WS10 – Enabling robust, converged networks for Industry 4.0

OPC UA PubSub and its integration into TSN networks

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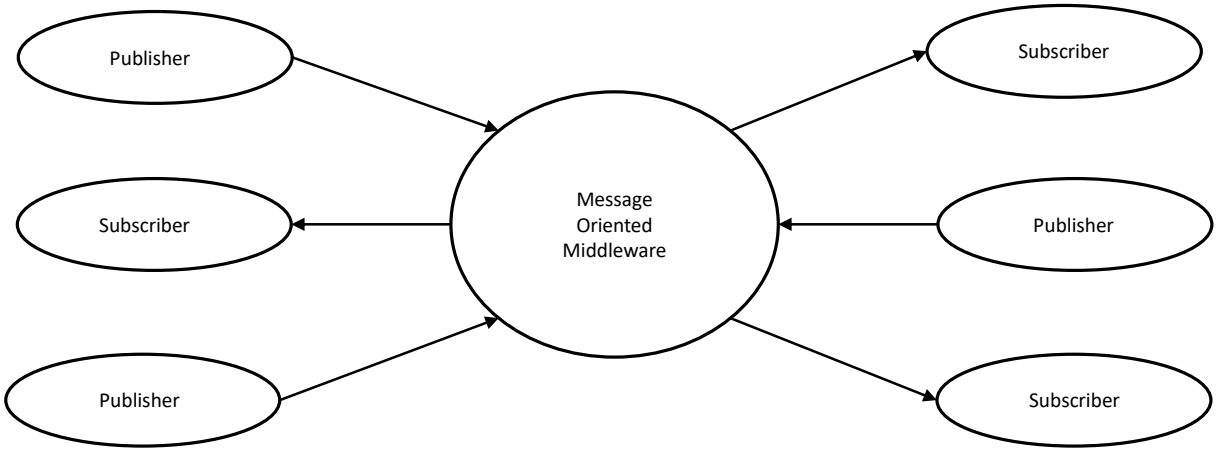
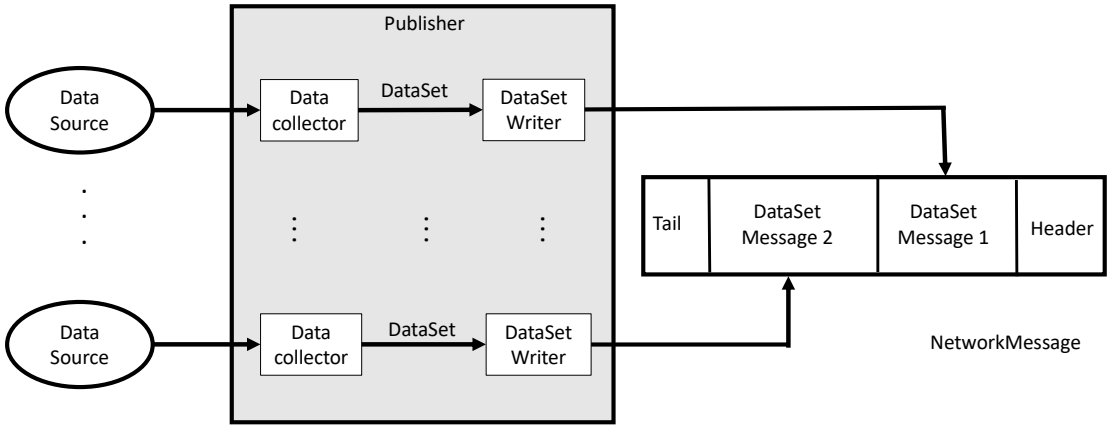
OPC UA

- Obsoletes and combines old OPC specifications
- Flexible information model and platform independency
- Security
- Client/Server and PubSub
- PubSub as suitable model for real time requirements

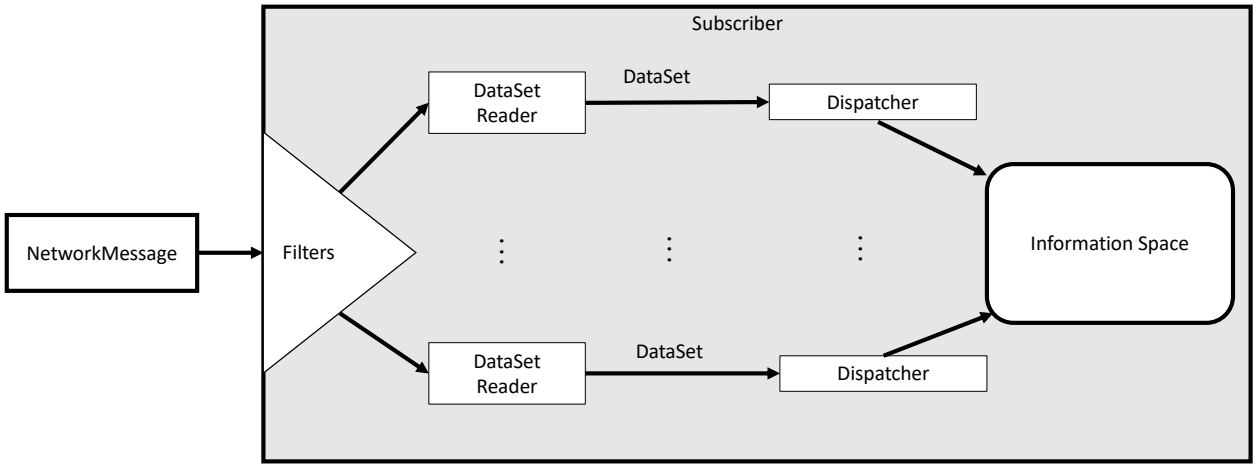
The (simplified) PubSub Model according to OPC UA Part 14



Publisher



Subscriber



Message Oriented Middleware

Broker-Based Middleware

- A broker is responsible for message forwarding
- Scalable applications for end devices

Broker-Less Middleware

- Typical network device is responsible for message forwarding
- Enables fast message transmission

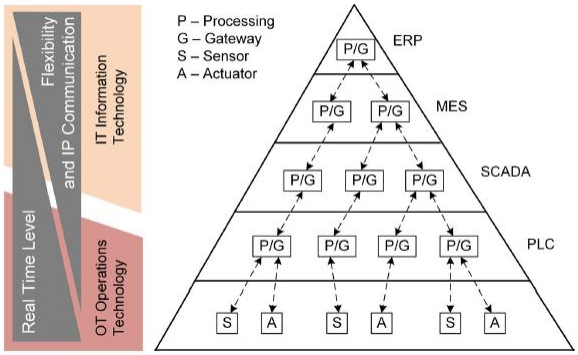
Transport Protocol Mappings

- MQTT
- AMQP
- OPC UA UDP
- Ethernet

OPC UA over TSN

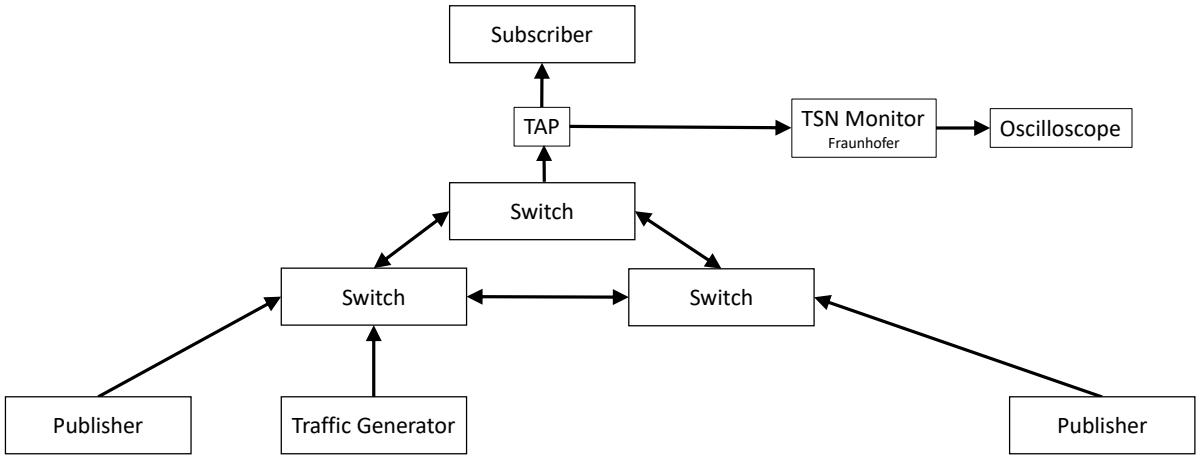
- TSN mechanisms to extend standard Ethernet with real-time capabilities
- OPC UA as a common interface on a vertical level on the automation pyramid
- OPC UA as an interface to higher horizontal levels of the automation pyramid

IT and OT Systems



Source: Bruckner, D., Stănică, M. P., Blair, R., Schriegel, S., Kehrer, S., Seewald, M., & Sauter, T. (2019). An introduction to OPC UA TSN for industrial communication systems. *Proceedings of the IEEE*, *107*(6), 1121-1131.

A Reference System for CINI4.0



Overview of available TSN-capable devices

Vendor	Model	Supported TSN Features		
		AS	Qbv	Qbu
Belden/Hirschmann	BOBCAT Series	x	x	-
Relyum	RELY-TSN-BRIDGE	x	x	x
NXP	Layerscape LS1028A	x	x	x
CISCO	IE 4000 Series	x	x	-
Phoenix Contact	FL Switch TSN 2316	x	x	x
TTTech	TSN Starter-Kit incl. B&R 0ACST052.1	x	x	x
InnoRoute	RaspberryPi RT-Hat	x	x	-

Current version of the reference system

Implementation OPC UA over TSN

- Usage of OPC UA PubSub
- Implementation of open62541
  - Open source
  - C-Implementation
  - Widely applied
  - Active community
- Usage of RELY-TSN-Bridge
  - More to come
- Usage of Prototype from Hilscher
  - OPC UA Publisher
  - Time Synchronized

To be implemented in future

- OPC UA Client/Server
- Different Transport protocols
- Security
- Configuration
- Integration of SPE

Summary

- Various possibilities to implement the specified OPC UA PubSub model
- OPC UA PubSub over TSN
- A Reference System for CINI4.0
- Limited number of devices available
- Current version of the network
- Outlook

References

- OPC Foundation, OPC UA Specification: Part 1 - Overview and Concepts. November 22, 2017. Version 1.04
- OPC Foundation, OPC UA Specification: Part 14 - PubSub. February 06, 2018. Version 1.04
- Open Source OCP UA Implementation: open62541, Online: https://open62541.org/
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- Konradi, O.; Schoppmeier, M.; Wisniewski, L.; Jasperneite J.: Practical investigation of an industrial converged network based on OPC UA PubSub and TSN. KommA 2022 – Jahreskolloquium Kommunikation in der Automation, 2022,
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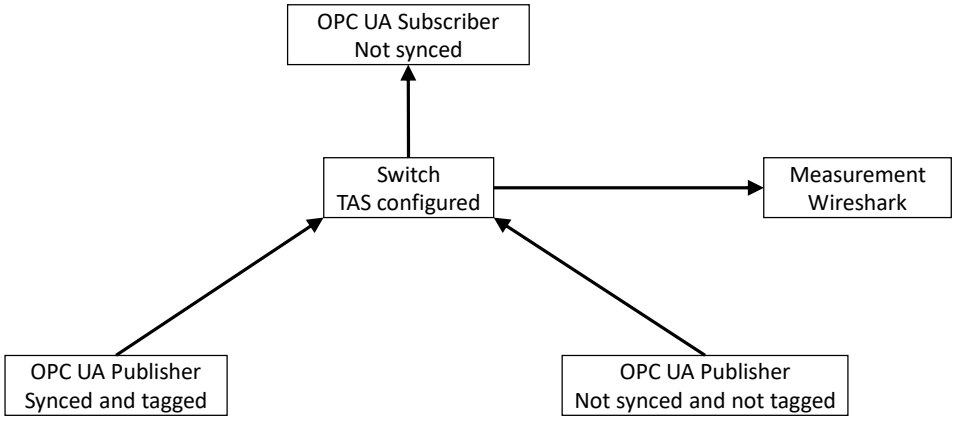
Discussion and demonstration