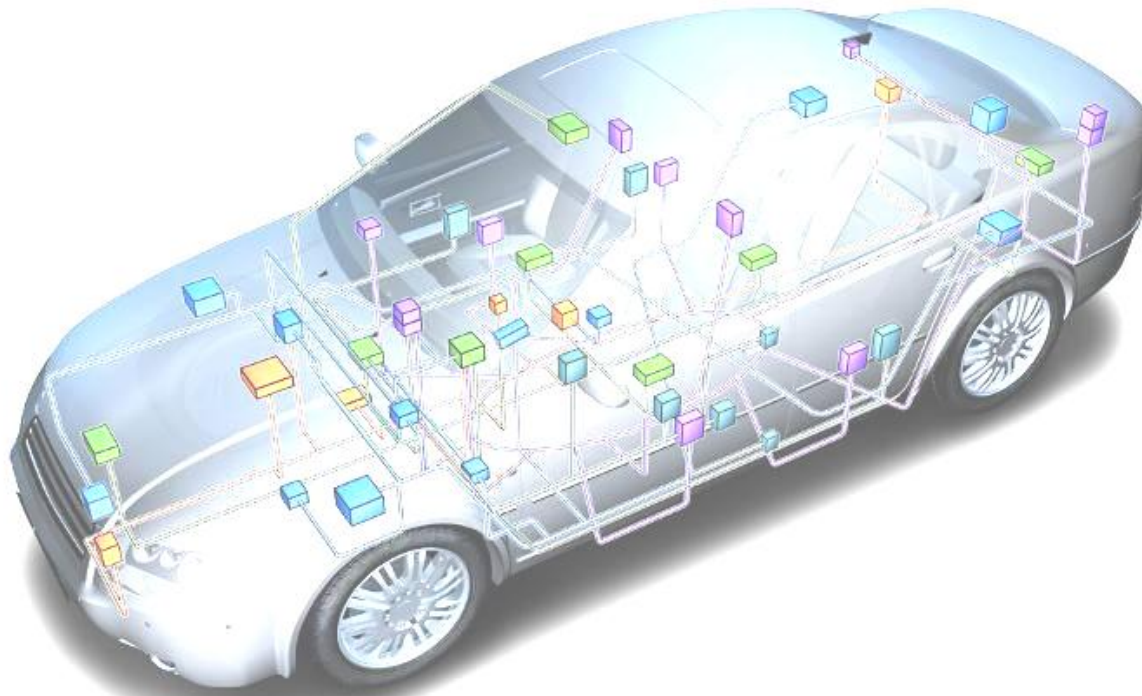




Automotive Gateways

Bridge & Gateway from FlexRay/CAN/LIN to AVB Networks



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Content

- Gateways in current/future architectures
- Main GW functions (Routing, Diagnostic, ...)
- Main principles of GW's functionality (SW aspects, protocol aspects, AUTOSAR aspects)
- LIN/CAN/FlexRay 2 Ethernet transport mechanisms (1722a)
- GW performance aspects
- Ethernet GW/Switch in future EE architectures

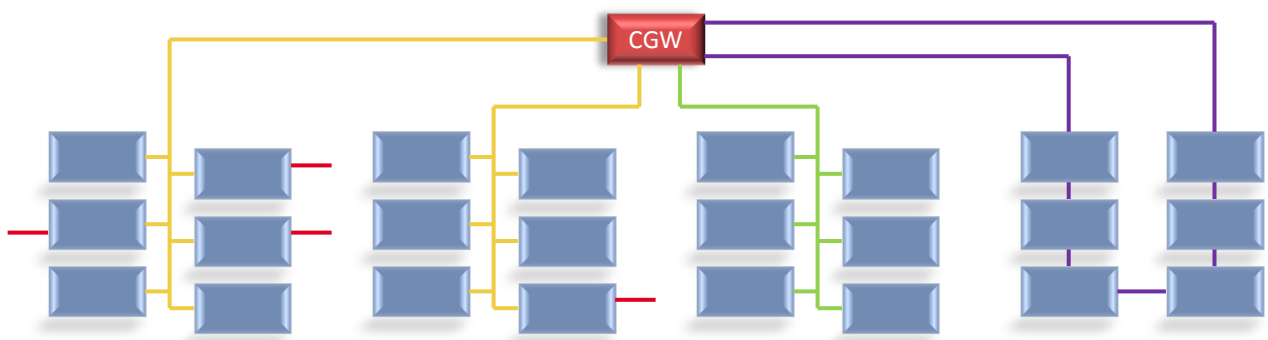


Gateways in current/future architectures

Transition from Central Gateway to Backbone Arch



Today



CAN (FD)

LIN

FlexRay

MOST

Ethernet

CGW

Central Gateway

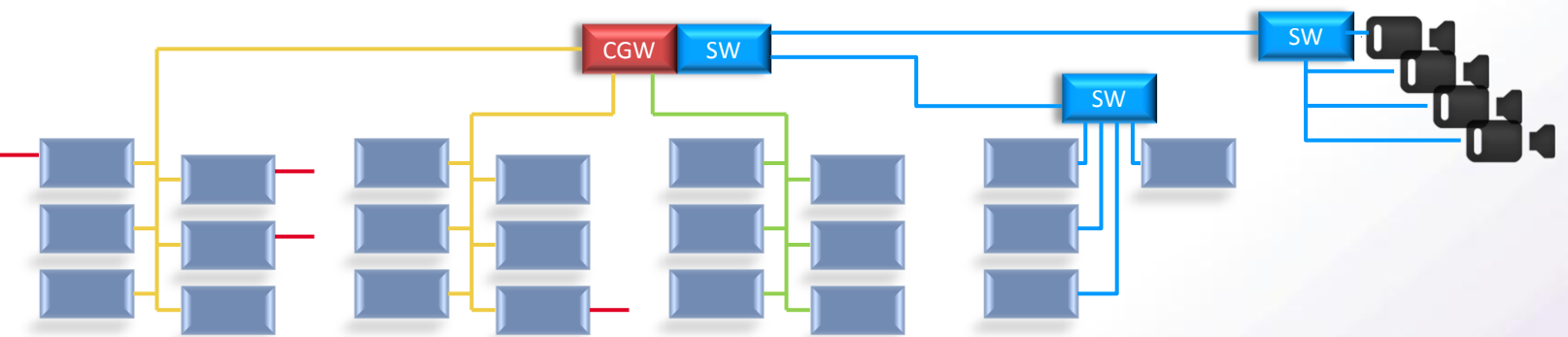
DCU

Domain Control Unit

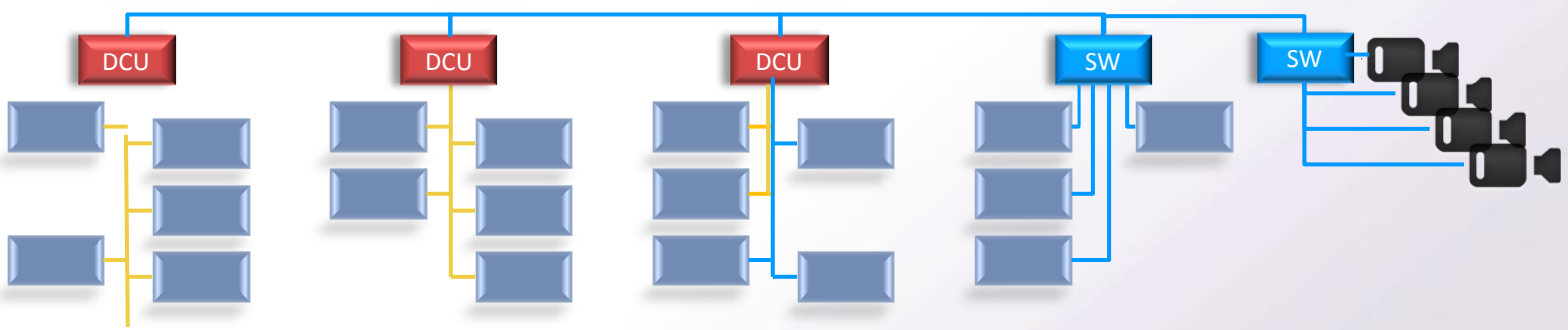
SW

Switch

Mid-term



Long-term





Characteristics of different GW types*

	No. of interfaces	No. of GWs per vehicle	Diagnostic interface	Comments
Central GW	any no. of LIN/CAN/FR	≤ 1	x	Increasing no. of itfs.
Local GW	1 x domain bus itf. n x subdomain bus itfs.	≥ 0	-	
Domain GW	1 x domain bus itf. 1-2 x backbone itf.	≥ 0	possible	
GW with integrated Switch	any no. of LIN/CAN/FR/Eth	≥ 0	possible	

* From the EE architecture point of view



**Main GW functions
(Routing, Diagnostic, ...)**

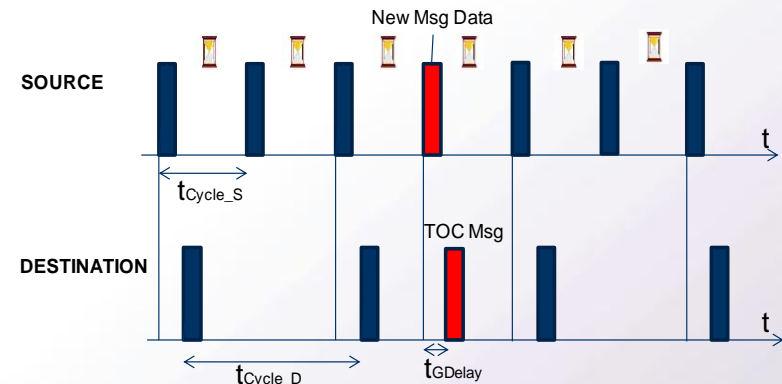


Routing Features



- Message Routing
- Packet Routing
- Signal Routing (eventually with signal processing)
- Routing with High Priority
- Different sorts of rate adaption between received and transmitted message, e.g.

Periodic & Immediate Transmit On Change (TOC)



- Y Routing
- Diagnostic Routing



Other Gateway Functions

- Nominal-actual configuration comparison
- Diagnostic tester
 - CAN and Ethernet interface provided
- Flash function
- Message mirroring on diagnostic bus
- Network management
- OEM specific features

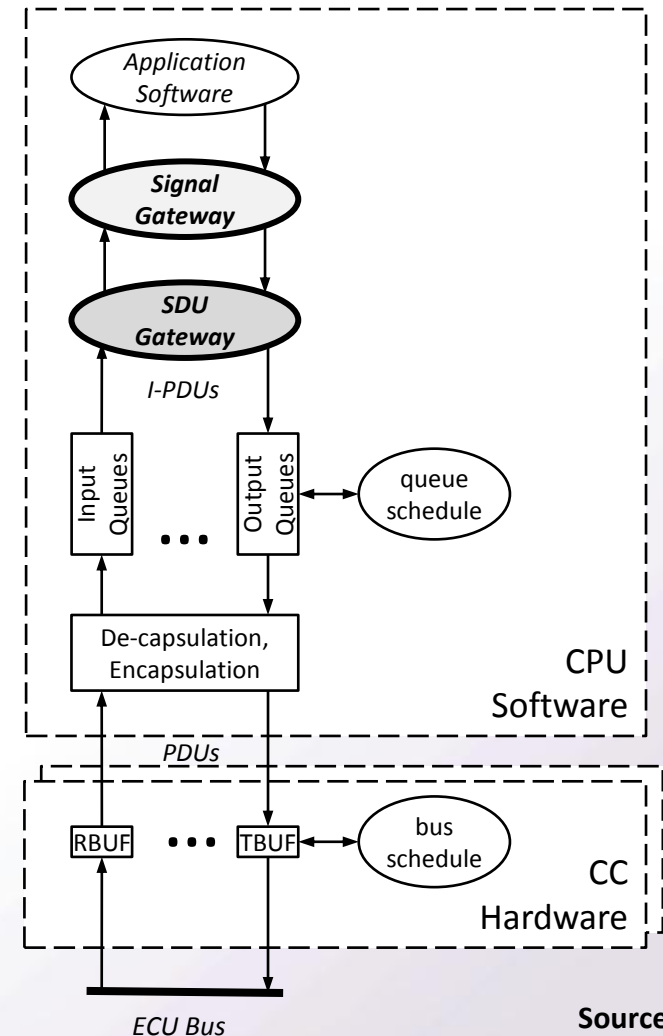
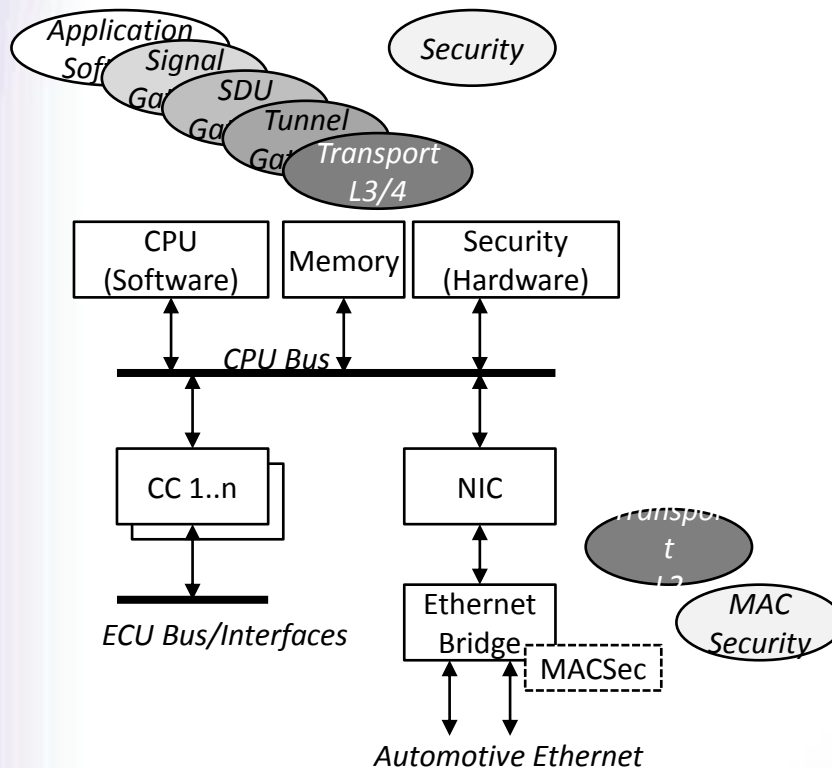
Components Configuration	ECU_1	ECU_2	ECU_3	ECU_4
	ECU_1	ECU_2	ECU_3	ECU_4
Nominal	1	1	0	1	...
Actual	1	0	0	1	...



**Main principles of GW's functionality
(SW aspects, protocol aspects,
AUTOSAR aspects)**

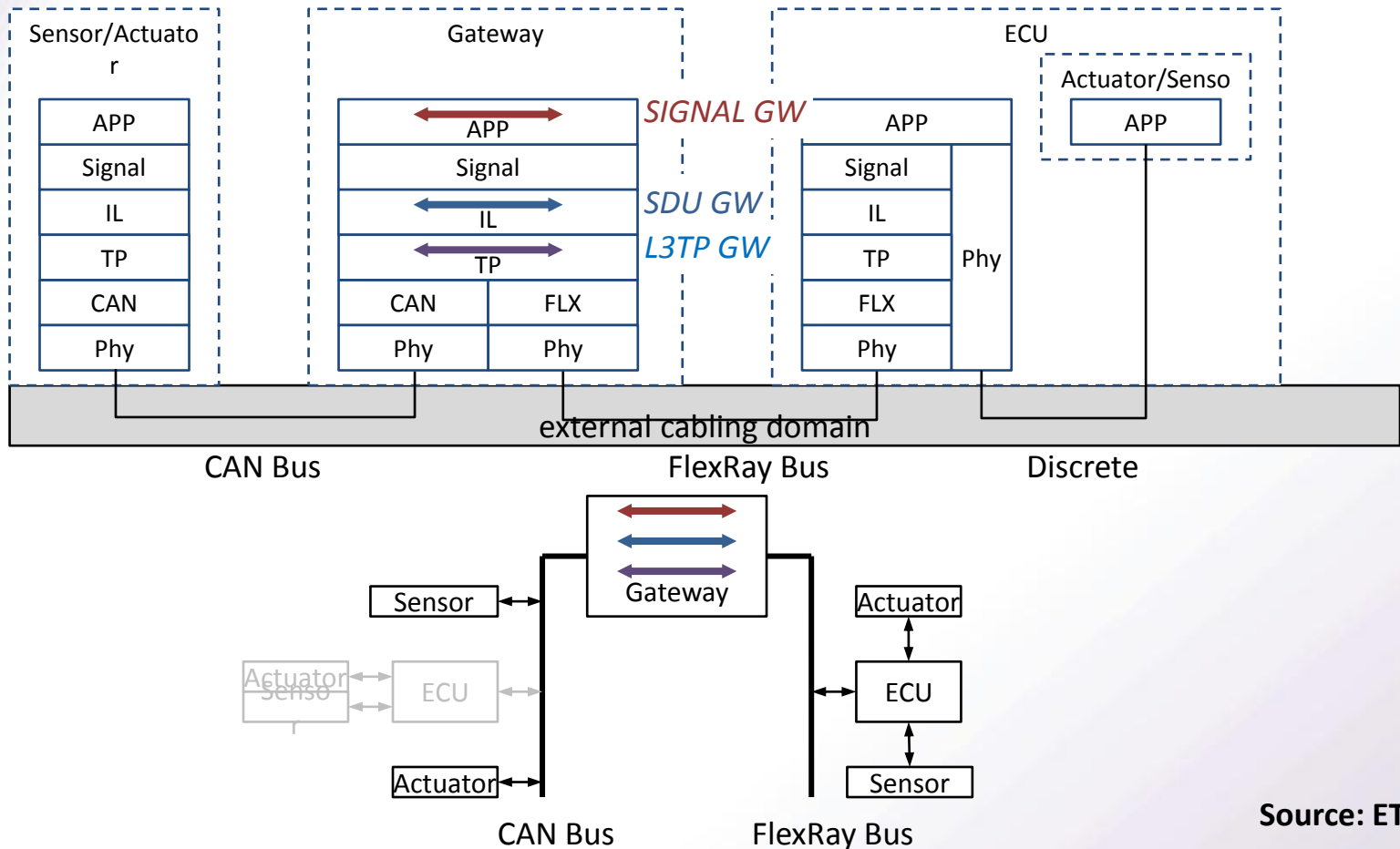


State of the Art: Software Gateway in Central Processing Unit (CPU)





Gateway Protocol Stack Overview



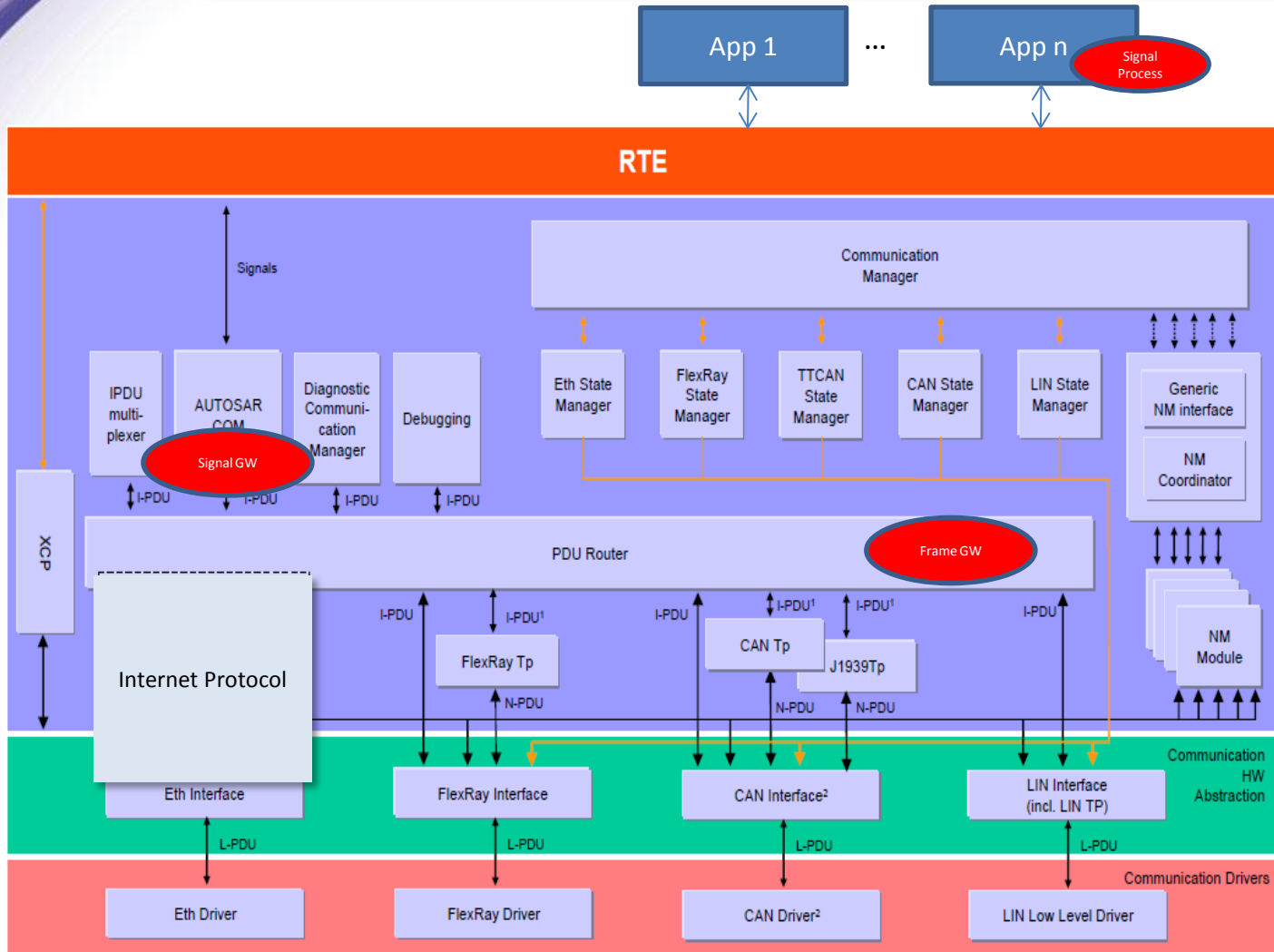
Source: ETAS

Notes:

IL = Interaction Layer according OSEK Comms 3.03 and AUTOSAR; adopts messages/signals to PDUs



AUTOSAR Aspects



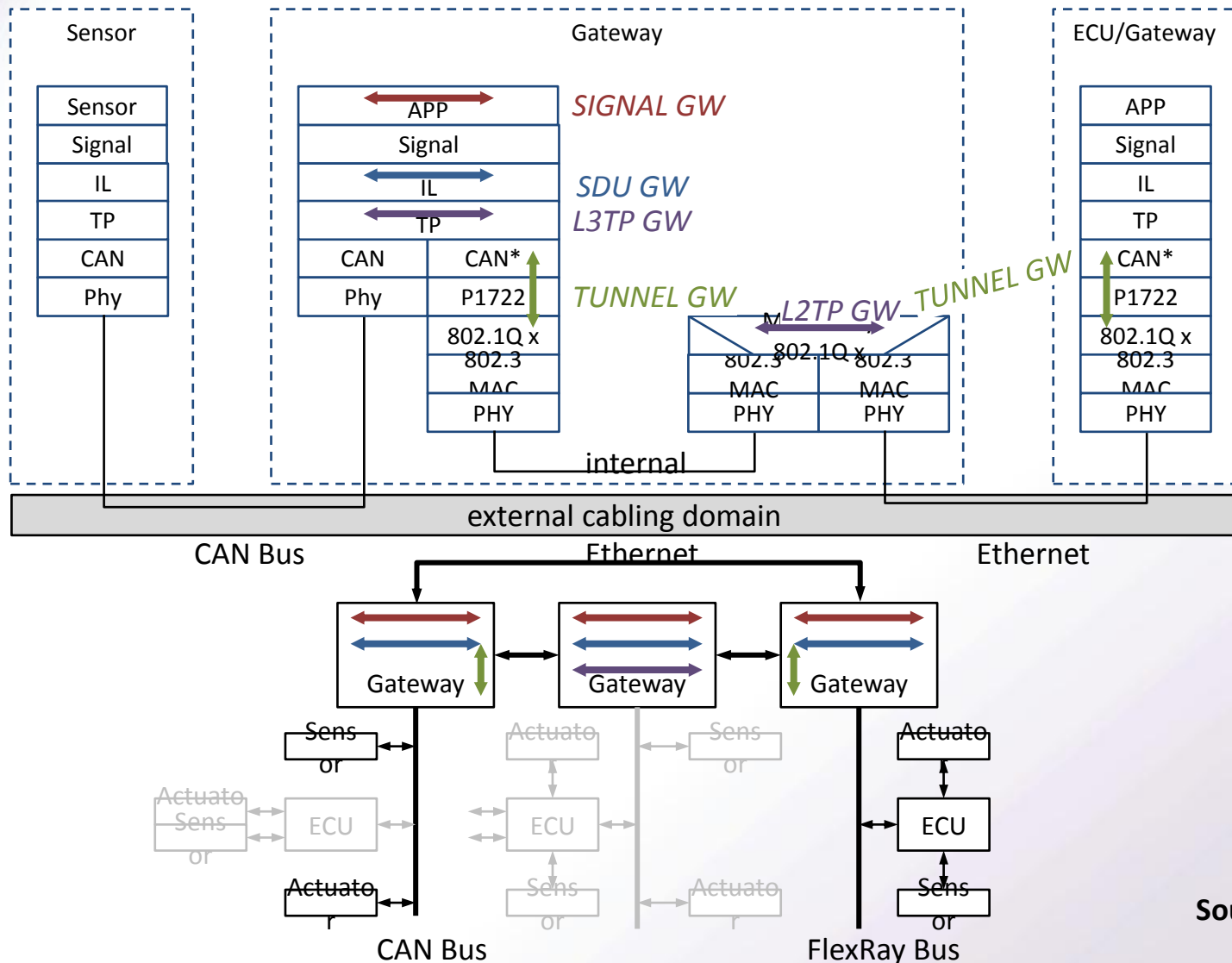
- Message Routing performed in the PDU Router
- Signal Routing performed in AUTOSAR COM
- Signal Processing performed in Apps



**LIN/CAN/FlexRay 2 Ethernet
transport mechanisms (1722a)**

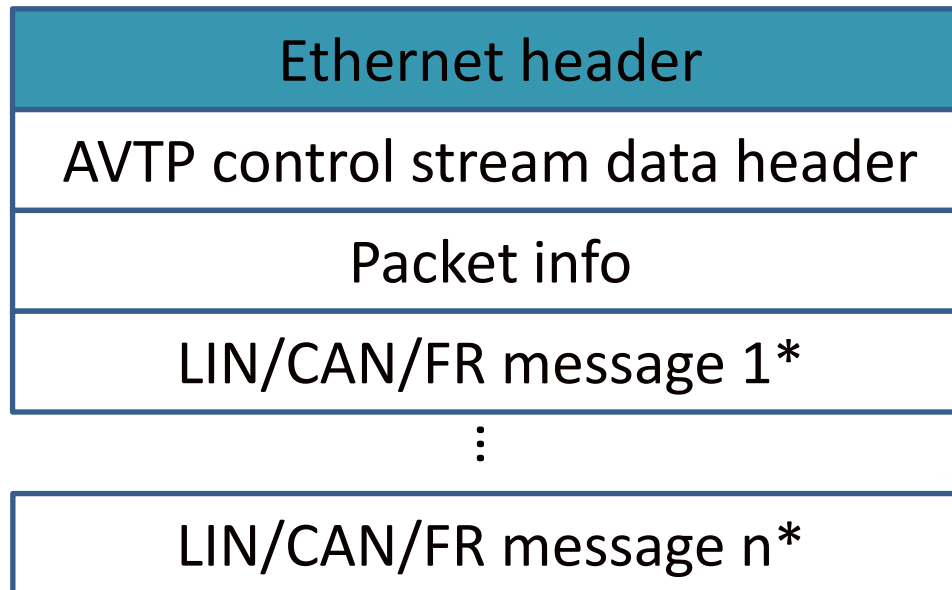


Gateway Protocol Stack with 1722 Tunneling





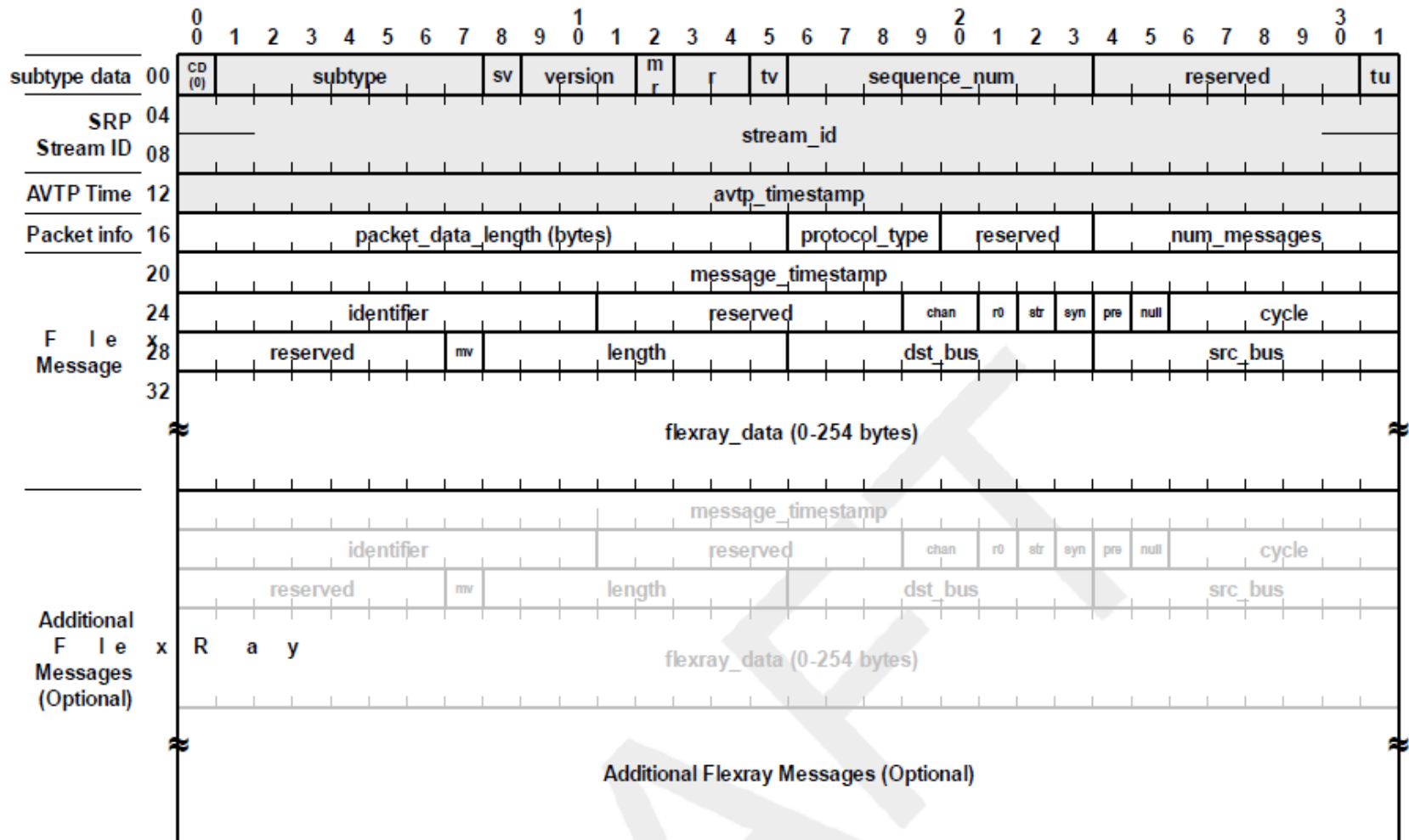
1722a Ctrl Stream Data Generic Frame Format



* only messages of the same type allowed in one frame



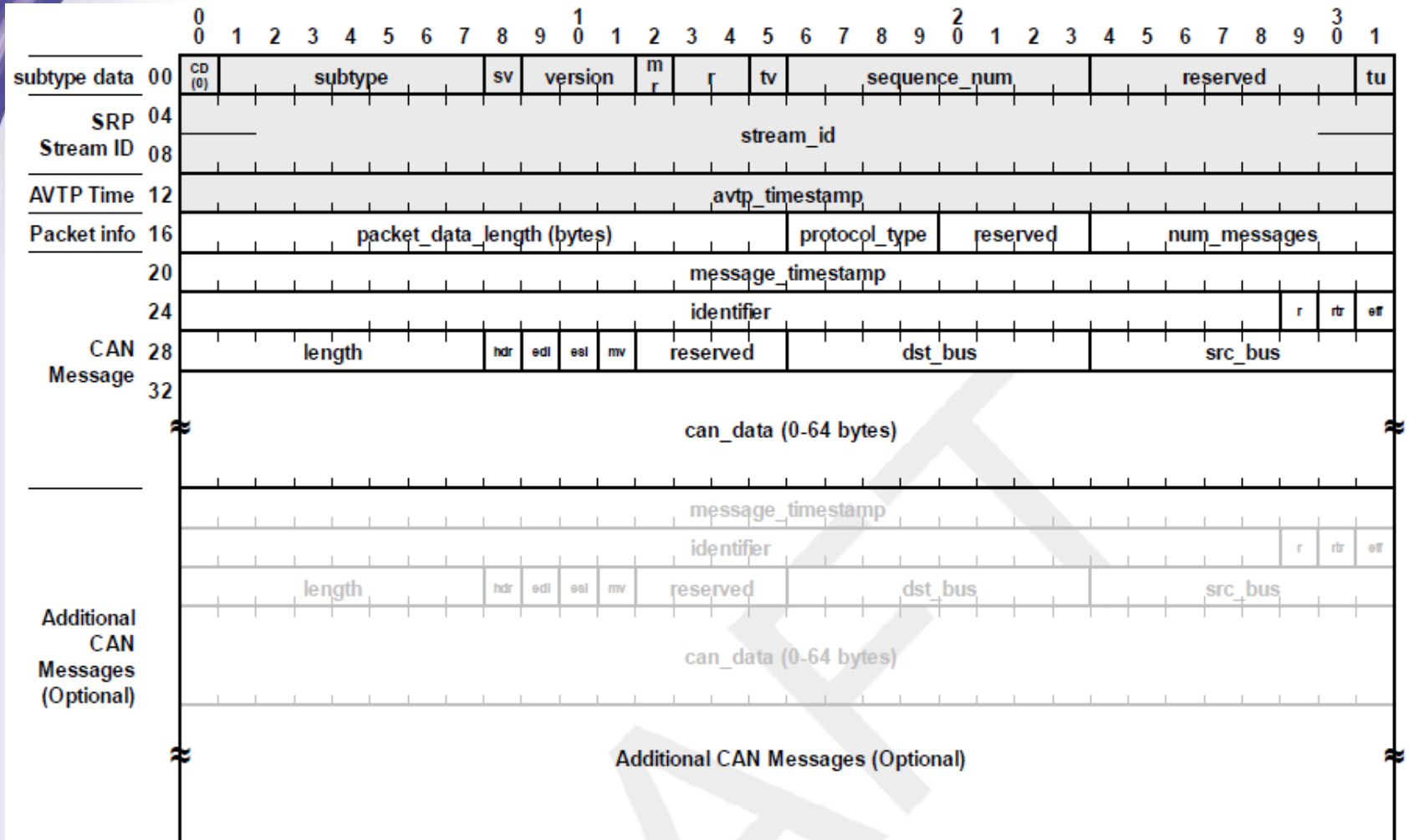
1722a FlexRay PDU Format



→ The FlexRay PDU consists of a control stream PDU and one or more FlexRay messages



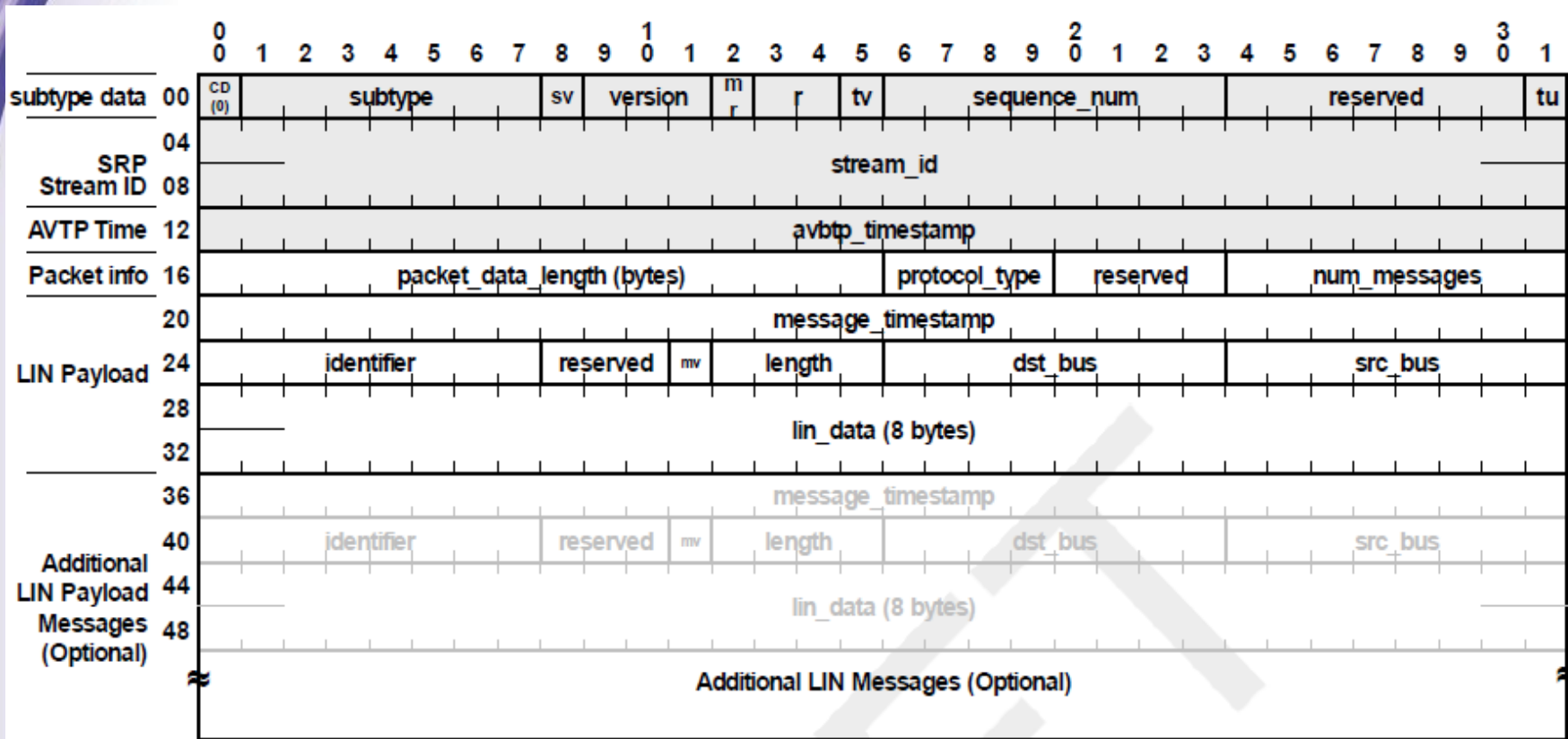
1722a CAN PDU Format



→ The CAN extended PDU consists of a control stream PDU and one or more CAN extended messages



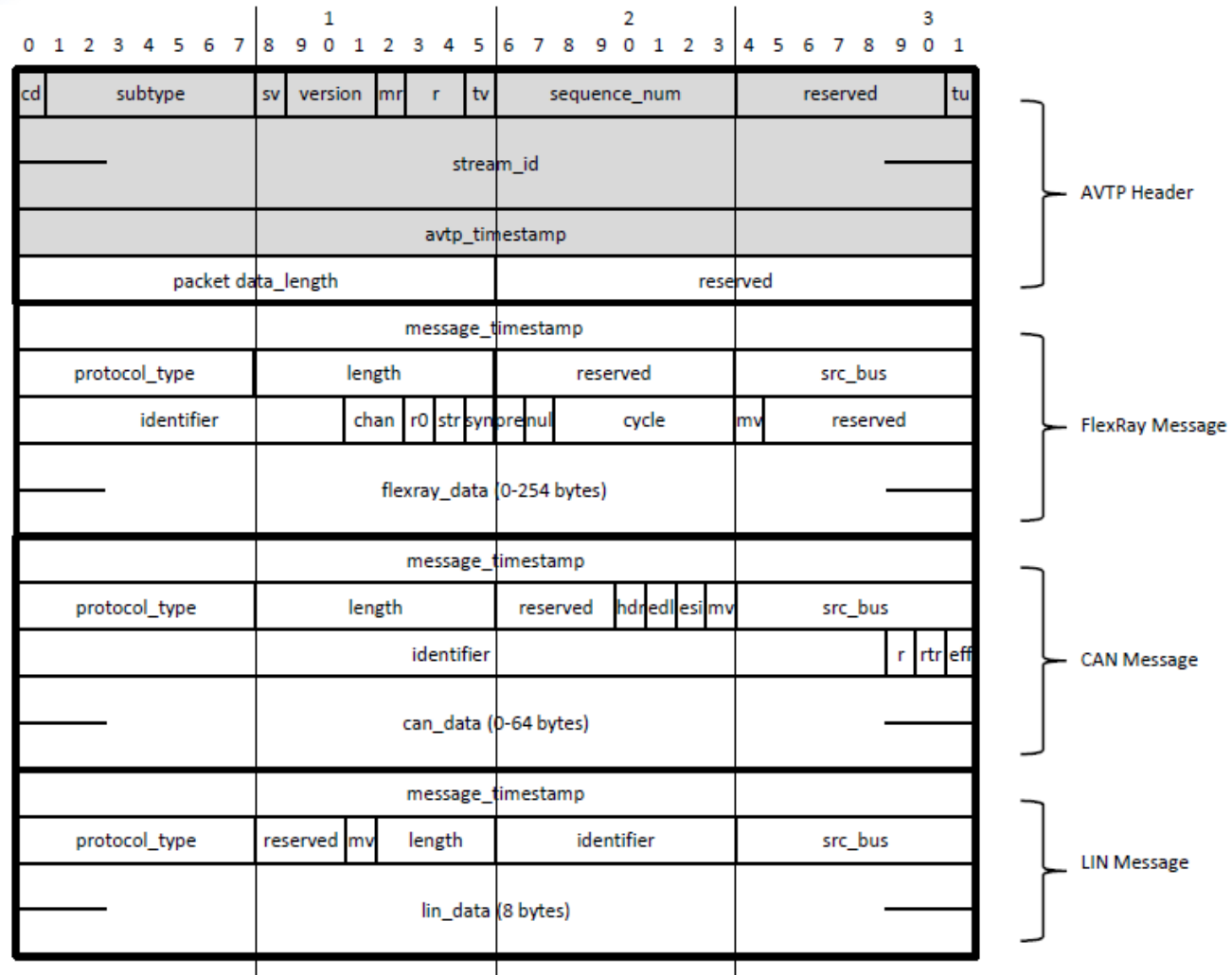
1722a LIN PDU Format



→ The LIN PDU consists of a control stream PDU and one or more LIN messages



ETAS Contribution to IEEE 1722a



→ Optimized Gateway Messages: The transport PDU consists of a control stream PDU and one or more LIN, CAN, FR messages

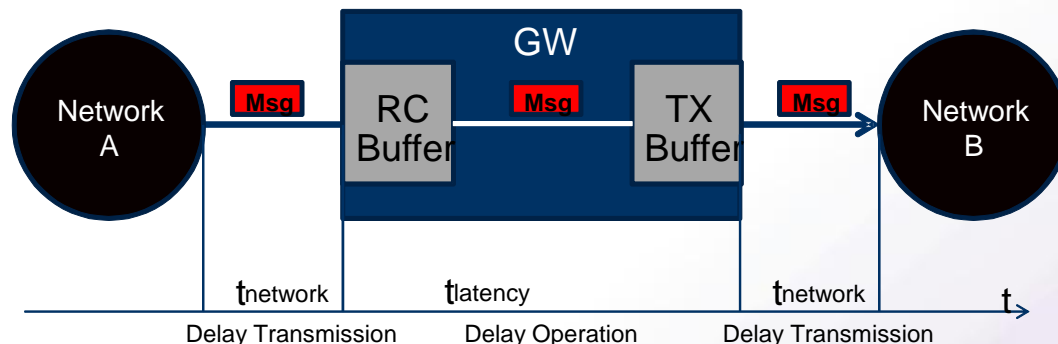


GW performance aspects



GW performance aspects

- The routing performance should allow all messages received on several buses with 100% load to be loss-free transmitted on the destination interfaces (which are considered to be in ideal condition)
- Latency time requirements are strongly OEM specific, e.g.:
 - OEM1: $t_{\text{latency}} < 2 \text{ ms}$
 - OEM2: $t_{\text{latency}} < 500 \mu\text{s}$
 - Toyota's ultra low latency: $100\mu\text{s}$ over 5 hops, i.e. $20\mu\text{s}/\text{hop}$



- Startup time (time needed to start communication)

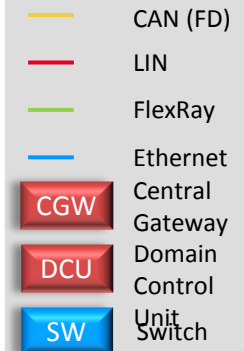
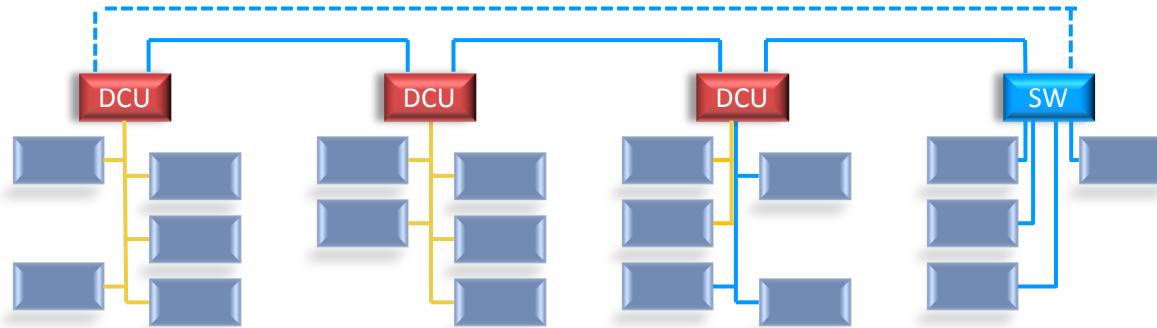


Ethernet GW/Switch in future EE architectures

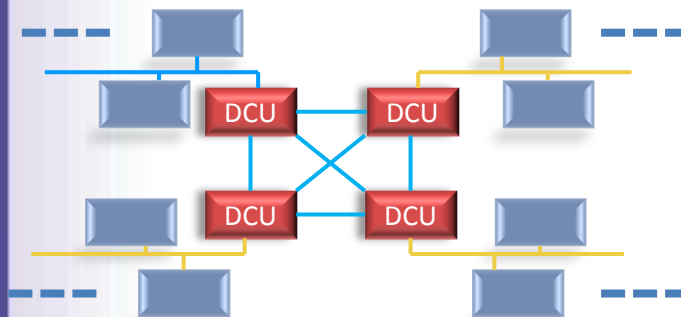


Ethernet GW/Switch in future EE architectures

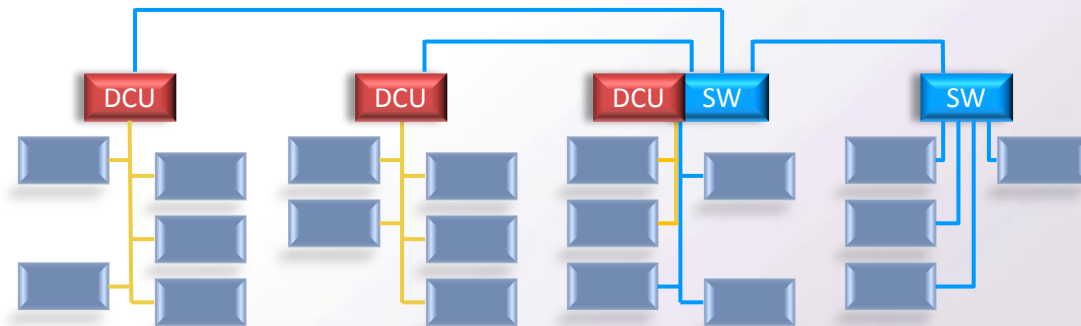
Daisy Chain with
optional
redundant path



Switched Architecture CGW inspired



Full Meshed redundant
Backbone



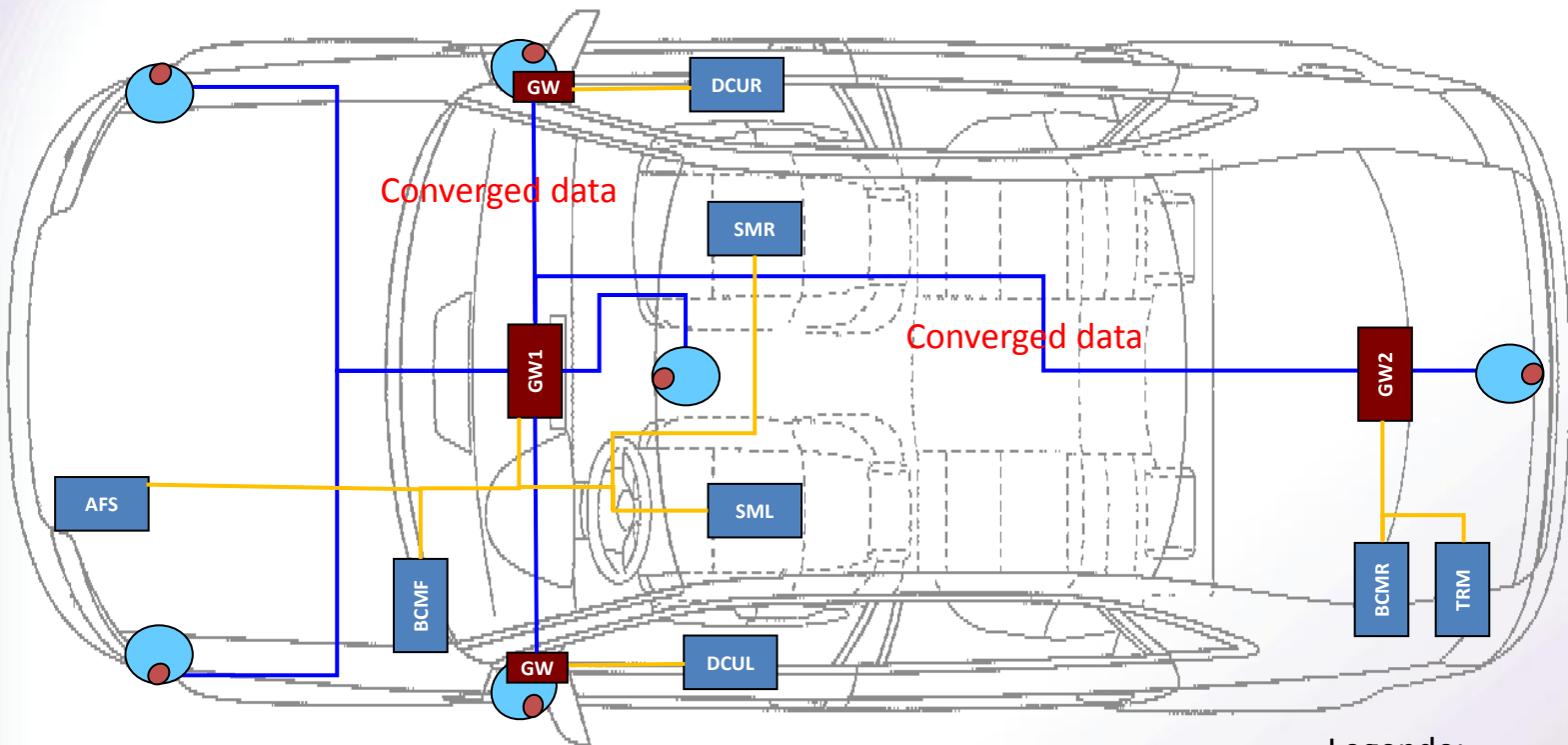


Gateway as possible Time Master

- TBD hope to get the permission from an OEM to insert a slide



Gateway as convergence device



- ➔ Zone oriented architecture makes use of Ethernet backbone (which connects all main areas of the vehicle)
- ➔ Inside the zone CAN/LIN networks
- ➔ Ethernet AVB ensures data type convergence on backbone

Legende:

- Video camera
- Gateway + Switch
- ECU
- Ethernet
- CAN (FD)



Thank you!



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