Automotive TSN profile based on features, architectures or requirements?

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Content of this presentation

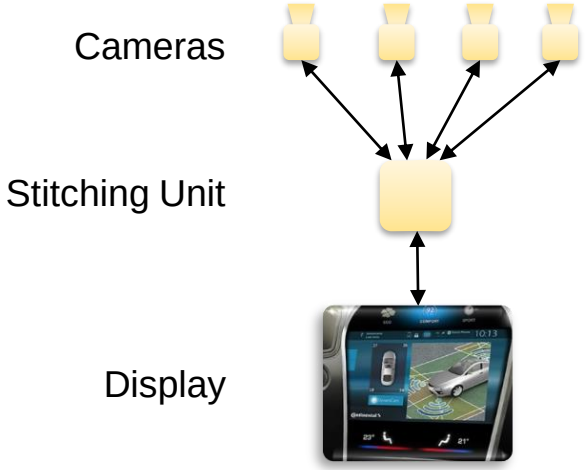
- Example feature – *Common at first glance, different in detail*
- Diversity in IVN architectures – *horizontally, vertically and in data paths*
- Common base requirements – *the path to go?*

Definitions for this presentation

- IVN = In-Vehicle Network (all of the data communication within a vehicle, power distribution network is excluded in the cases shown here)
- Feature = E.g. *Surround View, Adaptive Cruise Control, Autonomous Driving, …*
- Requirement = A specific detail of the implementation in the IVN, e.g. *Startup time xxx ms, Max. Latency xx ms, …*

- What this presentation is NOT:
  - *Disclosing:* Showing specific numbers from real architectures
  - *Complete:* There are many more features, variants, requirements, …
  - *Definite:* Please provide your opinion, open discussion!

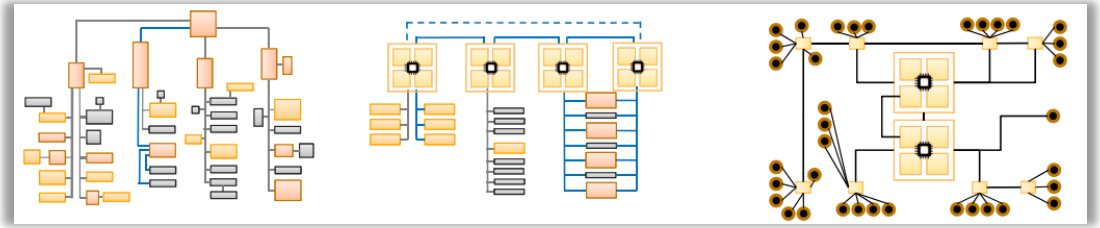
Common automotive feature – Surround View example



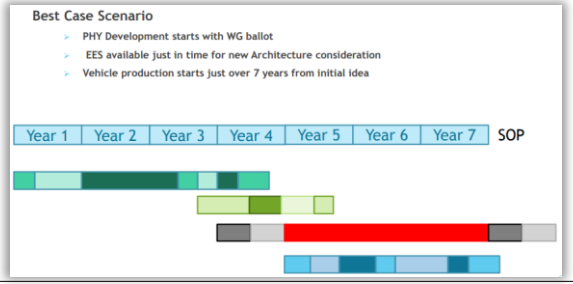
- Using a Surround View (aka top-view) is a common feature amongst multiple car manufacturers and vehicle segments
  - Setup is always similar: 4 cameras, a stitching unit, a display
- Different usage however: Connecting the Surround View data with other features, e.g. autonomous parking
- Besides the common physical layer (e.g. Automotive Ethernet), other technical aspects may be very different: Codec, frame rate, specifics of image sensor, …

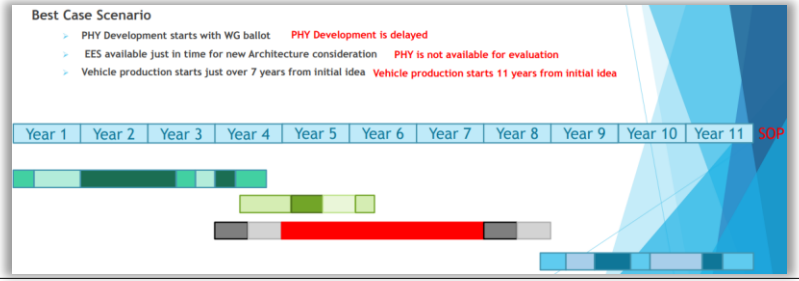
Many architectures at the same time

- From *dg-zinner-automotive-architecture-evolution-0319-v02.pdf*:

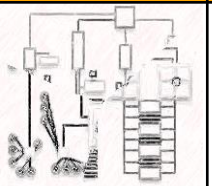
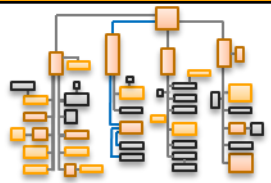
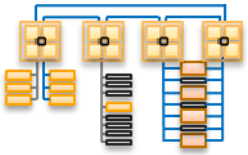
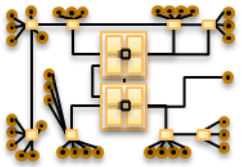
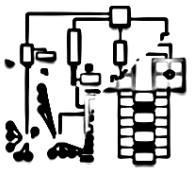
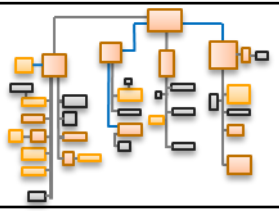
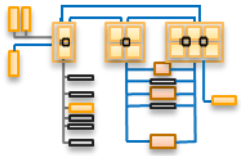
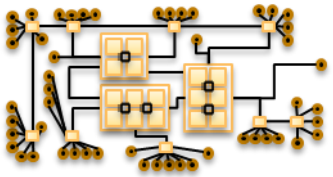
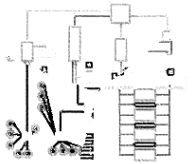
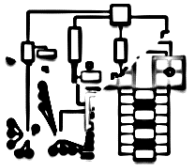
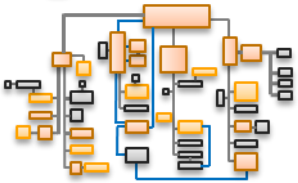
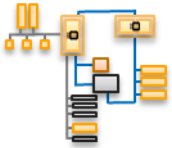
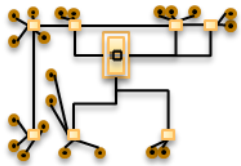


- All of these architecture concepts (and probably mishmash in between) will coexist for a long time
  - Using a new technology for a new IVN architecture takes between seven to eleven years
    (from http://www.ieee802.org/3/ad_hoc/ngrates/public/16_07/MGAuto_CFI_ecdc_01_0716.pdf):



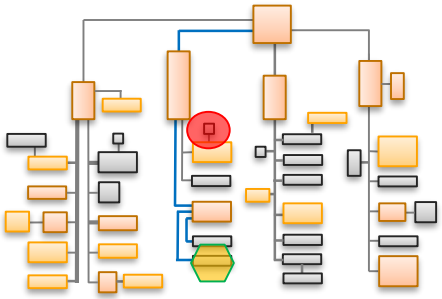


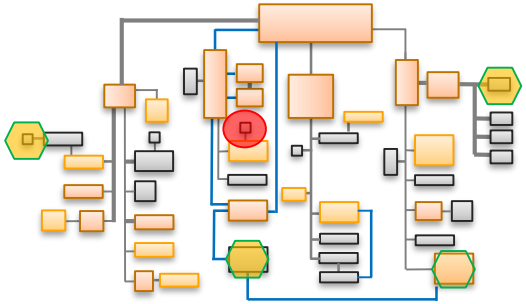
Diversity among architectures

	…	Architecture pattern A	Architecture pattern B	Architecture pattern C	…
Architecture variant A					
Architecture variant B					
Architecture variant C					
Architecture variant *n*	…	…	…	…	…

Diversity in data paths

› Same source, same car manufacturer's architecture, different sinks





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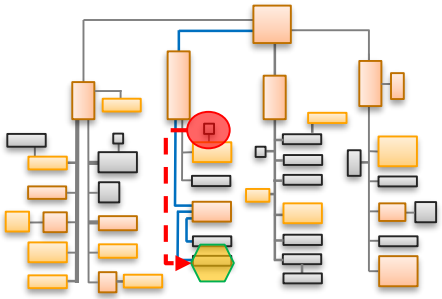
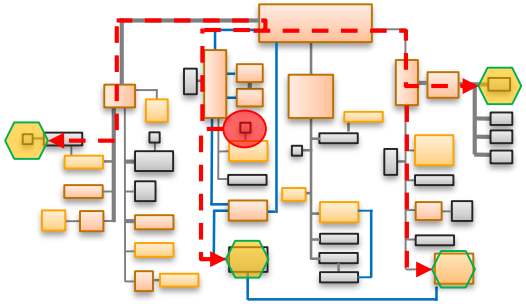


› „Unicast“
› Fixed # of hops
› Multiple network technologies



› „Multicast“
› Multiple paths, different hops
› Multiple network technologies

Perils of feature-based approach

- Features may seem common at first glance
  - But as motivated, they differ in the technical details
- Creating a profile based on a few features only could fit only a small number of car manufacturers
  - The profile might be not used as much because being too specific

Common base requirements

- **The good news**
  - There are common requirements – at least at a base level
    - Startup time
    - Bound latencies
    - Security
    - Power concept
    - …
- Suggestion to the group: Provide contributions with input for this sort of requirements

Some ideas for base requirements

Requirement	Goal	Derived requirements for TSN	Remark
Startup time (power off → link up)	100 – 130 ms	After this time, the following should be working: • (Fault-Tolerant) Time-Sync • All shapers for data paths (all? Just critical ones?) • Seamless redundancy(?)	Source for time values: http://www.ieee802.org/3/ch/public/may17/Wienckowski_3NGAUTO_01_0517.pdf; Faster intervals? Static config? Pre-stored values?
Bound latency for audio	<= 2 ms for latency in network	Prioritization / Shaping of data	2 ms is the original value used around AVB
Fault isolation	No error propagation in the network	Ingress Filtering and Policing • Capability to silence streams after breaking contracts	Possible # of entries based on segments: low, mid, servers?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