# Cut-Through Forwarding (CTF) in Bridges and Bridged Network – Need for Unified and Standardized Management

**Johannes Specht**
(Self; Analog Devices, Inc.; Mitsubishi Electric Corporation; Phoenix Contact GmbH & Co. KG; PROFIBUS Nutzerorganisation e.V.; Siemens AG; Texas Instruments, Inc.)

**Dieter Proell**
(Siemens AG)

DCN 1-22-0031 01 ICne

# Introduction

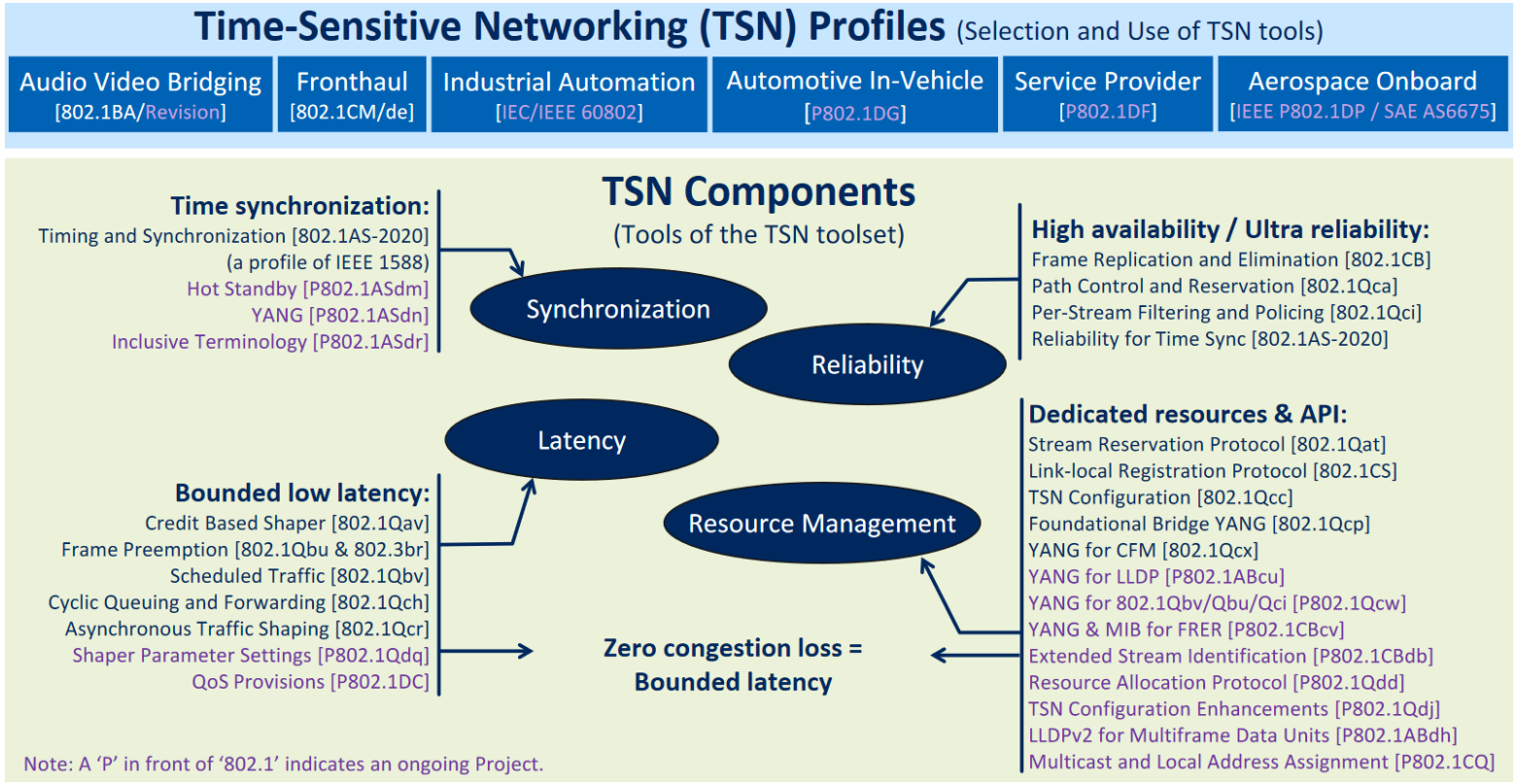
- This slide set describes the need for unified bridge management for CTF standardized in IEEE 802.1:
  - The contents follows the suggestions from the NEA/Nendica joint ad hoc meeting on CTF from June 1 for progressing.
  - To the author's understanding, it is not understood by some IEEE 802.3 individuals why standardizing CTF is required
    (e.g., at least in absence of errors, frame formats are identical under CTF and S&F).
- A unified bridge management for CTF is one of the motivations for standardizing CTF (this slide set)
- Additional motivation is found in https://mentor.ieee.org/802.1/dcn/21/1-21-0037-00-ICne-ieee-802-tutorial-cut-through-forwarding-ctf-among-ethernet-networks.pdf

# The Need for Unified and Standardized Management for CTF

# IEEE 802.1 TSN background

- The need for unified and standardized management is nothing introduced by CTF:
  - It is needed in systems utilizing various IEEE 802.1 TSN tools like shapers and policers with the need for hard end-to-end QoS guarantees.
  - Such systems exist in various markets (e.g., Industrial Automation, professional Audio/Video, Automotive), not just a single market.
- Providing hard end-to-end QoS guarantees implies management on a per network/network segment resolution, not just a single port/port-pair.
- In many cases, systems using TSN tools rely on automatic configuration instead of human operators:
  - Computational intensive configuration tasks
  - Requiring hard QoS guarantees disqualifies 99% approaches
- In many cases, systems using TSN tools are composed by multi-vendor equipment and therefore require interoperable and unified management.

# IEEE 802.1 is the best Venue




Source: https://www.ieee802.org/1/files/public/docs2021/admin-TSN-summary-1121-v01.pdf

- IEEE 802.1 is the "home" of the other TSN tools → fits into the existing management system
- Standardized orchestration of per-device management from a network level point of view
- Broad acceptance by vendors/markets expected (e.g., IEEE/IEC P60802 profile)

# Example: Simple TSN Management Flow and relationship to CTF

The simple management flow in this section is one of many possible management flows. See IEEE Std 802.1Qcc-2018, amendments to IEEE Std 802.1Q-2018 and ongoing amendments projects for further details.

# One (out of many) TSN Configuration Flows (simplified)

## 1. Gather **device capabilities**

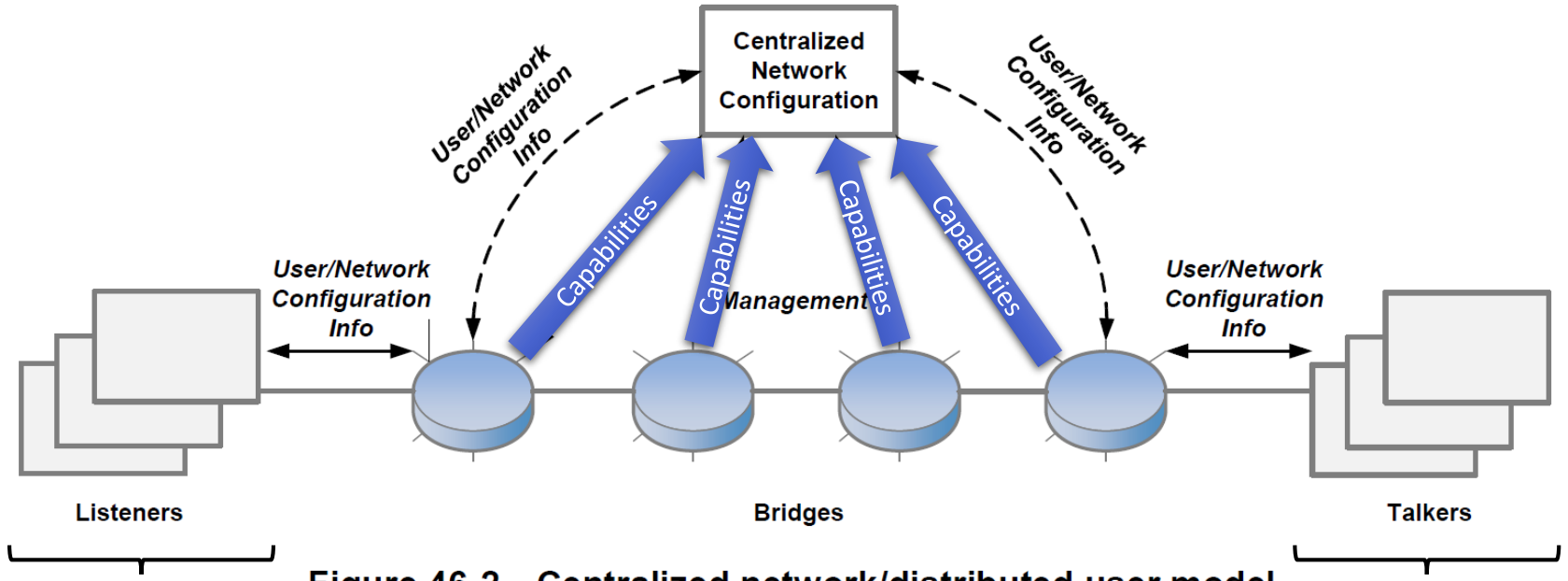



**Figure 46-2—Centralized network/distributed user model**

In End Station(s)

In End Station(s)

Based on Figure 46-2 of IEEE Std 802.1Qcc-2018

# One (out of many) TSN Configuration Flows (simplified)

## 2. *Stream* requests (per *stream* information)

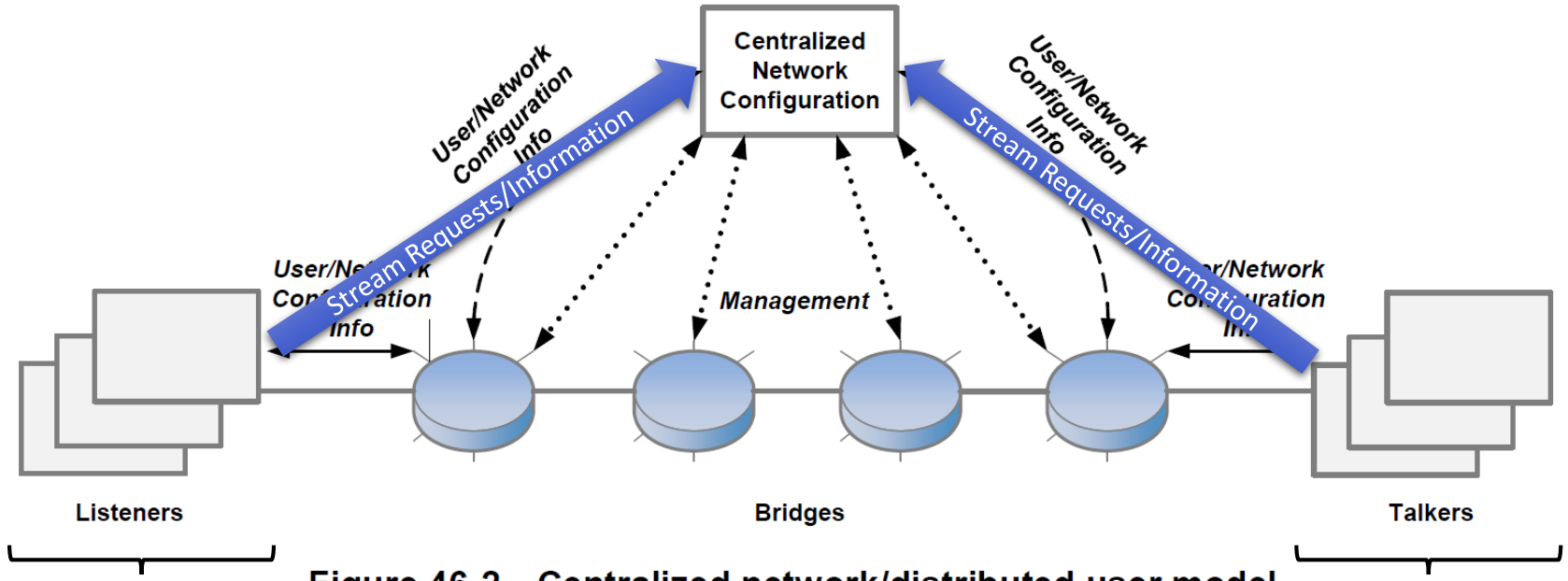



**Figure 46-2—Centralized network/distributed user model**

In End Station(s)

In End Station(s)

Based on Figure 46-2 of IEEE Std 802.1Qcc-2018

# One (out of many) TSN Configuration Flows (simplified)

3. Compute and setup **device configuration** (depends on stream requests)

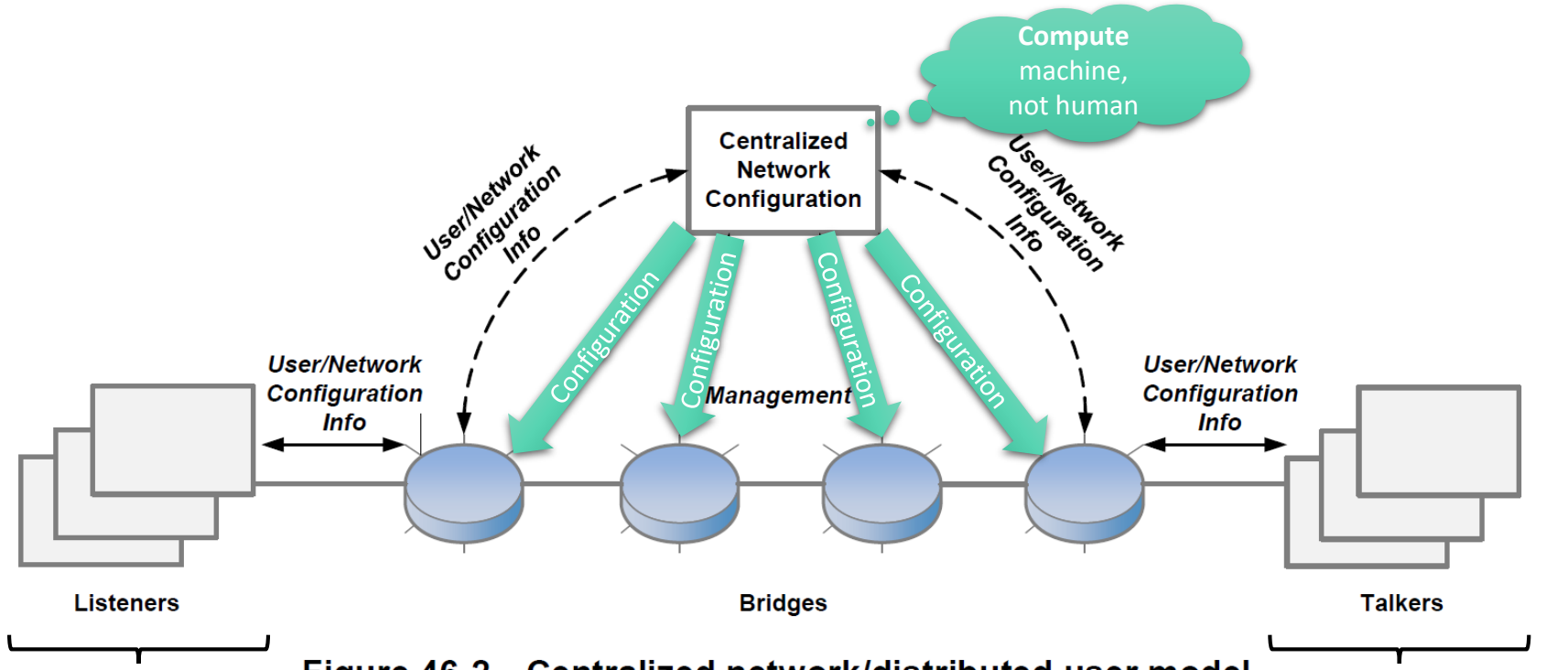



**Figure 46-2—Centralized network/distributed user model**

In End Station(s)

In End Station(s)

Based on Figure 46-2 of IEEE Std 802.1Qcc-2018

# One (out of many) TSN Configuration Flows (simplified)

## 4. *Stream* **configuration** and information

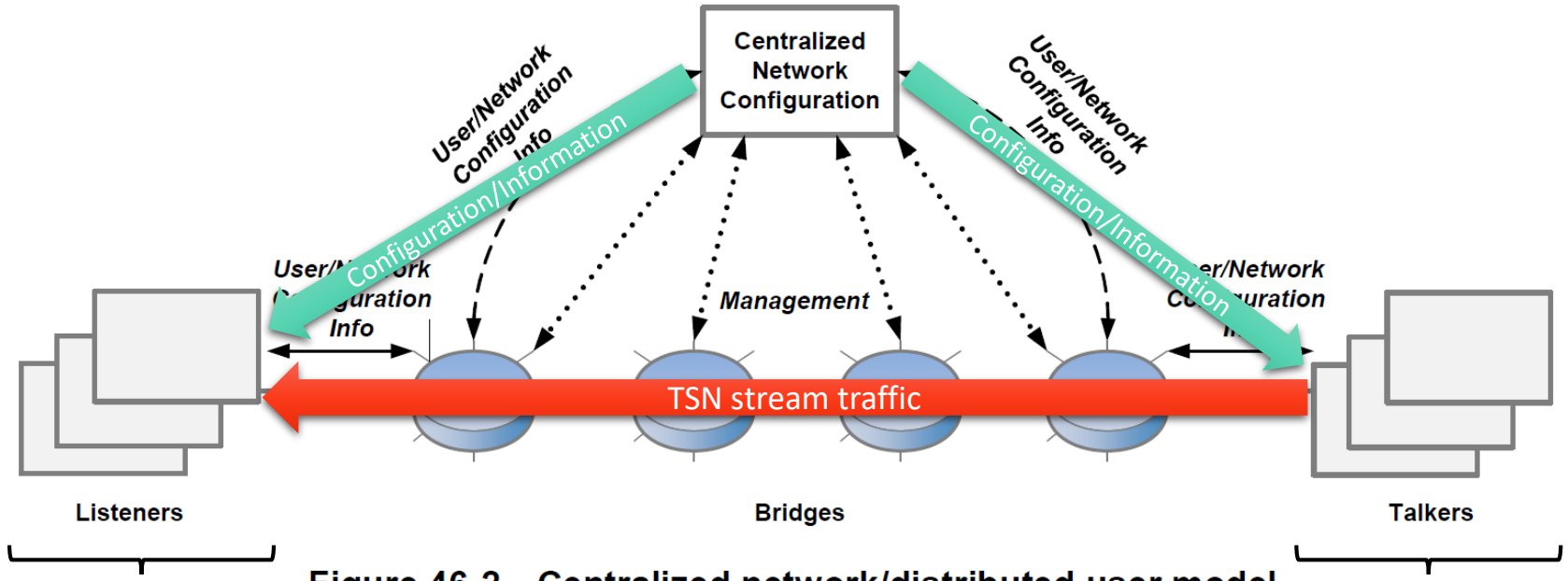


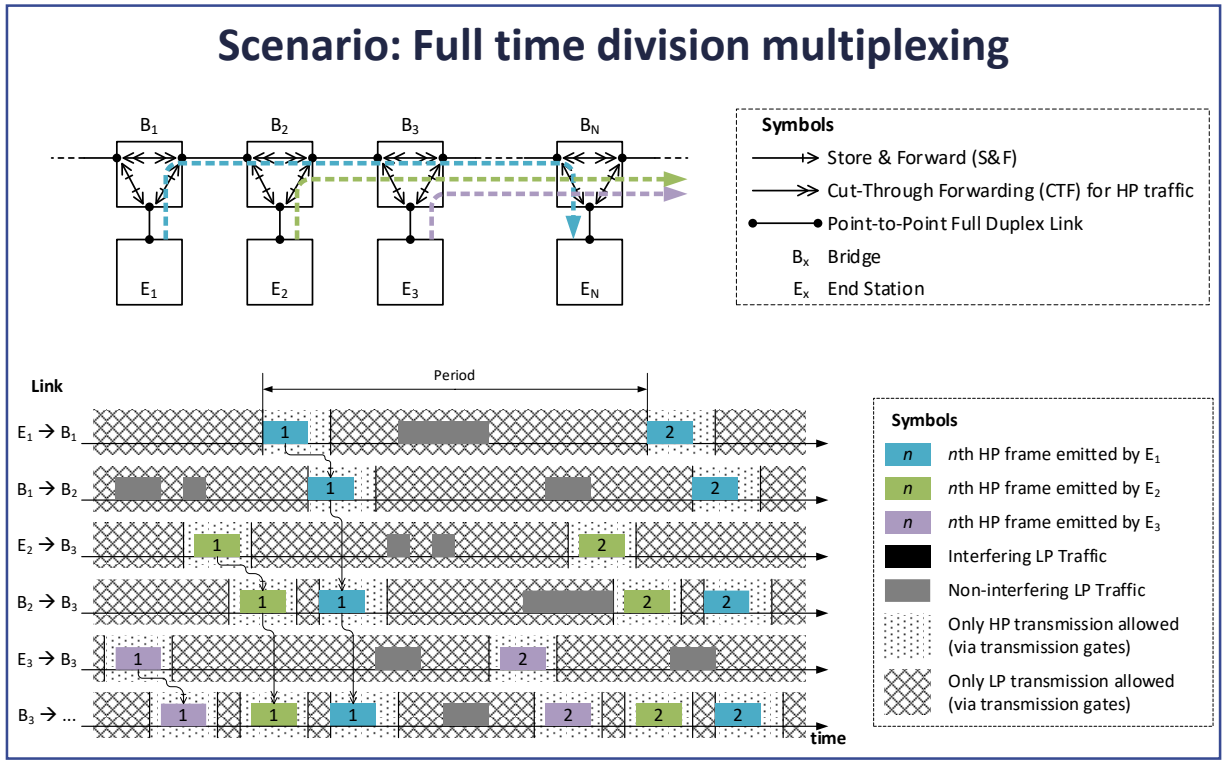

**Figure 46-2—Centralized network/distributed user model**

In End Station(s)

In End Station(s)

Based on Figure 46-2 of IEEE Std 802.1Qcc-2018

# Simple CTF Example: Full TDM[1], Line Topology

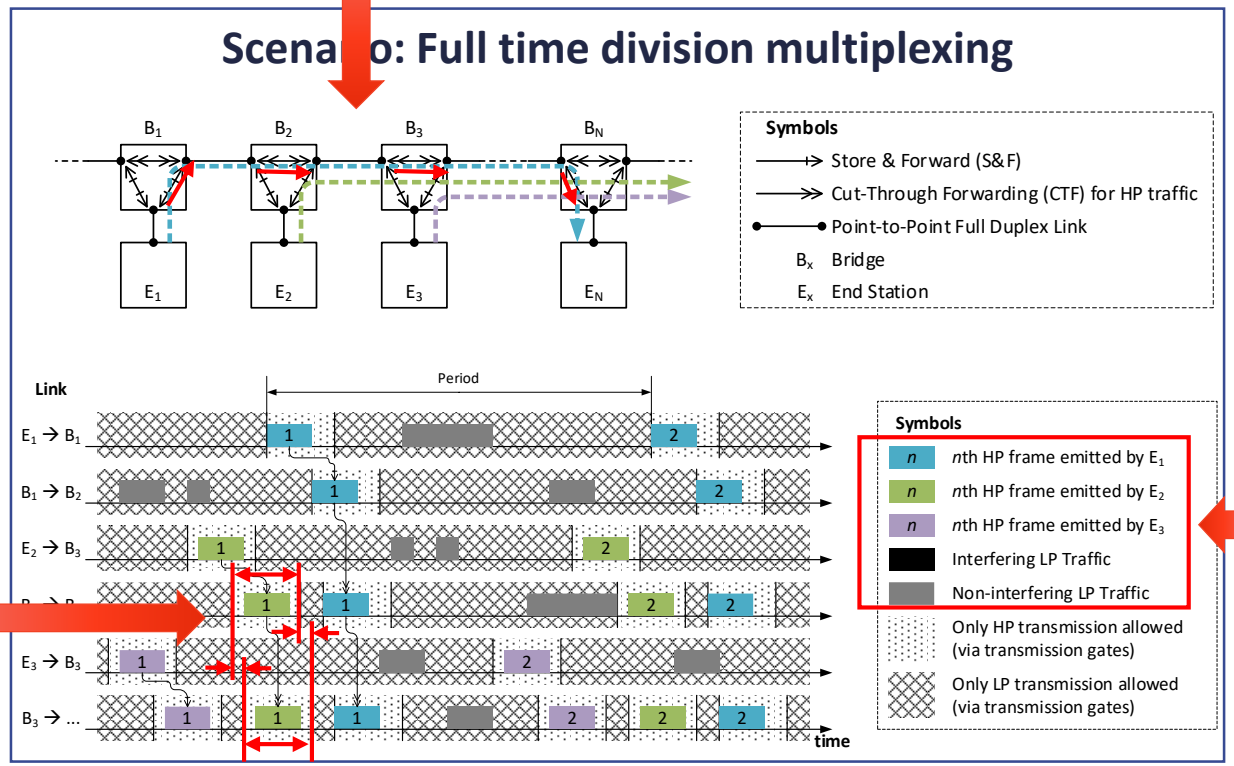



**Notes**

1: This is one example out of many configurations CTF can be used. See section "Introduction" of https://mentor.ieee.org/802.1/dcn/21/1-21-0037-00-ICne-ieee-802-tutorial-cut-through-forwarding-ctf-among-ethernet-networks.pdf for further details and additional examples.

# Simple CTF Example: Full TDM[1], Line Topology

**I. CTF or S&F?**
Can depend on the topological location
→ **Network level** point of view required




**II. Planning TDM Windows**
Tight windows can be preferable for efficiency
→ **Per device capabilities** on RX-to-TX timing under CTF
→ **Network level** point of view required

**III. CTF or S&F?**
Can depend on the traffic/ traffic class
→ Per port/traffic class **configuration** (CTF on/off)
→ Per port/traffic class/ **device capabilities** (CTF support yes/no)

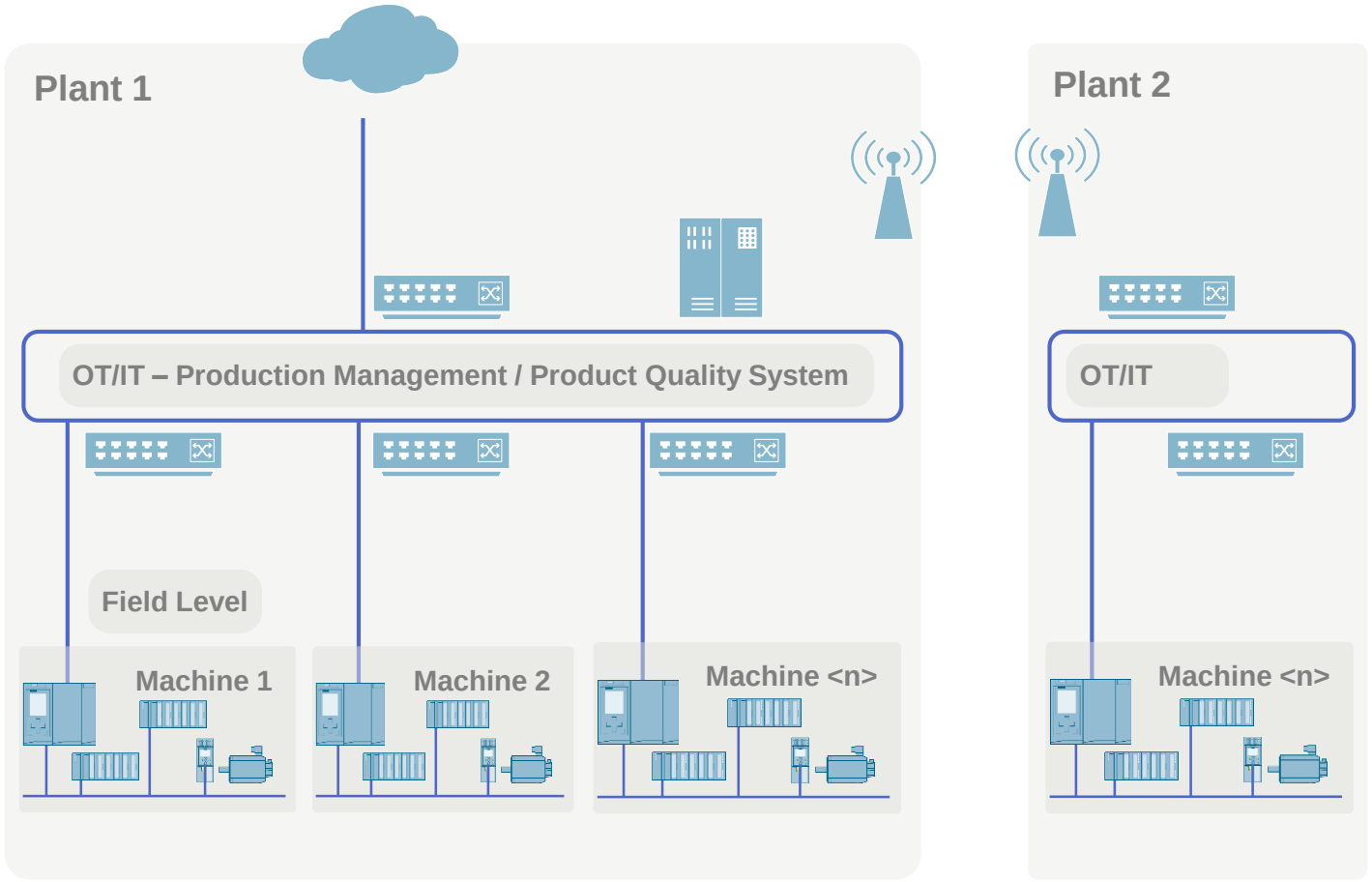
**Notes**
1: This is one example out of many configurations CTF can be used. See section "Introduction" of https://mentor.ieee.org/802.1/dcn/21/1-21-0037-00-ICne-ieee-802-tutorial-cut-through-forwarding-ctf-among-ethernet-networks.pdf for further details and additional examples.

# Example: Management in Industrial Automation and relationship to CTF

Industrial Automation is one of many relevant markets. See https://mentor.ieee.org/802.1/dcn/21/1-21-0037-00-ICne-ieee-802-tutorial-cut-through-forwarding-ctf-among-ethernet-networks.pdf for slides on other markets.

# Converged Network – simplified Industry Automation example

Please note, to see more details and more examples from Audio/Video and DataCenter, we recommend the Tutorial from July 2021 Plenary.
Link https://1.ieee802.org/2021-07-plenary-tsn-agenda/#IEEE_802_Tutorial with Video Recording




- Plant operators expects a design following industry 4.0 and request bounded low latency and quality of service to all components and levels.
- Data exchange is requested by the plant operator from / to:
  - Machine to Machine
  - Machine to OT/IT
  - Machine to Cloud
  - OT/IT to Cloud
  - Plant to Plant
- Industry 4.0 features are requested on wired and wireless network (Wifi, 5G)
- Different companies built the machines and OT/IT network.
- Companies use different products from different vendors, based on their experience or request from plant operator.

→ Converged network is answer and enabler of industry 4.0
See IEEE SA TSN Industrial 2020 Flyer

**Requirements**

➢ Standardization of relevant communication and management features

➢ This includes the feature Cut-Through

# Thank You for Your Attention!

Questions,
Comments,
Opinions,
Ideas?