**IEEE 802.24**

**Vertical Applications TAG**

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# Describe why TSN is needed in a utility

In the context of this white paper, the utility is considered the entity (or entities) that manage the distribution of electricity from the transmission grid, to the distribution grid, to the customers. The power distribution network involves substations, and various protective and control devices that communicate over communications networks.

Typical utility terminology is a “low latency network”

Define what “realtime” means in the context of specific grid use cases and applications. Real-time behabor of Ethernet based communication networks is defined in IEC 61784-2. There are 6 (plus one technology specific) consistent sets of parameters decribed to define the requested and achieved Real-time Ethernet behabor of end-to-end stations.

For the network components using TSN is an effort ongoing in IEC SC 65C.PT61784-6, dealing with a TSN profile for industrial automation applications.

Teleprotection – differential protection schemes require very low (<10ms) end to end latency, which must be highly consistent and predictable.

 Type of connection – typically fiber

Intra-substation LAN. Support for IEC 61850 Generic Object Oriented Substation Event (GOOSE) messages for controlling relays and switches within the substation. TR61850-90-13 addresses this

 Type of connection – typically Ethernet (copper or fiber)

Shared IT/OT networks over a common medium. The OT networks require a controlled, predictable latency, and freedom from dropped or lost packets. This behavior is required regardless of the loading or overloading of the IT network.

How does TSN affect this? The important benefit is providing a converged multi-service architecture. Critical services can have guaranteed performance and bounded latency. This saves cost by converging several networks into one.

But not all TSN behaviors can be build in one network component without a difficult engineering. A profile for Utilities is needed to reduce the effort of engineering. IEC TC57 is looking for such a profile and is collaborating with the IEC SC65C/MT9.PT61784-6 project team.

IEEE 802.3br provides the best basis for this instead of using only shapers.

Critical voice services from field or substation. Ensuring voice traffic is unaffected by other data flow on common network.

Field Area Network Applications – Fault Location Identification and Service Restoration (FLISR) requires predictable low latency to re-route distribution power grids to isolate faulted areas and restore power to customers so quickly that they don’t notice an interruption. TSN capabilities in the FAN could enable FLISR to operate on shared medium networks. The same low latency communication with a Distributed Energy Resources Management System (DERMS) will allow local DER devices to participate in the restoration. The DERMS may be located at a central location (away from the DER equipment). End to end connectivity between the DERMS and the DER equipment may require multiple networks, each able to support low latency applications.

Similar requirements exist with MicroGrids. Dynamic protection, reverse power flows, etc.

(investigate use cases around wind farms – there may be situations where TSN is needed – protection algorithms are the main driver.)

# Describe how TSN works

Don’t focus on the standards themselves, but focus on basic capabilities.

Goal of low latency vs maximum worst case latency, and leading to zero congestion loss.

A new optimization, compared to best-effort packet world.

It is not just low latency, but bounded, deterministic worst case latency. That enables the application.

Shifting paradigm from acting on the packet to acting when the packet says to act.

Secondarily, ability to guard against equipment failure.

Informational material: 802.1Qbu, 802.3br, 802.1Qbv, 802.1Qat, 802.1Qca, CB, Qcc, Qch, Qci, Qcn, Qcr, AEcg

Discuss 802.1CM and BA, as an example of industry profiles for the use of TSN

# Understand IEC 61850 activities and relationships

How standardized APIs are integrated into 61850

What is the set used for grid applications? Relate to IEC TC57 Profiles

Harmonization of TC65 (automation) with TC57 profiles

# Explain relationships to time synchronization in 802.1AS

Power Profiles of IEEE 1588

# Relationship to IETF DETNET and RTCWEB

DETNET works over a routed network.

RTCWEB is focused on video and audio mostly, but supports it over the Internet.

What is the opportunity for wireless standards to leverage?