USE CASES & REQUIREMENTS FOR IEEE802.3 RTPGE

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Contents

- Goals and Objectives for IEEE802.3 RTPGE
  - Use cases and future architectures for the automotive industry
  - Background information for basic understanding on why and how the automotive industry intends to employ Gbps Ethernet
  - The first draft of requirements
- Use Cases
  - Domain Architecture and Backbone
  - Driver Assistance Applications
  - Infotainment and Connectivity Applications
  - Powertrain and Chassis
- Automotive Requirements for IEEE802.3 RTPGE

Disclaimer

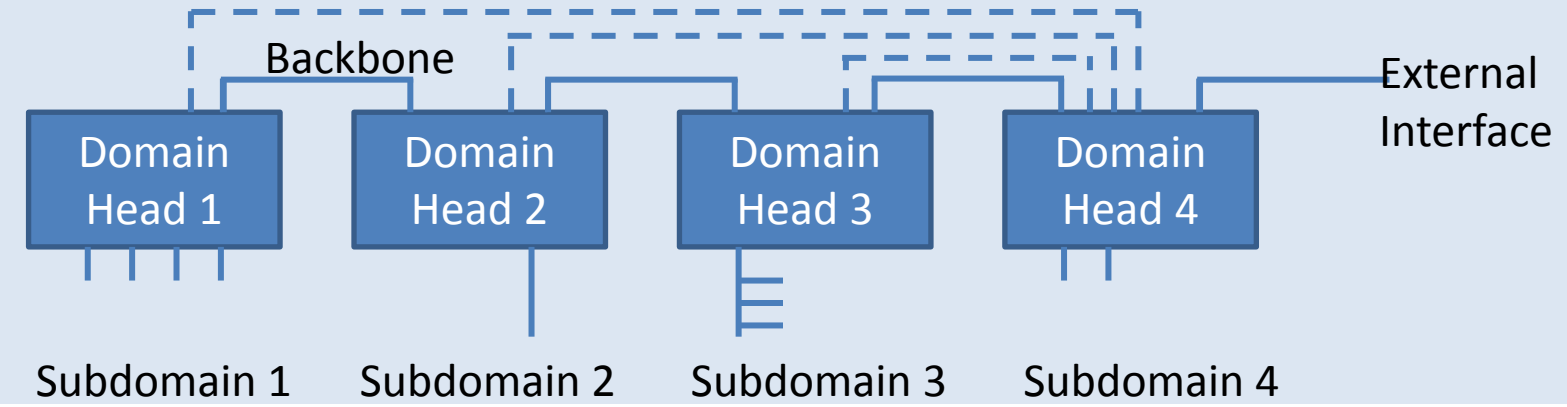
- This presentation is not providing a complete list of requirements

Domain Architecture and Backbone

The future architecture in cars will be based on domains. The exact design of the domain architecture can vary:

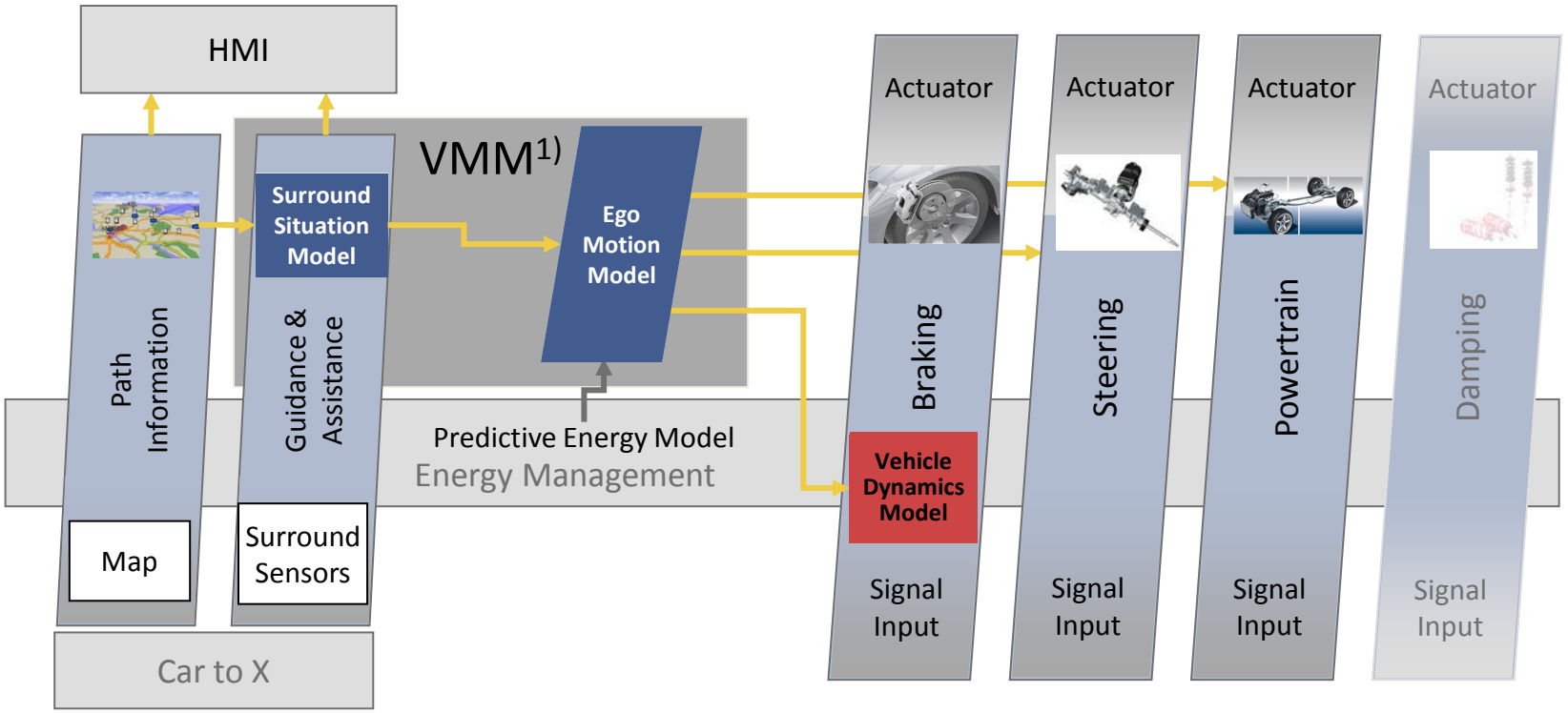
- Variety of topologies for backbone (redundant or not redundant, daisy-chain, star, …)
- Domain head ECUs are chosen by different criteria (e.g. function, location, bandwidth/networking load, see also next slides)
- Domain head ECUs are just gateways (without functional processing of data) or domain control units (incl. functional processing)

Whatever variation is chosen, the backbone will represent the lifeline of the cars and therefore needs to be reliable and fast.



Example Domain Architecture

Driver Assistance Use Cases

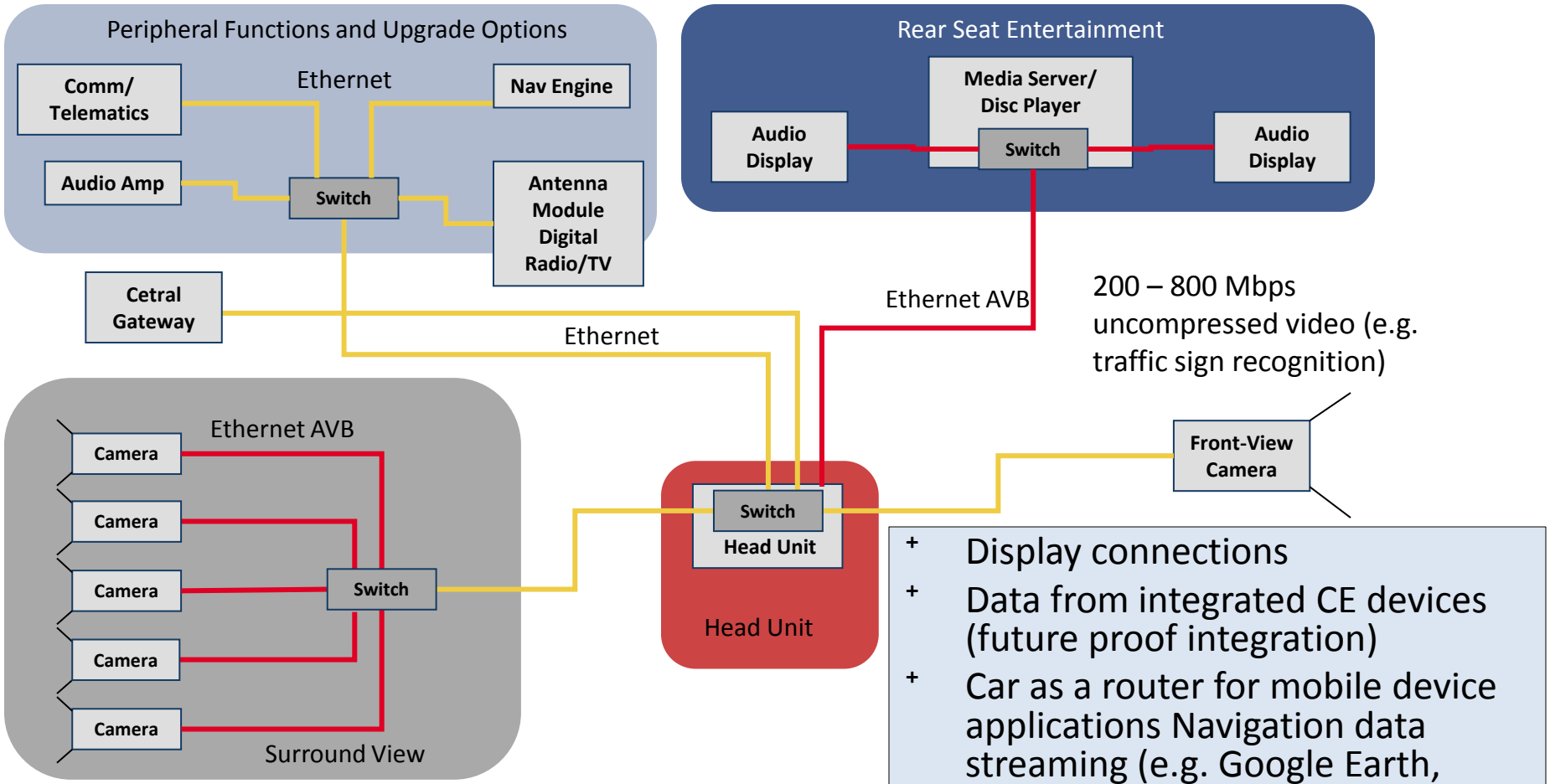


VMM[1)] generates the environment of the Vehicle and coordinates the requirements to the functional chains accordingly in the area of „vehicle motion vector“.

➔ **Significant increase of Data across Vehicle domains with higher latency requirements**

Example Architecture

Infotainment and Connectivity



- Display connections
- Data from integrated CE devices (future proof integration)
- Car as a router for mobile device applications Navigation data streaming (e.g. Google Earth, Streetmap)
- Cloud Computing (distributed in-vehicle computation)
- Cloud Computing (extern)

Example Architecture

Powertrain and Chassis

- Distributed engine control (electric/hybrid vehicles)
- Multi engine systems for electric/hybrid vehicles (stability, braking,…)
- Suspension control
- Electric/hybrid vehicle charging protocol (e.g. PLC)
- Authentication protocol for charging process

Automotive RTPGE Requirements

	Mandatory	Additional/optional
Physical Medium	Electrical wiring harness, UTP preferred	others are possible (coax is one option)
Max. link length	15 m for passenger vehicles	40 m for commercial vehicles
No. of in-between connectors	3	
Remaining Bit Error Rate	$< 10^{-10}$	
Electro-Magnetic Compatibility	Will be explained in detail by Stefan Buntz (Daimler)	
DC decoupling	Necessary (capacitive with common mode choke or transformer)	
Connectors	As compact as possible, own specification, first electrical parameters (impedance etc.), then mechanical, Multi-Pin connecter is preferred	
PoE	Yes	
Data interface to Layer 2 (MAC)	Standard interfaces (low pin count), RGMII, SGMII	

Automotive RTPGE Requirements

	Mandatory	Additional/optional
IEEE802.3az (EEE)	yes	
PHY Latency TX MAC to TX MDI	Tbd (fundamental effect on the PHY)	
PHY Latency RX MDI to RX MAC	Tbd (fundamental effect on the PHY)	
PHY jitter	Tbd in IEEE802.3	
Crystal accuracy	+/- 100 ppm; Crystal must meet automotive temperature range	Depended on cost and added value +/- 50 ppm might be OK

Additional Requirements

these requirements must be met to guaranty interoperability and common diagnosis concepts in automotive that are supported by higher layer standards (e.g. AUTOSAR, JASPAR)

	Mandatory	Additional (optional)
PHY-Wake-UP	Typical wake-up concepts in automotive must be considered. Typically wakeUP through buslines and Microcontroller	
Link acquisition time (PHY to PHY link start up time)	< 100 ms	
Diagnosis for link up	Signal Quality Indicator	
Enhanced diagnosis	Cable and link break/ short circuit/	
Control interface to Microcontroller	standard automotive µc interfaces (MDIO,…)	
Safety Concept	HW pin (EN) with Glitch filter	

Some Typical Product Requirements

	Mandatory	Additional (optional)
Ambient Temperature	-40 … 125 °C	
Quiescent current for PHY while system is switched off	< 10 µA	
Power Consumption	As small as possible (e.g. < 300 mW per port for the available process node today)	
Configuration interface	Standard Interfaces for automotive Microcontroller (MDIO, …)	
Automotive Qualification	AEC Q-100	
I/O Voltage Level GP	3.3 V	Selectable if possible (EMC optimization)
Diagnosis	wrong supply voltage	
Costs	competitive in respect to total cost of ownership (PHY, peripherals, connector, cables)	