

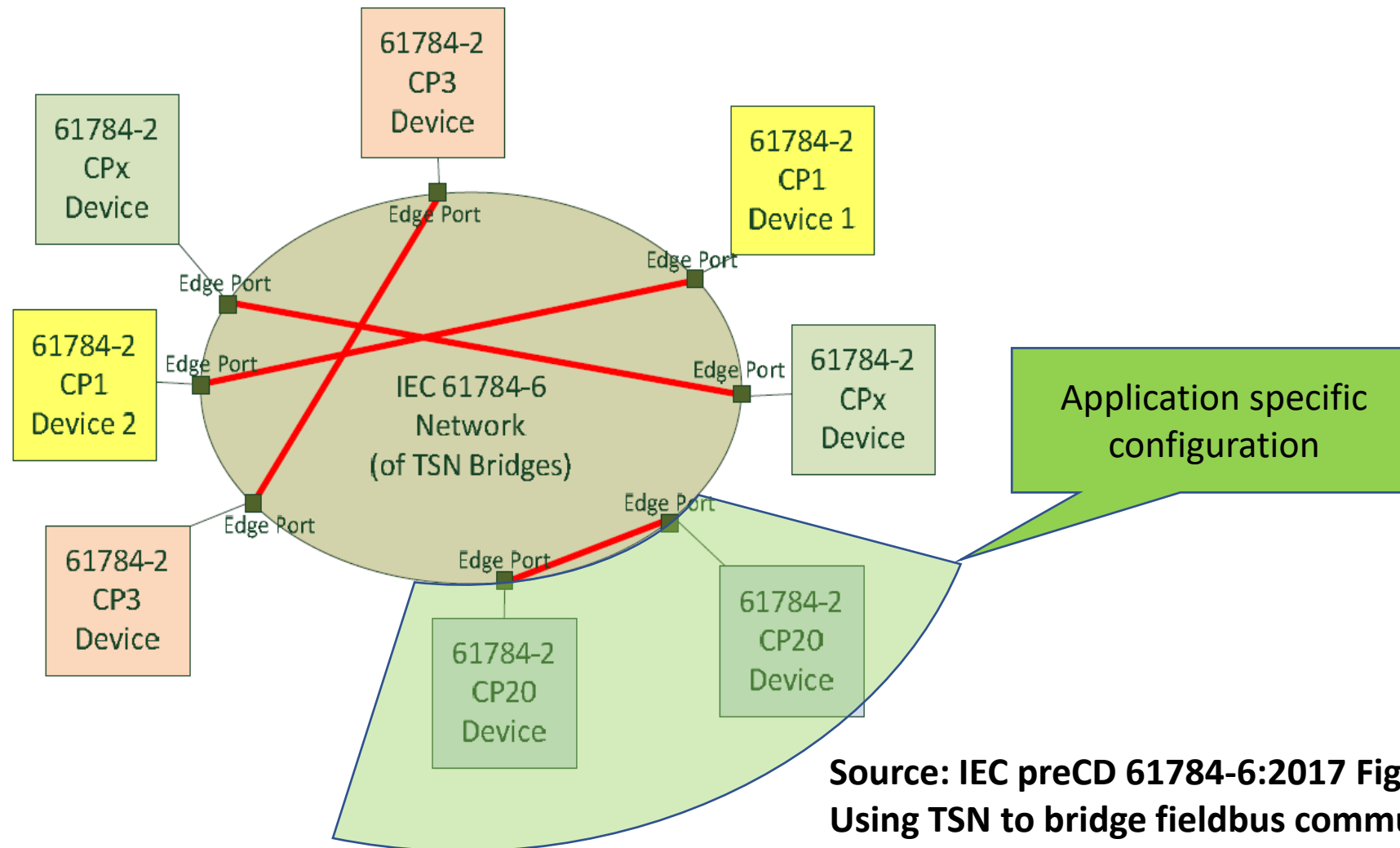
TSN Communication between a Control System and a set of dependable Devices

Contribution Beckhoff Automation

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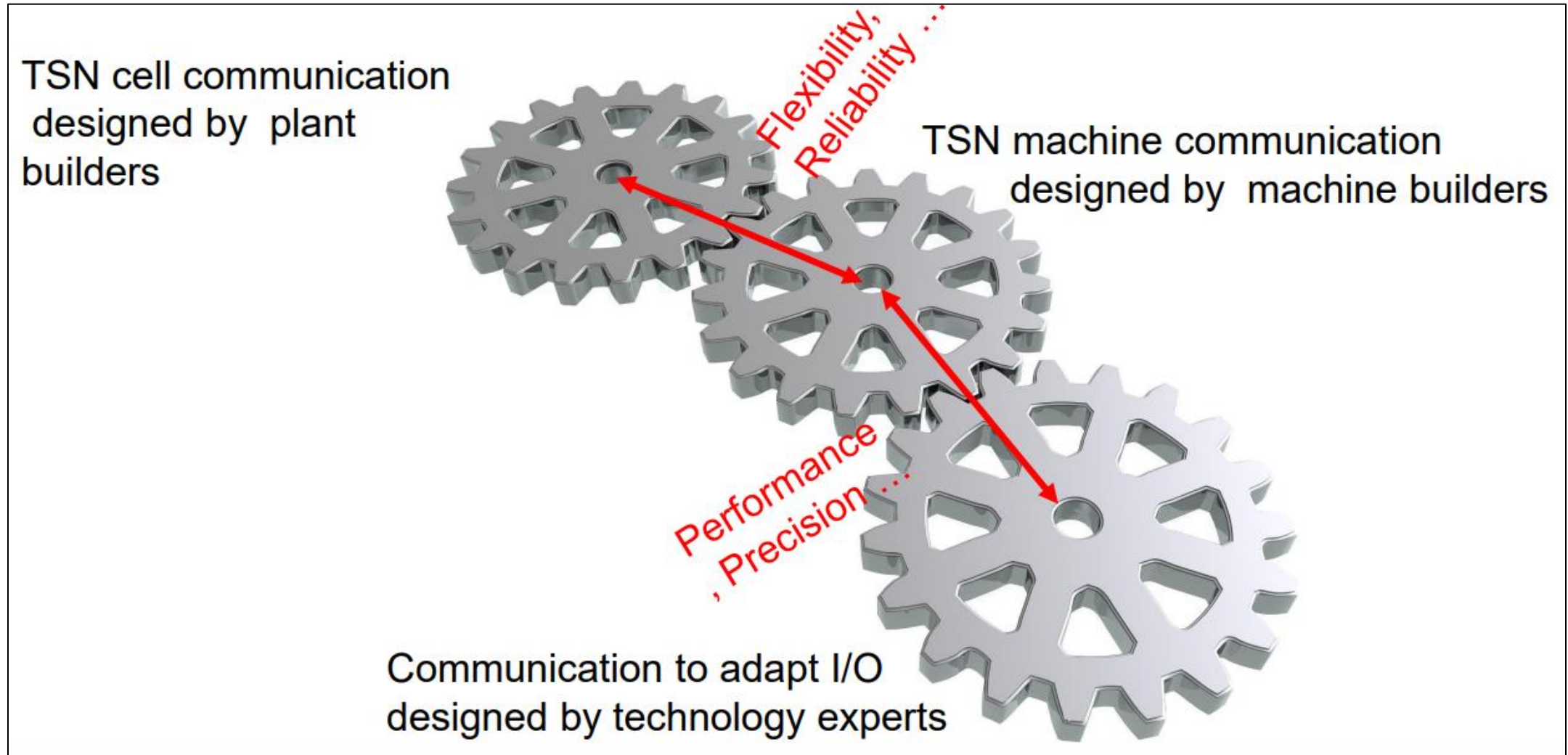
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Recap: IEC TSN work before 60802



Source: IEC preCD 61784-6:2017 Figure 2
Using TSN to bridge fieldbus communication

Discussion during requirements discussion in 2018



With some conclusions ... Configuration and Set-Up

The term **configuration** is related to general parameters while **set-up** is related to establish a relationship

Machine **configuration**:

- describes resources, tasks
- often realized by a configuration file in textual form
- main elements are used IO-Modules + some communication parameters

A system with distributed components requires a **set-up** procedure between end nodes (control unit, smart devices) and network (forwarding)

set-up is initiated by a control unit based on the **configuration** - including the dependable devices

⇒ Dependable devices are controlled by **binary** protocols to keep the implementation footprint **low**

A way for offline configuration is required

60802 Solution requires large footprint for simple end devices

60802 requires 13 YANG modules for secure end station management *(as of now, more expected)*

➔ High effort to integrate simple devices and subsystems

Current component footprints are asymmetric:

Multiple simple dependent devices and only a few powerful control units

Effort in the Application Engineering to enable simple dependable end stations

NOTE: CUC/CNC-Interaction is within the control unit

The Typical communication setup is a very limited set of parameters for control units followed by a large number of application specific things
(e.g. which modules, parameters, ... different for each existing IEC 61784-2 CP)

Following slides focus on one subsystem interaction with the control system.

There are usually more– but the general behavior and effort to implement the communication setup is unchanged

Application

Different IEC-based flavors (Language)

Language specific Configuration and Management

Each Application configure it's generalized devices for the current job and thereby also **defines the required Data Exchange**

Information for Set-Up is only one part

Communication may also include IP and/or other Best-effort services

Network

One „converged“ TSN Network

IEEE 802 basic mechanisms with different feature sets

60802 profile for secured **network** management

Single responsible Entity per TSN Domain (60802 CNC) with **common underlying model**

Multiple Applications / CUCs and one CNC

Applications

- **1** control unit + **many** dependent devices

Control unit typically configure his dependent devices

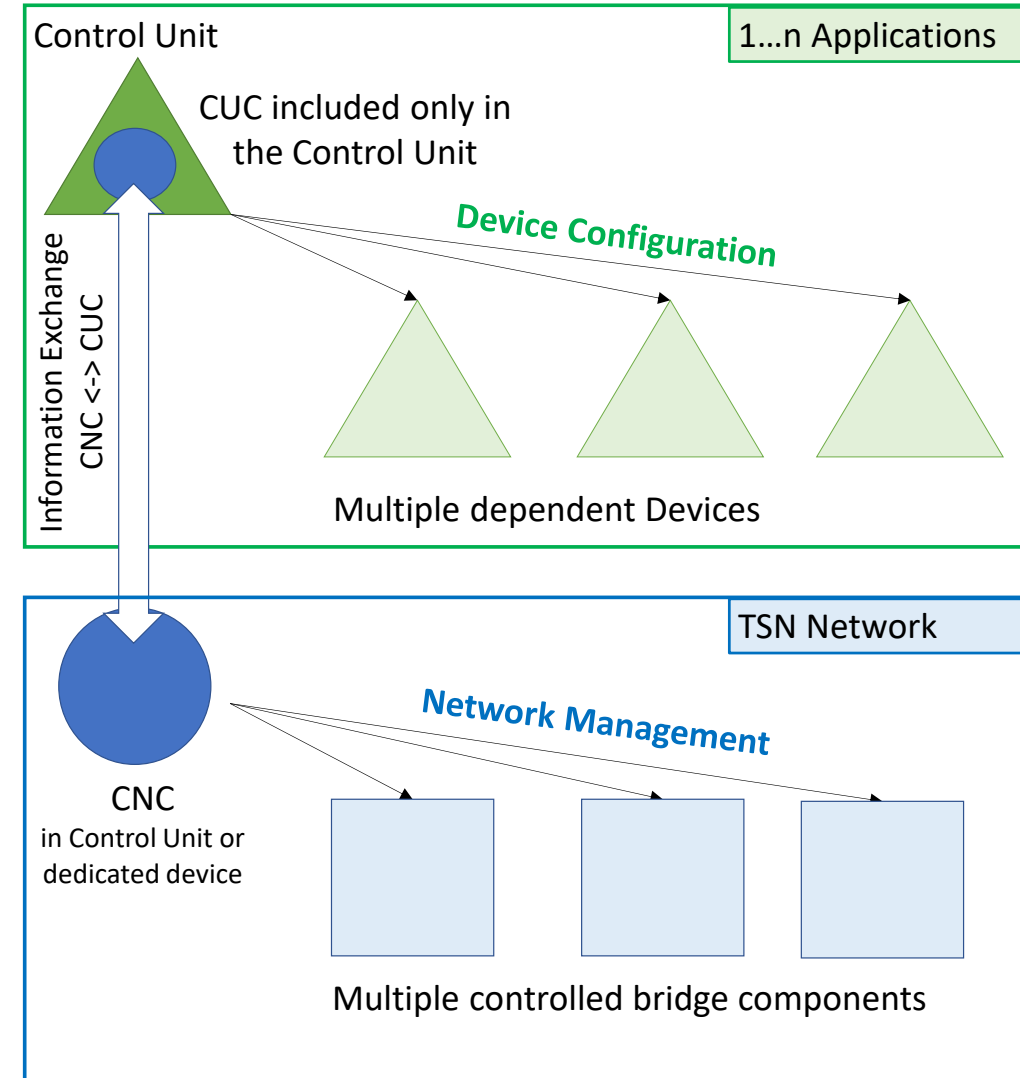
A single configuration for a (Sub-)network

- Configures all bridge instances

Network configuration doesn't configure "pure" end stations

Application doesn't configure "pure" network components

=> security model limited to one instance



Overview of Requirements

- Configure end stations (**Application-specific** + network adaptation)
- Set-up of the **network components** (Forwarding of Data)

Note: topology related information is required from end stations for network configuration

Information exchange between both using the defined UNI / Objects

60802 introduced instances:

Configuration of a **Bridged End Station** should be as if **a network component** and **an end station** were installed in only **one housing**

No need for including the high volume of simple devices in the network configuration as the **settings are done by the control system**

Backup

- The following slides include backup material for further discussion

Current definitions for CUC and CNC

Qcc added the following definitions:

3.x Centralized User Configuration (CUC): A centralized entity that discovers end stations, retrieves end station capabilities and user requirements, and configures TSN features in end stations. The protocols that the CUC uses for communication with end stations are specific to the user application, not specified in this standard. A CUC exchanges information with a CNC in order to configure TSN features on behalf of its end stations.

3.x Centralized Network Configuration (CNC): A centralized component that configures network resources on behalf of TSN applications (users).

Both definitions fit to the separation of Configuration and Set-Up!

The CUC to End stations communication **is application specific** and out of scope
=> Definition of the Fully centralized model in chapter 46.1.3.3 of Qcc

Single Entity for Configuration

Each Application flavor has different requirements regarding the **configuration** of end station instances – major information part for end stations is configuration

⇒ Existing User-specific protocols for end stations – out-of-scope for Qdj / 60802

CNC must be able to control all network instances of his domain

⇒ Requires common **secured** management model

Goal: Only one entity in charge per instance

End Station instances by CUC

Bridge instances by CNC

Note: Some existing industrial automation solutions configure the network functionality as part of the application project and thereby prevent a convergent network, even multiple applications of the same kind are not possible in such a network