AllGo Connectivity Middleware

Based on TSN

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Presented By

SANJEEV MADHAVANKUTTY

Agenda

- New In-Car Architectures
  - Evolving Architectures
  - Connectivity Middleware
- Autonomous Use cases
  - Connectivity Middleware requirement for Autonomous
- Inter-ECU communication
- Infotainment Use cases
  - Media Sharing over Ethernet
  - Remote Peripheral Access over Ethernet
- AllGo Ethernet Connectivity Middleware Portfolio

New In-Car Architectures

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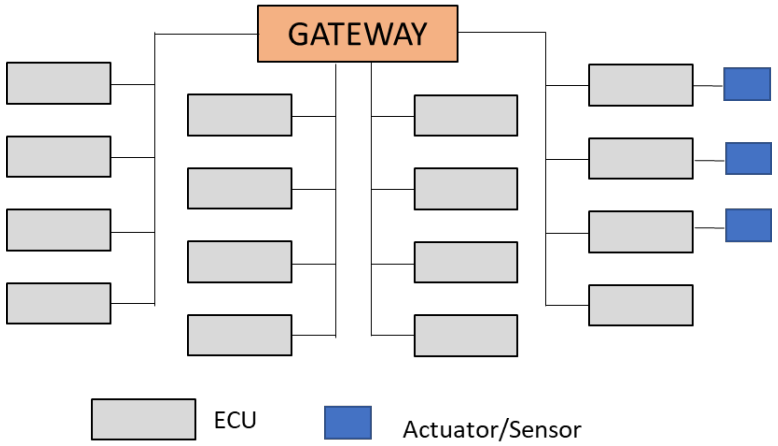
Traditional In-Car Architecture

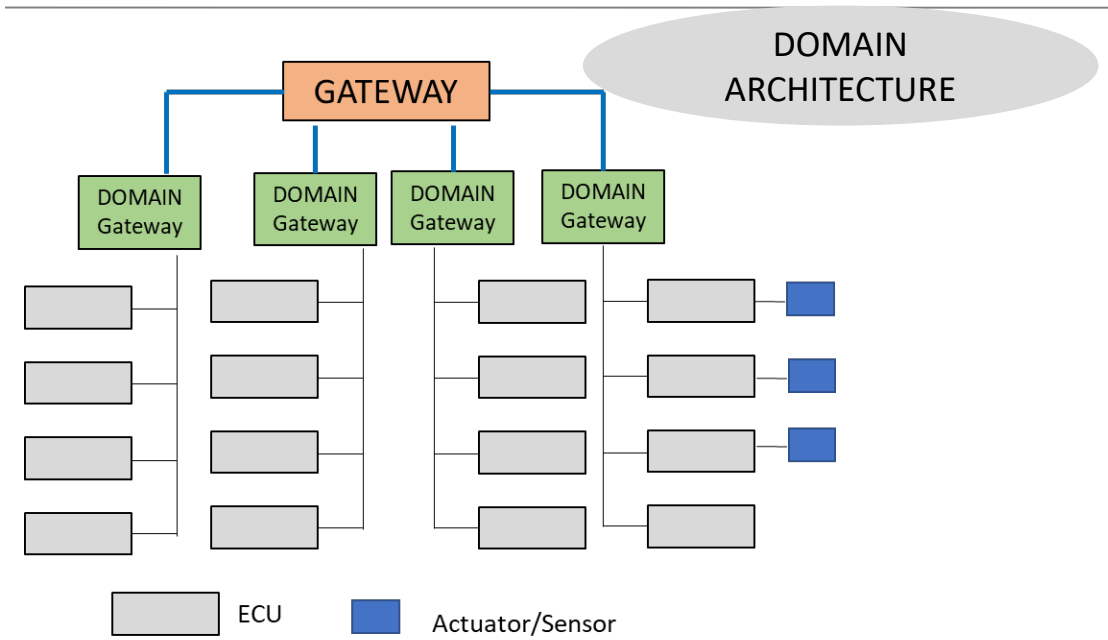


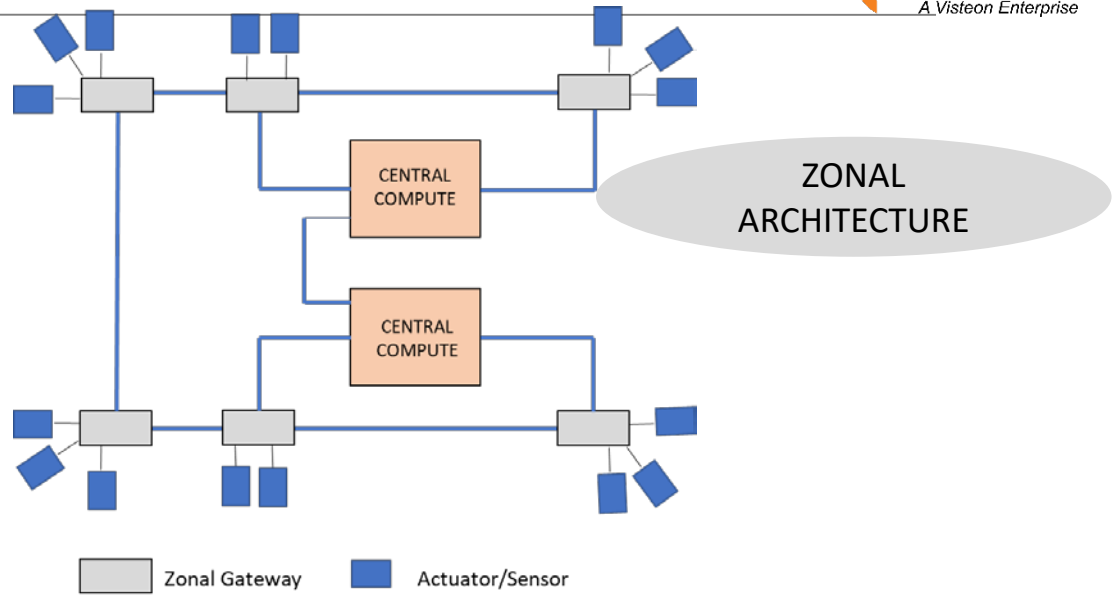
- ECUs are clustered based on the application
- Central Gateway to do heterogenous communication translation
- High communication load occurs on Central gateway

WHY New Architectures are Required?

- ECUs in a Car are increasing
- Sensors with high bandwidth for Autonomous
- As a result Traffic Congestion in current architectures

New In-Car Architectures





- ECUs Clustered into functional domains
- Congestion in Central gateway reduced
- Scalable: Any additional function to be adapted only into the functional domain

- Clustering based on physical placement of ECUs
- Processing moved to a Central Entity
- Flexibility: Integration of a new function by adding peripheral to the zone controller

OBSERVATION: In these evolving Architectures
- Ethernet is the preferred choice for back bone
- QoS required for data transmitted over the Ethernet backbone
- Backbone network should be Reliable and Fail Safe.

Connectivity Middleware

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What is a Connectivity Middleware:

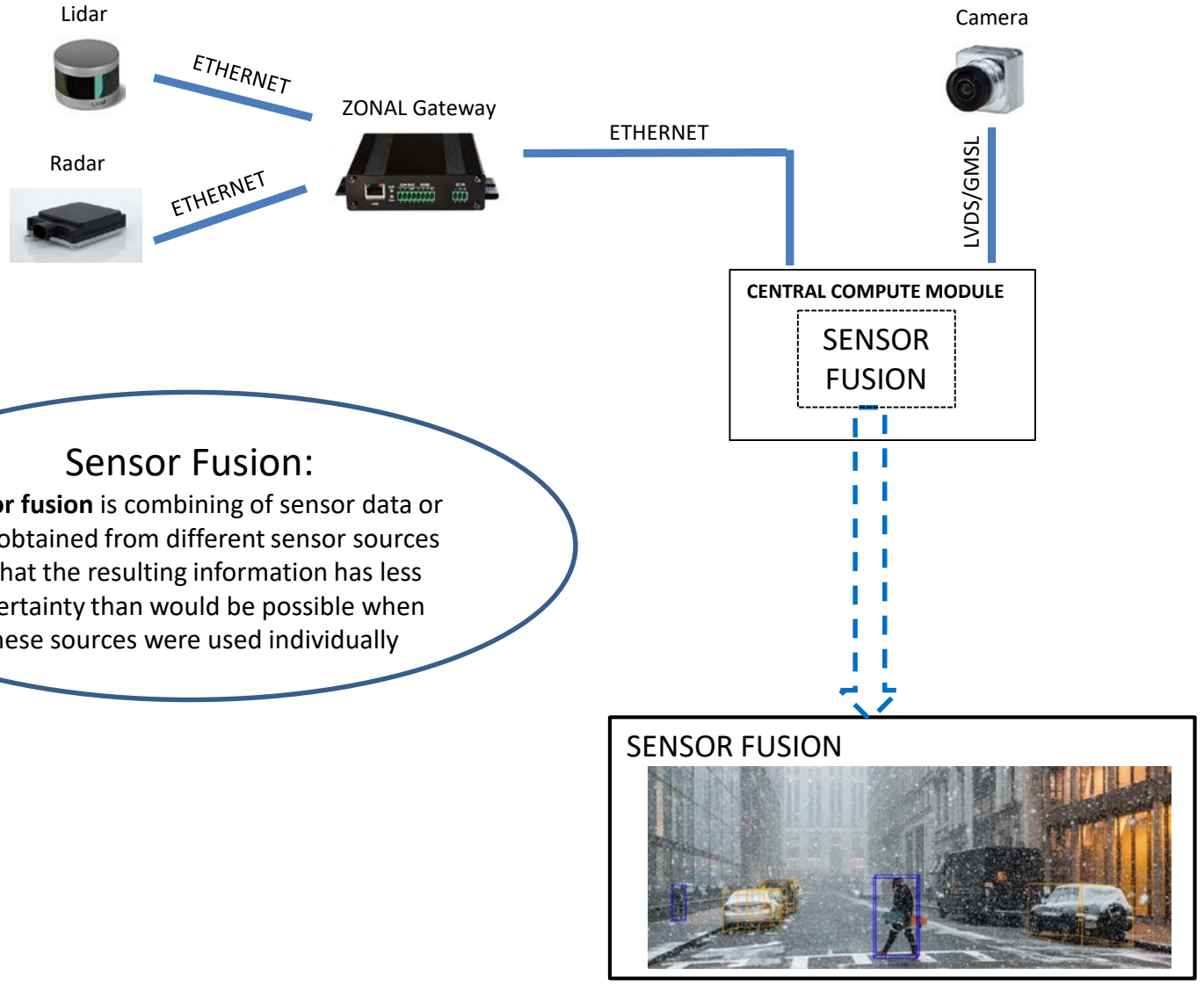
The Communication Framework with the necessary protocols and standards required for reliable data transfer between the ECUs to realize the different Automotive use cases.

What Follows:

We will look at the different use cases of Autonomous and Infotainment with the New Architectures

Look at the Connectivity and Communication Requirements and Middleware solutions

Connectivity Requirements: Sensor Fusion



Sensor Fusion:

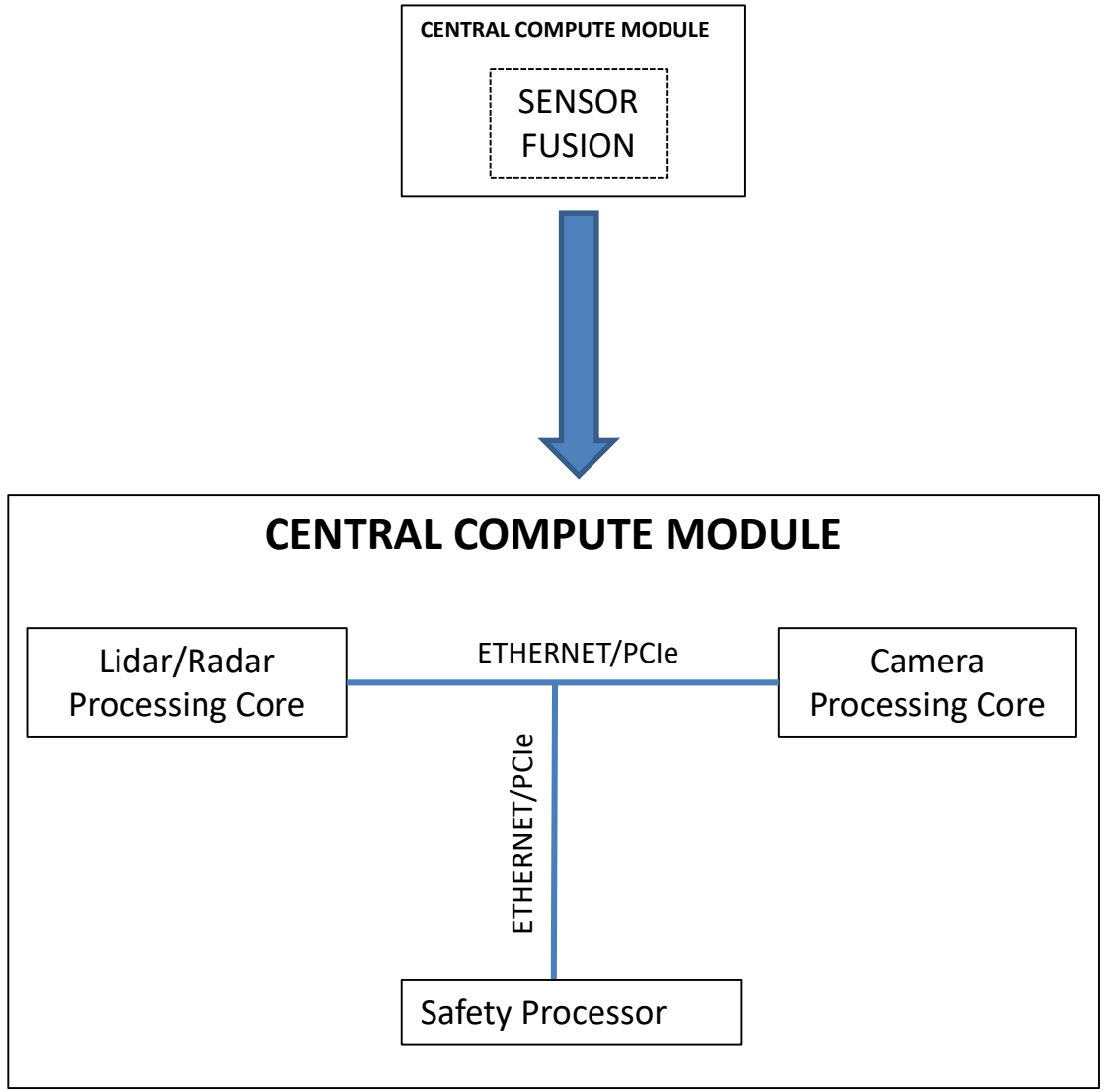
Sensor fusion is combining of sensor data or data obtained from different sensor sources so that the resulting information has less uncertainty than would be possible when these sources were used individually

Sensor data to be Synchronized

Sensor data to arrive at Low latency

Robust communication mechanism required

Connectivity Requirements: Central Compute Module



- Multi Processor System
- Ethernet or PCIe Connectivity
- Requires Very High bandwidth data sharing with low latency

ROS2 over TSN

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ROS2 over TSN could be the Solution

WHY ROS2?

- Defacto standard Robotics SDK
- Solves common and recurring challenges
  - Transferring large amounts of sensor data to multicore computers for processing,
  - Sending processed info to multiple actuators
- Complete ecosystem of tools, such as visualization, simulation, build tools
- Used by almost all autonomous companies in R &D
- Agnostic of Transport (PCIe/Shared Memory/Ethernet)

WHY TSN?

- TSN brings in Precise, Reliable and Synchronized Clock
- Traffic Shaping algorithms to ensure Low Latency
- Frame Elimination and Replication (802.1CB) for Reliable transport of Sensor Data.

Inter-ECU communication over TSN

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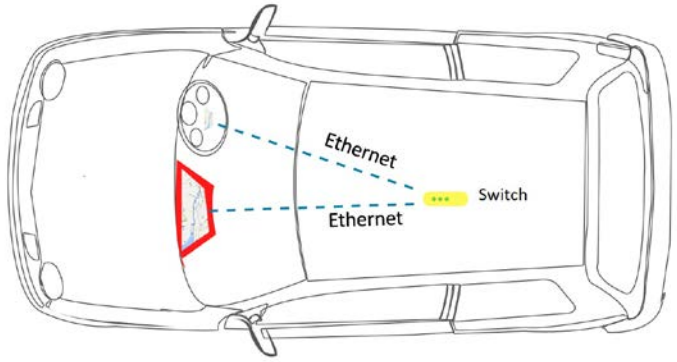
CAN to ETHERNET

- New Architectures will still have ECUs with traditional connectivity like CAN.
- ECUs will need to send out time critical periodic data or Inter-ECU control data
- Low latency CAN to Ethernet translation middleware required.
- IEEE 1722 (AVTP Control Streams) one option to do the CAN to Ethernet Translation

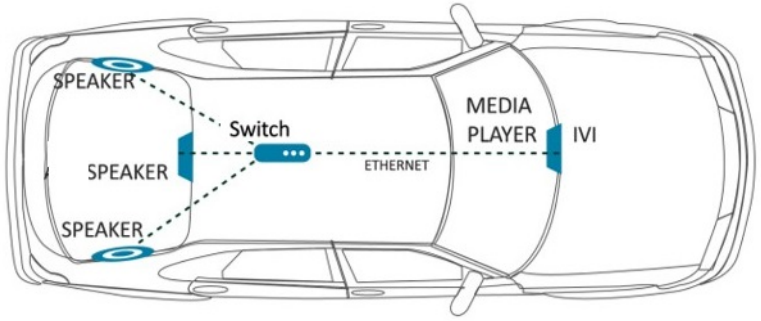
Over TSN

- Ethernet QoS provided by TSN traffic required for reliable Low latency communication between ECUs.
- TSN Frame Replication and Elimination standards for reliable connectivity through redundant paths
- Gateways act as Proxy TSN Endpoints for these ECUs connected over CAN

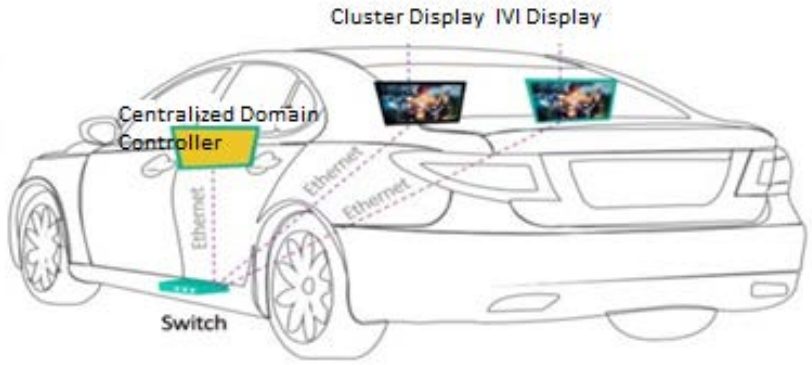
New In-Car Architectures: Media Over Ethernet



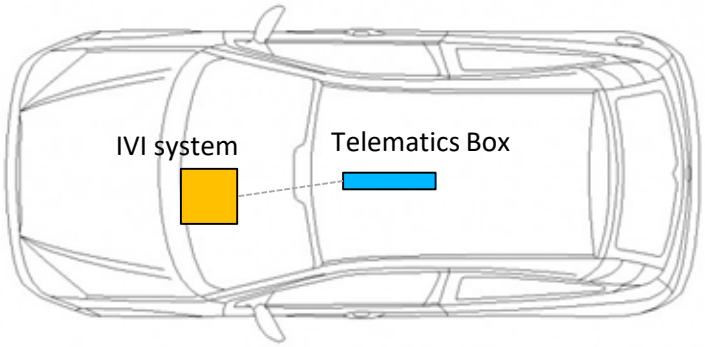
Streaming of Navigation Maps from IVI to Cluster



Streaming Audio to Remote Speakers



Centralized Domain Controller driving remote Thin client displays.



Mirroring Contents from Telematics Box to IVI

Key Requirements

- Time Synchronization between Devices
- Dedicated Bandwidth for Media Streams to avoid packet drops
- Low Latency – Prioritization of A/V streams over Best effort traffic
- Real time A/V Streaming protocol

New In-Car Architectures: Media Over Ethernet

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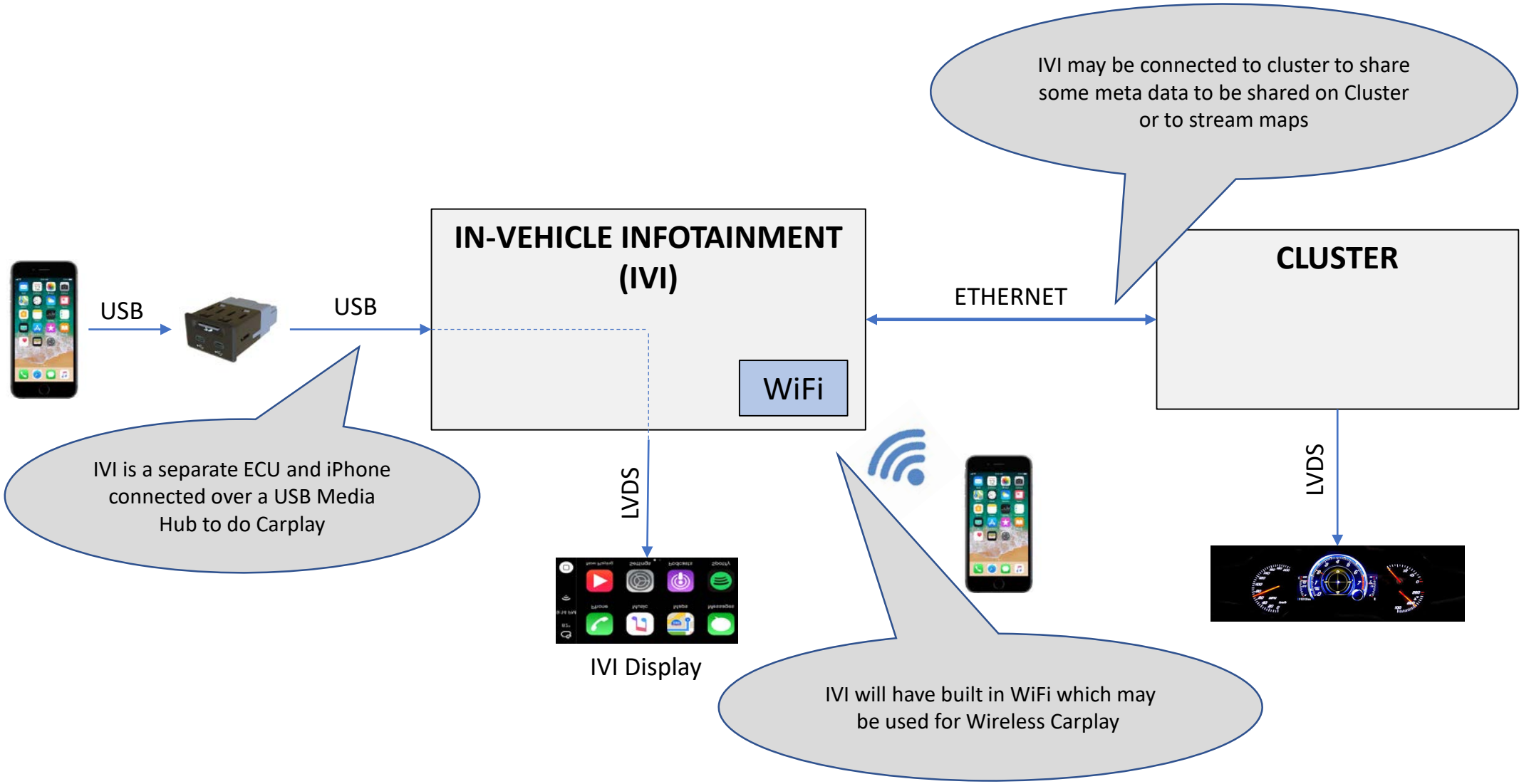
Ethernet AVB

- Transport of Time Sensitive Audio and Video over Ethernet
- Time Synchronization (802.1AS), Credit Based Traffic Shaper (802.1Qav), AVTP transport (IEEE 1722), Bandwidth Reservation (802.1Qat) implemented as part of AVB.

RTP over AVB

- RTP transport instead of AVTP with AVB
- Easier Integration into the existing RTP based Systems
- Based on IEEE 1733 (RTP over AVB) standard.

Infotainment Connection Topology



New Architecture: Infotainment Connection Topology

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Dedicated lengthy wires from Central compute to Displays needed.

Can the Displays be connected over Ethernet?

ETHERNET

ZONAL Gateway

ETHERNET

ETHERNET

ZONAL Gateway

ETHERNET

Smart Antenna may have the WiFi module

Can the IVI function on the Central compute remotely access the WiFi module on the smart antenna?

ETHERNET

CENTRAL COMPUTE MODULE

IVI

CLUSTER

ETHERNET

ZONAL Gateway

ETHERNET

ETHERNET

ZONAL Gateway

ETHERNET

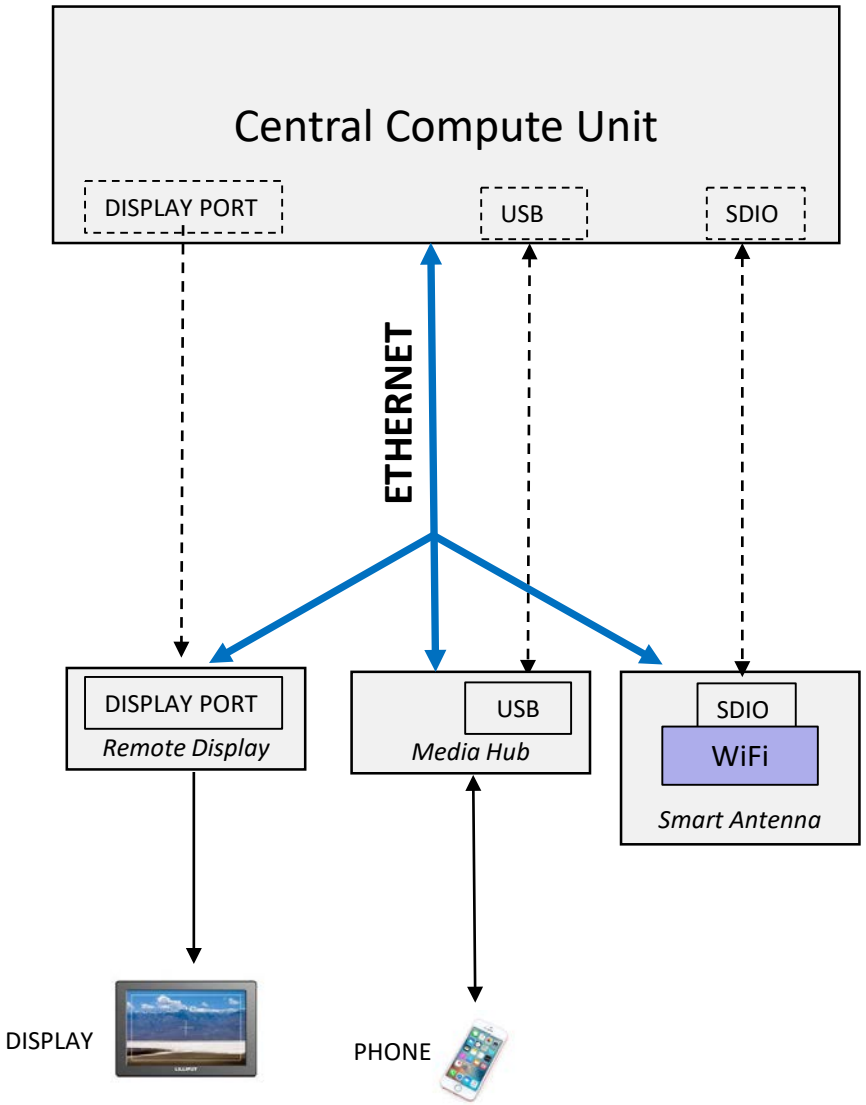
ETHERNET

Central Compute Module may run IVI and Cluster functions in a Zonal Architecture

Dedicated Lengthy USB cables needed to connect the Media Hub to the Central Compute

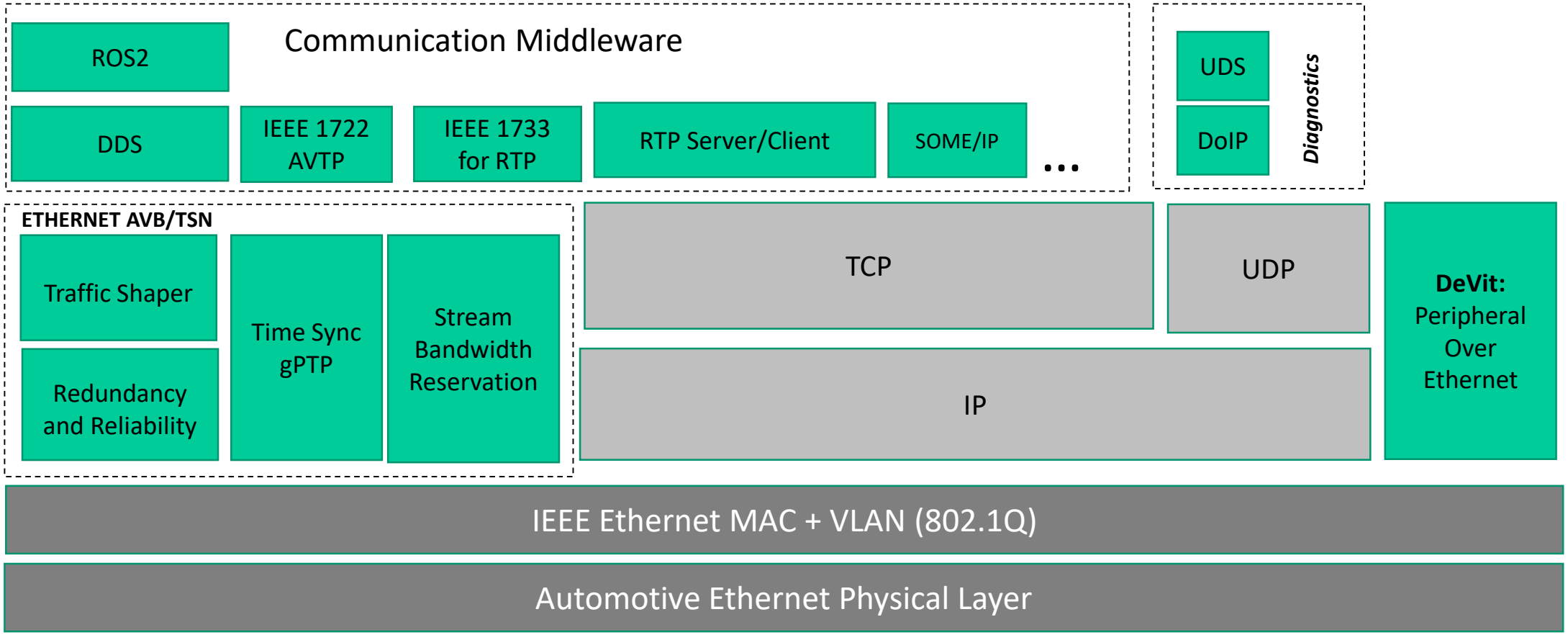
Can the Media hub be accessed over Ethernet?

AllGo Device Virtualizer (DeVit) – Peripherals Over Ethernet



- AllGo's Device Virtualizer (DeVit) Technology to access Devices connected to Remote Peripheral Interfaces over Ethernet
- Devices Connected to Interfaces like USB, SDIO, Display Port, HDMI are remotely accessed over Ethernet
- Remote ports appear as virtual ports on the Host. Higher layers are not aware that the port is remote
- Integrated with TSN to guarantee Quality of Service over Ethernet.

Ethernet Technologies Summary



BSP HW

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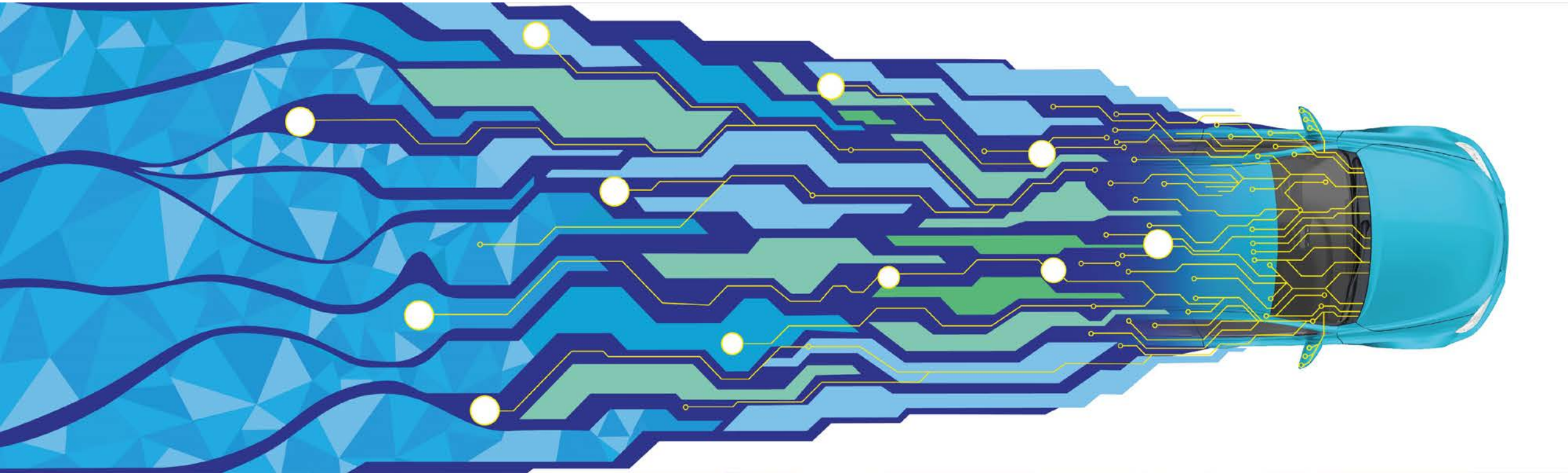
Thank you!



contact@allgosystems.com