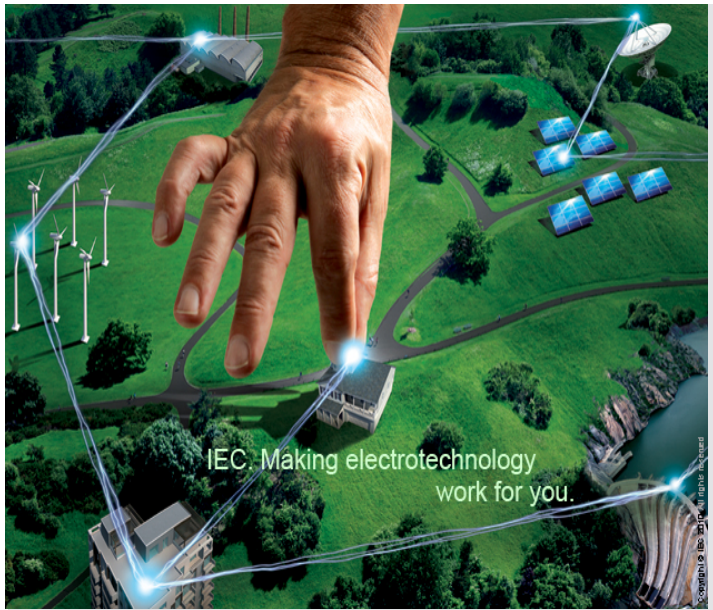
INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

TR IEC 61850-90-13
Deterministic Networking



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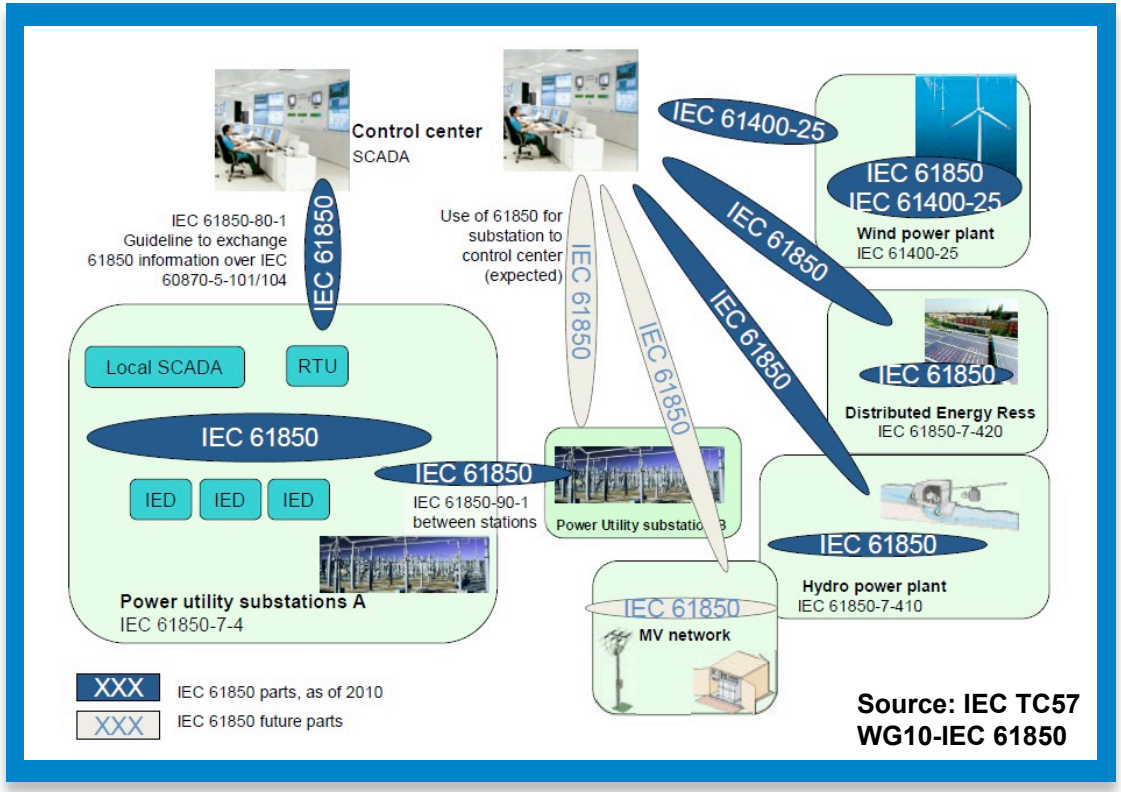
IEC 61850 in a nutshell

Title: Communication networks and systems for power utility automation

The design objectives are:

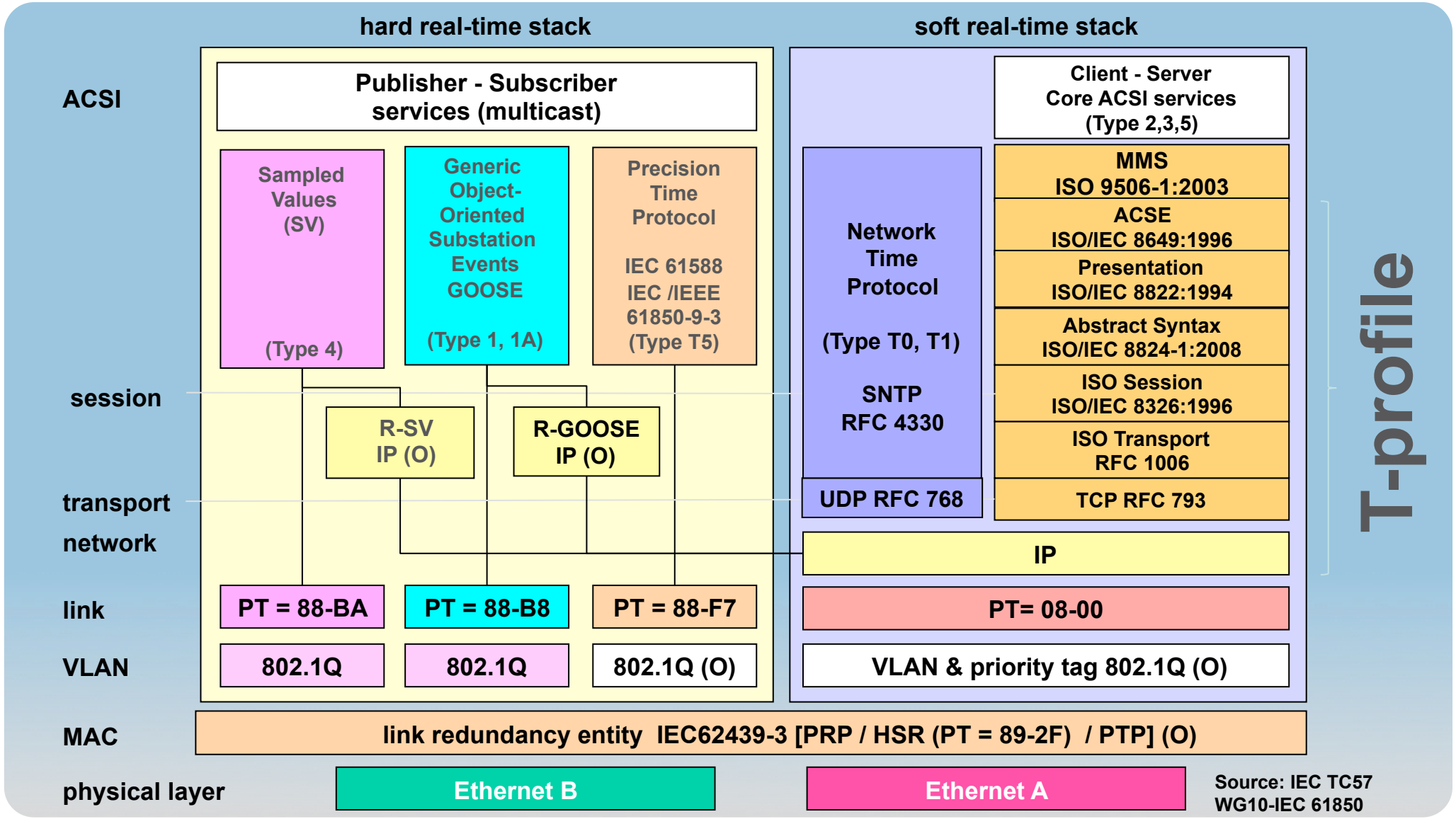
- **Interoperability (between devices & systems)**
- **Free configuration (free allocation of functions to devices)**
- **Long term stability (layered, object-model based design, consistent configuration language)**
- **Extensibility (into new domains or even other IoT verticals)**
- **Contains also environmental and conformance testing requirements**
- **Security is defined in IEC 62351 (1-13)**

IEC 61850 has left the substation!

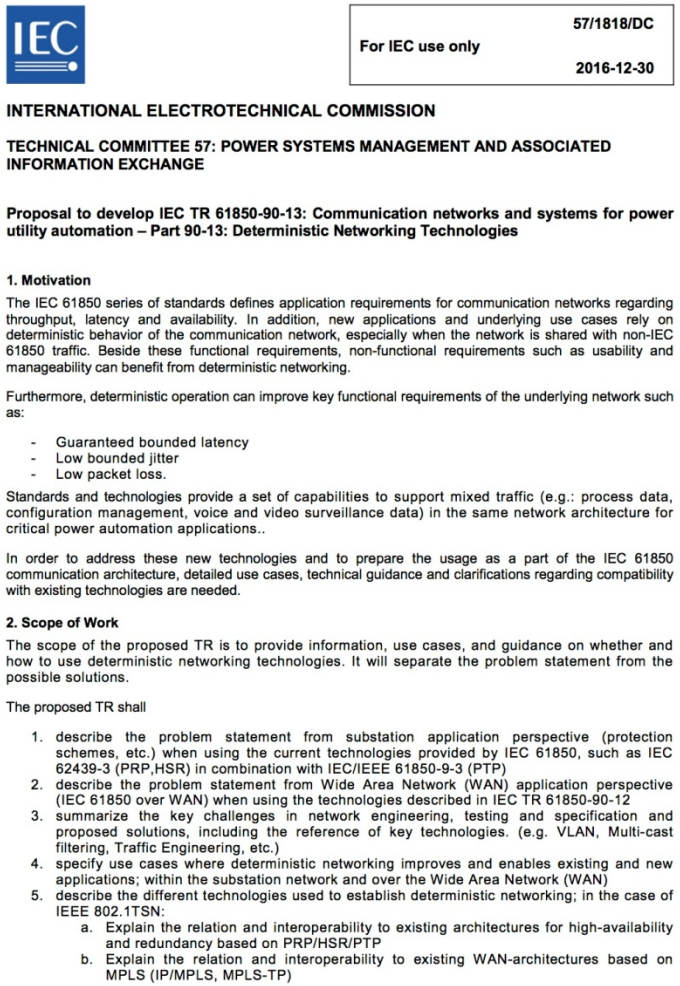


Status: No Fieldbus Variety in Power Automation

Intro – IEC 61850 Protocol Stack



Intro: TR IEC 61850-90-13



57/1818/DC

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2016-12-30

INTERNATIONAL ELECTROTECHNICAL COMMISSION

TECHNICAL COMMITTEE 57: POWER SYSTEMS MANAGEMENT AND ASSOCIATED INFORMATION EXCHANGE

Proposal to develop IEC TR 61850-90-13: Communication networks and systems for power utility automation – Part 90-13: Deterministic Networking Technologies

1. Motivation

The IEC 61850 series of standards defines application requirements for communication networks regarding throughput, latency and availability. In addition, new applications and underlying use cases rely on deterministic behavior of the communication network, especially when the network is shared with non-IEC 61850 traffic. Beside these functional requirements, non-functional requirements such as usability and manageability can benefit from deterministic networking.

Furthermore, deterministic operation can improve key functional requirements of the underlying network such as:

- Guaranteed bounded latency
- Low bounded jitter
- Low packet loss.

Standards and technologies provide a set of capabilities to support mixed traffic (e.g.: process data, configuration management, voice and video surveillance data) in the same network architecture for critical power automation applications..

In order to address these new technologies and to prepare the usage as a part of the IEC 61850 communication architecture, detailed use cases, technical guidance and clarifications regarding compatibility with existing technologies are needed.

2. Scope of Work

The scope of the proposed TR is to provide information, use cases, and guidance on whether and how to use deterministic networking technologies. It will separate the problem statement from the possible solutions.

The proposed TR shall

1. describe the problem statement from substation application perspective (protection schemes, etc.) when using the current technologies provided by IEC 61850, such as IEC 62439-3 (PRP,HSR) in combination with IEC/IEEE 61850-9-3 (PTP)
2. describe the problem statement from Wide Area Network (WAN) application perspective (IEC 61850 over WAN) when using the technologies described in IEC TR 61850-90-12
3. summarize the key challenges in network engineering, testing and specification and proposed solutions, including the reference of key technologies. (e.g. VLAN, Multi-cast filtering, Traffic Engineering, etc.)
4. specify use cases where deterministic networking improves and enables existing and new applications; within the substation network and over the Wide Area Network (WAN)
5. describe the different technologies used to establish deterministic networking; in the case of IEEE 802.1TSN:
   a. Explain the relation and interoperability to existing architectures for high-availability and redundancy based on PRP/HSR/PTP
   b. Explain the relation and interoperability to existing WAN-architectures based on MPLS (IP/MPLS, MPLS-TP)

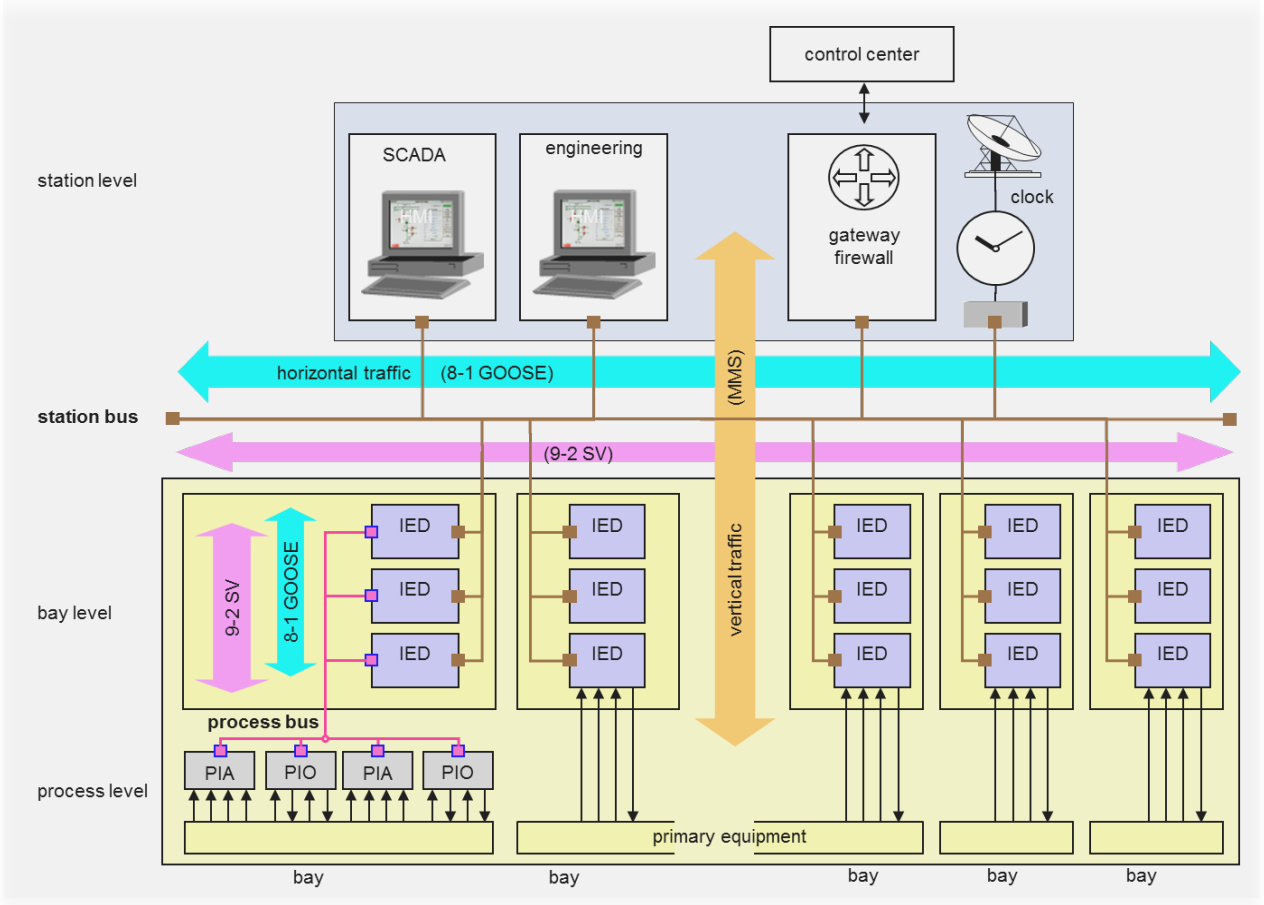
- The NWIP (IEC 61850-90-13: Deterministic Networking Technologies) has been approved in 2017
- A Task Force has started to develop the Technical Report on Deterministic Networking
- The TR covers LAN (Substation Automation Network) and WAN uses cases and applications
- Utility, Communication, and Device Experts (IED) are participating in this effort
- Liaisons with SC65C and with JWG IEC/IEEE 60802 & 802.1TSN in place/planned
- Compatibility and brown-field deployments are key concerns
- **DC finalized and in circulation (TC57 P-members are invited to comment until: 2019-DEC-06)**

IEC TR 61850-90-13: Content

- Problem Statement
- Determinism and converged networking
- Support and improvements for existing use cases (Substation, WAN)
- New use cases and opportunities (Converged Networking)
- Deterministic networking technologies (Overview)
- Relation of TSN to technologies such as SDN (Software Defined Networking) and NFV (Network Function Virtualization)
- Use Cases related to non-functional requirements: Usability, Manageability, Network Security, Multi-Service Architecture
- Future Utility Profile – Design Considerations
- Interoperability and Brownfield considerations

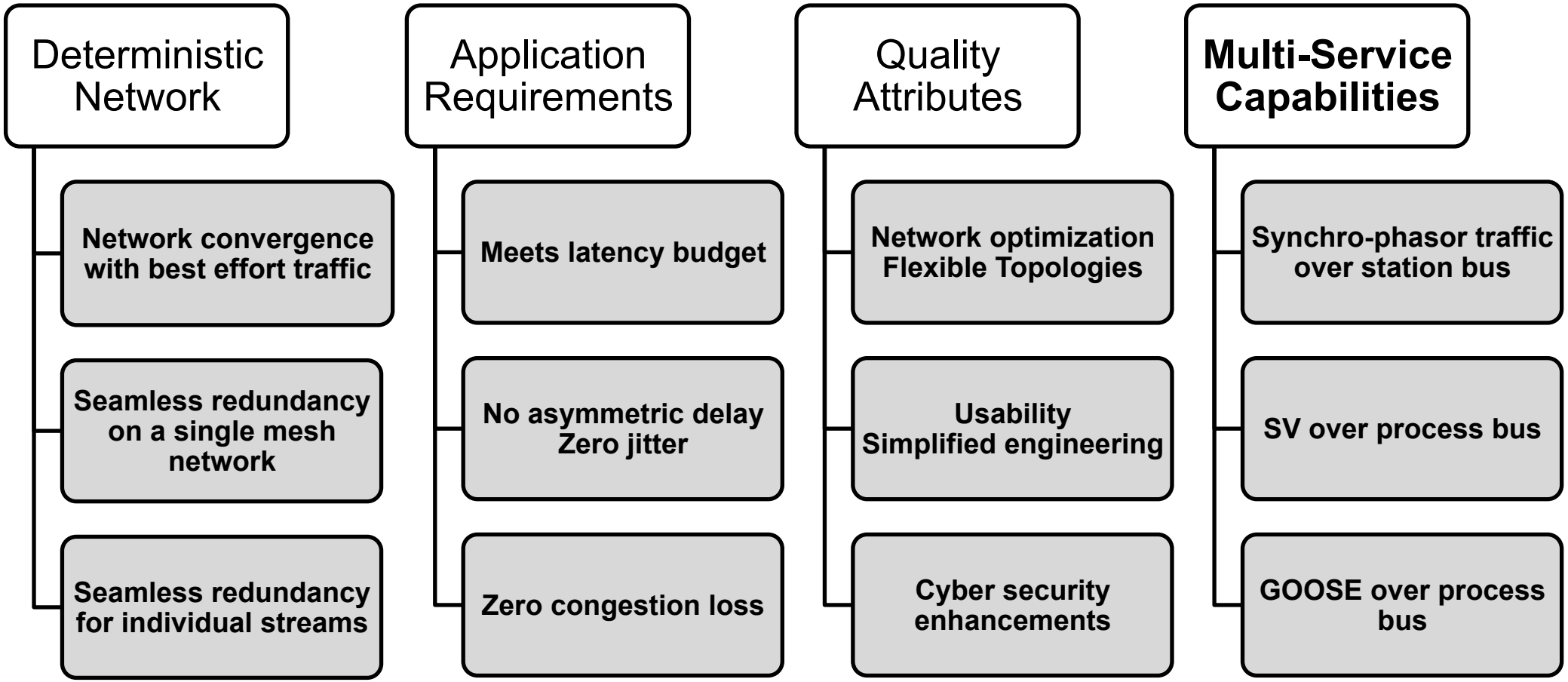
TF 61850-90-13: Current LAN-Architecture (in a nutshell)

Currently, the power automation industry uses a packet switched architecture (especially in substation automation) supported by high-speed Ethernet. In order to achieve the delay and packet loss requirements, the network bandwidth is overprovisioned, this providing very low efficiency in terms of resource usage.



Source: IEC TC57 WG10-IEC 61850

TF 61850-90-13: TSN-Benefits



IEC TR 61850-90-13 and IEC/IEEE 60802 (I)

- Requirements from IEC and from stakeholders to keep profile development in snych
- Worth noting: 90-13 is a TR, not a profile. Profile definitions might evolve moving forward with the development of IEC 61850-90-13
- 90-13 contains Design Considerations for a Future Utility Profile
  - It identifies traffic patterns and traffic type characteristics: periodicity, synchronized, guarantees, tolerance to interference/jitter, criticality, …
  - Characteristics are listed for IEC 61850 protocols (GOOSE, SV, MMS) and Non-61850 protocols (104, DNP3, management, audio/video, …)
- Key difference: in IEC 61850, GOOSE is a key function/protocol for protection applications (sporadic/event-based, deadline, latency, critical, no tolerance to loss)
- And, Time-synchronization in IEC 61850 is defined in IEC 61850-9-3. It is highly unlikely that IEC 61850 will adopt IEEE 802.1AS

IEC TR 61850-90-13 and IEC/IEEE 60802 (II)

- IEC/IEEE 60802 lists gaps in Annex Z; Item 12 contains:
  - *Do we need to specify link aggregation in support of event-based control?*
  - *http://www.ieee802.org/1/files/public/docs2018/60802-stanica-event-based-control-1118-v02.pdf*
  - *http://www.ieee802.org/1/files/public/docs2018/60802-stanica-link-aggregation- 1118-v02.pdf>*
- Comment: link aggregation is not a core need in IEC 61850, but traffic patterns might require a special mapping (shaping) as part of a profile

TF 61850-90-13: Objectives and Next Steps

- Support and improvements for existing use cases (Substation, WAN)
- Address new use cases and opportunities (Multi-Service capabilities based on converged networking)
- Utility Automation Profile in synch with IEC/IEEE 60802
- Interoperability and Brownfield is key (based on a user survey)

- Depending on the results of the DC circulation, the following steps are thinkable:
  - DC2
  - Development of an Utility Automation TSN-Profile
  - Integration of the outcome into the relevant standards of IEC 61850

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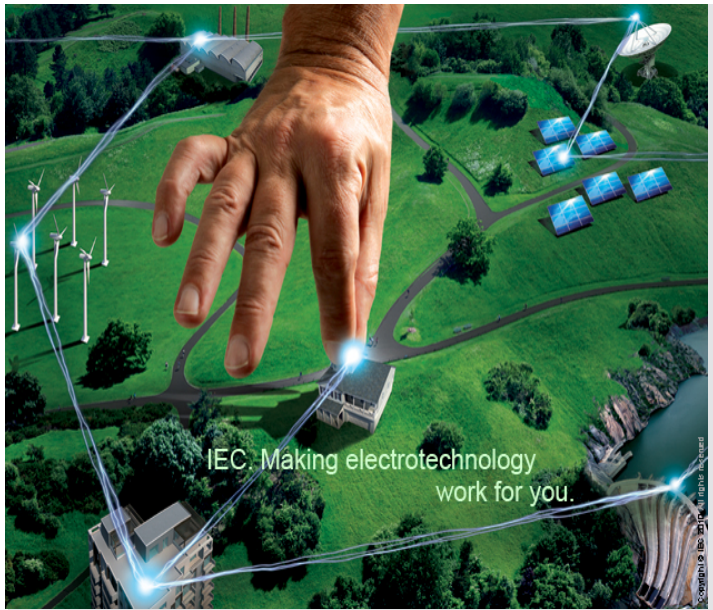
Questions?



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