IEC/IEEE 60802 TSN Profile for Industrial Automation

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DetNet – TSN **workshop**, Bangkok, 11. Nov. 2018

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Agenda

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- History of IEC/IEEE 60802 in IEC TC 65
- Joint organization and its impact
- Benefits of IEC/IEEE 60802
- Workflow in the IEC/IEEE 60802 joint project
- IEC/IEEE 60802 timeline
- Examples: use case and requirements
- Network configuration aspects
- Summary
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Introduction

International Electrotechnical Commission (IEC)

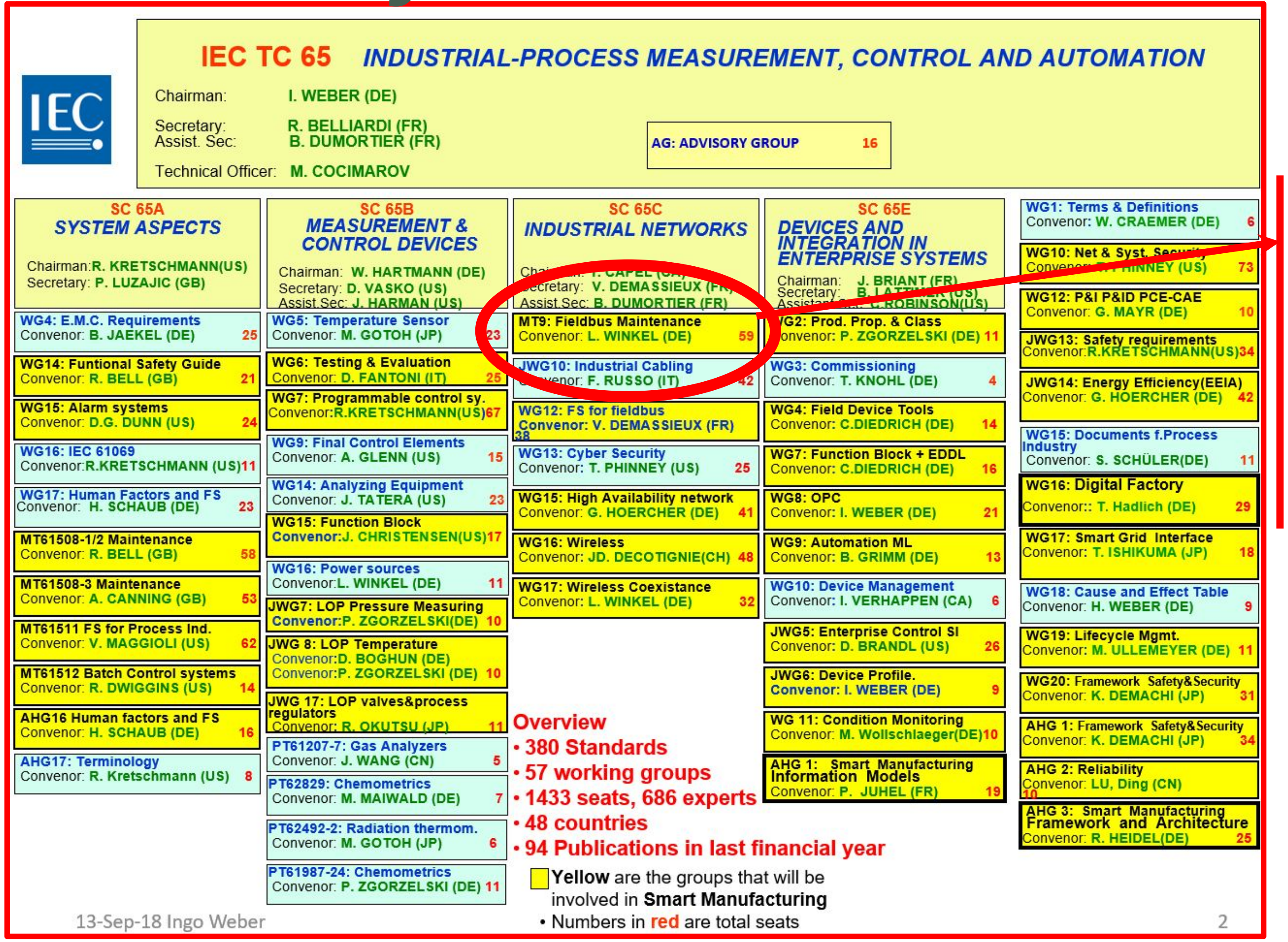
- Leading organization for the preparation and publication of International Standards for all electrical, electronic and related technologies; collectively: "electrotechnology"
- Consensus of every nation participating in IEC work

Institute of Electrical and Electronics Engineers Standards Association (IEEE-SA)

- Leading consensus building organization that nurtures, develops and advances global technologies
- Broad range of individuals and organizations from a wide range of technical and geographical origin to facilitate standards development and standards related collaboration

IEC/IEEE 60802 Joint Project to ensure that the right experts are involved in defining the use of IEEE 802.1 Time-Sensitive Networking (TSN) for Industrial Automation (IA)

History of IEC/IEEE 60802 in **IEC TC65**



IEC 61784-6 TSN profile
IEC 65C NP (65C/875/NP) approved in July 2017

More details and starting point: http://www.ieee802.org/1/files/public/docs2017/new-winkel-tsn-profile-0917-v00.pdf

Joint Organization and Its Impact

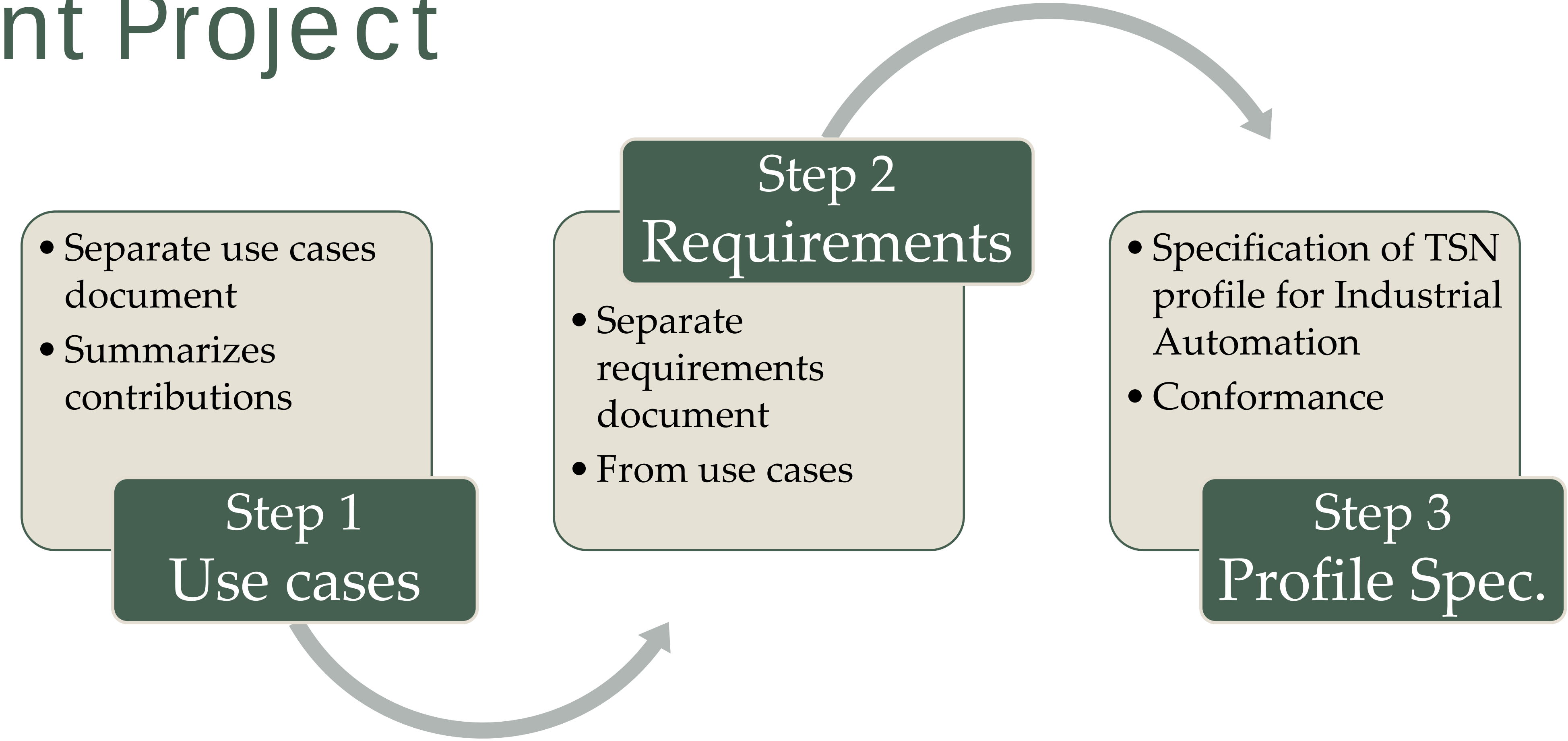
- The IEC/IEEE 60802 joint project experts:
  - know the Use cases and requirements of the entire industrial Automation world.
  - extract the requirements to the network communication focusing on TSN.
  - identify gaps in the TSN Standards and initiate projects to fill the gaps.
  - make standardized provisions for the devices.
  - provide the basis to write test specifications in appropriate committees (e.g. IECEE) to ensure interoperability in a converged network.
- Good participation (about 30 to 60 per meeting; 59 nominated experts in 65C/MT9), Major industrial vendors

- Both IEC and IEEE 802.1 processes apply: IEC - IEEE cooperation process details: http://www.ieee802.org/1/files/public/docs2018/admin-IEC-IEEE-JWG-cooperation-process-0118.pdf

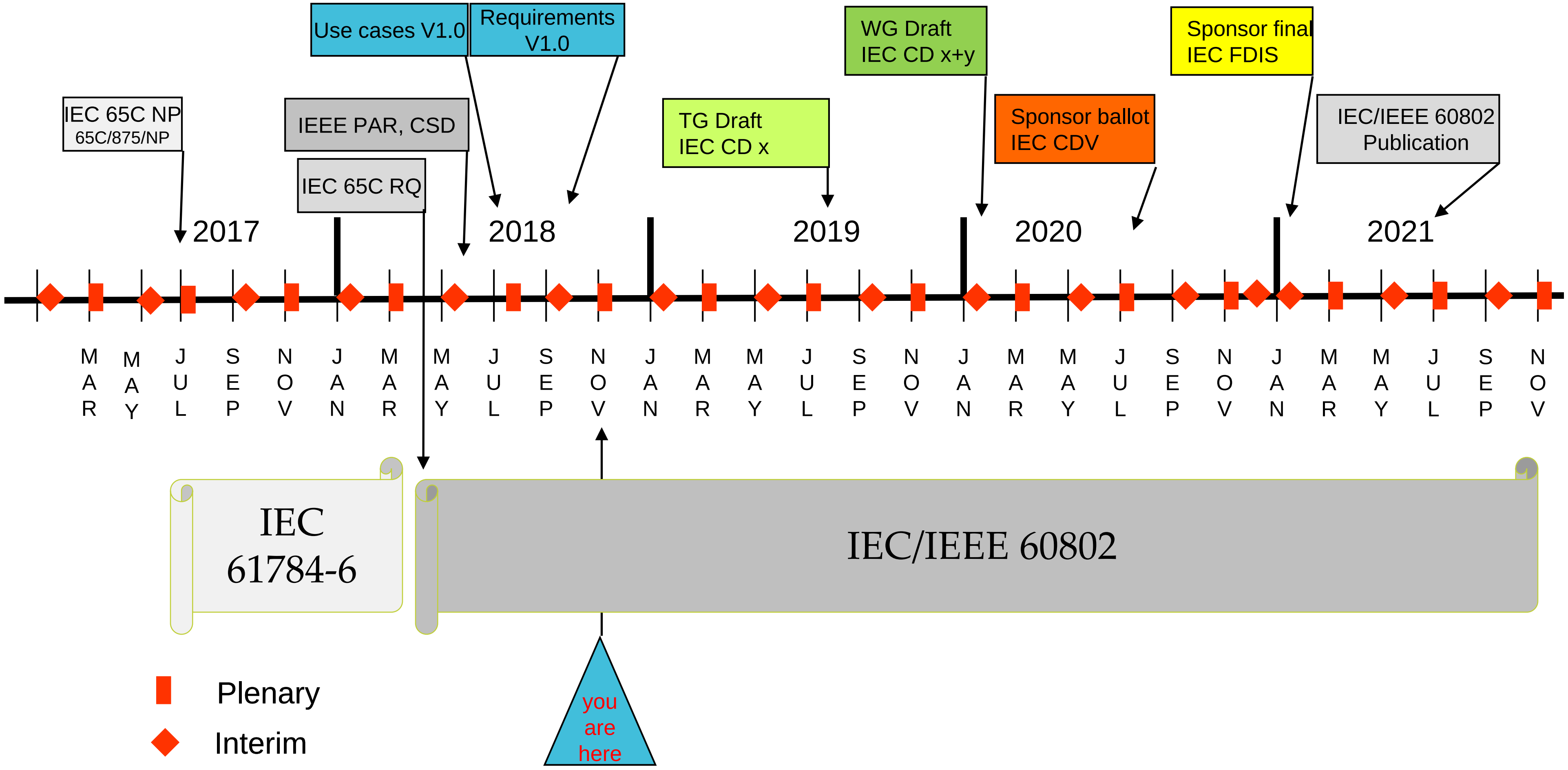
Benefits of IEC/IEEE 60802

- IEEE 802.1 TSN gives an opportunity to converge networking for industrial automation
  - TSN is the foundation providing interoperability and connectivity
  - Simultaneously support operations technology traffic and other traffic
- Many industrial automation players consider TSN as the next generation networking technology in smart manufacturing
- The IEC/IEEE 60802 standard is beneficial for
  - Vendors offering and/or developing TSN products, as well as
  - The users of industrial automation technologies

Workflow in the IEC/IEEE 60802 Joint Project



IEC/IEEE 60802 Timeline



Example "Use case"

Example "Requirements"

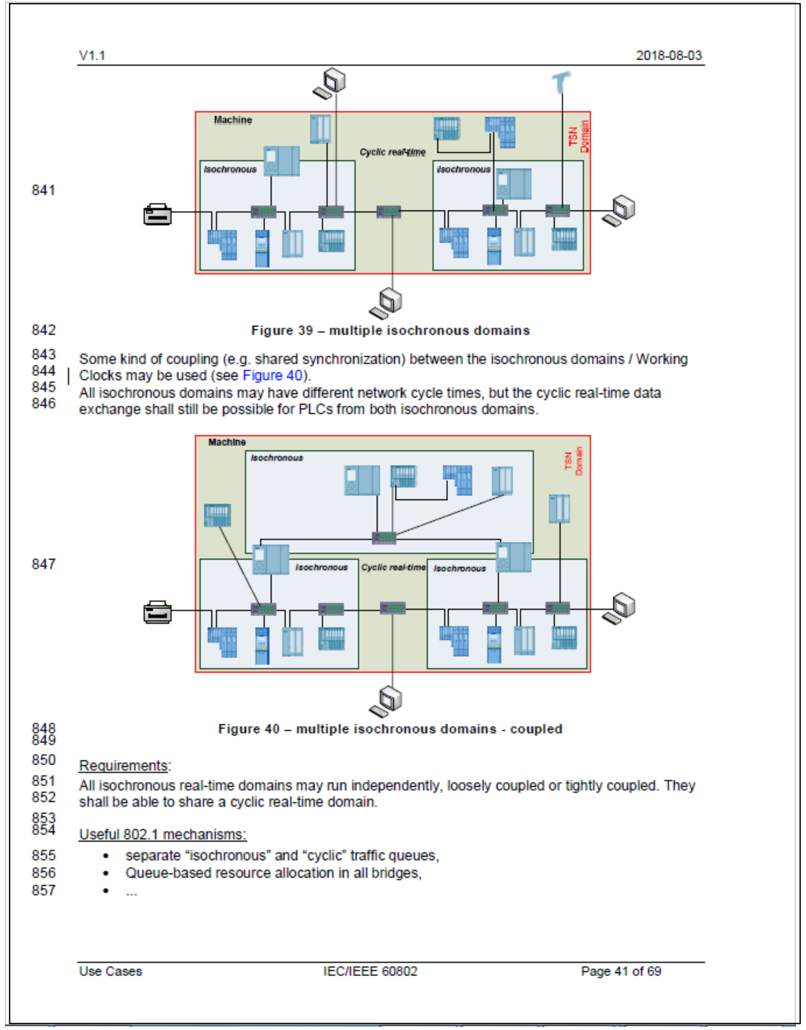


Figure 39 – multiple isochronous domains

Some kind of coupling (e.g. shared synchronization) between the isochronous domains / Working Clocks may be used (see Figure 40).
All isochronous domains may have different network cycle times, but the cyclic real-time data exchange shall still be possible for PLCs from both isochronous domains.

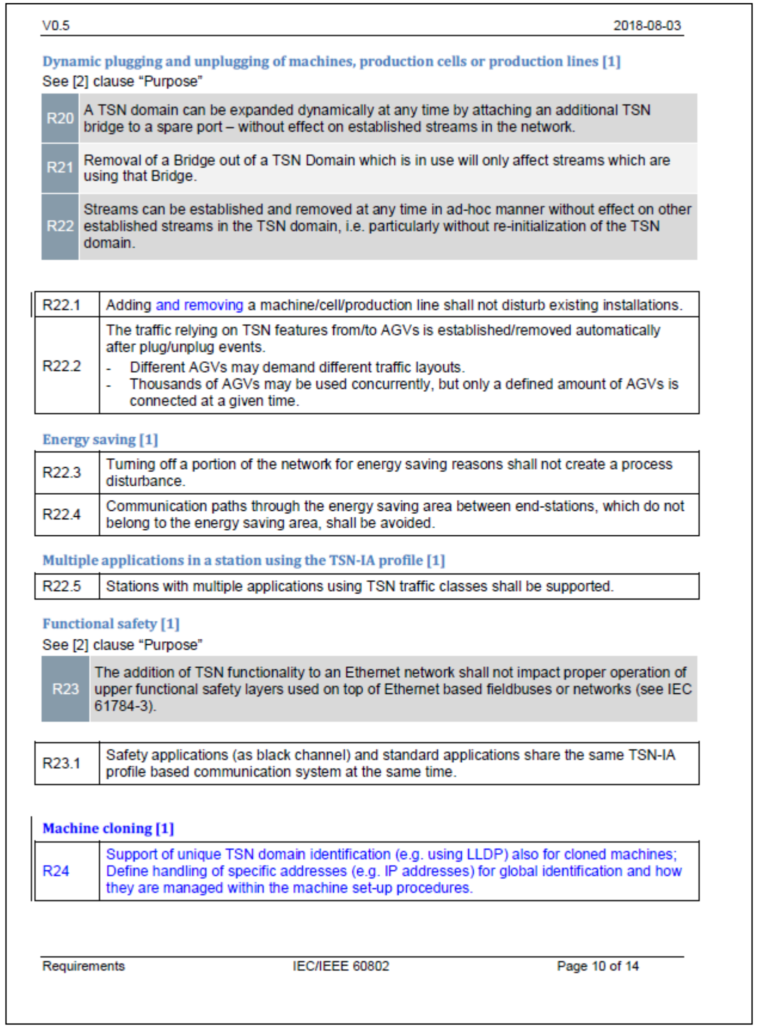
Figure 40 – multiple isochronous domains - coupled

Requirements:
All isochronous real-time domains may run independently, loosely coupled or tightly coupled. They shall be able to share a cyclic real-time domain.

Useful 802.1 mechanisms:

- separate "isochronous" and "cyclic" traffic queues,
- Queue-based resource allocation in all bridges,
- …

Relates to



Dynamic plugging and unplugging of machines, production cells or production lines [1]

See [2] clause "Purpose"

R20	A TSN domain can be expanded dynamically at any time by attaching an additional TSN bridge to a spare port – without effect on established streams in the network.
R21	Removal of a Bridge out of a TSN Domain which is in use will only affect streams which are using that Bridge.
R22	Streams can be established and removed at any time in ad-hoc manner without effect on other established streams in the TSN domain, i.e. particularly without re-initialization of the TSN domain.

R22.1	Adding and removing a machine/cell/production line shall not disturb existing installations.
R22.2	The traffic relying on TSN features from/to AGVs is established/removed automatically after plug/unplug events. - Different AGVs may demand different traffic layouts. - Thousands of AGVs may be used concurrently, but only a defined amount of AGVs is connected at a given time.

Energy saving [1]

R22.3	Turning off a portion of the network for energy saving reasons shall not create a process disturbance.
R22.4	Communication paths through the energy saving area between end-stations, which do not belong to the energy saving area, shall be avoided.

Multiple applications in a station using the TSN-IA profile [1]

R22.5	Stations with multiple applications using TSN traffic classes shall be supported.

Functional safety [1]

See [2] clause "Purpose"

R23	The addition of TSN functionality to an Ethernet network shall not impact proper operation of upper functional safety layers used on top of Ethernet based fieldbuses or networks (see IEC 61784-3).

R23.1	Safety applications (as black channel) and standard applications share the same TSN-IA profile based communication system at the same time.

Machine cloning [1]

R24	Support of unique TSN domain identification (e.g. using LLDP) also for cloned machines; Define handling of specific addresses (e.g. IP addresses) for global identification and how they are managed within the machine set-up procedures.

Link to "use cases"

Link to "requirements"

Network Configuration Aspects

Application

Industrial communication standards Organizations

IEC 61158
IEC 61784

Companion Specs

OPC Foundation

IEC 62541

Application Model and Configuration
(Application Profile, Communication Profile, Vendor Model, …)

Middleware
(Fieldbus Layer, OPC UA, …)

IEC/IEEE 60802 TSN Profile for Industrial Automation
(a profile selecting features from various IEEE 802 stds)

- Network Configuration (netconf, restconf/YANG, SNMP/MIB,
- Stream Configuration and Establishment (SRP, RAP, restconf,
- Ethernet/TSN (Synchronization, Neighborhood detection, bounded latency communication,

Test & Certification

Summary

- Good feedback on the Joint Project
- Good participation
  (about 30 to 60 per meeting; 59 nominated experts in 65C/MT9)
- Several key players are looking forward to apply the standard

- The IEC/IEEE 60802 Joint Project is important for the success of the TSN technology
- It is the interest of all players to have **only one** TSN profile standard for Industrial Automation

How to Participate

- IEC participation is through National Committees
- IEEE 802 participation is on individual basis
- Come to face to face meetings (registration required via meeting page)
- Attend conference calls
- Subscribe to the IEEE 802.1 email list
- Project web page: http://ieee802.org/1/tsn/iec-ieee-60802-tsn-profile-for-industrial-automation

Thank you for your attention!

Questions?