OPC Day Finland 2018

OPC UA Technical Update: PubSub Model and Time Sensitive Networks (TSN)

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OPC Foundation Board of Directors
Editor OPC UA working group
Chairman DI, BACnet and PubSub working group

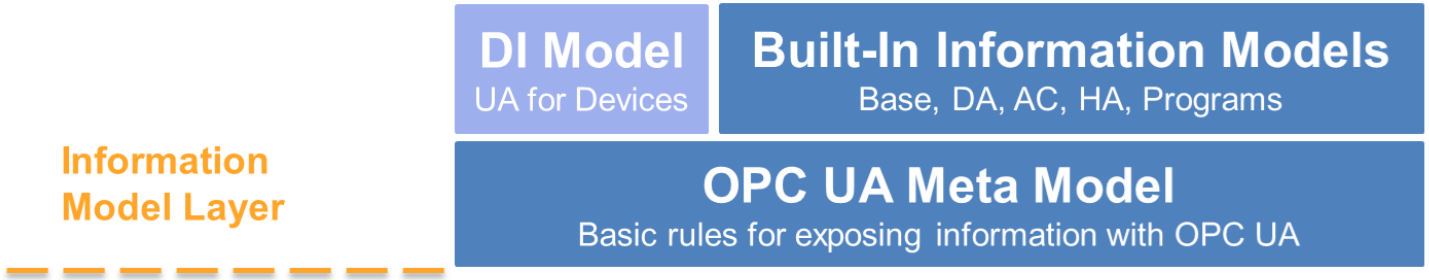
Agenda

- OPC UA Overview and Status Update
- Status OPC UA over TSN
- OPC UA PubSub and TSN Configuration Model
- OPC UA Roadmap

OPC Unified Architecture

OPC Foundation develops and maintains OPC UA as generic and neutral communication architecture with

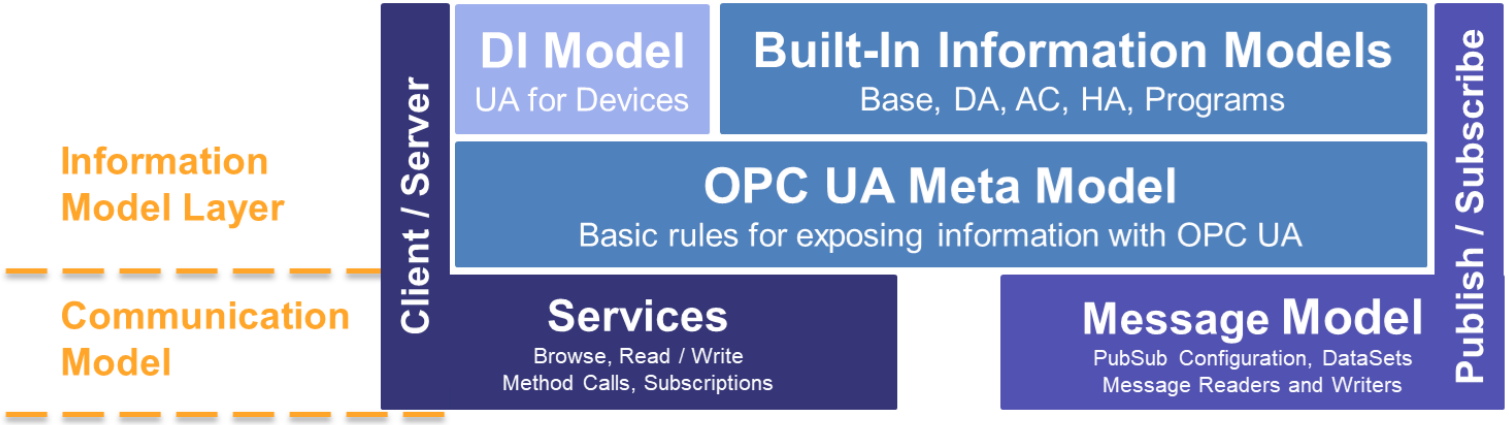
- Information Model Framework



OPC Unified Architecture

OPC Foundation develops and maintains OPC UA as generic and neutral communication architecture with

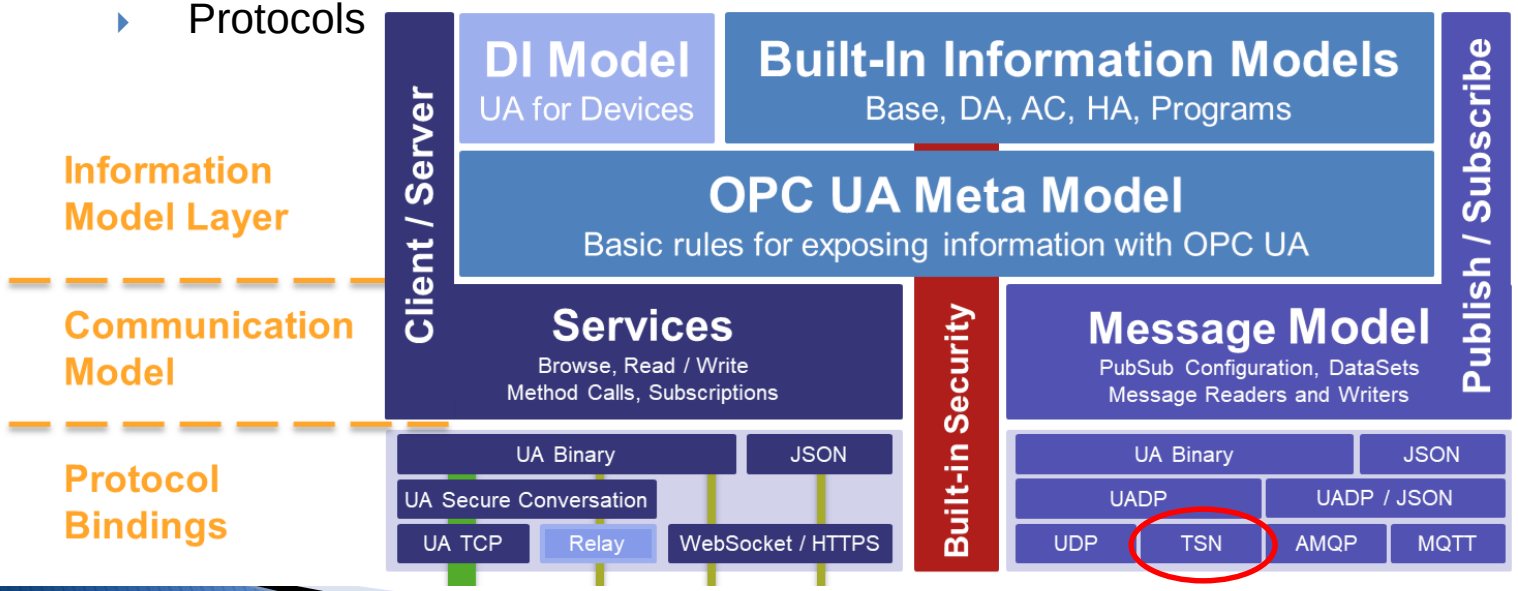
- Information Model Framework
- Communication Models



OPC Unified Architecture

OPC Foundation develops and maintains OPC UA as generic and neutral communication architecture with

- Information Model Framework
- Communication Models
- Protocols



OPC Foundation Collaboration with Partners

Specific Models

Use case specific models

Industry specific models

Device / machine specific models

Vendor Specific Extensions

Companion Information Models

PLCopen, ADI, FDI, FDT, BACnet, MDIS, ISA95, AutomationML, MTConnect, AutoID, VDW, EUROMAP, Robotics, Vision Systems IEC 61850/61400, Sercos, Powerlink, PROFInet and more coming

Developed with partner organizations

Information Model Layer

Communication Model

Protocol Bindings

Client / Server

DI Model
UA for Devices

Built-In Information Models
Base, DA, AC, HA, Programs

OPC UA Meta Model
Basic rules for exposing information with OPC UA

Services
Browse, Read / Write
Method Calls, Subscriptions

Message Model
PubSub Configuration, DataSets
Message Readers and Writers

Publish / Subscribe

Built-in Security

UA Binary | JSON

UA Secure Conversation

UA TCP | Relay | WebSocket / HTTPS

UA Binary | JSON

UADP | UADP / JSON

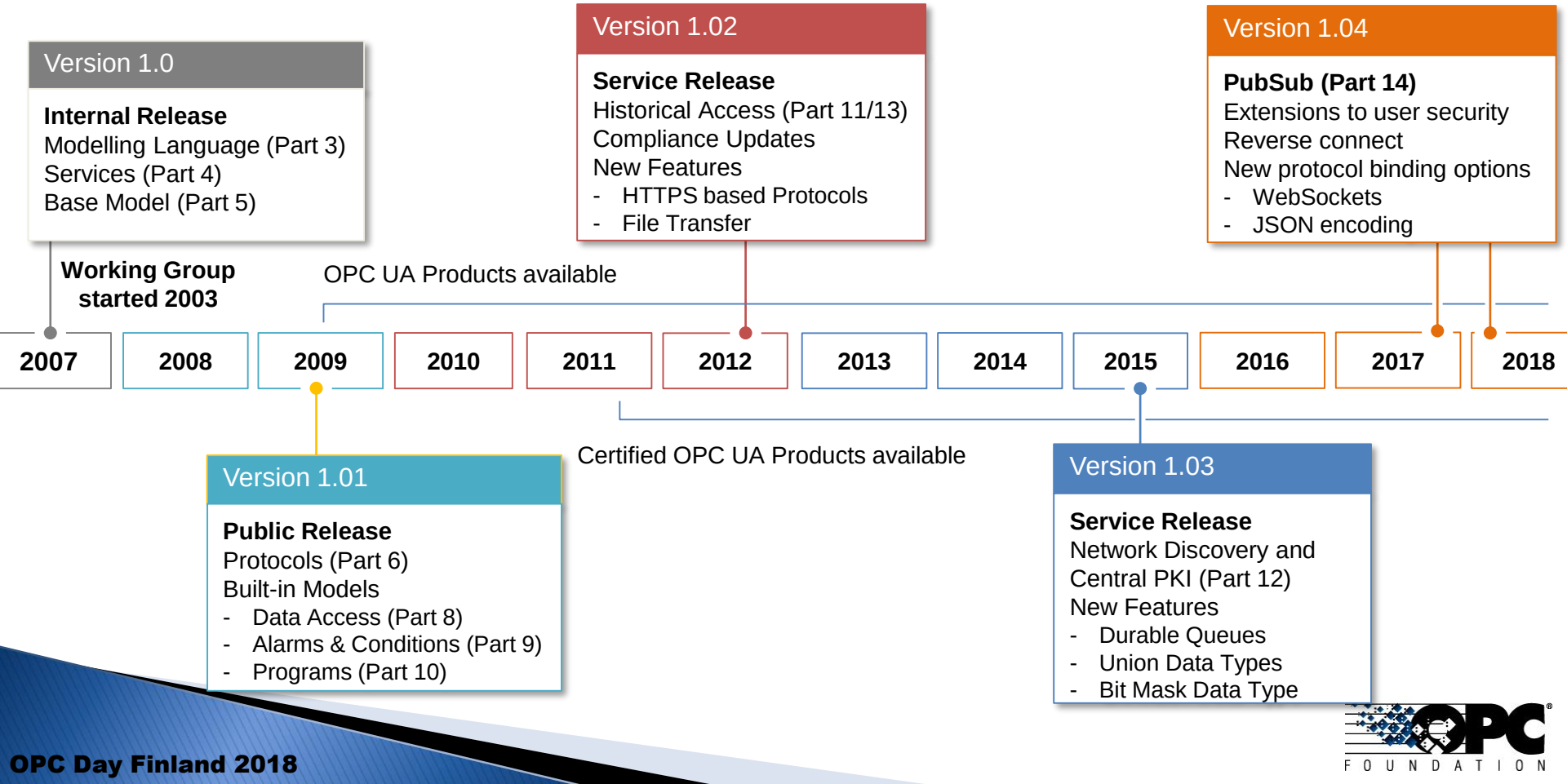
UDP | TSN | AMQP | MQTT

OPC Foundation Responsibility

OPC UA = IEC 62541

OPC FOUNDATION

OPC UA Working Group Releases



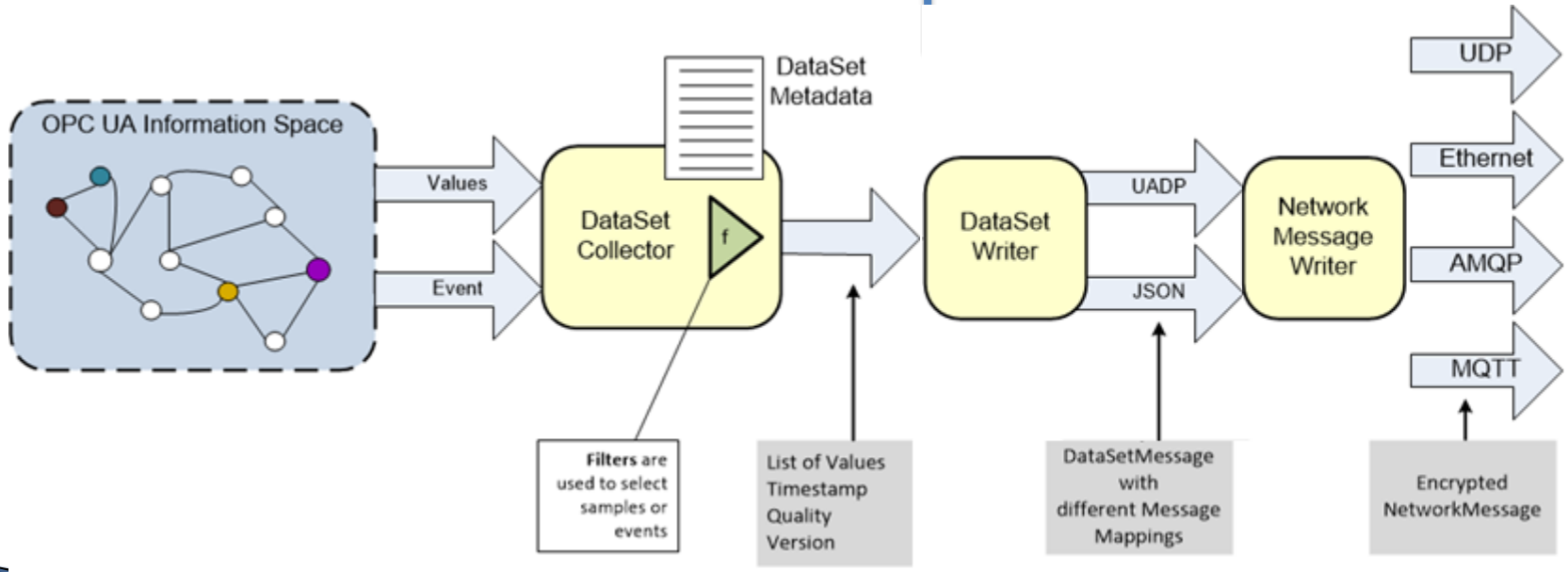
OPC UA 1.04 Features

- **1.04 Release between 10/2017 and 3/2018**
- **Compliance and Security clarifications**
- **New Specification Parts**
  - Part 14 – PubSub
- **Changes**
  - SecurityPolicies
    - Deprecated Basic128RSA15 and Basic256
    - New Aes128-Sha256-RsaOaep
    - New Aes256-Sha256-RsaPss
  - Structure DataType information
    - Moved legacy Type Dictionary to Part 5
    - Adds new DataTypeDefintion Attribute on DataType Nodes in Part 3
- **New Features**
  - Client / Server transport mappings (Part 6)
    - Adds Websockets as Transport Protocol
    - Adds JSON as Encoding
    - Adds reverse connect to Transport Protocol
- **New Features**
  - Session-less Services calls (Part 4)
  - User Authorization and Authentication
    - Affects Part 3, 4, 5 and 5
    - Adds new issued user token JWT (JSON Web Token)
    - Adds OAuth2 as single sign on protocol
    - Adds Role management and User to Role mapping
    - Adds permission masks for Nodes
    - Adds Attributes RolePermissions, AccessRestrictions and UserRolePermissions
  - Support for IEC 62682 / ISA18.2 alarm standards in Part 9
  - Extents File Transfer Annex in Part 5
    - Adds TemporaryFileTransferType
  - New network services in Part 12
    - Authorization Services – get JWT user token for single sign on through OPC UA Method calls
    - Credential Management Services
  - New Decimal DataType

OPC UA 1.04 Features – PubSub with different protocols

Message creation from
OPC UA Information Model

Different
Message Mappings
Transport Protocol Mappings



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- OPC UA Roadmap

Status OPC UA over TSN

OPC UA over TSN Technology Stack and Responsibilities

- Standard Ethernet with TSN extensions **IEEE**
  - Released
    - IEEE 802.1Qbv Enhancements for Scheduled Traffic
    - IEEE 802.1Qbu Frame Preemption
    - IEEE 802.1Qca Path Control and Reservation
    - IEEE 802.1CB Seamless Redundancy
    - IEEE 802.1Qcc Stream Reservation
  - Draft
    - IEEE 802.1AS-REV Time Synchronization (Required)
    - IEEE 802.1Qcp Yang Data Models
    - IEEE 802.1Qcr Asynch Traffic Shaper
    - IEEE 802.1CS Link local registration

Status OPC UA over TSN

OPC UA over TSN Technology Stack and Responsibilities

- Standard Ethernet with TSN extensions (partially released) **IEEE**
- Industrial Profiles and Network Configuration **IEEE / IEC**
  - Industrial Profiles define necessary subsets of TSN standards
  - IEC / IEEE 60802
  - Network wide configuration of bridges and endpoints
    - Centralized Configuration Model
    - Distributed Configuration Model
  - Work in progress

Status OPC UA over TSN

OPC UA over TSN Technology Stack and Responsibilities

- Standard Ethernet with TSN extensions (partially released) **IEEE**
- Industrial Profiles and Network Configuration (in work) **IEEE / IEC**
- OPC UA Part 14 PubSub **OPC Foundation**
  - Released in March 2018
  - Includes UADP Message Mapping with capabilities for fixed, cyclic message layout
  - Includes Ethernet (Layer 2) Transport Protocol Mapping
  - EtherType (B62C) registered for UADP Protocol
  - Data Plane for OPC UA over TSN completely defined

Status OPC UA over TSN

OPC UA over TSN Technology Stack and Responsibilities

- Standard Ethernet with TSN extensions (partially released) **IEEE**
- Industrial Profiles and Network Configuration (in work) **IEEE / IEC**
- OPC UA Part 14 PubSub (released) **OPC Foundation**
- OPC UA Quality of Service Parameters for TSN **OPC Foundation**
  - TSN related OPC UA sub-working group
  - Definition of TSN related configuration parameter representation in OPC UA
  - OPC UA related configuration flows
  - Draft documents available

Status OPC UA over TSN

OPC UA over TSN Technology Stack and Responsibilities

- Standard Ethernet with TSN extensions (partially released) **IEEE**
- Industrial Profiles and Network Configuration (in work) **IEEE / IEC**
- OPC UA Part 14 PubSub (released) **OPC Foundation**
- OPC UA Quality of Service Parameters for TSN (draft) **OPC Foundation**
- OPC UA Black Channel for Safety **OPC Foundation**
  - OPC UA over TSN is base for Black Channel for Safety
  - Black Channel mappings for different safety protocols
    - Active working group with PNO regarding Profisafe

Status OPC UA over TSN

OPC UA over TSN Technology Stack and Responsibilities

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- OPC UA Part 14 PubSub (released) **OPC Foundation**
- OPC UA Quality of Service Parameters for TSN (draft) **OPC Foundation**
- OPC UA Black Channel for Safety (in work) **OPC Foundation**
- OPC UA for Devices **OPC Foundation**
  - Generic device configuration model released since 2013 (V1.01)
  - Working group started new revision in February 2018
    - Adding definitions for the management of a device through the whole lifecycle
    - Clarification and enhancements base on input from Companion Working Groups

Status OPC UA over TSN

OPC UA over TSN Technology Stack and Responsibilities

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Industrial Profiles and Network Configuration (in work)	**IEEE / IEC**
OPC UA Part 14 PubSub (released)	**OPC Foundation**
OPC UA Quality of Service Parameters for TSN (draft)	**OPC Foundation**
OPC UA Black Channel for Safety (in work)	**OPC Foundation**
OPC UA for Devices (enhancement in work)	**OPC Foundation**
Device specific OPC UA Information Models	**Partners**

- EUROMAP 79
- Robotics
- Vision Systems
- Integrated Assembly Solutions
- More coming…

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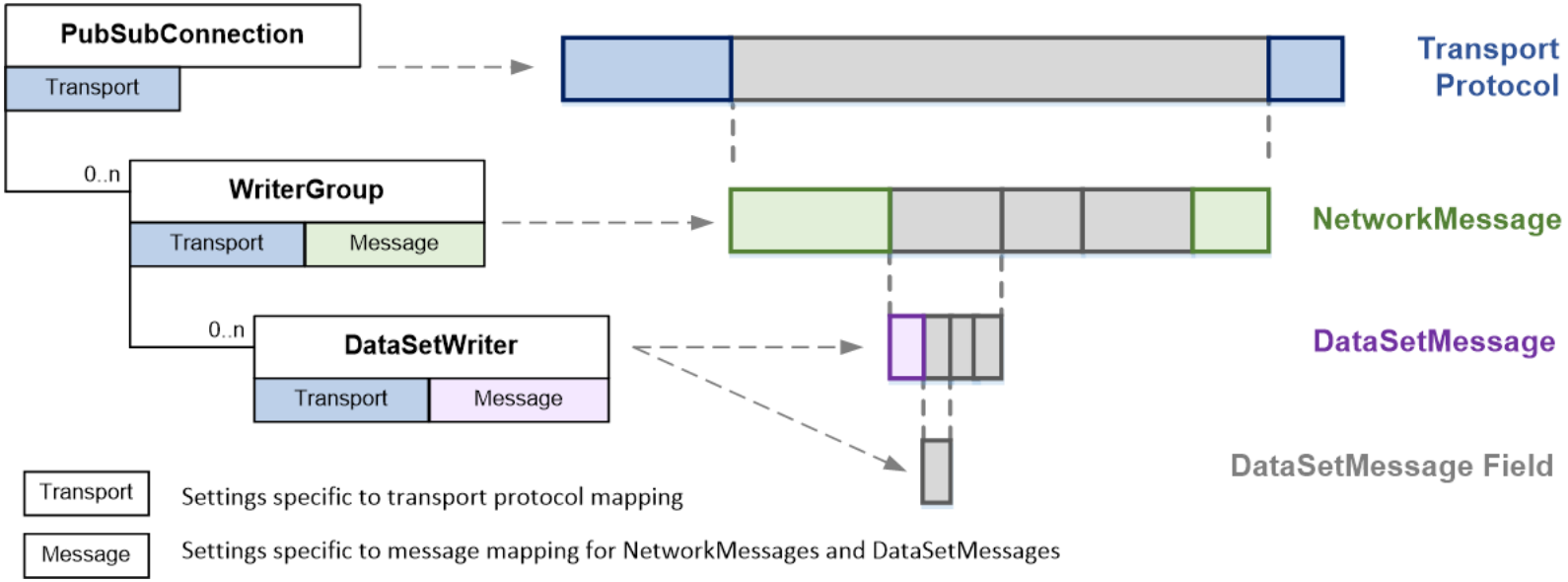
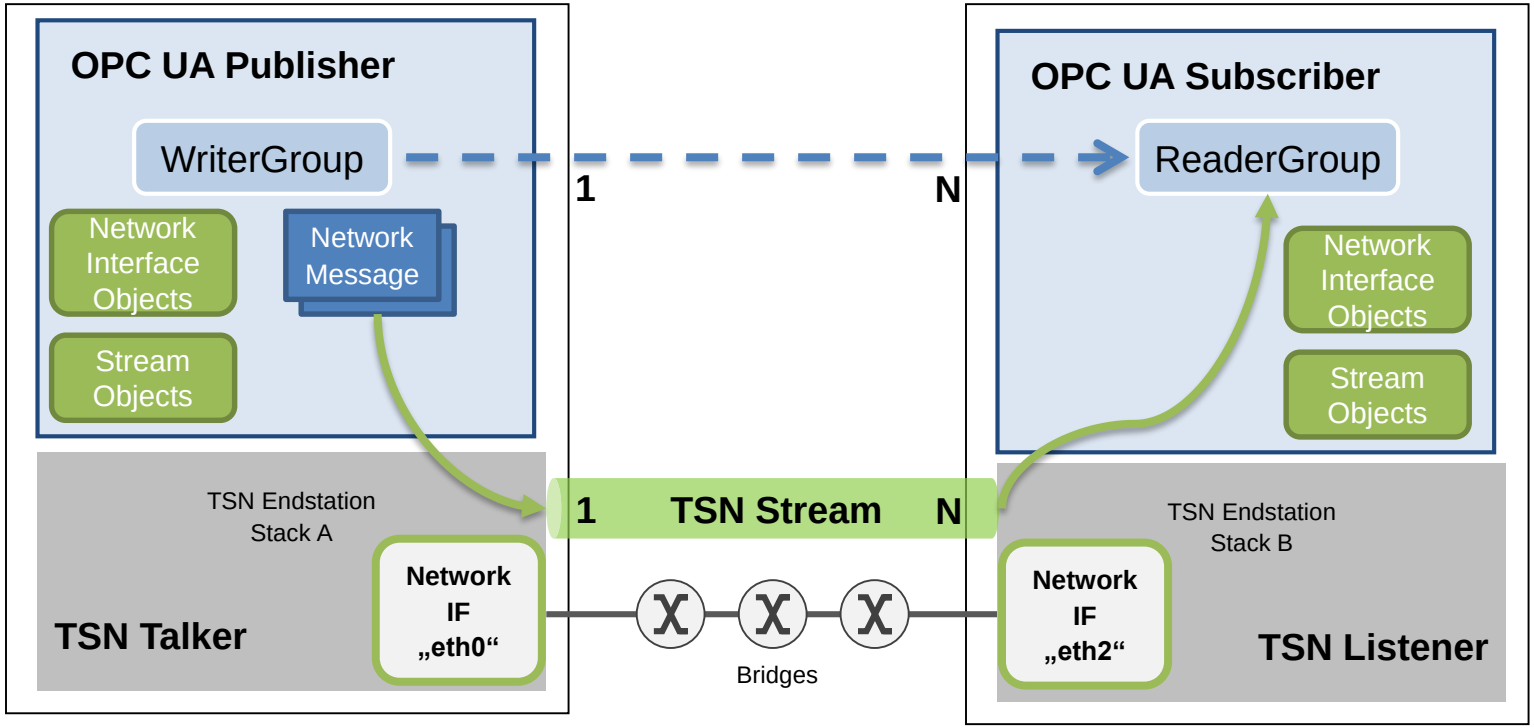
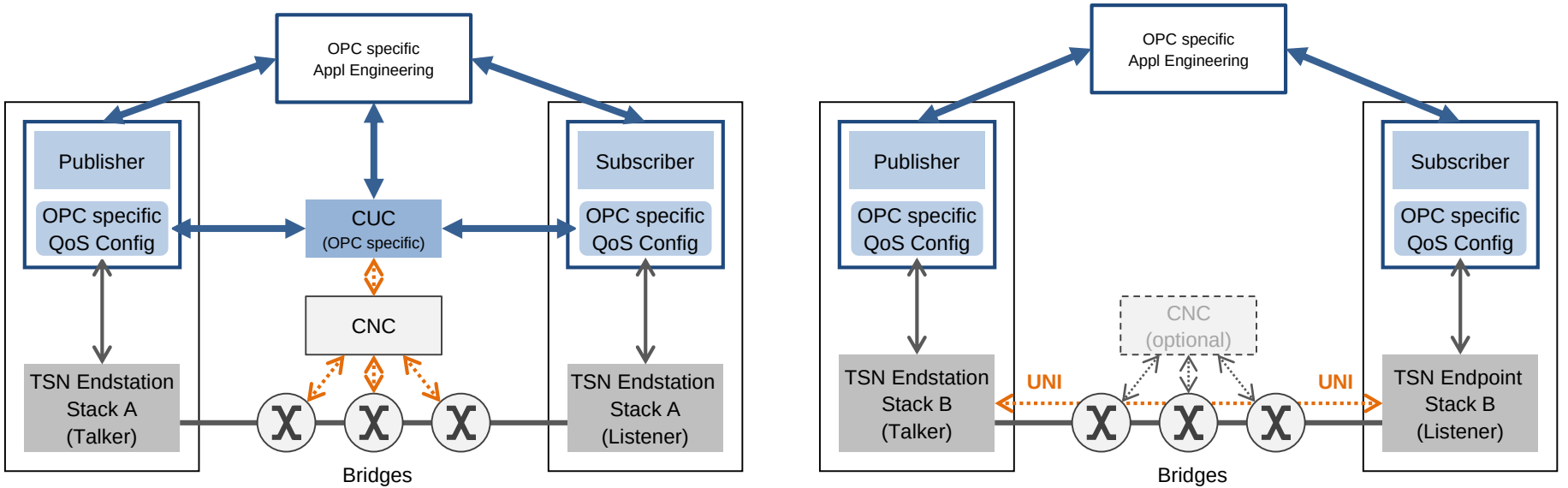
PubSub Configuration Model and Terms



TSN Terms and Configuration Model



Centralized vs. Distributed Network Configuration Model



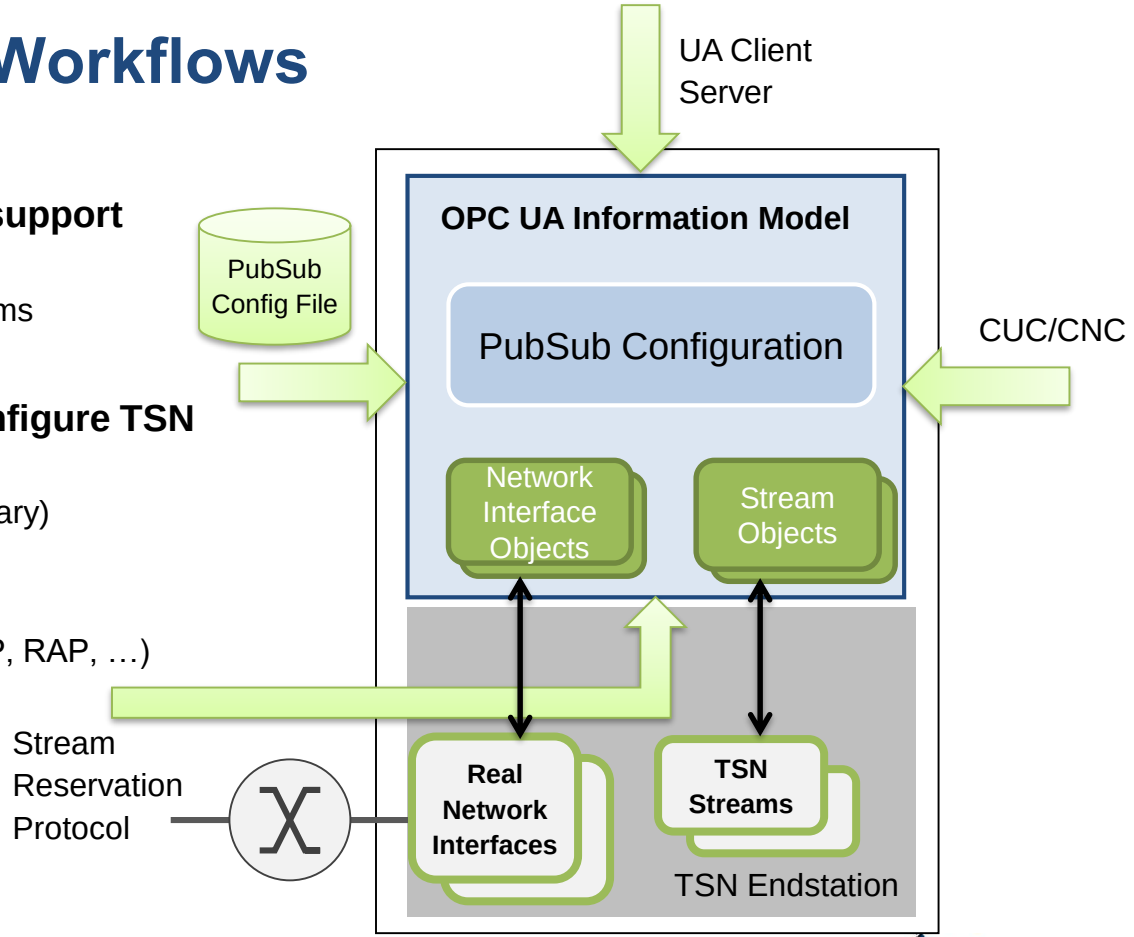
Centralized Configuration

Distributed Configuration

TSN Configuration Workflows

- **Configuration Workflows must support**
  - Pre-engineered Streams
  - “Ad-Hoc” / “On-demand” TSN-Streams

- **Support multiple ways to do configure TSN for OPC UA PubSub via:**
  - PubSub Configuration Files (UA-Binary)
  - UA Client / Server
  - CUC + CNC
  - Stream Reservation Protocol (MSRP, RAP, …)



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Enhancement of Release Model

- Expected OPC UA Specification Release Cycle is three years
  - 2009 → V 1.01
  - 2012 → V 1.02
  - 2015 → V 1.03
  - 2018 → V 1.04
  - 2021 ?? → V 1.05 ??
- Minor enhancements are often requested short term
  - Companion working harmonization (common information model types)
  - TSN / 5G
  - Security
- OPC UA Working Group will release Amendments to OPC UA Specifications
  - Enhancements as feature releases between major spec releases
  - Dedicated Amendment per feature

Amendments in the pipeline

- Enhancements to VariableTypes with Unit and Range properties (Released)
- Enhanced Metadata for Methods (Released)
- Enhancement of State Machine with Choice States and Guards (Released)
- ECC Support (Elliptic Curve Cryptography)
- Reference to external data dictionaries and semantics
- UADP Header Layouts (PubSub)
- Interfaces and AddOns
- TSN Configuration Model

Extended Scope of OPC UA over TSN

- Initial OPC UA over TSN scope was controller to controller communication
- Discussion of extended scope including field device communication started 2017
- Extension OPC UA over TSN to field level announced on November 5, 2018
- New working groups will identify, manage and standardize the OPC UA relevant topics focused on industrial automation including
  - harmonization and standardization of application profiles e.g. IO, motion, safety
  - standardization of OPC UA information models for field level devices (online/offline)
  - mapping of OPC UA application profiles related to real-time operations on Ethernet networks including TSN
  - definition of certification procedures
  - Alignment with IEC/IEEE 60802 (TSN Profile for Industrial Automation)
- More details will be announced at SPS/IPC/Drives November 27, 2018
- New working groups expected to start work early 2019