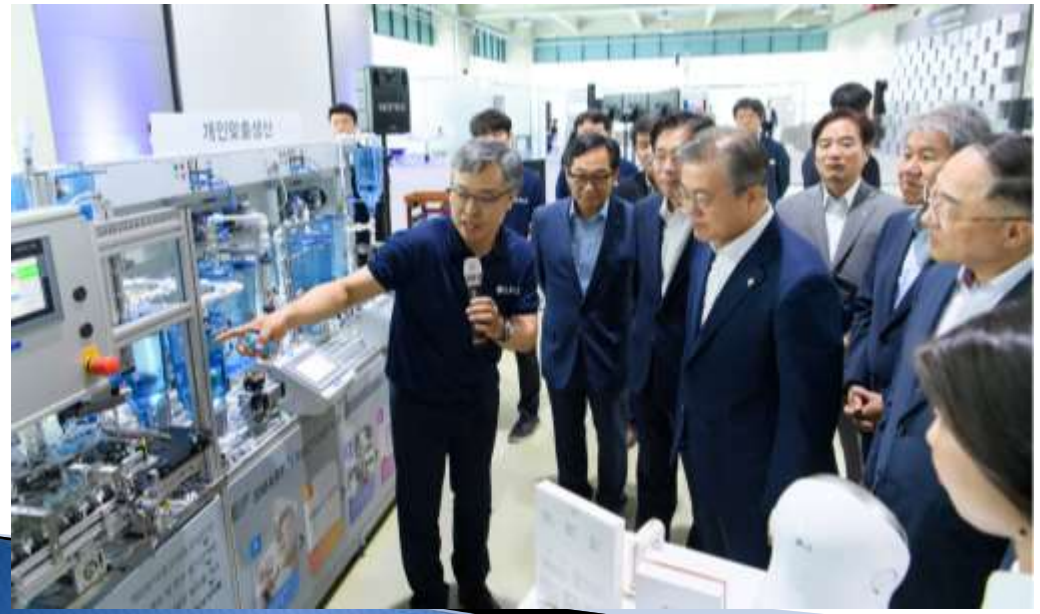
OPC Foundation in Korea: Manufacturing Renaissance

smart manufacturing korea 4.0

- Manufacturing Renaissance Vision Proclamation in June 19th, 2019
  - The for powers of manufacturing in the world until 2030
  - Support 8 trillion won of R&D fund for new industries

- OPC UA is Korea national Standard
  - Parts 1~6 have been completed

- Official announcement from Government: “Manufacturing Renaissance : Made in Korea”
  - OPC UA as standard of essential projects of smart factory in Korea



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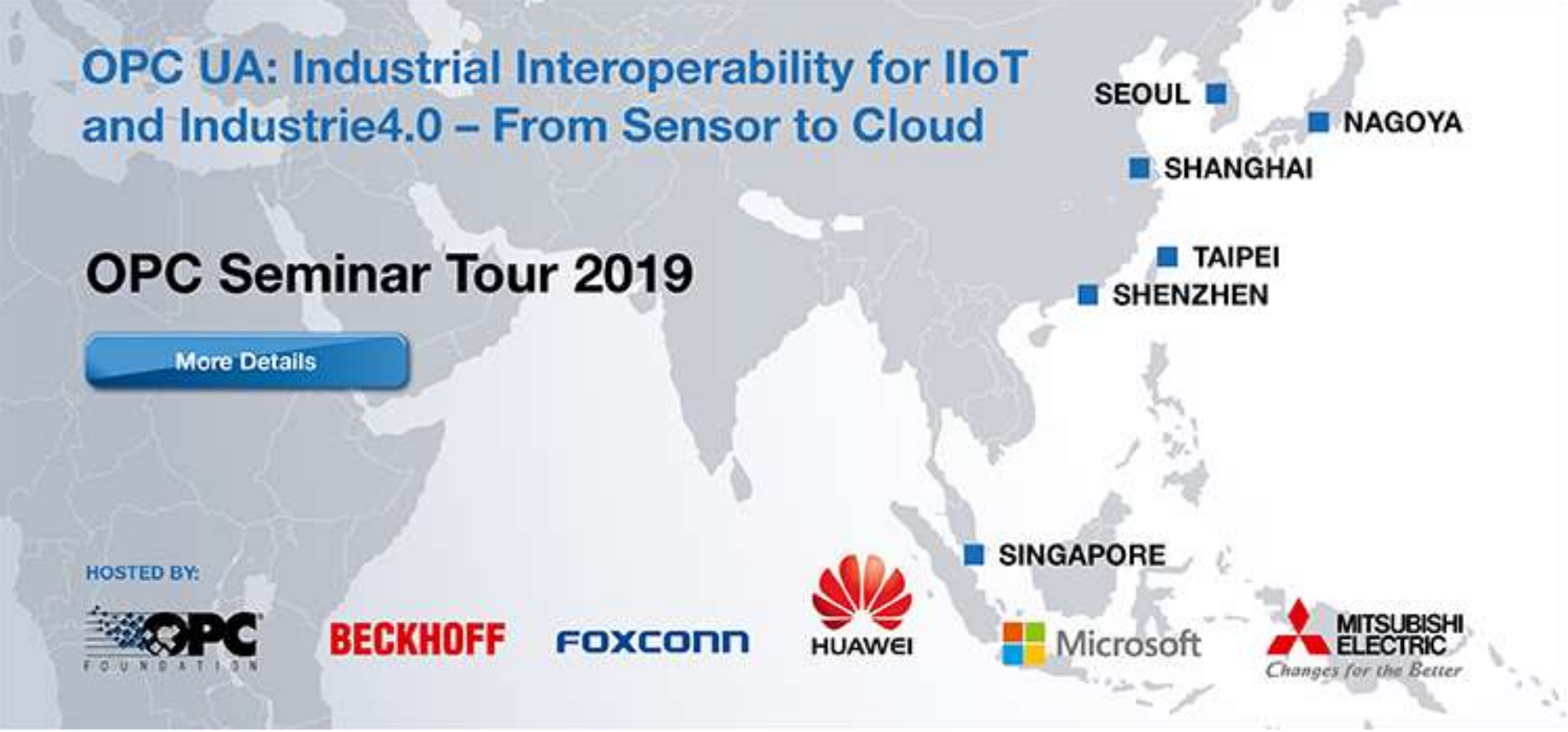
OPC UA is a Chinese national Standard GB/T 33863

ITEI helps OPC Foundation convert OPC UA (IEC 62541) into Chinese National Standard GB/T 33863.

ITEI and OPC Foundation cooperate to establish OPC China Test Lab for testing compliance of products.



150+	July	3rd – OPC Day Shanghai hosted by Huawei, China
151:	July	4th – OPC Day Nagoya hosted by Mitsubishi, Japan
119:	July	5th – OPC Day Seoul, Korea
157:	July	8th – OPC Day Taipei, Taiwan hosted by Microsoft
150+	July	9th – OPC Day Shenzhen hosted by Foxconn, China
115:	July	10th – OPC Day Singapore sponsored by Beckhoff

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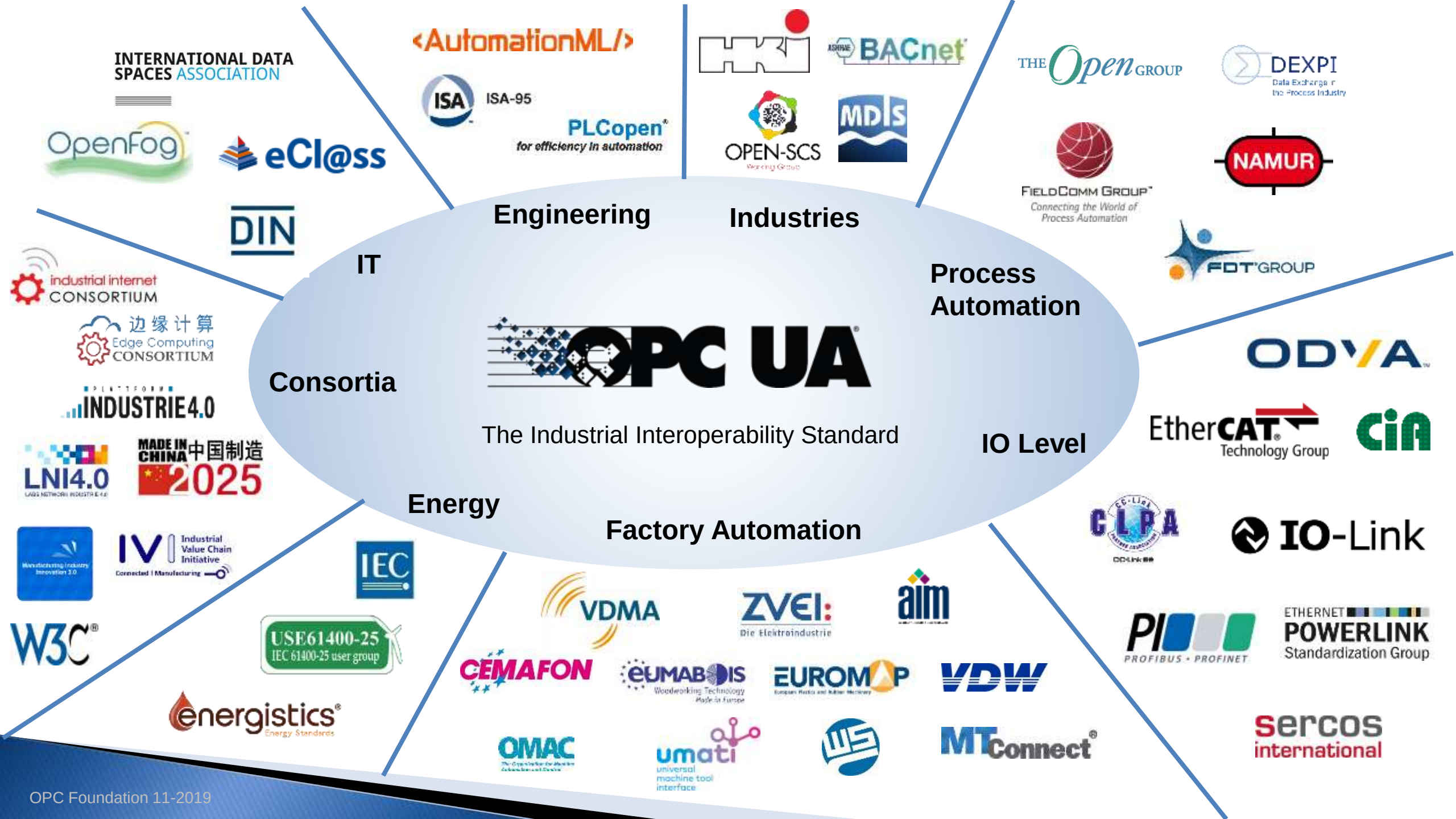
INTERNATIONAL DATA SPACES ASSOCIATION
OpenFog
eCl@ss
DIN
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ISA
ISA-95
PLCopen
for efficiency in automation
BACnet
OPEN-SCS
MDIS
THE Open GROUP
DEXPI
NAMUR
FIELDCOMM GROUP
Connecting the World of Process Automation
FDT GROUP
industrial internet CONSORTIUM
边缘计算
Edge Computing CONSORTIUM
INDUSTRIE 4.0
LNI4.0
MADE IN CHINA 中国制造 2025
Industrial Value Chain Initiative
Connected | Manufacturing
IEC
W3C
USE61400-25
IEC 61400-25 user group
energistics
Energy Standards
VDMA
ZVEI
Die Elektroindustrie
aim
CEMAFON
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Woodworking Technology Made in Europe
EUROMAP
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universal machine tool interface
MTConnect
ODVA
EtherCAT
Technology Group
CiA
CLPA
IO-Link
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PROFIBUS • PROFINET
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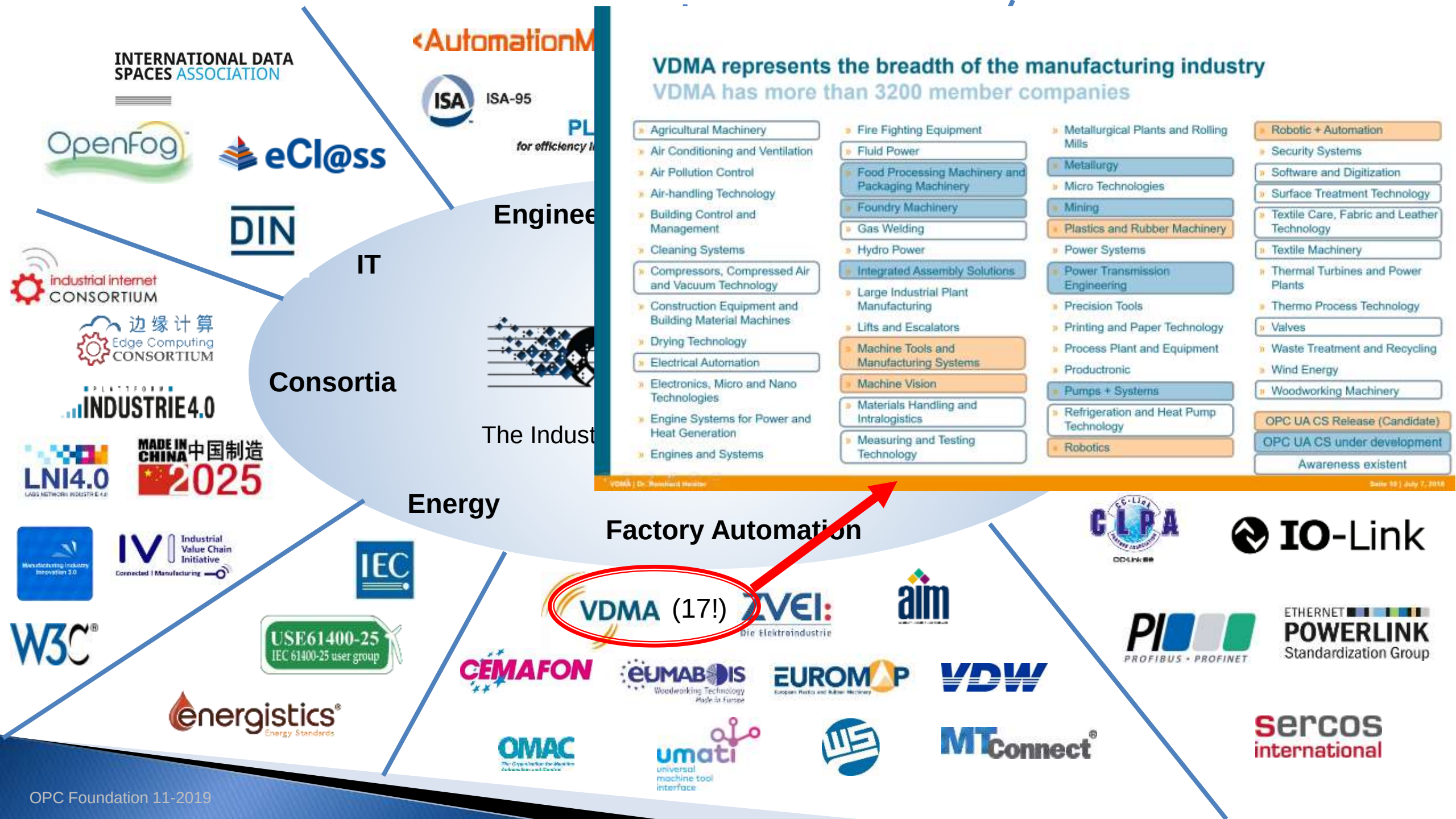
Energy
Factory Automation


INTERNATIONAL DATA SPACES ASSOCIATION
OpenFog
eCl@ss
ISA-95
DIN
industrial internet CONSORTIUM
边缘计算 Edge Computing CONSORTIUM
INDUSTRIE4.0
LNI4.0
MADE IN CHINA 中国制造 2025
IV Industrial Value Chain Initiative
IEC
W3C
USE61400-25 IEC 61400-25 user group
energistics Energy Standards
IT
Consortia
Energy
Factory Automation
VDMA (17!)
ZVEI: Die Elektroindustrie
aim
CEMAFON
EUMABOIS Woodworking Technology
EUROMAP
VDW
OMAC
umati universal machine tool interface
MTConnect
CLPA
IO-Link
PI PROFIBUS · PROFINET
ETHERNET POWERLINK Standardization Group
sercos international
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 Digitization
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 Release (Candidate)
OPC UA CS under development
Awareness existent

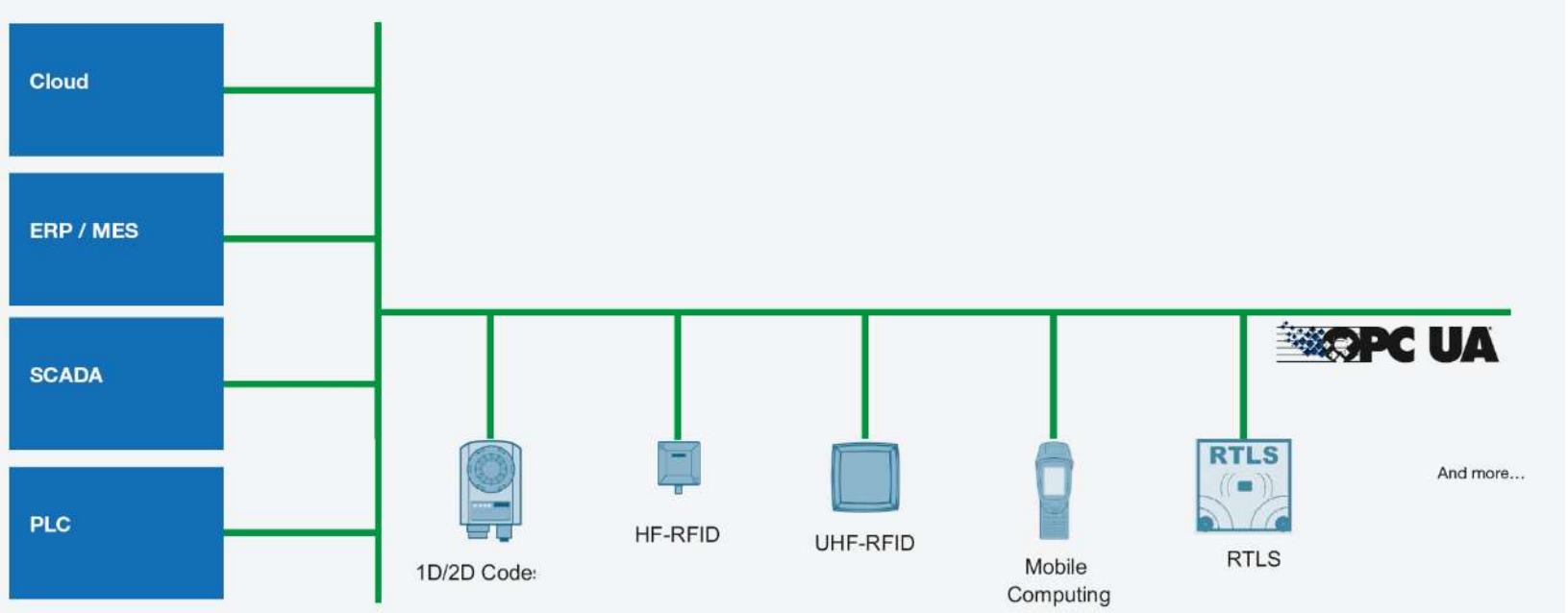
OPC UA for AutoID

One communication standard for the whole AutoID world

- **Standardized, secured data and interfaces**
- **Different devices like**
  HF/UHF-RFID, OCR, Optical (1D/2D barcode), RTLS

Adaption

- **Harting, Siemens (4 types)**
- **Balluff, Leuze (2 types), Sick, Turck, (P+F 2019)**



OPC Foundation: Library of Description of Industrial Things

OPC UA Companion Specs

… description of data, interfaces, features, behavior,

… a description of a thing.

Future:
"The OPC Foundation will become the world library for descriptions of industrial things."

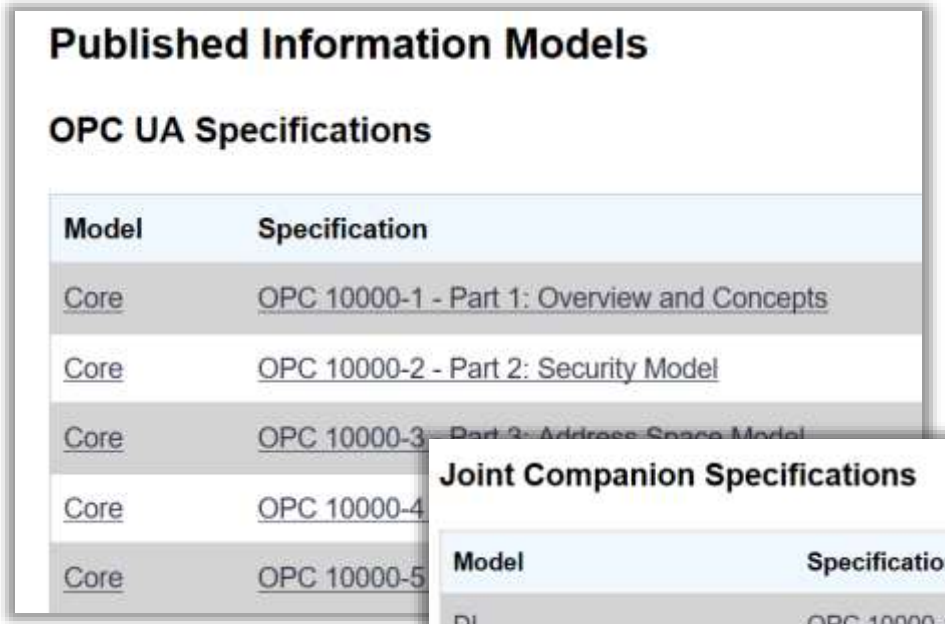
OPC Foundation: Information

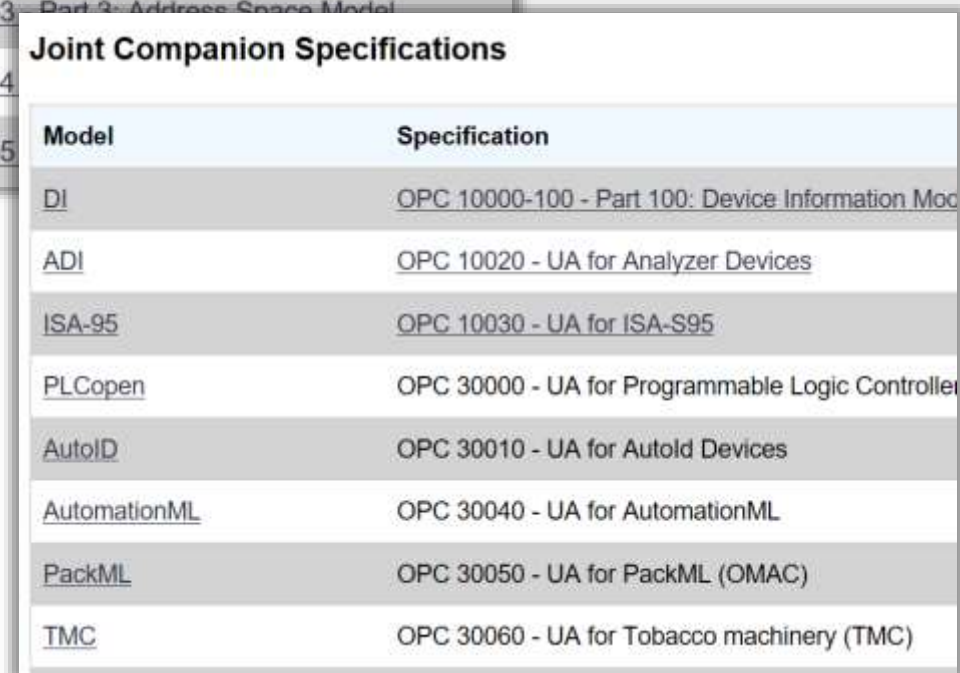
https://opcfoundation.org/

Published

- Online reference
  https://reference.opcfoundation.org

- Listing data types, interfaces …
  - All OPC UA specifications
  - All joint Information models



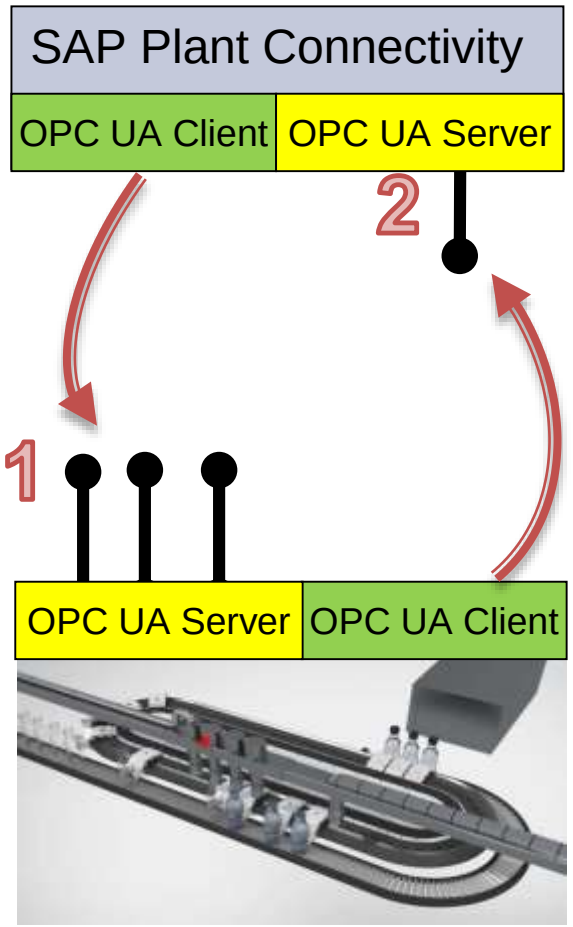


SAP & OPC UA: SoA Reshape Automation Pyramid

Industrie4.0 demo at Hannover Messe SAP booth since 2016, 2017, 2018, 2019… 2020?

Architecture: What is an asset? 1/3)

- Asset is an intelligent device / machine providing functionality



1 XTS Transport system provide functionalities:

- ProvideEmptyTransport (OrderNr, TargetPos)
- ProvideTransport (OrderNr, TargetPos)
- CleanTransport (OrderNr)

2 XTS Transport to confirm actions

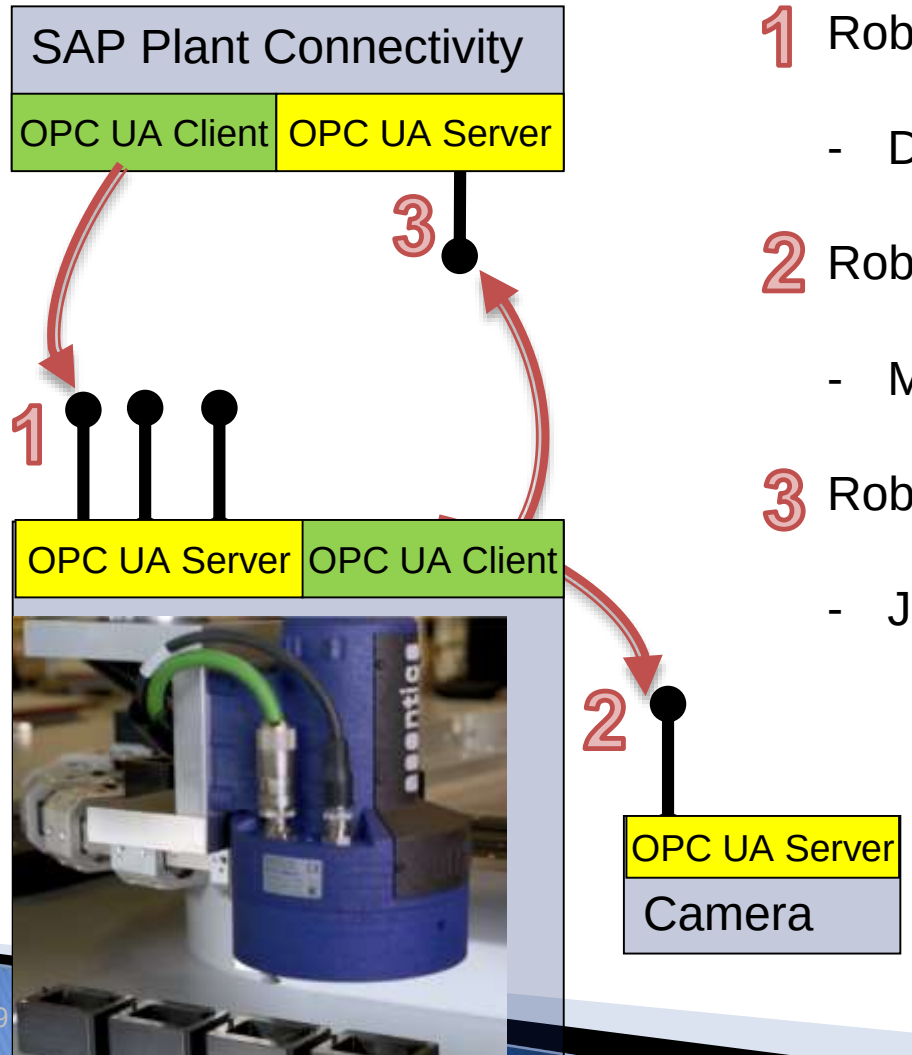
- JobDone (OrderNr)
- InitializationDone()

SAP ←→ XTS
Only vertical communication

The transport system is not aware of any other asset!

Architecture: What is an asset? (2/3)

- Asset is an intelligent device / machine providing functionality



1 Robot provide functionalities:

- DoPickandPlace(OrderNr, PreTeachedNr)

2 Robot call service from camera

- MakePictureAndAnalyze(OrderNr)

3 Robot can confirm job

- JobDone(OrderNr)

Vertical & horizontal communication

- SAP is not aware of vision camera
- The robot appears as a “Smart Robot”

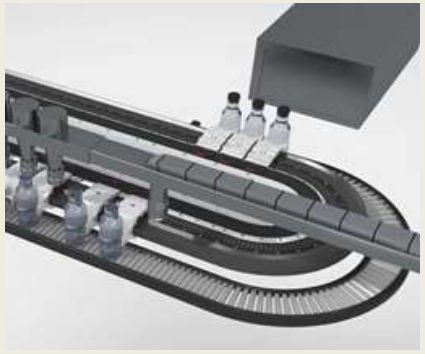
Architecture: What is an asset? (3/3)

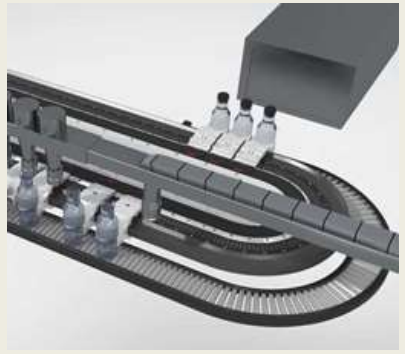
SAP Plant Connectivity

SAP can handle both….what does customer need?

Individual assets
- Only easy pick & place
- No high speed coordinated actions master slave coupling etc

Smart assets
- Internally combined functionality
- High speed coordinated actions on the flyer pick & place etc





Fieldbus

SAP: Asset integration in 10min

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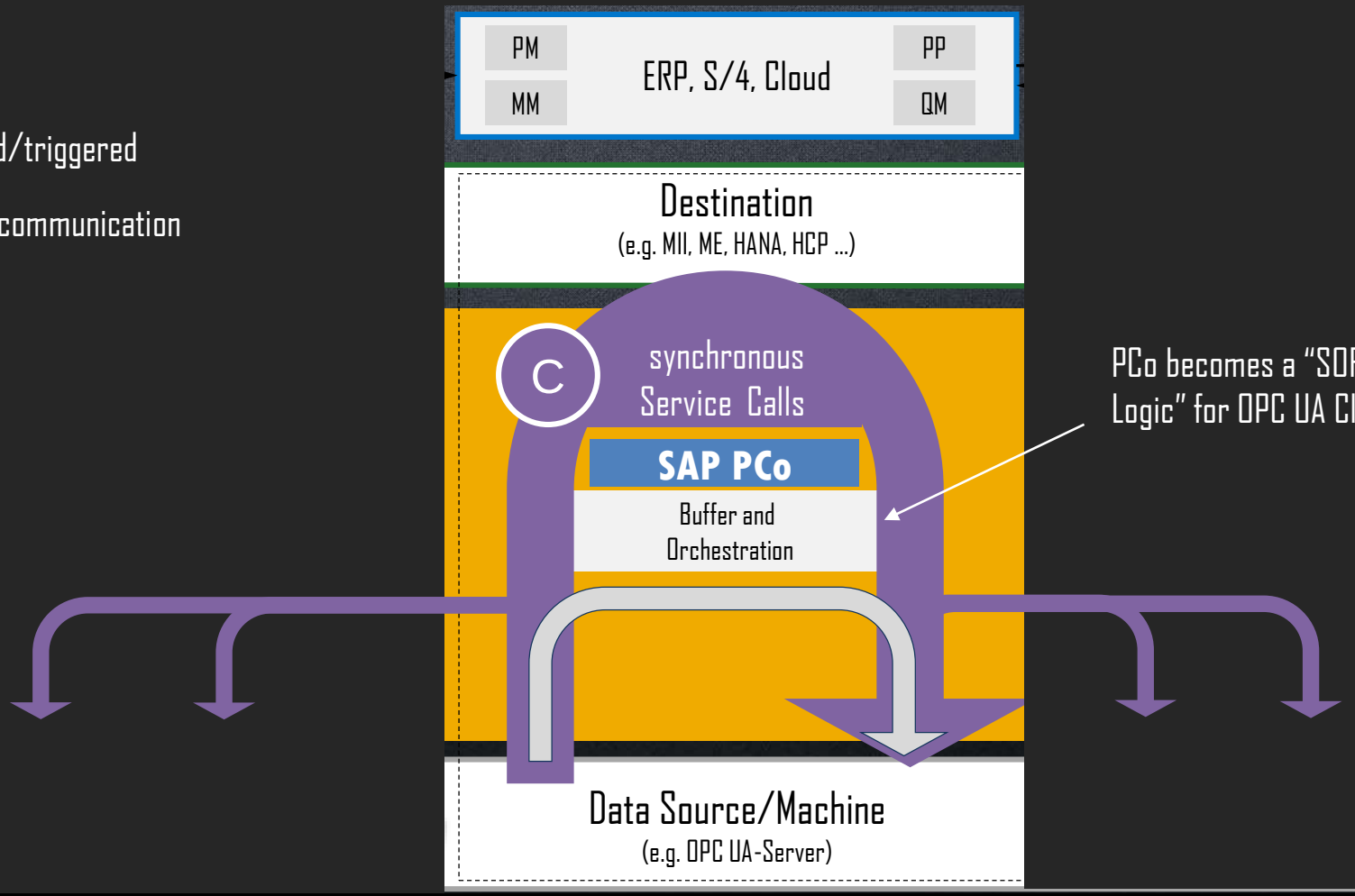
(1) Event occurs on Machine Unit X

(2) Machine Unit Y needs to be notified/triggered

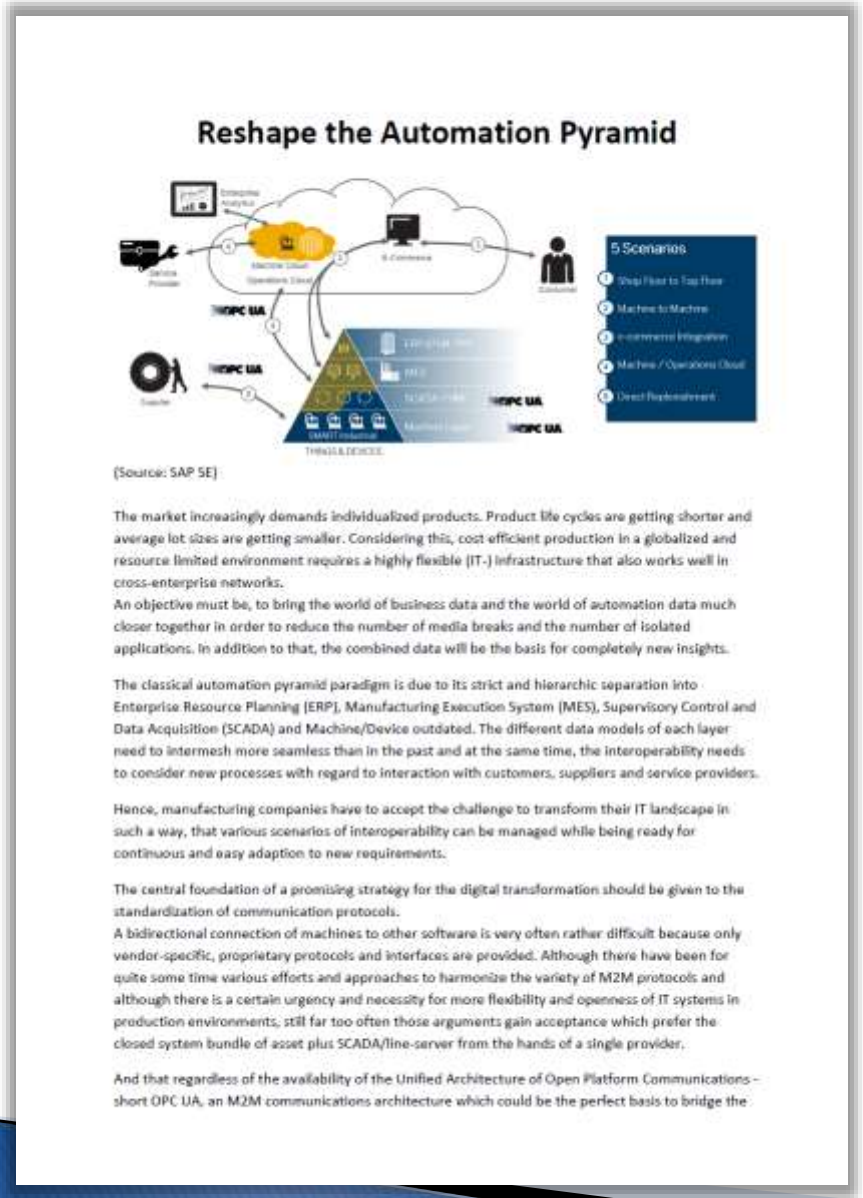
(3) PCo can be configured to execute communication between units



PCo becomes a "SOFT PLC with Business Logic" for OPC UA Client/Server bundles

OPC UA

Read the 2 page article… public since February 2016



Reshape the Automation Pyramid

(Source: SAP SE)

The market increasingly demands individualized products. Product life cycles are getting shorter and average lot sizes are getting smaller. Considering this, cost efficient production in a globalized and resource limited environment requires a highly flexible (IT-) infrastructure that also works well in cross-enterprise networks.
An objective must be, to bring the world of business data and the world of automation data much closer together in order to reduce the number of media breaks and the number of isolated applications. In addition to that, the combined data will be the basis for completely new insights.

The classical automation pyramid paradigm is due to its strict and hierarchic separation into Enterprise Resource Planning (ERP), Manufacturing Execution System (MES), Supervisory Control and Data Acquisition (SCADA) and Machine/Device outdated. The different data models of each layer need to intermesh more seamless than in the past and at the same time, the interoperability needs to consider new processes with regard to interaction with customers, suppliers and service providers.

Hence, manufacturing companies have to accept the challenge to transform their IT landscape in such a way, that various scenarios of interoperability can be managed while being ready for continuous and easy adaption to new requirements.

The central foundation of a promising strategy for the digital transformation should be given to the standardization of communication protocols.
A bidirectional connection of machines to other software is very often rather difficult because only vendor-specific, proprietary protocols and interfaces are provided. Although there have been for quite some time various efforts and approaches to harmonize the variety of M2M protocols and although there is a certain urgency and necessity for more flexibility and openness of IT systems in production environments, still far too often those arguments gain acceptance which prefer the closed system bundle of asset plus SCADA/line-server from the hands of a single provider.

And that regardless of the availability of the Unified Architecture of Open Platform Communications - short OPC UA, an M2M communications architecture which could be the perfect basis to bridge the

Rüdiger Fritz

Director - Product Management SAP Plant Connectivity (PCo)

Production Planning & Manufacturing

SAP SE

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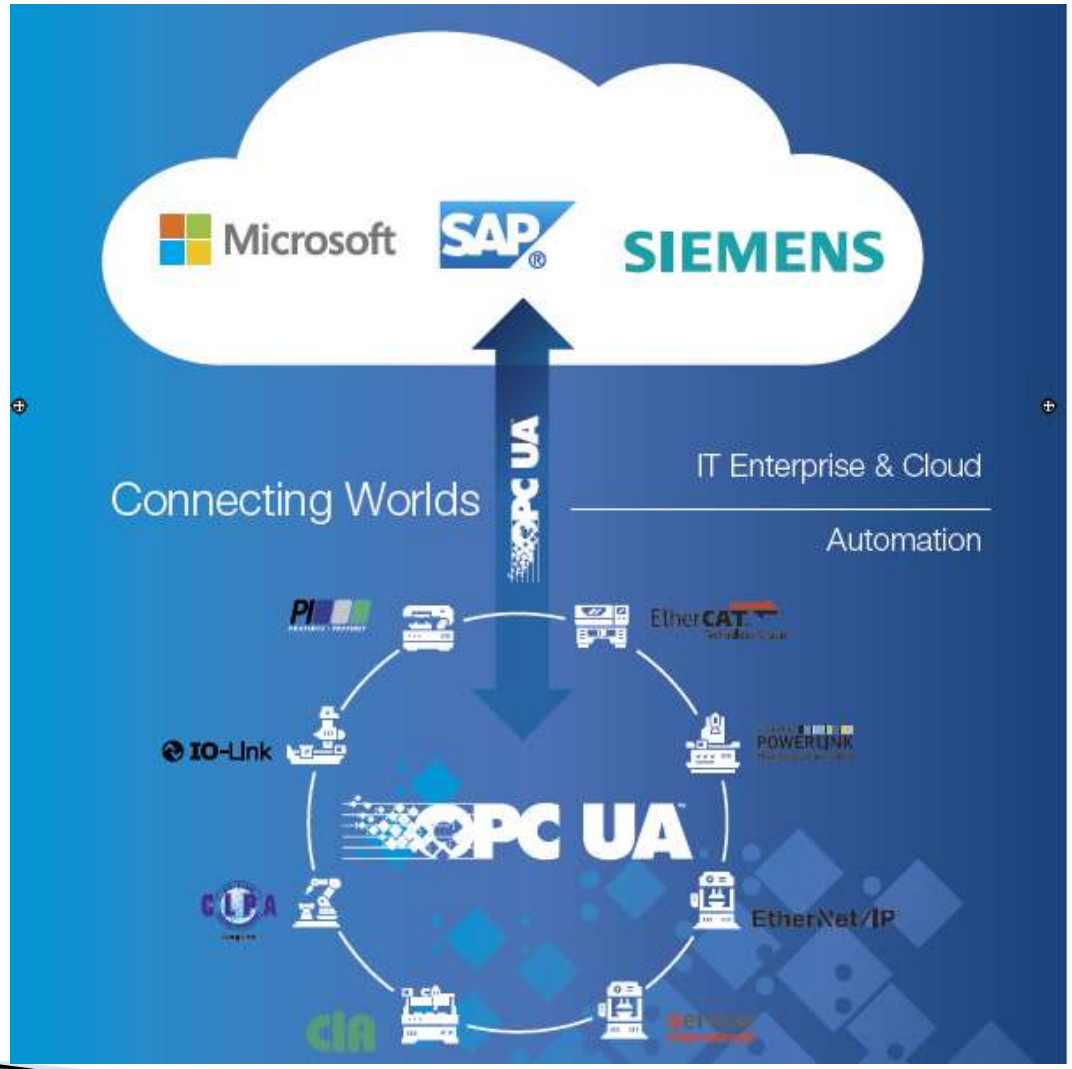
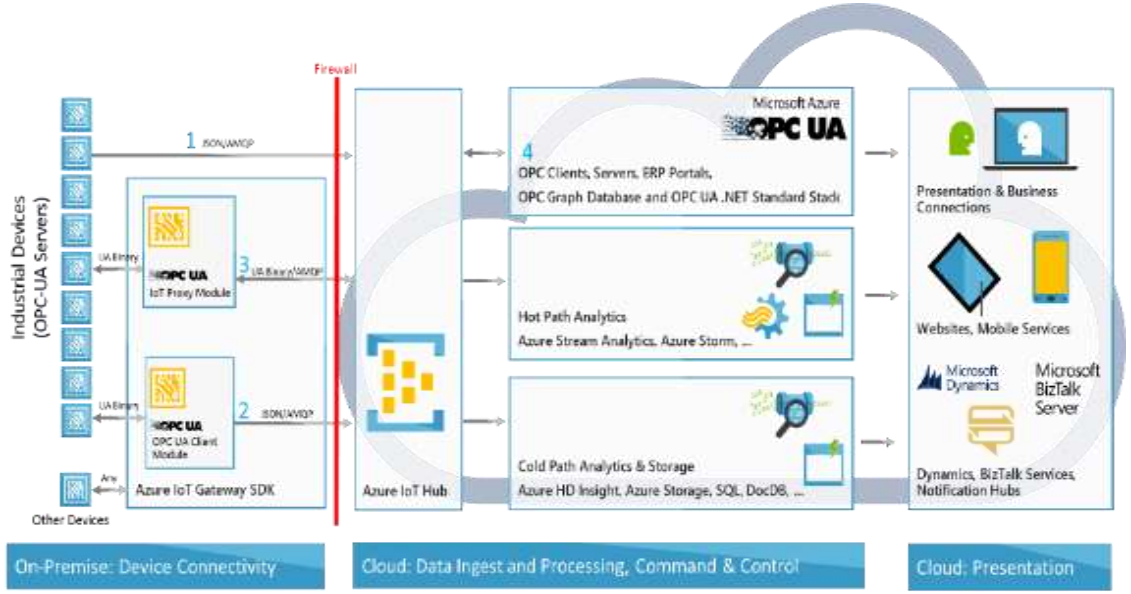
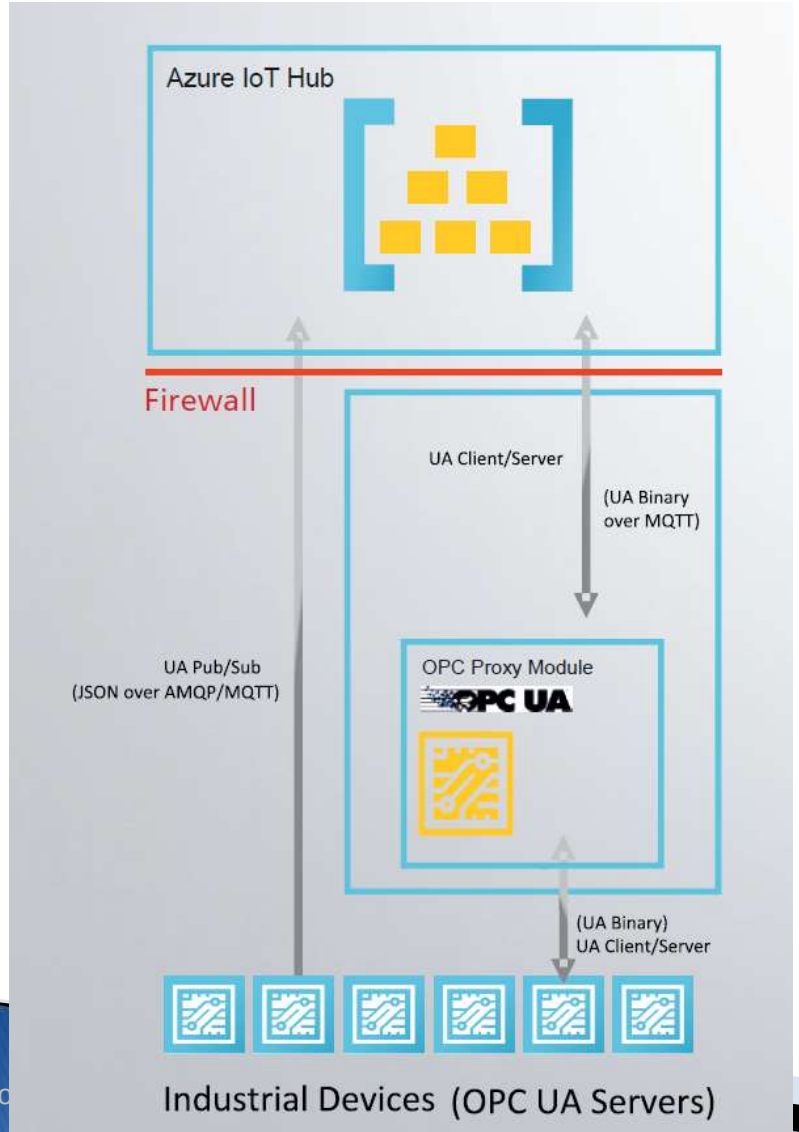
Microsoft commitment





- See video Microsoft Azure & OPC UA here https://youtu.be/QJ1DWTvGQxo
- Microsoft is the world largest open source contributer for the OPC Foundation.
  Contributed over 3.5 million source lines of code, more than everyone else together
- OPC UA Open Source on GitHub:
  7.500 visitors per week for OPC UA .NET Standard

Microsoft: OPC UA integration into Azure IoT



Microsoft Proxy Module (open source)

- „South Port“
  Act as OPC UA client to Third Party devices

  Support
  - complex data
  - method calls
  - …. Everything!

- „North Port“
  Tunnel OPC UA binary via MQTT into Azure

- Benefit
  Transparent OPC UA from Cloud to Field level

M2M & IoT in decentralized, intelligent equipment

Success Story

Branch
Water Treatment

OPC FOUNDATION

Intelligent Water Management with OPC-UA Enabled Smart Devices

M2M Communication Based on PLCopen OPC-UA Client Function Blocks

Testimonial: Licensing Costs Reduced by 90%

Who?
Joint Water and Wastewater Authority
Vogtland, Germany
Silvio Merz, Divisional Manager, s.merz@zwav.de

What?

- Supply water to about 240,000 people and treating their wastewater as well
- Operate almost 600 Water and Wastewater treatment plants
  - Waterworks
  - Water pumps
  - Water reservoirs
- Distributed over about 1400 Km²

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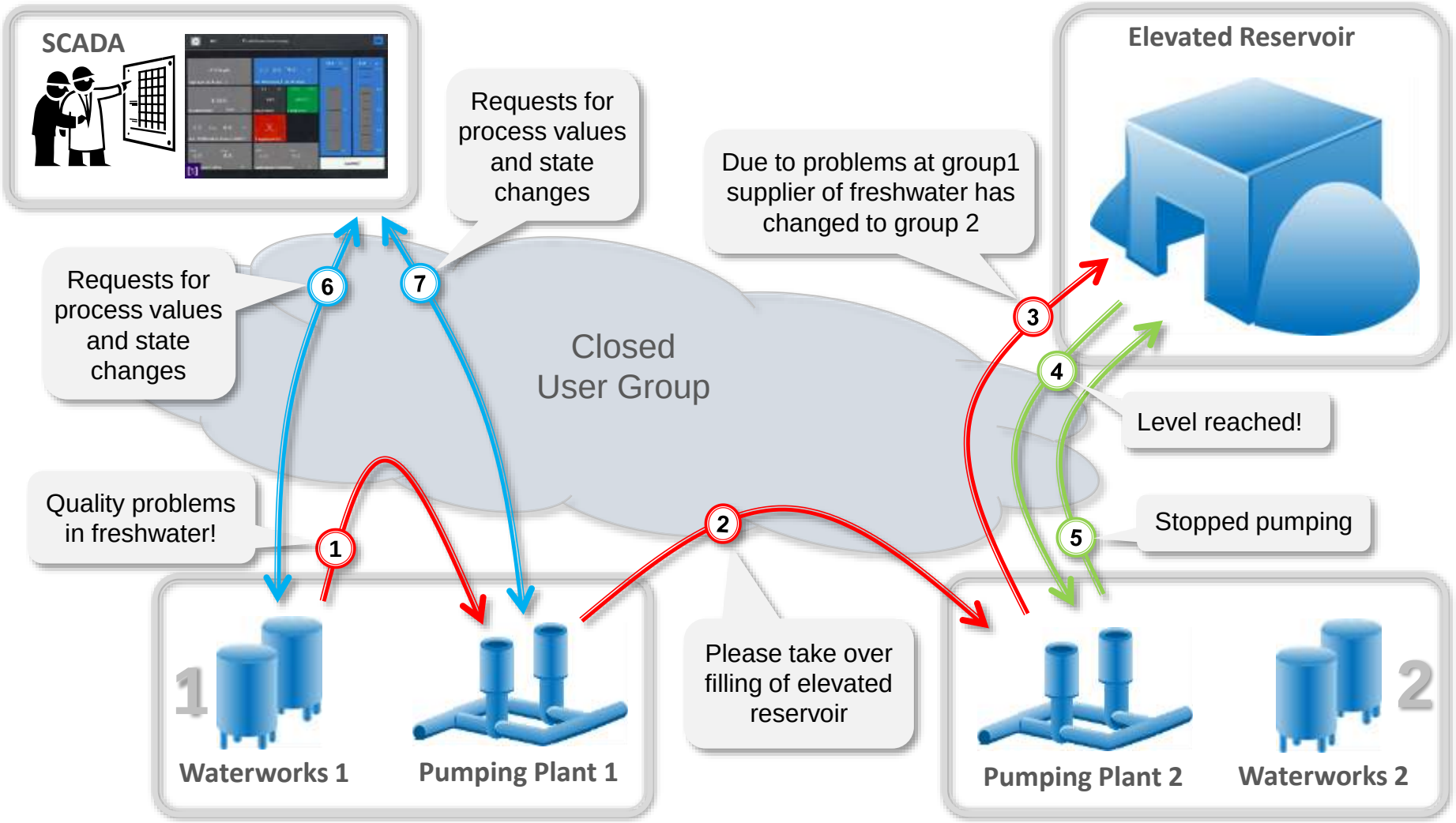
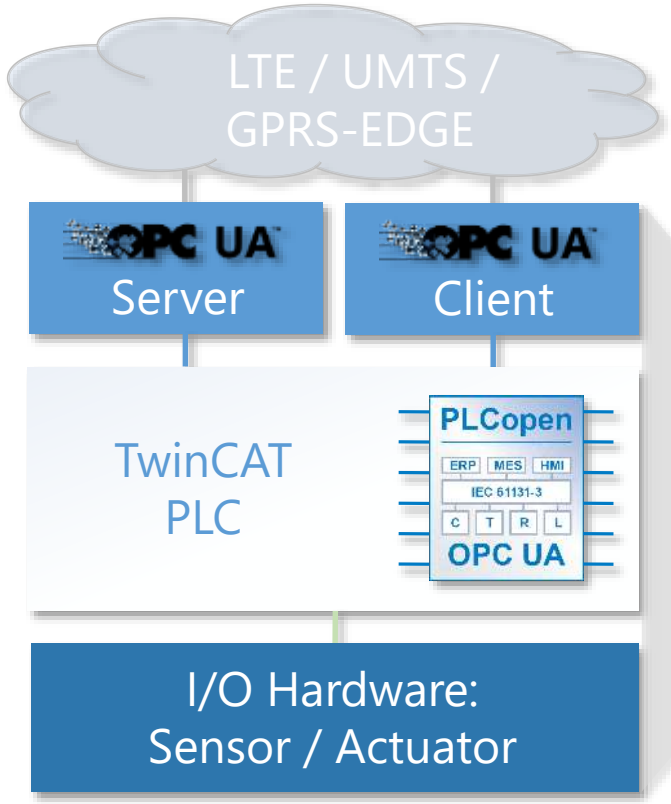
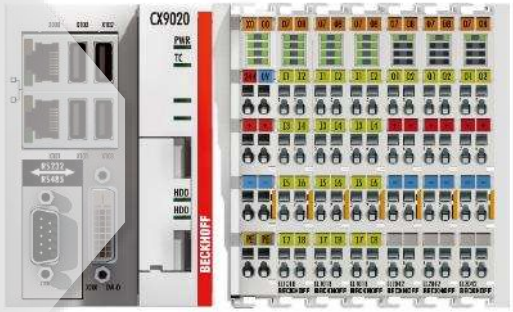
M2M & IoT in decentralized, intelligent equipment

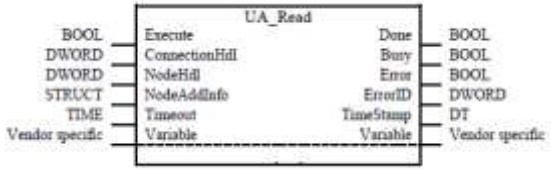


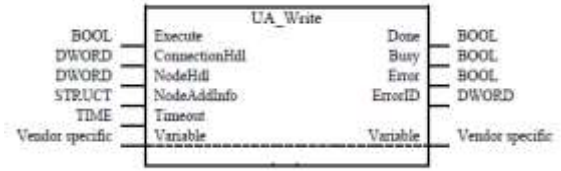
M2M & IoT in decentralized, intelligent equipment

TwinCAT OPC-UA Client (PLCopen-based) and TwinCAT OPC-UA Server are integrated into one of the smallest Beckhoff controllers, a CX9020 Embedded PC









M2M & IoT in decentralized, intelligent equipment

Cost saving effects

- Transmission of complex data structures -> there's no configuration of every single datapoint required
- Replacement of a proprietary solution with a combined OPC-UA client/server. Standardization of data communication reduces interfaces, just the OPC-UA client and server.
- A physical interruption of the connection does not lead to a loss of information -> automatically buffered in the OPC-UA server for a time and can be retrieved as soon as the connection has been restored
- Using security mechanisms like authentication, signing and encryption integrated in OPC-UA in addition to a closed mobile radio group to ensure the integrity of the confidential data
- **"The solution provided us with a saving on the initial licensing costs of more than 90 % per device."**

OPC Foundation: United Nations for Industrial Automation

Independent / Neutral ground to work together / No company, no country can dominate OPC Foundation
Standards can only developed together

Information: Brochures Updated (v9a) -> v10 official for 2020

- “Interoperability for Industrie 4.0 and the Internet of Things”

- Edition „2020“: Extended with
  - New: OPC History
  - Updated: UA Technology article like PubSub integrated into OPC UA
  - New: FLC (2 pages)
  - New: Collaborations (released once)

  - https://opcfoundation.org/resources/brochures/

English

Updated

German

To be translated

Japan

To be translated

China

To be translated

Korea

To be translated

OPC UA Videos

- Landing page https://opcfoundation.org/resources/multimedia/
  - OPC UA Vision, Thomas Burke https://youtu.be/7mUmfq0M29U
  - Learn about OPC UA technology – video series by Uwe Steinkrauss
    - 1: "OPC UA Concepts" (06-2019), 9:30 min - https://youtu.be/E2XJfmAEdqw
    - 2: "OPC UA Transport" (06-2019), 17min - https://youtu.be/VCQnLIy0cDY
    - 3: "OPC UA Security" (06-2019), 11min - https://youtu.be/z4zNgNdauLY
    - 4: "OPC UA Profiles" (06-2019), 8min - https://youtu.be/CCvlLASACjE
    - 5: "OPC UA Discovery" (06-2019), 6min - https://youtu.be/1NlbUAlOdcA
  - Learn about certification - video by Alexander Allmendinger - https://youtu.be/LoYLqvRIyYk
  - OPC UA Security, Darek Kominek https://youtu.be/NFQfZeU90Kw

OPC UA Videos

- Collaboration

VDMA Overview	VDMA Overview 3min, https://youtu.be/5roRSuNlEF0 VDMA Overview in detail 9min https://youtu.be/LhOlC7GNcmI
VDMA Plastics and rubber machinery	VDMA Plastics and rubber machinery - 6min https://youtu.be/jSvSRjFX_RI VDMA EuroMAP 12min, https://youtu.be/wwAl2D_fyMw
VDMA Machine Vision	VDMA Machine Vision Overview - 4min, https://youtu.be/BUywlZ1oong VDMA Machine Vision Overview in details - 12min, https://youtu.be/zK8yhyugGNI
VDMA Robotics	VDMA Robotics - Overview - 2min, https://youtu.be/-xgFKg1hXTg VDMA Robotics - Overview in details - 8min, https://youtu.be/ZdLVFI_1S54

OPC Foundation: The United Nations for Industrial Automation

Thank you! - Questions?

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Looking for more information?
https://opcfoundation.org/