



8. Innovation-Workshop - Online-Sessions (IWOS) 2020

OPC UA over TSN in der Theorie

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- Einführung
- Informationsmodellierung und OPC UA Companion Specifications
- Neue Anwendungen
- Neue Features
- Zusammenfassung

Alle bedeutenden Branchenführer sind Teil der Initiative OPC UA over TSN

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Pressekonferenz der OPC Foundation @ SPS IPC Drives 2018



> 85% Globaler Marktanteil



OPC Unified Architecture
The Industrial Interoperability Standard

ABB

BECKHOFF

rexroth
A Bosch Company



CISCO



MITSUBISHI
ELECTRIC

molex

MOXA

OMRON

PHENIX
CONTACT

PILZ
THE SPIRIT OF SAFETY

HIRSCHMANN
A BELDEN BRAND



kalycito
creating a difference

KUKA

Rockwell
Automation

Schneider
Electric

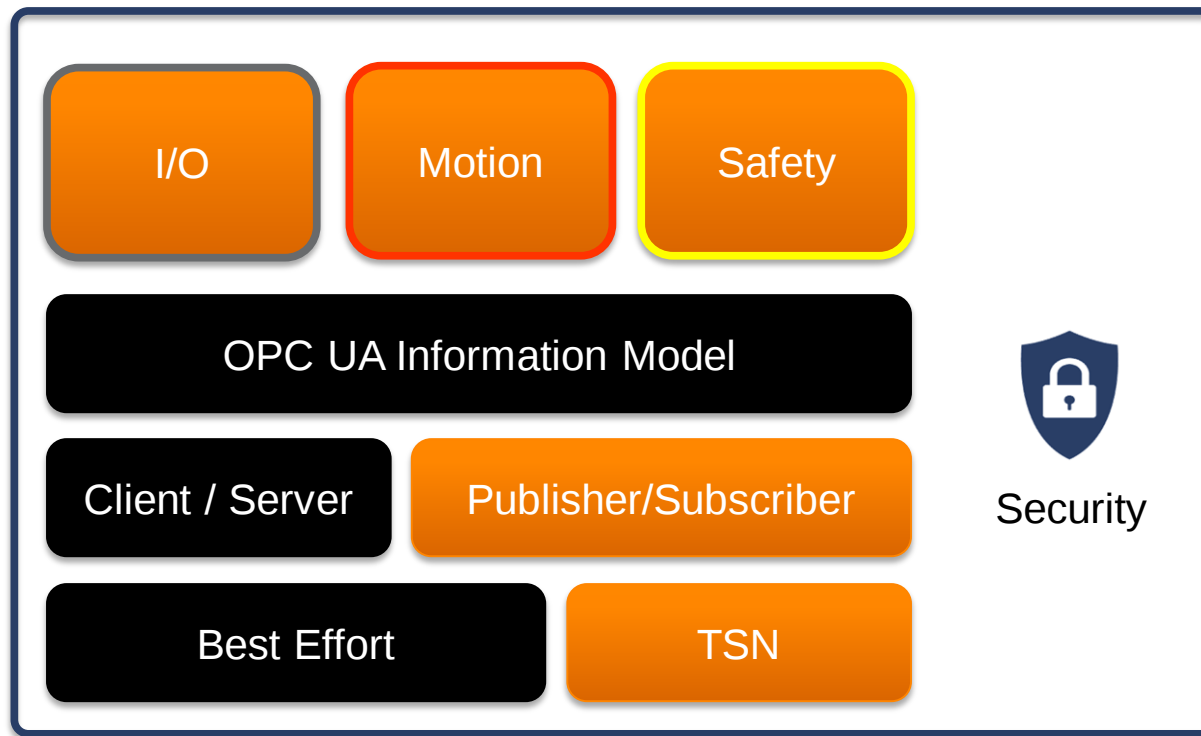
SIEMENS
Ingenuity for Life

TTTech
Ensuring Reliable Networks

WAGO



YOKOGAWA



 Neue Spezifikationen

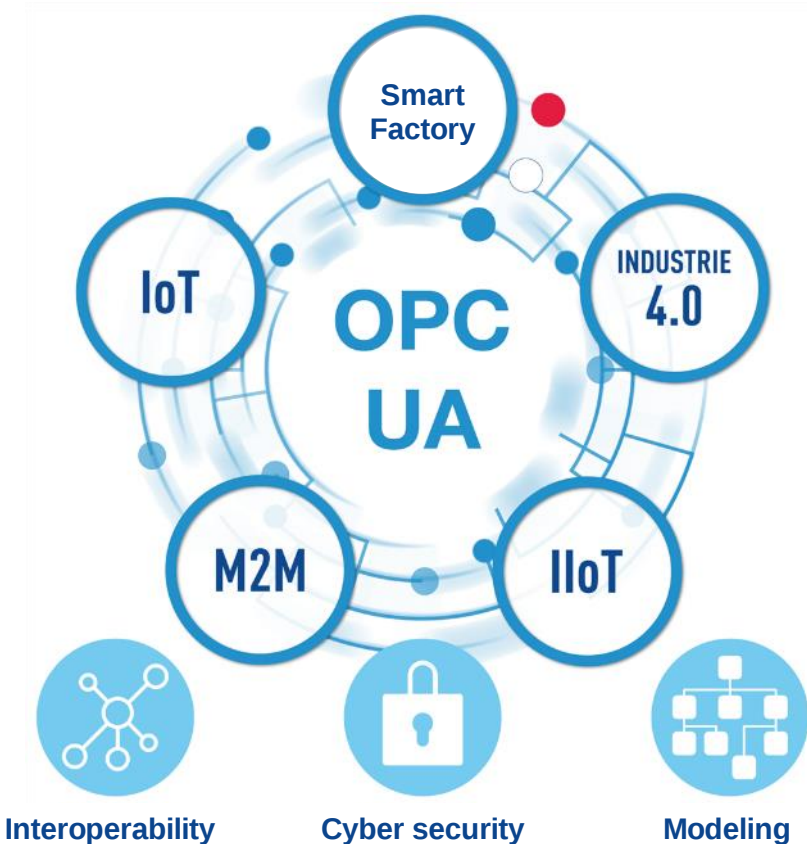
 Standard



OPC UA

**The standard for industrial
interoperability**

Three pillars of OPC UA (IEC 62541)



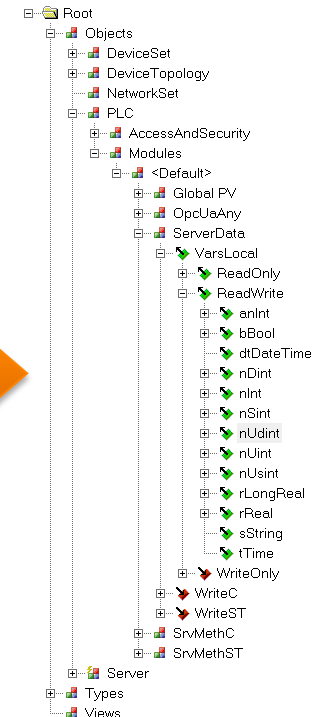
1. Interoperability
2. Cyber security
3. Modeling

OPC UA ist Voraussetzung für Industrie 4.0 !



2.	Industrie 4.0 communication	Transfer of product data and data files for interpretation or simulation, for example; product data in standardised form 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) 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

<https://www.zvei.org/en/press-media/publications/industrie-40-product-criteria-for-industrie-40-technologies/>

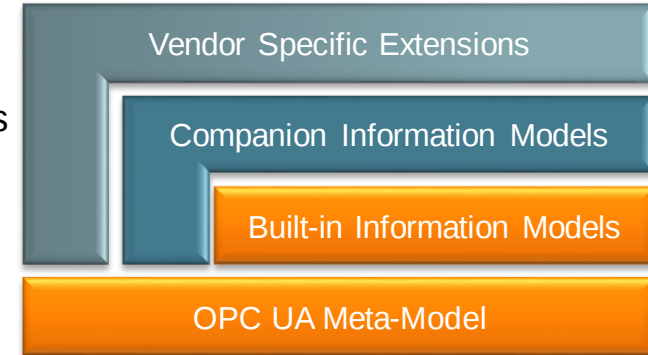




Object-oriented, flexible and scalable concept

In OPC UA a **device or machine** provides **semantic information** about itself, which properties, variables, process values and capabilities it has.

OPC UA thus meets the requirements of a standardized, **Service Oriented Architecture, SOA**



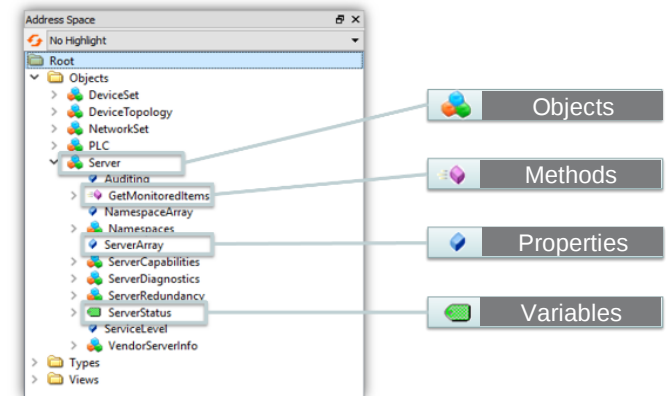
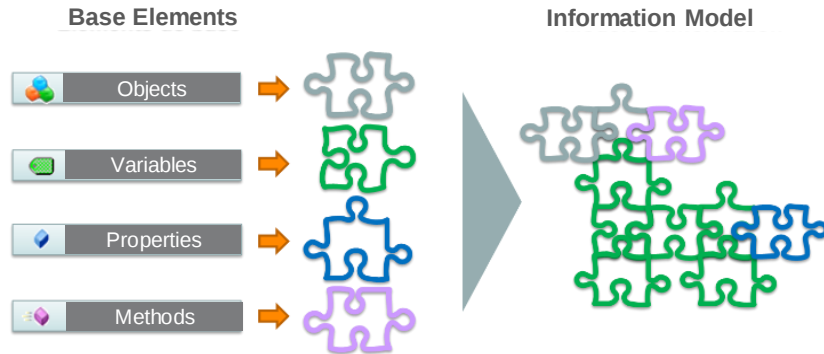
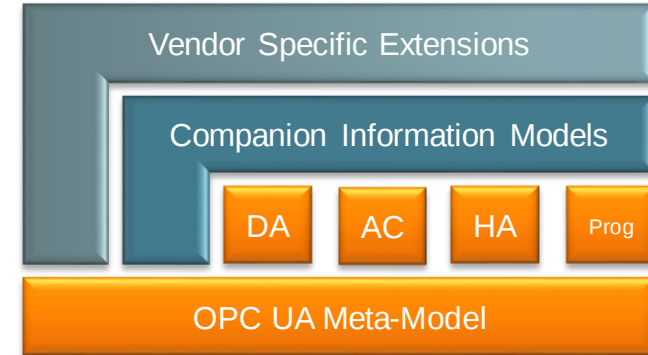
OPC UA basic models



Object-oriented, flexible and scalable concept

- **OPC UA Meta-Model** provides base services. It is the foundation of all OPC UA information models.
- **Built-in Information Models** define the basic information model and the information models related to the different types of access

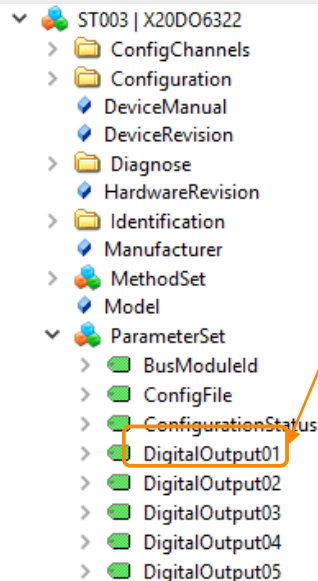
DA=Data Access, AC=Alarms and Conditions , HA=Historic Access, Prog=Programs





Node Description

- Provides detailed information for each OPC UA node
- Included semantics:
 - Description
 - DataType
 - Timestamp
 - UserAccessLevel
 - Samplingintervall

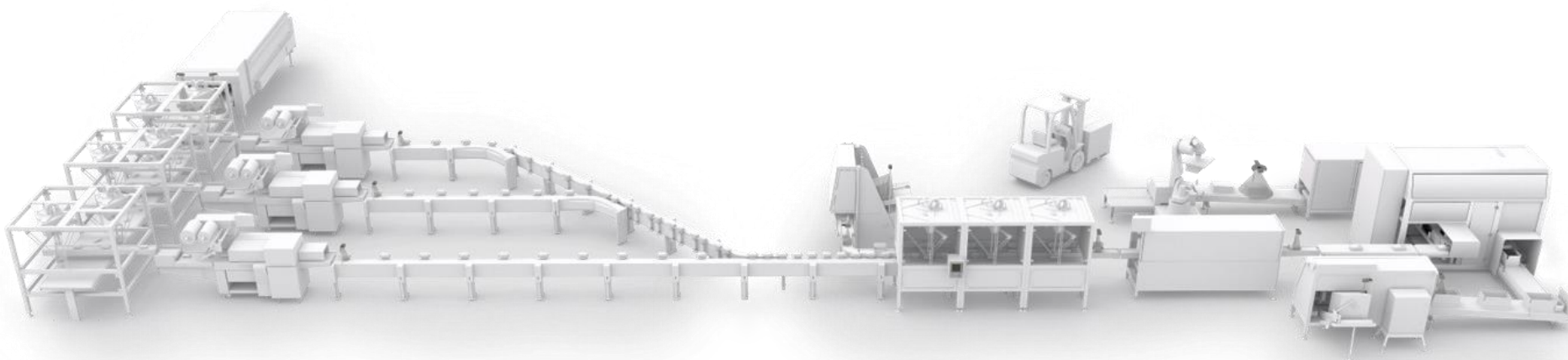
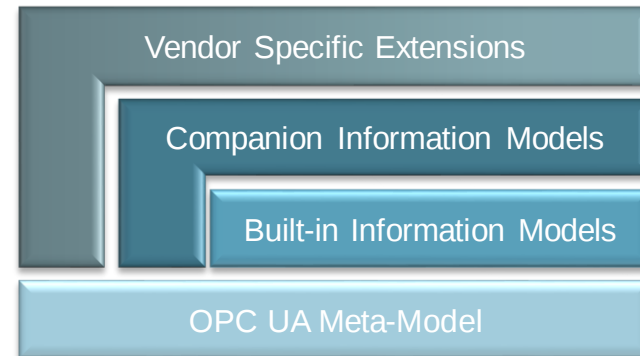


Vendor Specific Extensions	
Companion Information Models	
Built-in Information Models	
OPC UA Meta-Model	
SourceTimestamp	03.01.2017 02:50:31.031
SourcePicoSeconds	0
ServerTimestamp	03.01.2017 02:50:31.031
ServerPicoSeconds	0
StatusCode	Good (0x00000000)
Value	false
DataType	Boolean
NamespaceIndex	0
IdentifierType	Numeric
Identifier	1 [Boolean]
ValueRank	-1
ArrayDimensions	Null
AccessLevel	CurrentRead, CurrentWrite
UserAccessLevel	CurrentRead, CurrentWrite
MinimumSamplingInterval	10
Historizing	false



Industrial interoperability via standardized exchange

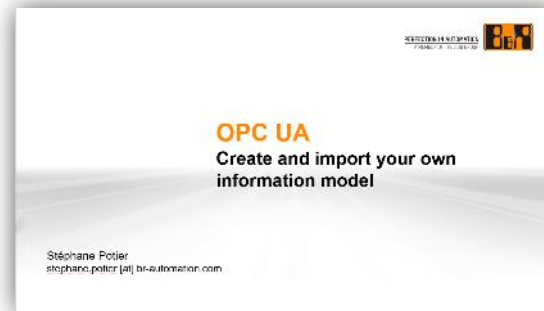
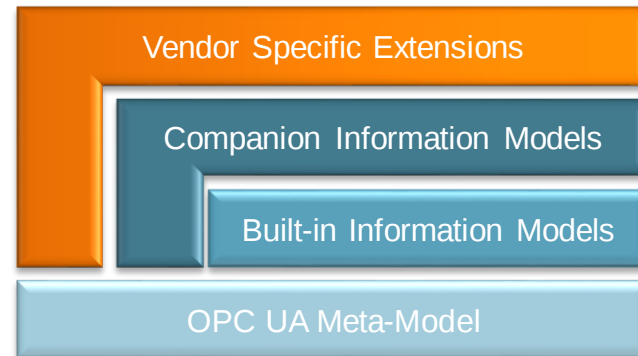
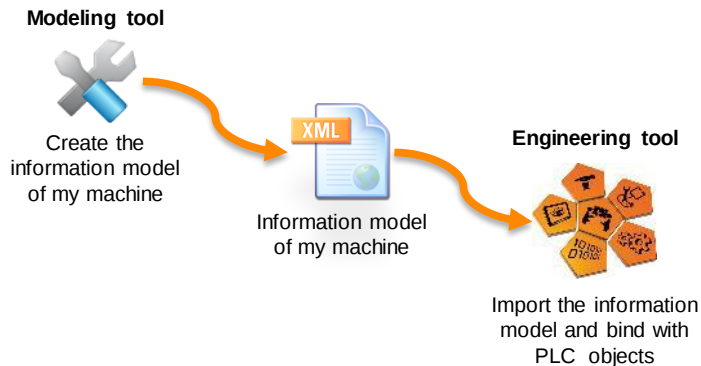
Information Models





Personalized information models

- Suppliers and users can create their **own information model**
- Once created, the specific model is **imported into the engineering tool** and the objects defined in the model are linked to the objects of the PLC (variables, methods, etc.)



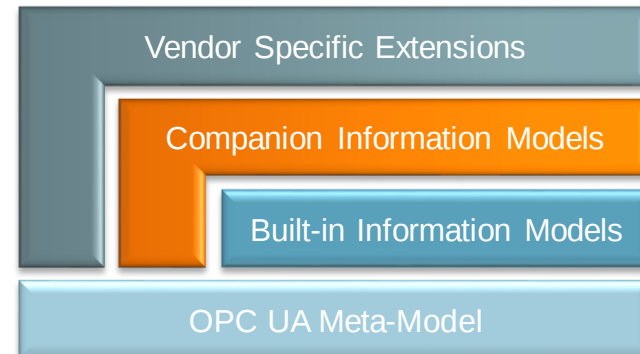
Companion specifications



Information models for business functions

The OPC Foundation collaborates with the main international standardization organizations

These collaborations make it possible to define **standardized exchanges** within the framework of **specific business functions** known as "Companion Specification"



"Why We Need VDMA OPC UA Companion Specification!" - VDMA Video: <https://www.youtube.com/watch?v=odDQ83bzoWE>



Companion specification implementation

Comparison of two different approaches



Approach comparison

Generic:

1. Download companion specification
e.g.: from OPC Foundation website
2. Create your machine specific information model
Using third party modeler e.g. UaModeler
3. Import information model to Automation Studio
OPC UA server
4. Define type definitions, variables, methods and events
5. Connect variables, methods and events to machine application
6. Map variables and methods to OPC UA server

B&R templates/samples:

1. Open B&R sample in Automation Studio
e.g.: C:\BrAutomation\AS47\Samples
2. Adapt B&R standard information model
Setting 'isPresent' data points to TRUE or FALSE
3. Connect variables, methods and events to machine application

B&R templates

- Faster implementation of companion specifications
- Adaptable, no modeler needed
- Tested code
- Support



Status

Industry	CS family	OPCF numbering	Status of CS ¹	B&R system availability	B&R templates availability ²
Plastics and rubber	Euromap	OPC 400XX	Release candidate 1.2	AS 4.7	AS 4.7++
Packaging	PackML	OPC 30050	Release 1.0.1	AS 4.7	On request
Machine tool	Umati (CNC)	OPC 40502	Release 1.0.0	AS 4.9	On request
Robotics	VDMA OPC Robotics	OPC 40010-1	Release 1.0.0	Evaluation	On request

XXXX	XXXX	OPC xxxx
....	yyyy	OPC yyyy

Continous extension

- Common CSs will be automatically added
- Specific CS per request
- Tested functionality

PackML

EUROMAP
European Plastics and Rubber Machinery

umati

VDMA
Robotics + Automation



¹ According to <https://www.euromap.org/en/40/overview-opcua-plastics/> on 03.Mar.2020

² AS x.x ... Automation Studio minimum version, SP ... Service pack, On request for AS x.x ... Sample will be created upon customer request for specified Automation Studio minimum version



Alarms & Conditions

Standardized alarm handling – configured via mappAlarmX



File-Transfer

Standardized file transfer via OPC UA information model



Method handling

Standardized implementation and calls of machine functionality



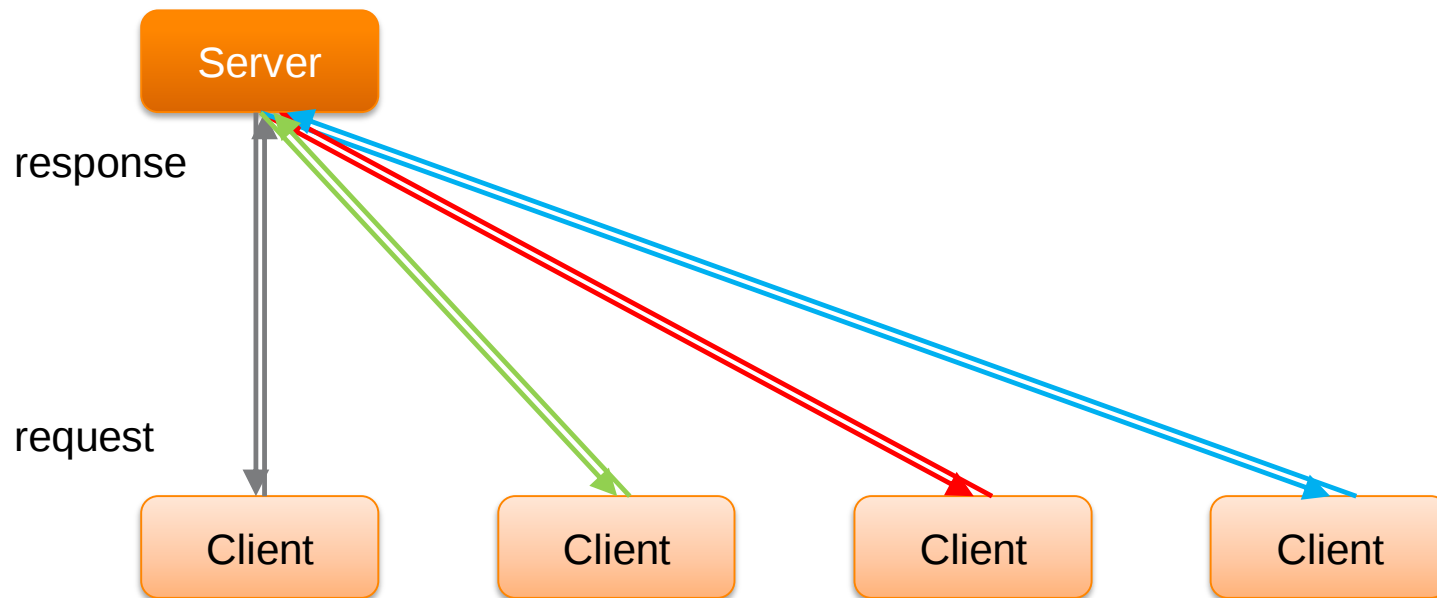


Different types of communication

Client-Server vs. Publisher-Subscriber

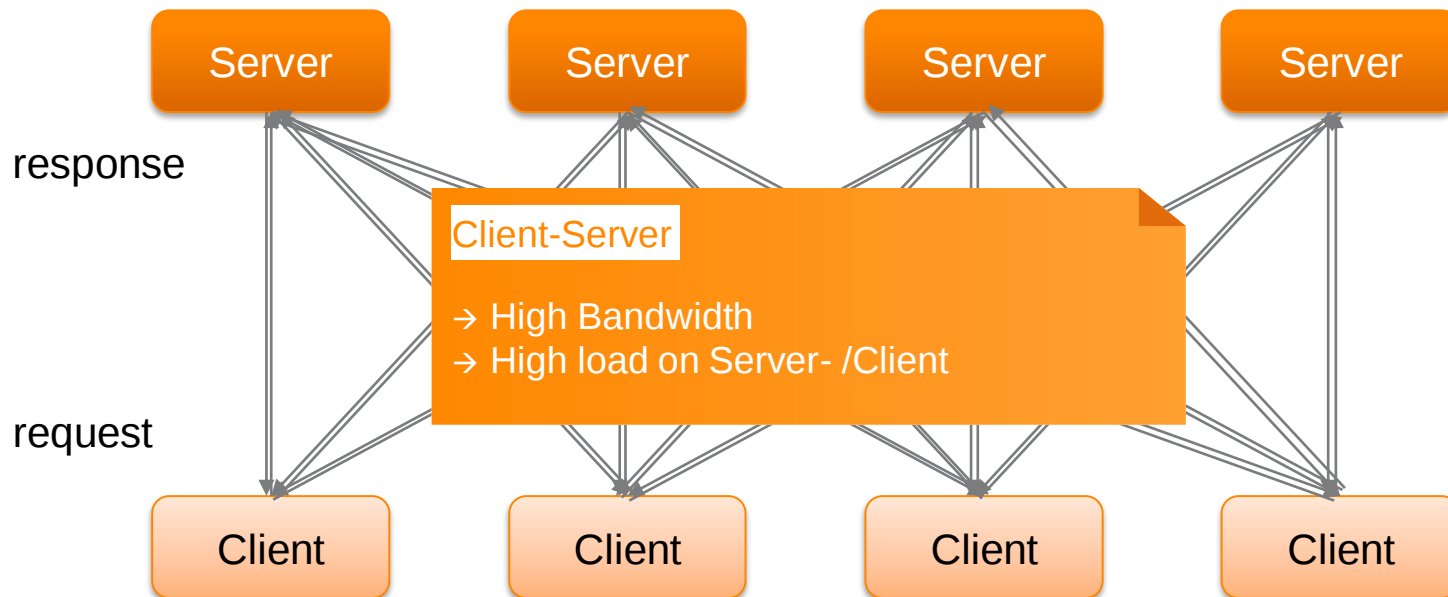


Client/Server vs. Pub/Sub



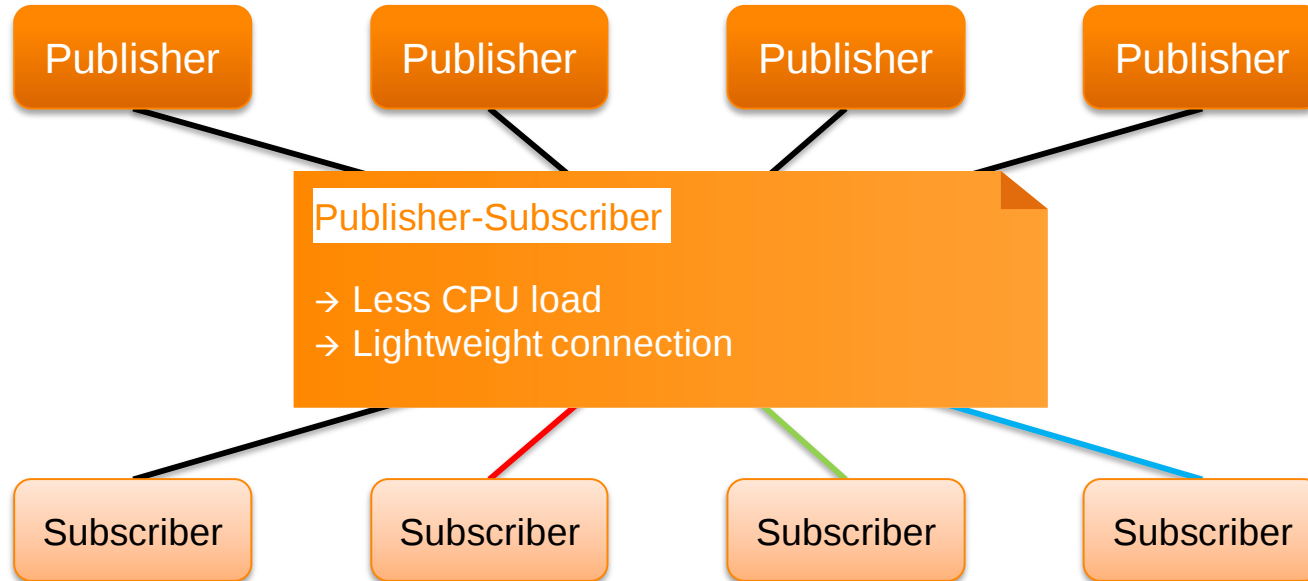


Client/Server vs. Pub/Sub



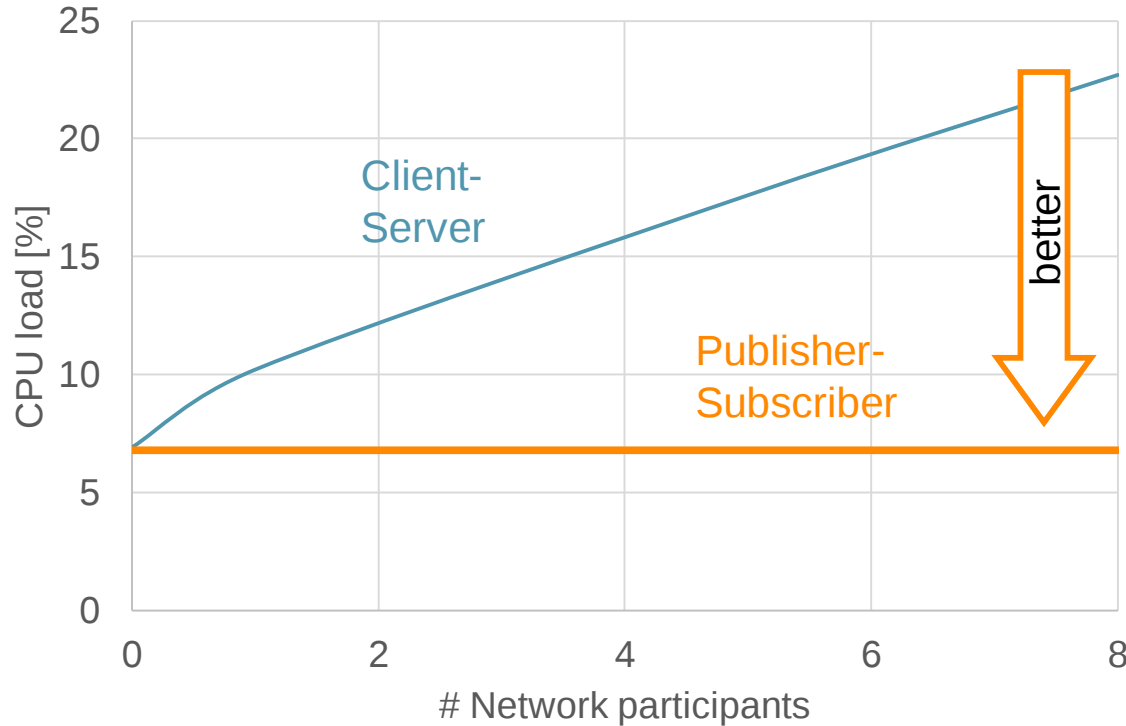


Client/Server vs. Pub/Sub





Client-Server vs. Publisher-Subscriber mechanism



Publisher-Subscriber

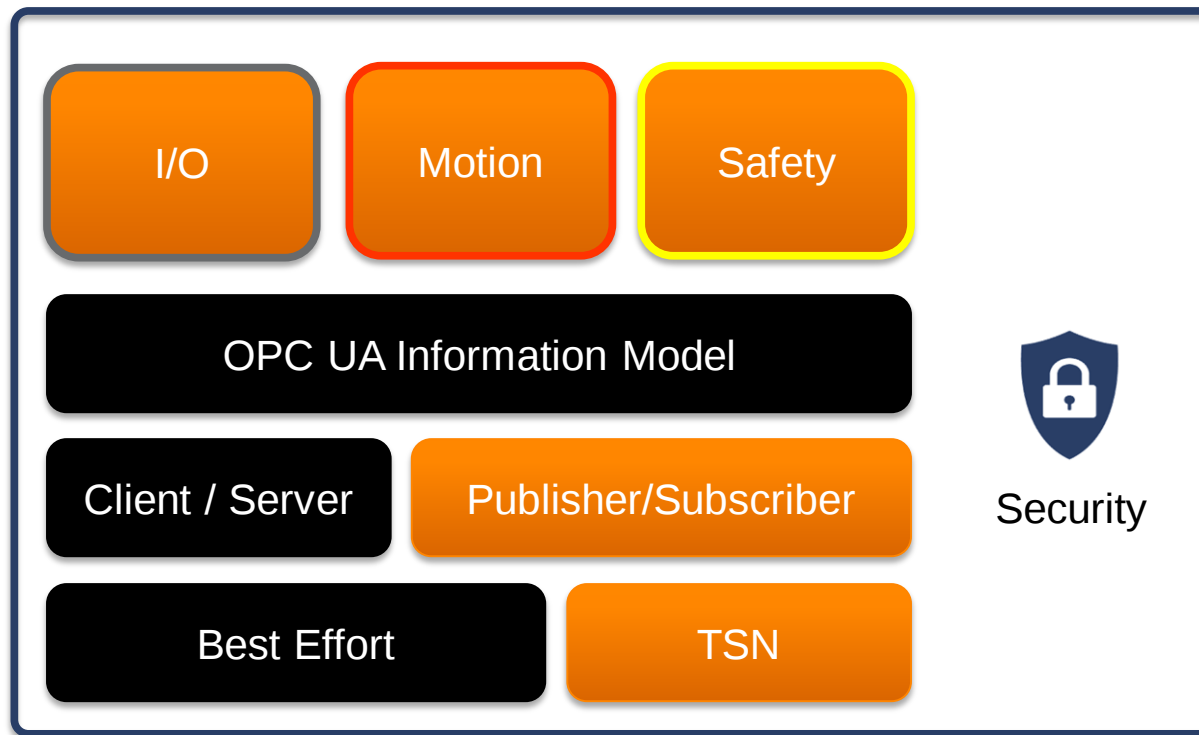
- Less CPU load
- Lightweight connection





TSN

**The standard for deterministic and
real-time industrial communication**



-  Neue Spezifikationen
-  Standard



OPC UA over TSN

OPC UA over TSN erweitert die Vorteile von OPC UA für die Feldebene !

- Determinismus ist auf der Feldebene für notwendig für Steuerungen, I/O, Antriebsregelung, etc.
- TSN ist die Evolution von dem Ethernet-Standard
- Damit ist Ethernet nun deterministisch

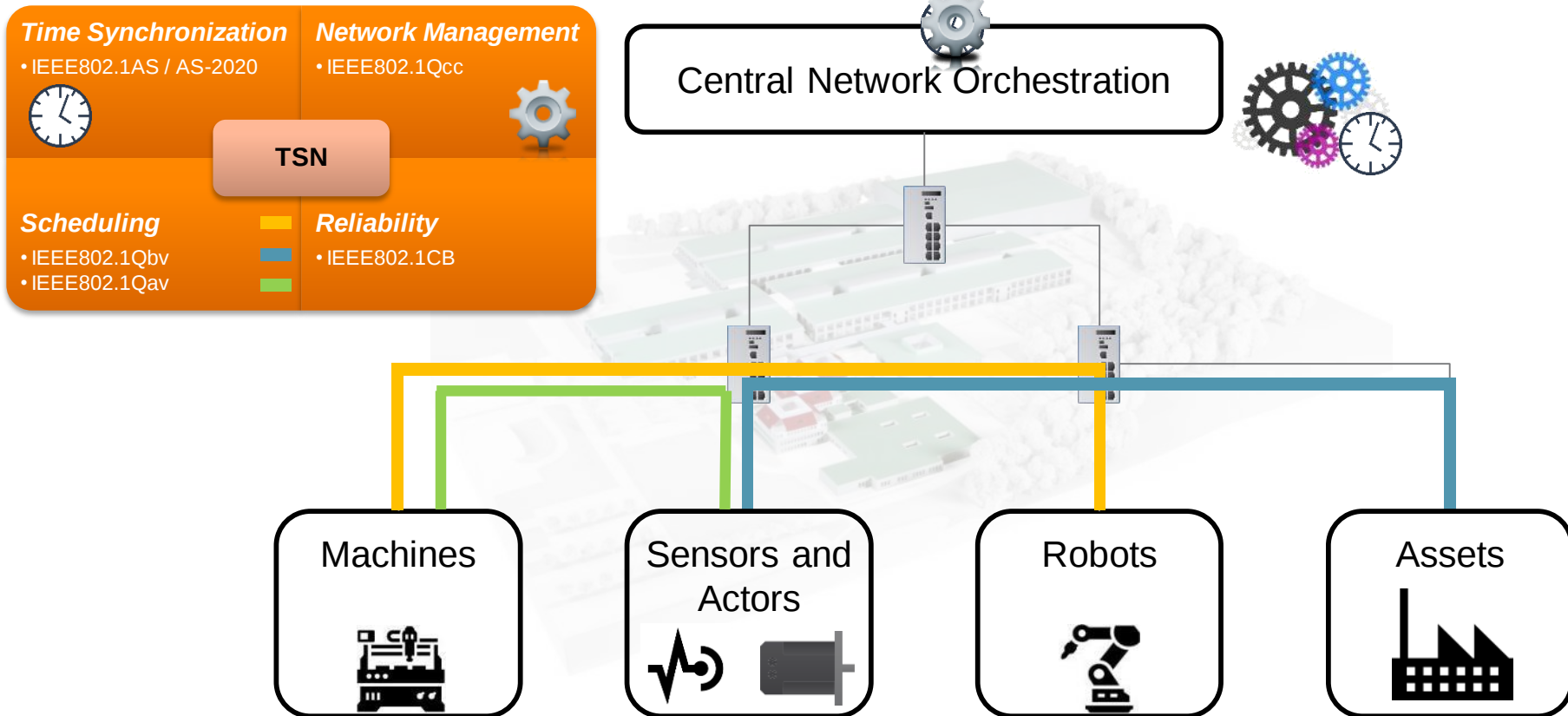
(TSN basiert auf international anerkannten IEEE Standards und keiner proprietären Lösung)



Time Sensitive Networking (TSN)



IEEE 802.1 Standards





IEEE 802.1AS

- IEEE Standard for Local and Metropolitan Area Networks – Timing and Synchronization for Time-Sensitive Applications in Bridged Local Area Networks
- IEEE1588-2008 = PTP(v2)



- Profile: **IEEE 802.1AS-2020 = gPTP = 802.1AS = „1AS“**



- Direct Access to process data from devices and machines
 - Condition Monitoring
 - Predictive Maintenance
 - Process Optimization
- Connecting machines via Companion Standards
 - OEM: Less time for engineering
 - End User: Less time for deployment, maintenance
- Controller to Controller Synchronization
 - Coupling of machines or machine modules
 - e.g. bending machine coupled with robot





Testimonials from members of the OPC Foundation

Volkswagen joins the OPC Foundation

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Volkswagen, and other end users such as LG CNS, Samsung and Miele, have adopted OPC UA to implement Industry4.0 and IIoT in their factories.

“With OPC UA at the heart of Industrie4.0, adopting the OPC UA technology and using it to its full potential in our factories is a natural progression. Being a member of the OPC Foundation guarantees early information to upcoming key technologies like the OPC UA Companion specifications which provide secured and standardized information and interfaces for assets.”

Michael Schweiger - Volkswagen



Foxconn becomes the 699th member of the Foundation

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The OPC Foundation welcomes Foxconn Industrial Internet as the 699th OPC Foundation member

11/26/2019

Foxconn Industrial Internet, a leading intelligent manufacturing solution provider standardizes on OPC UA to harness the power of the Industrial IoT.

Scottsdale, AZ – November 26th, 2019 – The OPC Foundation proudly welcomes Foxconn Industrial Internet (Fii) the six hundred and ninety ninth (699th) OPC Foundation member. As one of the world's leading intelligent manufacturing solution providers, Fii uses its industrial internet platform, and a host of edge products and services to do everything from running eight lights-out factories to managing over two hundred thousand machines and robots. Starting with its Robot MicroCloud, Fii adopted OPC UA to best access and utilize the rich contextual data those systems possess.

Fii is present in over 11 countries across four continents where it supplies intelligent manufacturing equipment and solutions centered on the industrial Internet platform. In a bid to lead the way to smart manufacturing Fii offers intelligent solutions based on its core technologies such as smart sensors, Fii Cloud, MicroCloud and Fog AI – an exclusive edge computing server. Uniting customers, suppliers, and partners in vertical markets, Fii is building a technology enabling ecosystem that leverages OPC UA and long-standing Fii resources in advanced technology such as industrial big data and industrial AI.

Mr. Cheng concluded "Fii has a strong track record of successfully contributing to and innovating OPC UA adoption use cases. For example, our industrial robots have built-in OPC UA server that provides real-time status and diagnostic/prognostic information to the Robot MicroCloud for intelligent operation management. The rich information content of each robot is organized using OPC UA's information model, facilitating data retrieval at different system/subsystem/module levels. Fii has developed a holistic communication infrastructure between industrial equipment and sensors to the cloud, and time-sensitive feedback control from the cloud back to equipment. We anticipate that OPC UA over TSN with 5G NR will prove to be a game changer in the field of smart factories."

Fii CAA Steve Chiu and Chia Day commented: "At the edge layer of an intelligent factory, data is collected from and commands are sent to machines built by a multitude of different suppliers. It becomes increasingly important to standardize the way data is communicated. OPC UA provides such a way so that various equipment and machine type can be integrated quickly and reliably. It takes some initial effort to try-out and to adjust to a new technology. Once a standard like OPC UA is adopted, everyone will benefit from it."





OPC UA over TSN löst heutige und zukünftige industrielle Herausforderungen

Dank Standardisierung auf OPC UA: Leichtere und schnellere Integration von Maschinen und Geräten sowie sicherer Zugriff auf die Daten

Roadmap:

Feature	B&R system availability
Information modeling	From AS 4.7 (released)
Companion specifications	From AS 4.7 (released)
Alarms and Conditions	AS 4.9 (December 2020)
File Transfer	AS 4.9 (December 2020)
Method handling	AS 4.9 (December 2020)
Publisher-Subscriber	AS 4.9 (December 2020)
Time Synchronization (gPTP / IEEE 802.1AS)	AS 4.11 (December 2021)



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