Short Ethernet Frames

Automotive Use Case

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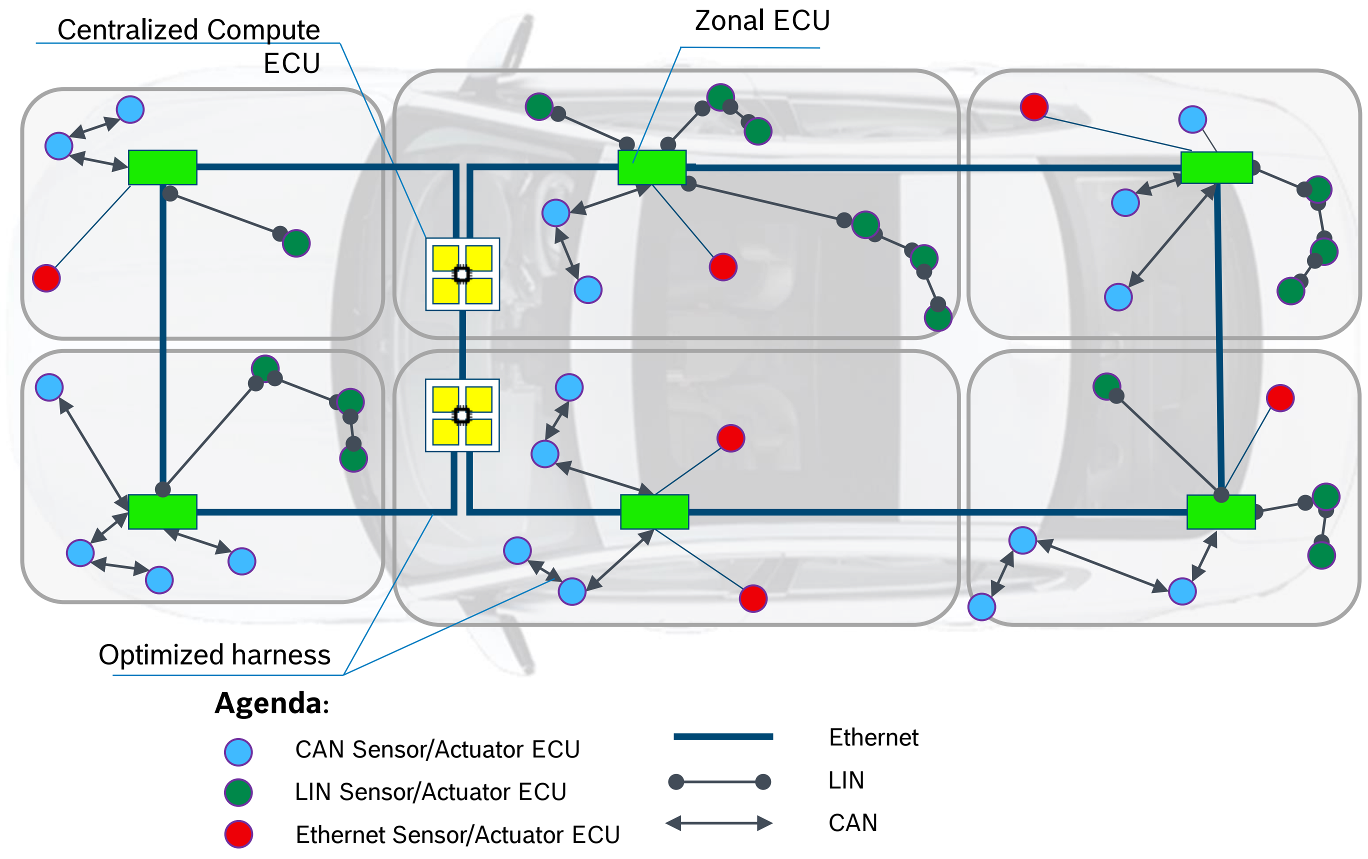
This topic was already presented in IEEE 802.3 NEA - in cooperation with Johannes Specht - and the following slides are a continuation of this contribution.

This contribution is not related to any profile discussion in IEEE 802.1DG. The aim of this presentation is to start a new discussion about “Short Ethernet Frames” at IEEE 802.1 TSN.

If there is a standard for shorten Ethernet Frames - which is currently not the case - a profile such as IEEE 802.1DG may can nominate this standard.

Short Ethernet Frames: Automotive Use Case
Assumptions



- Zonal architecture
- Zonal ECUs are connected with legacy communication, e.g., LIN, CAN
- Tunneling of legacy communication over Ethernet is required
  1. Zonal-to-Zonal ECU, and/or
  2. Zonal ECU-to-Centralized Compute ECU-to-Zonal ECU

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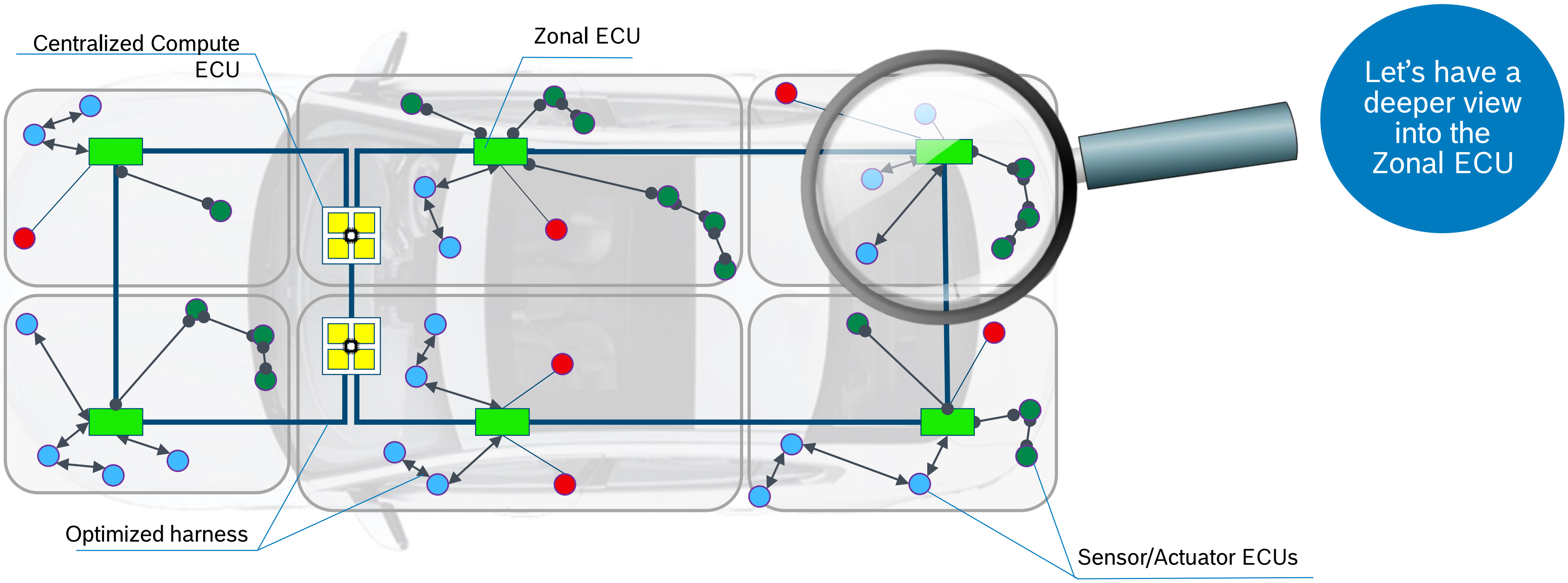
Short Ethernet Frames: Automotive Use Case
Deeper view of communication aspect



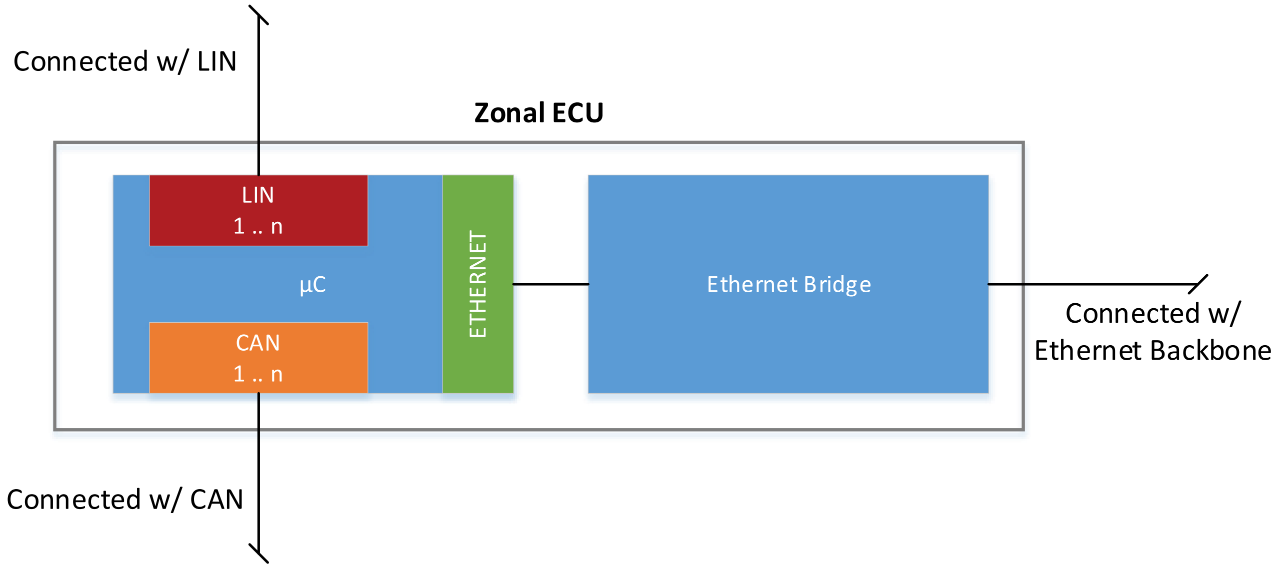
Short Ethernet Frames: Automotive Use Case
Deeper view of communication aspect

Focus:

- LIN and CAN communication & tunneling from Zonal ECU over the Ethernet backbone, via IEEE 1722-2016

An **easy** view of a Zonal ECU

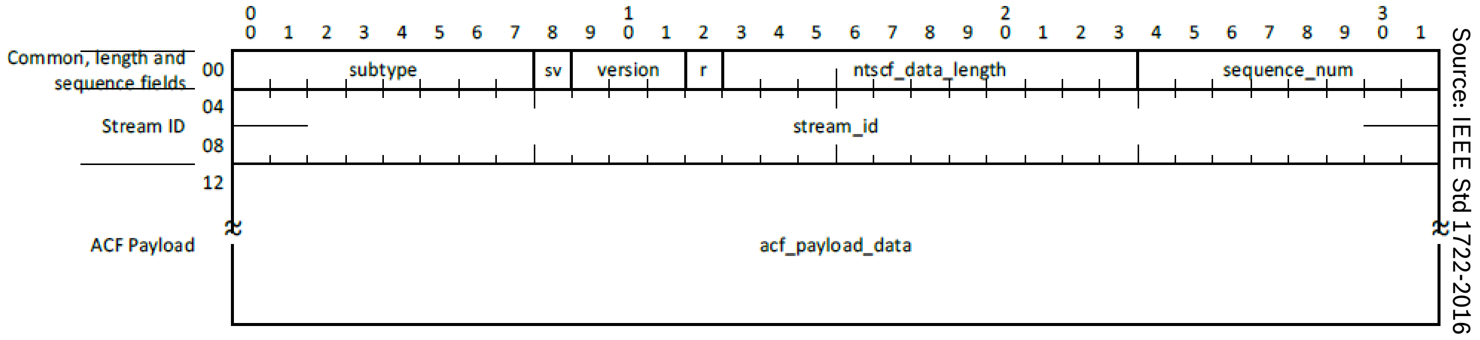
- Internal µC has legacy communication, e.g., CAN, LIN



Short Ethernet Frames: Automotive Use Case

Background: IEEE 1722-2016 (1/3)

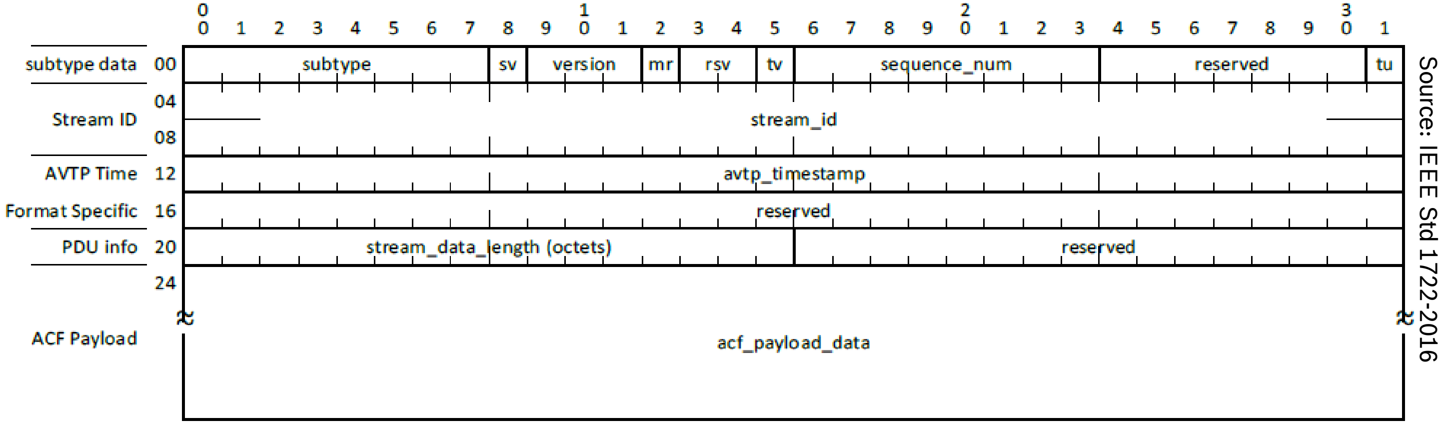
- Two different Control header:
  - **Non–Time-Synchronous Control Format header (NTSCF)**



Header size:

12 octets

- **Time-Synchronous Control Format header (TSCF)**



Header size:

24 octets

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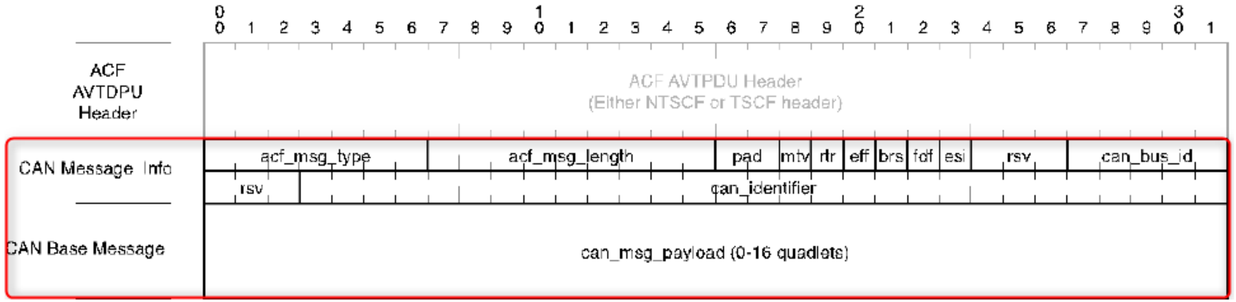
Short Ethernet Frames: Automotive Use Case
Background: IEEE 1722-2016 (2/3)

- Different ACF messages for different automotive legacy communication
  - **Abbreviated CAN**

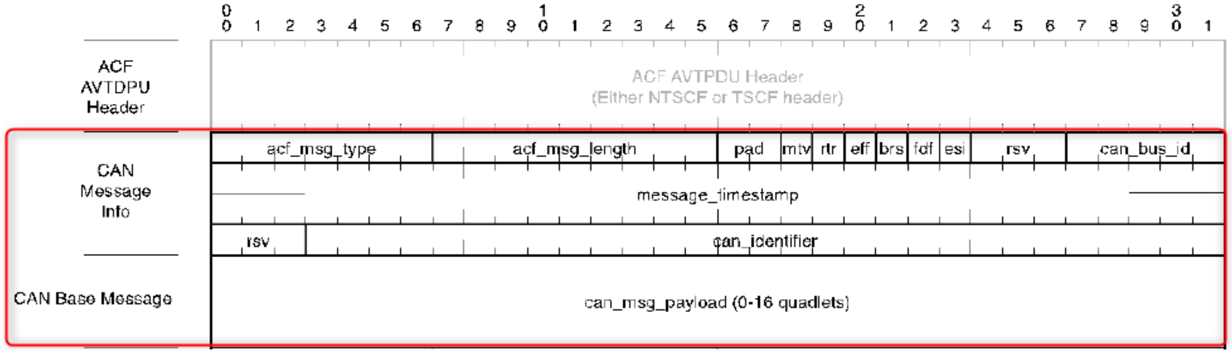


Source: IEEE Std 1722-2016

Message size (min/max payload) for **Classic CAN**:

8 octets / 16 octets

  - **CAN**



Source: IEEE Std 1722-2016

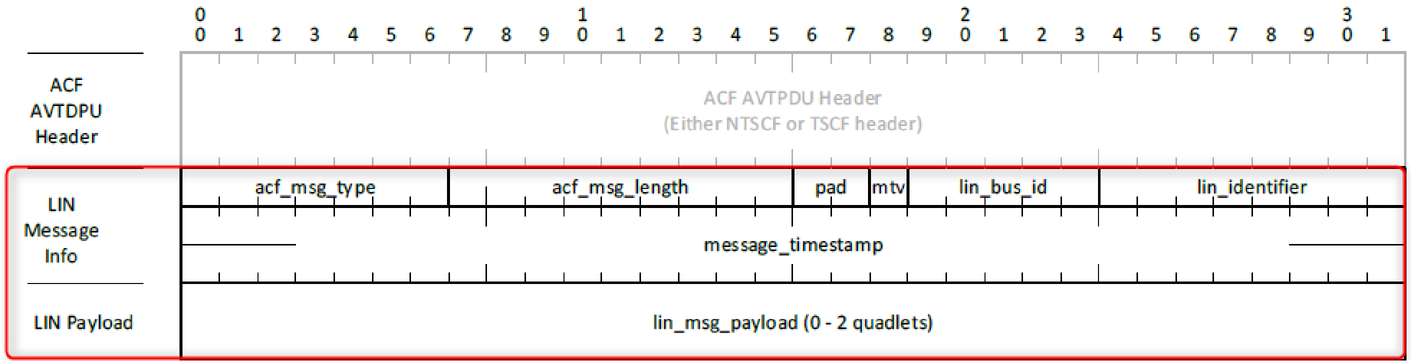
Message size (min/max payload) for **Classic CAN**:

16 octets / 24 octets

Short Ethernet Frames: Automotive Use Case

Background: IEEE 1722-2016 (3/3)

– **LIN**



Source: IEEE Std 1722-2016

Message size (min/max Payload) for **LIN**:

12 octets / 20 octets

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Ethernet Frame Length by using IEEE 1722-2016

Ethernet Frame (IEEE 802.3)

Preamble	Destination MAC	Source MAC	IEEE 802.1Q Tag (optional)	Ethertype/ Length	IEEE 1722-2016: NTSC header/ TSC header	IEEE 1722-2016: ACF message	CRC	IFG
8 octets	6 octets	6 octets	4 octets	2 octets	12/24 octets	Legacy Payload Inside	4 octets	12 octets

	Non-Time-Synchronous Control Saving (in %) for min. and max. legacy payload	**Time-Synchronous Control** saving (in %) for min. and max. legacy payload
Abbreviated CAN (Classic CAN)	**Frame w/ IEEE 802.1Q tag:** ▶ 26.2% ▶ 16.7% **Frame w/o IEEE 802.1Q tag:** ▶ 31.0% ▶ 21.4%	**Frame w/ IEEE 802.1Q tag:** ▶ 11.9% ▶ 2.4% **Frame w/o IEEE 802.1Q tag:** ▶ 16.7% ▶ 7.1%
CAN (Classic CAN)	**Frame w/ IEEE 802.1Q tag:** ▶ 16.7% ▶ 7.1% **Frame w/o IEEE 802.1Q tag:** ▶ 21.4% ▶ 11.9%	**Frame w/ IEEE 802.1Q tag:** ▶ 2.4% ▶ **no saving** **Frame w/o IEEE 802.1Q tag:** ▶ 7.1% ▶ **no saving**
LIN	**Frame w/ IEEE 802.1Q tag:** ▶ 21.4% ▶ 11.9% **Frame w/o IEEE 802.1Q tag:** ▶ 26.2% ▶ 16.7%	**Frame w/ IEEE 802.1Q tag:** ▶ 7.1% ▶ **no saving** **Frame w/o IEEE 802.1Q tag:** ▶ 11.9% ▶ 2.38%

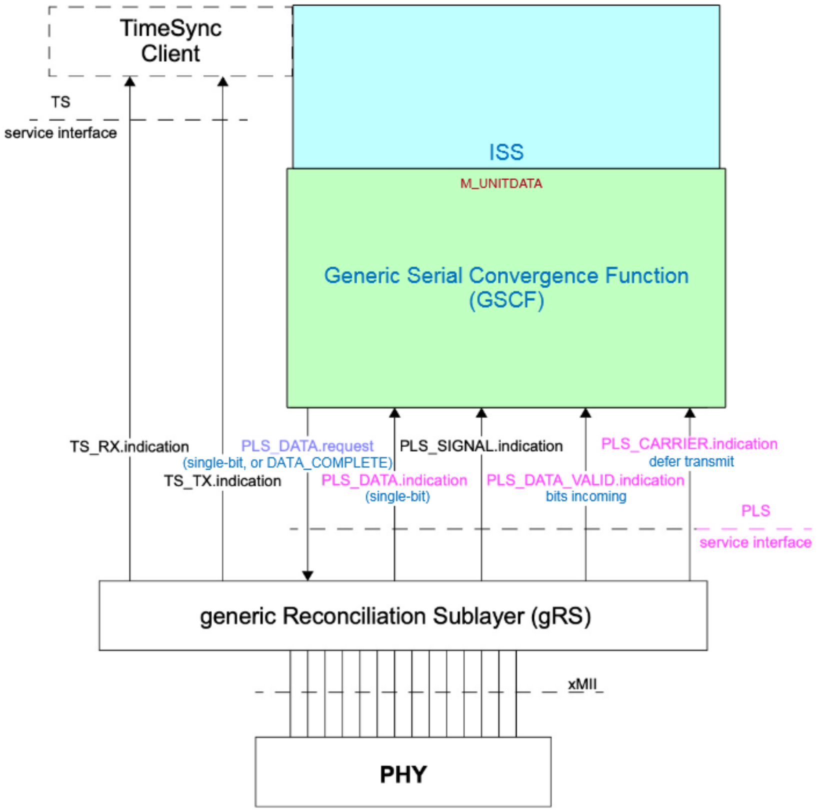
21 out of 24 cases the Ethernet Frame length is smaller than 84 octets

– only in 3 cases it is greater than 84 octets

Short Ethernet Frames: Automotive Use Case
How could be realized?

- Current Media Access Control (MAC) requires a minimum Ethernet Frame size of 84 octets
- There is a need to shorten the Ethernet Frame size
- Possible options for starting and realizing this activity:
  1. Enhance the MAC
  2. Create an additional MAC
  3. **Use the GSCF approach, as discussed in 802 Nendica/IEEE 802.1**

- GSCF does not depend on the 802.3 MAC's 84 octets minimum length constraint
  - *LEN_MIN* in [Technical Description for Cut-Through Forwarding in Bridges] and *lenmin* in [Generic Serial Convergence Function (GSCF)]
  - GSCF could be an enable for shorter Ethernet Frames in Automotive



Source: Generic Serial Convergence Function (GSCF)
For information about the GSCF, please have a deeper look on following pages of the referred source: 10, 19, 26 and 28

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Short Ethernet Frames: Automotive Use Case

Summary

- For automotive it would be **useful** of reducing the min. Ethernet Frame size below 84 octets
  - **The benefits are:**
    - increase bandwidth efficiency, as shown
    - decrease interference/delays
    - decrease complexity/delays
      (less multi legacy message packing in Ethernet frames)

- Legacy Traffic
  - Especially in case of tunneling automotive legacy communication into the Ethernet backbone and vice versa by using IEEE 1722-2016 transport protocol
  - **21 out of 24 cases** has been proven an advantage of reducing the min. Ethernet Frame size of 84 octets
  - Shorter headers other than 1722 may appear in future while legacy communication is assumed to remain for a longer period of time. In this case, the bandwidth efficiency **would increase further** by reducing the min. Ethernet Frame size

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Thank you for **your attention**