10G+ Automotive Ethernet Electrical PHYs

Call for Interest Consensus Meeting

IEEE802.3 Working Group

March 12, 2019

Vancouver, BC

CFI Panel Members

Chair & Presenter

- Steve Carlson (High Speed Design)

Supporters and Experts for the Q&A Session

- Christopher Mash (Marvell)
- Christoph Wechsler (Audi)
- Helge Zinner (Continental)
- Olaf Grau (Bosch)
- Natalie Wienckowski (GM)

Supporters

OEM affiliated

Olaf Krieger – Volkswagen
Samuel Sigfridsson – Volvo Cars
Jose Villanueva – Renault
Kirsten Matheus – BMW
Jinhwa Jun – Hyundai Motor Company
Syreeta Bath – Jaguar Land Rover
Hideki Goto – Toyota
Yong Kim – NIO
Mike Potts – GM
Keld Lange – Porsche
Sanaz Mortazavi - Volkswagen
Dongok Kim – Hyundai Motor Company
Jim Lawlis – Ford Motor Company
Haysam Kadry – Ford Motor Company

System affiliated

Daniel Hopf – Continental
Sven Hildebrandt – Harman
Thomas Hogenmueller – Bosch
Thomas Mueller – Rosenberger
Chris DiMinico – Panduit
Tamir Reshef – Semtech
Georg Janker – Ruetz System Solutions
Eric DiBiaso – TE Connectivity
Bert Bergner –TE Connectivity
Mike Gardner – Molex
Harsh Patel – Molex

Others

Chunhui (Allan) Zhu - Futurewei Technologies, Inc.
Jon Lewis – Dell/EMC
John D'Ambrosia - Futurewei Technologies, Inc.
Marek Hajduczenia - Charter

Semiconductor affiliated

Albert Kuo – Realtek
Kinny Chen – Realtek
Amir Bar-Niv – Aquantia
Conrad Zerna – IIS Fraunhofer
Kamal Dalmia – Dryv.io
Guy Hutchison – Dryv.io
Sujan Pandey – NXP
Hamid Salehi – Marvell
Brett McClellan – Marvell
Peter Wu – Marvell
Ramin Shirani – Ethernovia
Hossein Sedarat – Ethernovia
William Lo - Axonne
Tom Souvignier – Broadcom
Mehmet Tazebay – Broadcom
Ramin Farjad - Aquantia
Mike Tu - Broadcom
Gerrit Den Besten – NXP
Alex Tan – NXP
Claude Gauthier – NXP
Mike Jones – Microchip
Mark Bohm – Microchip
David Chalupsky - Intel

CFI Objective

To gauge interest in starting a study group developing

10G+ Automotive Ethernet Electrical PHYs

This Meeting will NOT:

- Fully explore the problem
- Choose any one solution
- Debate strengths and weaknesses of solutions
- Create a PAR or 5 Criteria
- Create a standard or specification

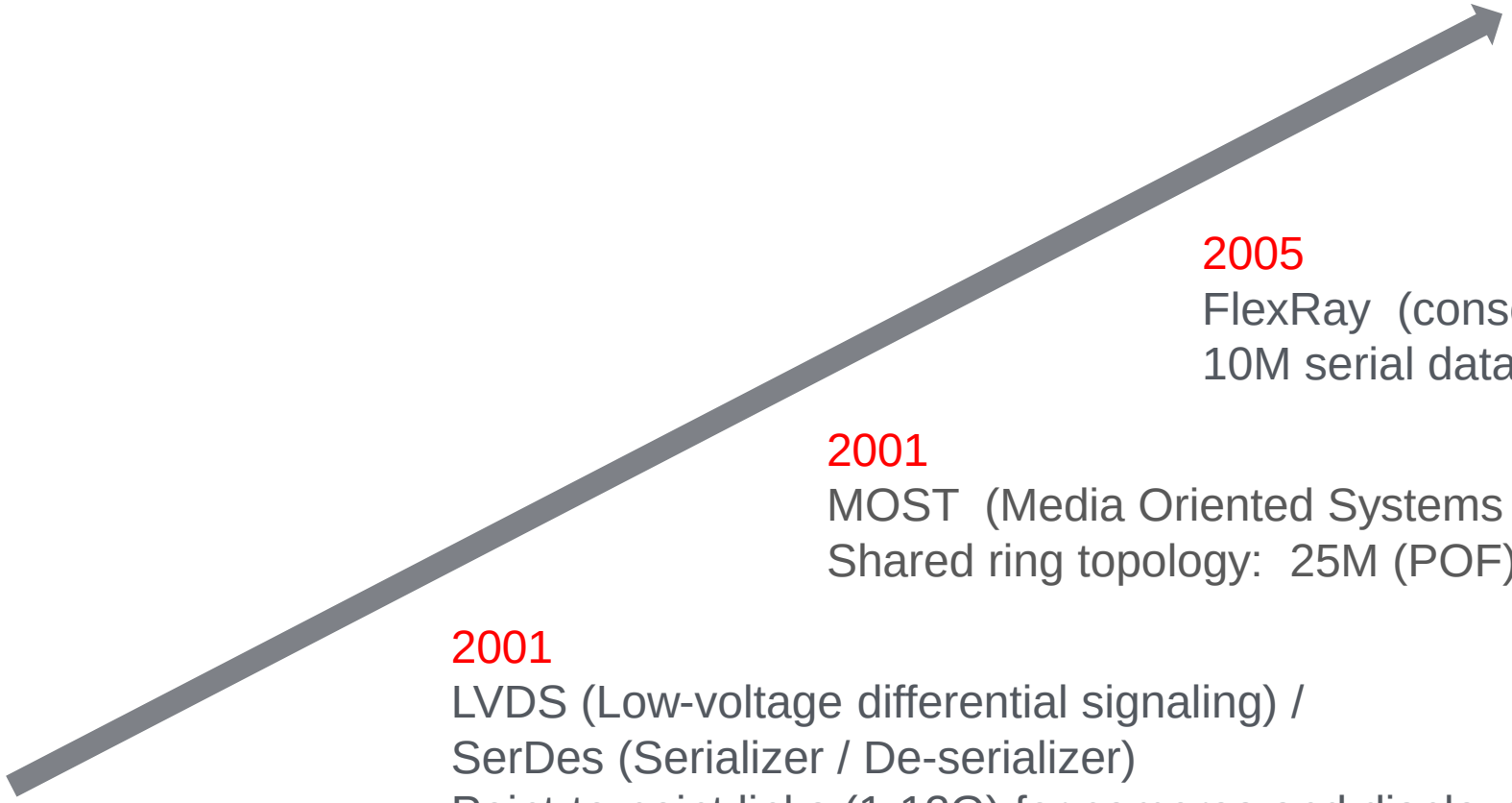
Anyone in the room may speak / vote

Respect … give it, get it

Agenda

- Automotive Networking Evolution
- Why 10G+ is needed
- Market Potential
- Why Now?
- Q&A
- Straw Polls

Automotive Networking Evolution



1991
CAN (Controller Area Network) (500K - 2M)
Low-speed serial data bus (<1K)

2001
LVDS (Low-voltage differential signaling) /
SerDes (Serializer / De-serializer)
Point-to-point links (1-12G) for cameras and displays

2001
MOST (Media Oriented Systems Transport)
Shared ring topology: 25M (POF), 50M (Cu), 150M (POF, Coax)

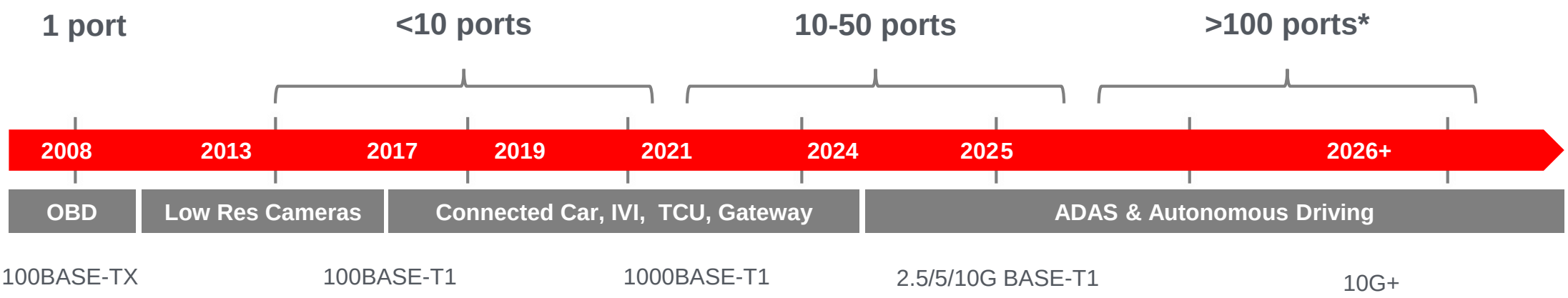
2005
FlexRay (consortium of automotive companies)
10M serial data bus (single or dual channel)

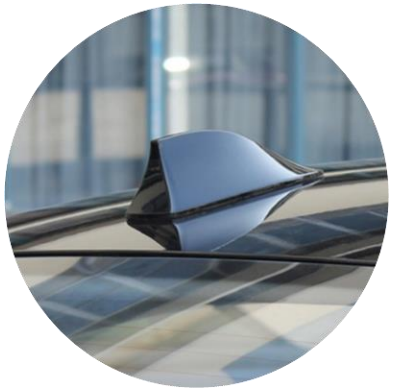
2008
Ethernet
10M, 100M, 1G, 2.5/5/10G, & 10G+

Automotive Electrical PHYs in IEEE802.3

- 802.3bp -1000BASE-T1
  - CFI 3/2012, Standard 6/2016
- 802.3bw -100BASE-T1
  - CFI 3/2014, Standard 10/2015
- 802.3cg -10BASE-T1S / (10BASE-T1L)
  - CFI 7/2016, Standard 2019 (est)
- 802.3ch -2.5/5/10G BASE-T1
  - CFI 11/2016, Standard 2020 (est)

Trends in Automotive Ethernet

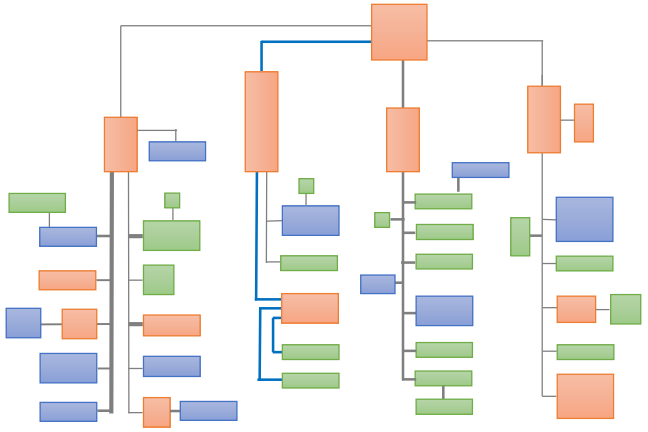




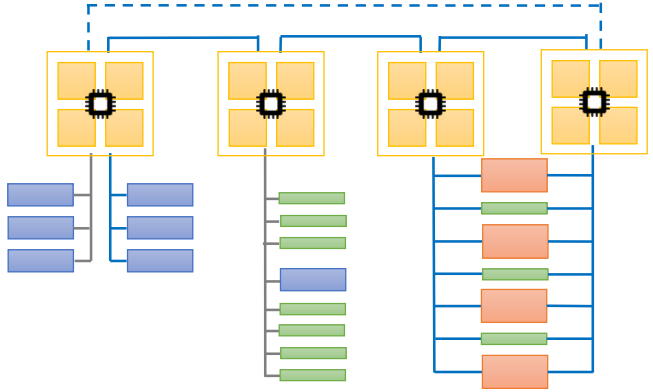
*Average Ethernet ports per vehicle

Why 10G+

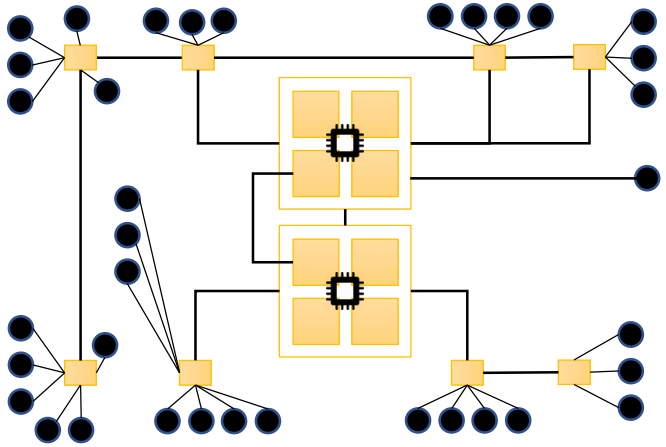
Traditional architecture



Domain architecture



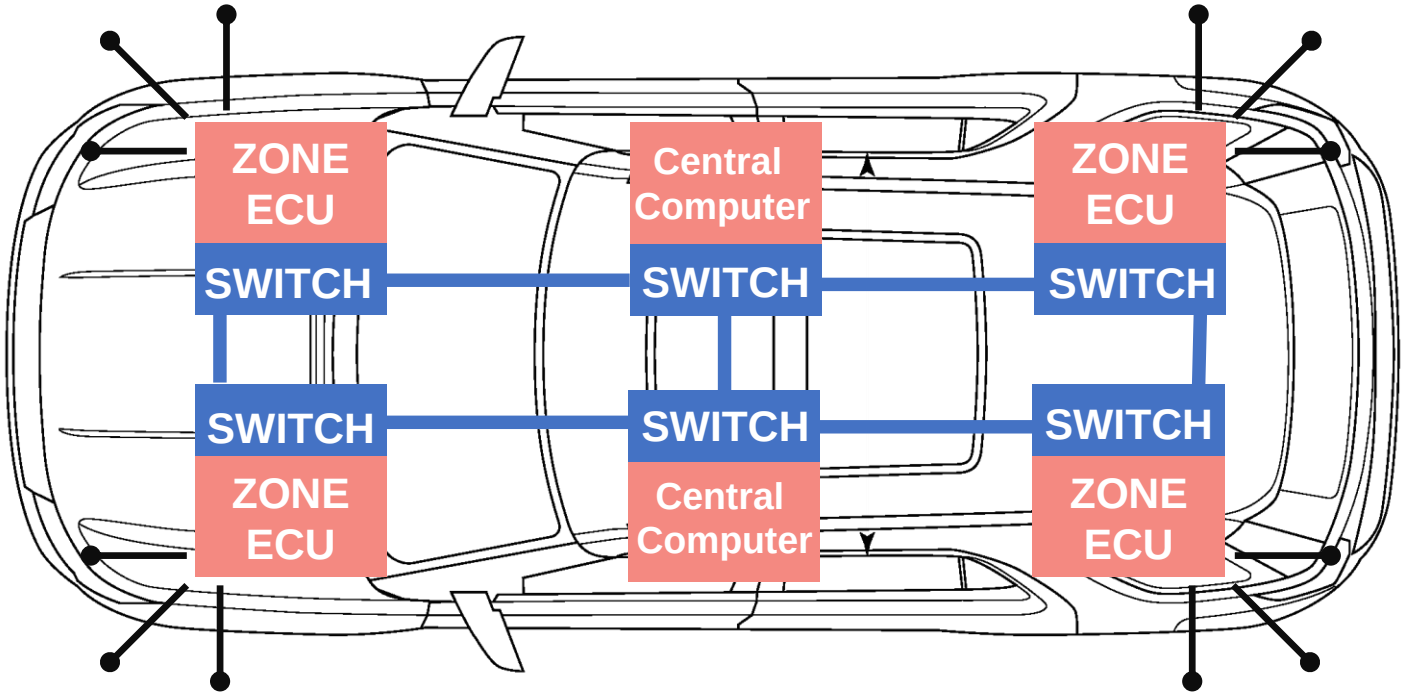
Zone architecture



Transition from domain to zonal architectures will require 10G+ links between the zonal ECUs

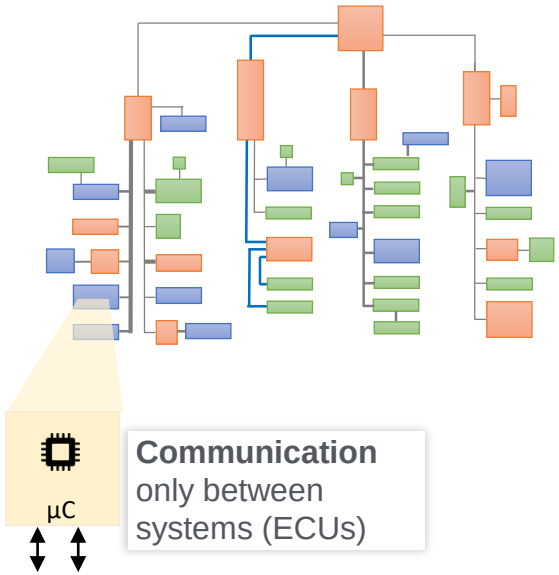
Zonal Overview

Very high bandwidth (10G+)
Full duplex traffic
> 6 links per car
Mixed data type
Redundant systems



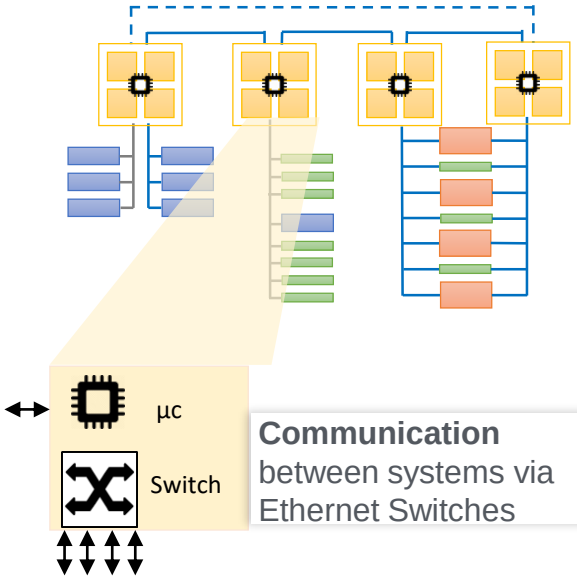
Zonal effects on ECUs

Locally distributed processing resources



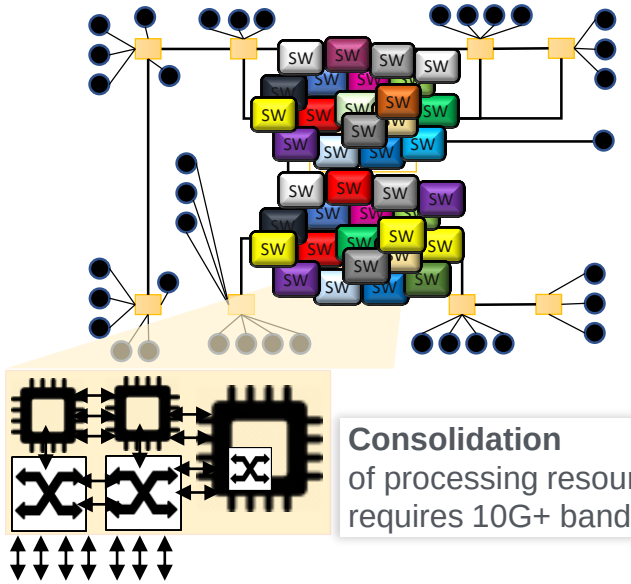
Communication
only between systems (ECUs)

Cross domain distributed processing resources



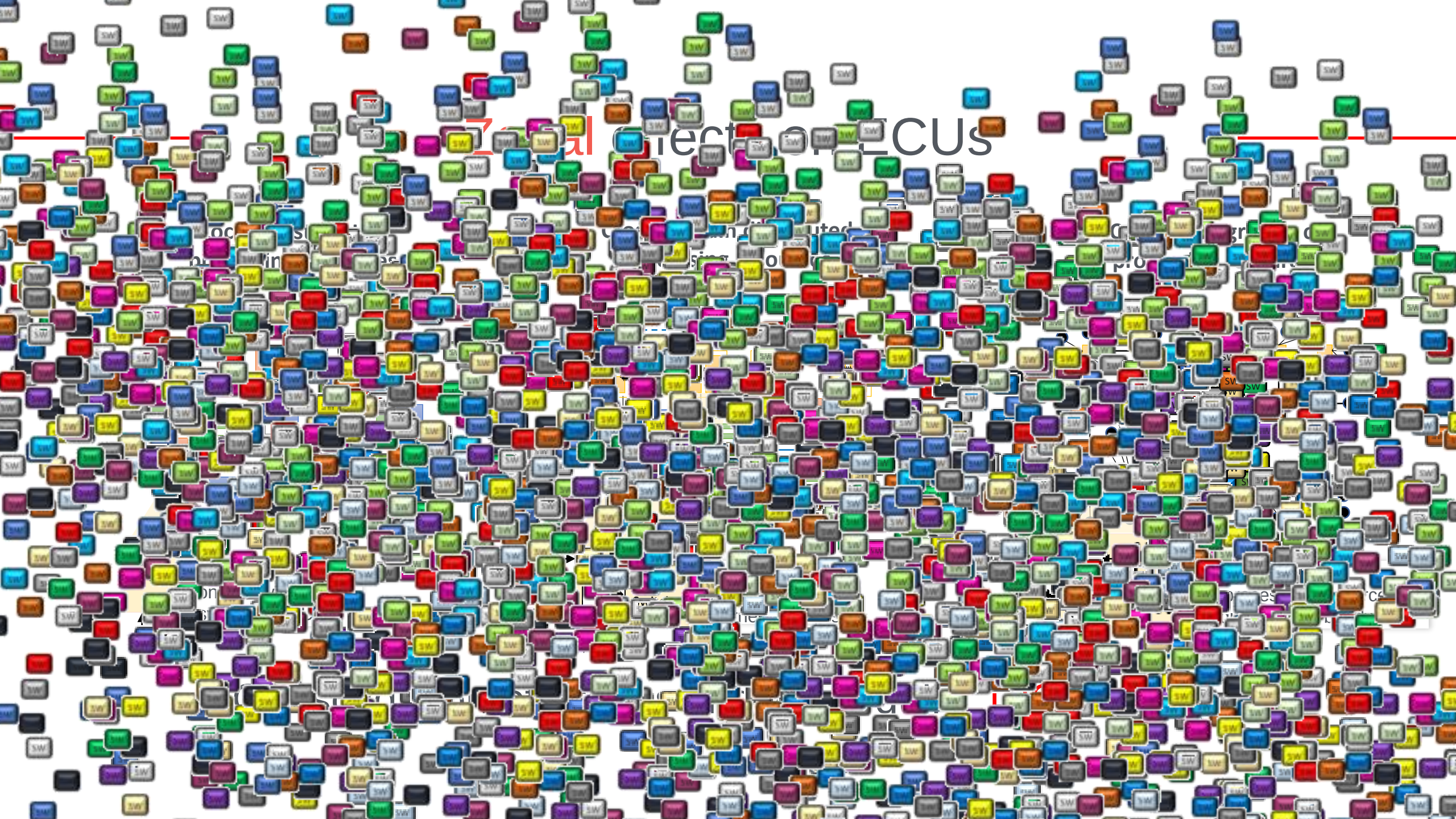
Communication
between systems via Ethernet Switches

Central integration of processing resources

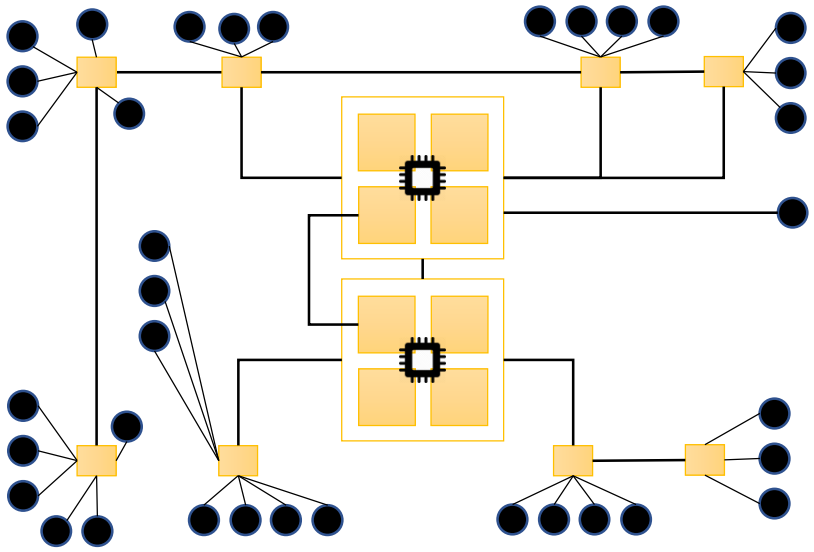


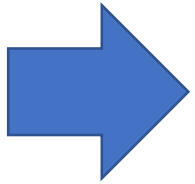
Consolidation
of processing resources requires 10G+ bandwidth

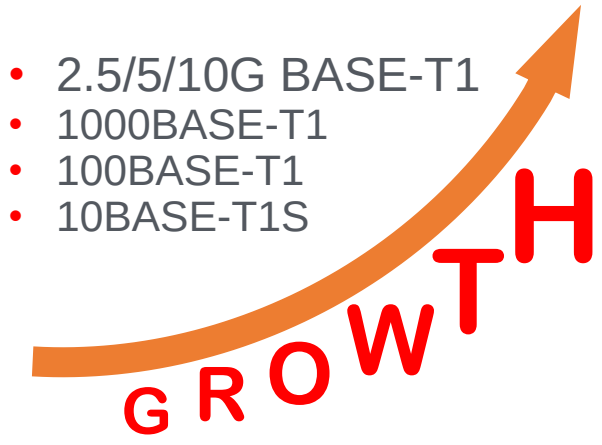
Consolidation of processing will require 10G+ links



Zonal effects on other Ethernet speeds







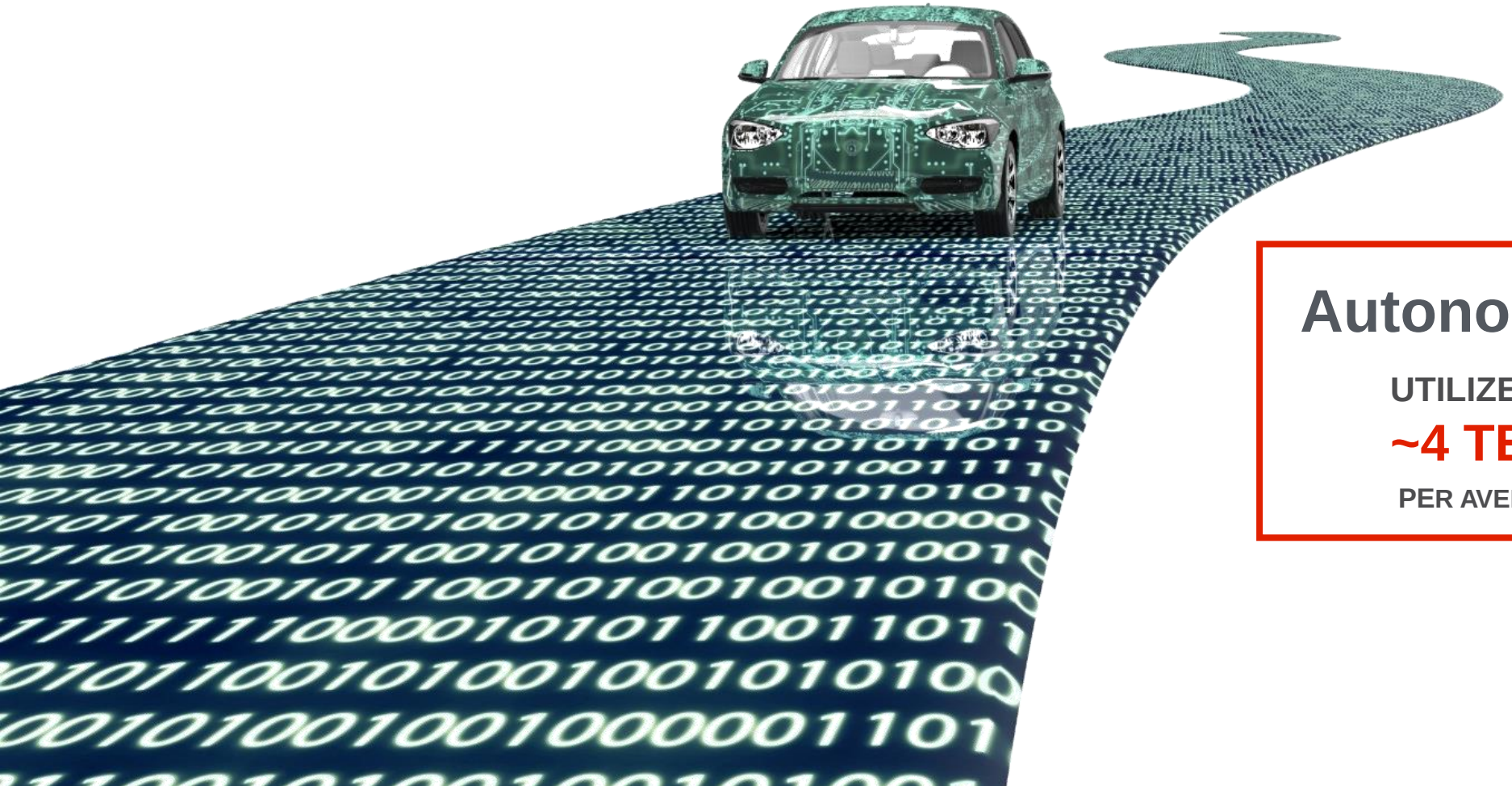
10G+ enables Zonal architectures ➔ more overall Ethernet links will be required (10Mbit/s -10Gbit/s)

Zonal / Central Architecture Introduction

- OEMs who have publicly announced investigation into Zonal / Central architecture;
  - Audi
  - General Motors
  - Jaguar Land Rover
  - Toyota
  - Volkswagen
  - Volvo Cars
- Additional OEMs expected to publicly announce this year

Source: Audi AG

Data Drives Autonomous Cars



Autonomous Vehicles

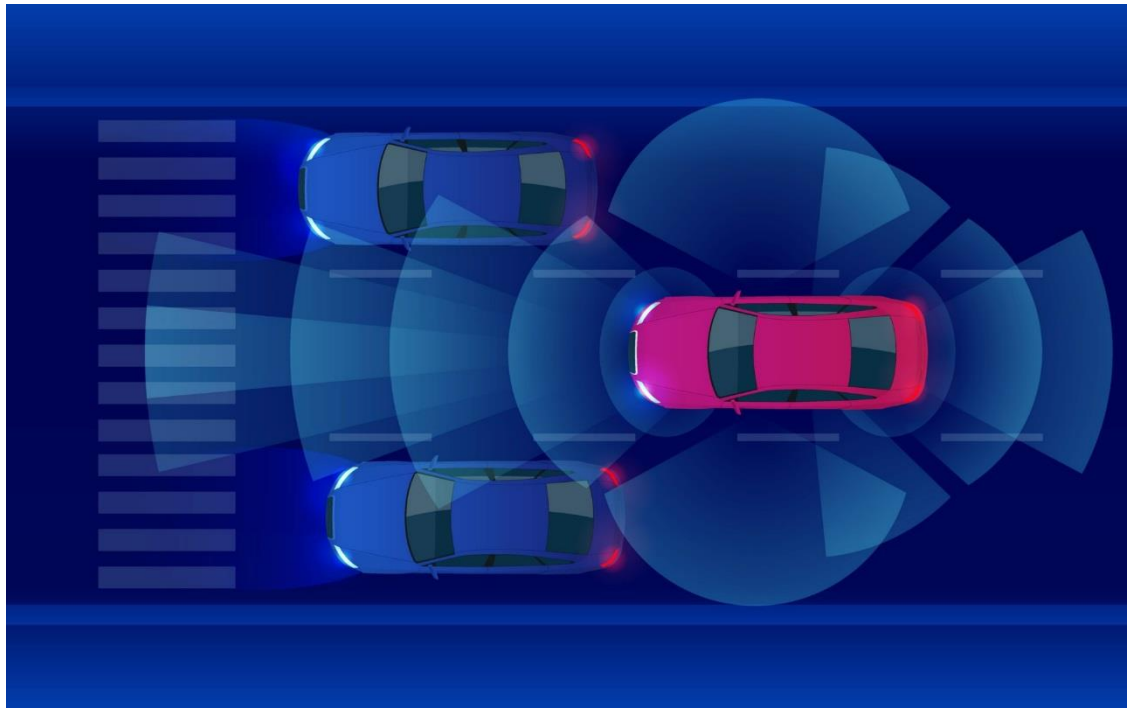
UTILIZE AVG

~4 TERABYTES

PER AVERAGE DAY

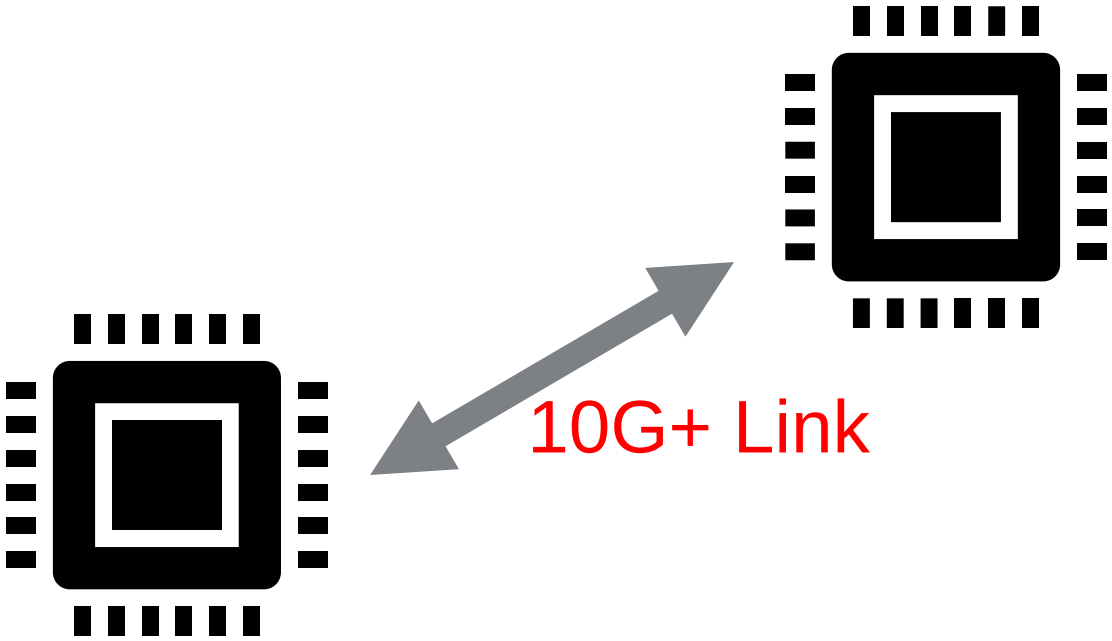
Source: Mashable January, 2017

Autonomous Cars Need High Bandwidth



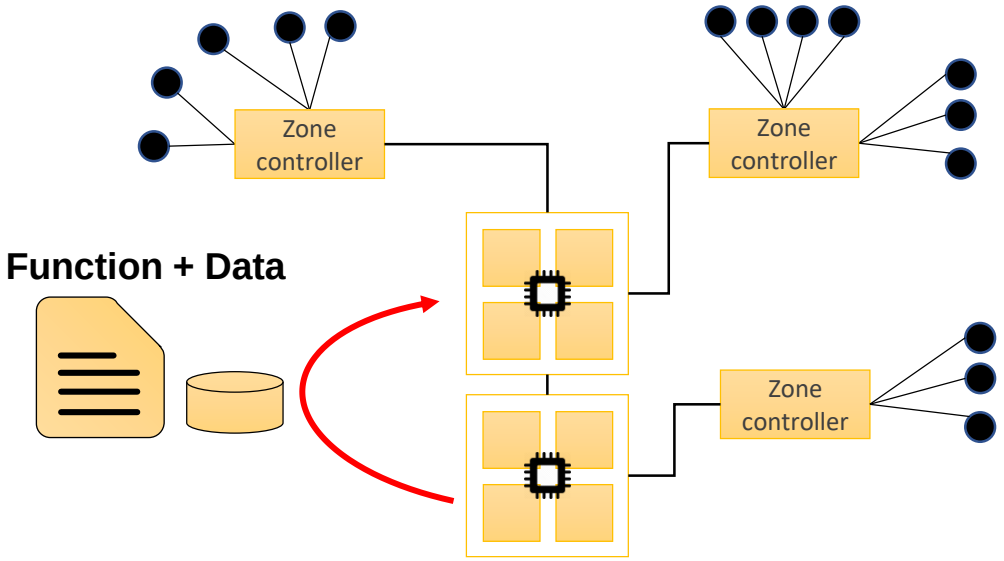
Autonomous Driving systems incorporate camera's that transmit uncompressed data requiring 10G+ bandwidth. Additional sensor (Lidar, radar, etc.) aggregation requires 10G+ bandwidth.

Autonomous Drive Interconnect



Redundant processing units needed to enable autonomous cars will require 10G+ connections

Software Migration

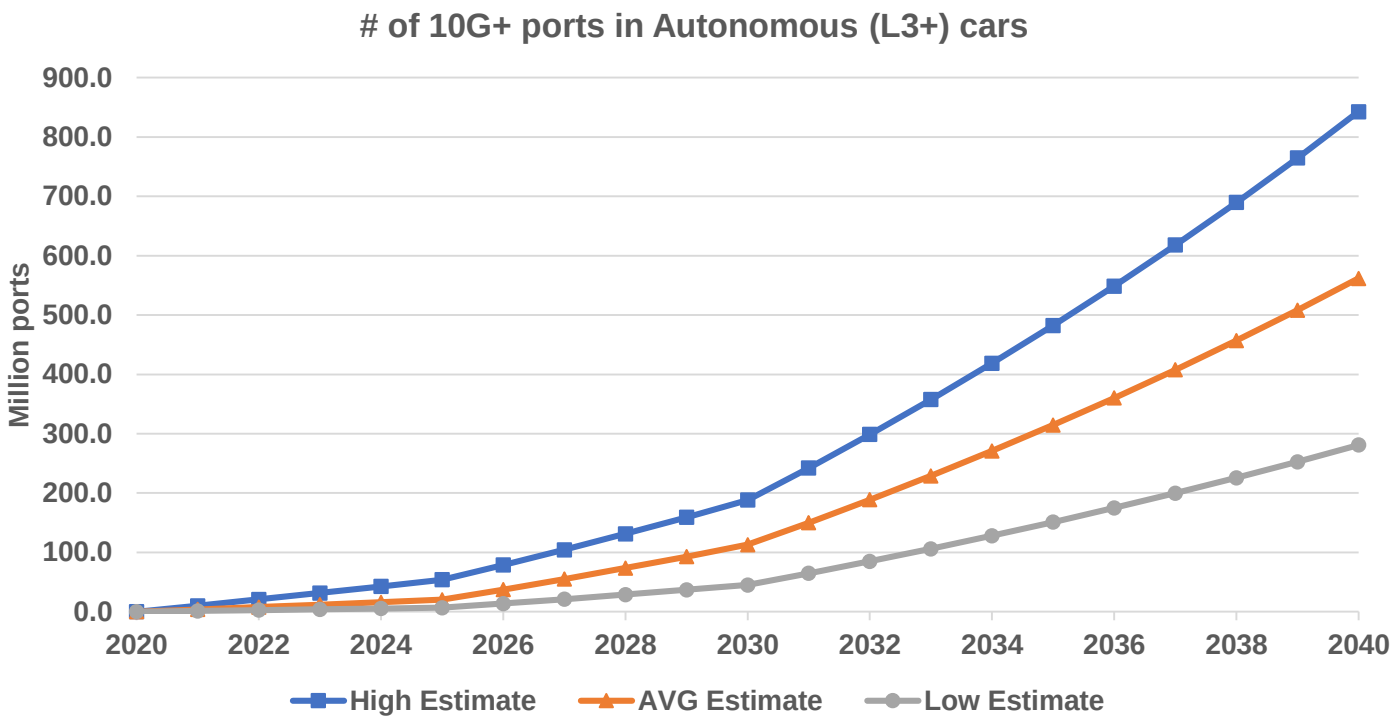


‘Live Software Migration’ supporting the transfer of processes across compute nodes or ECUs will require low latency 10G+ connections

Data Recorder

‘Black Box’ in the car will require significant bandwidth/capacity to store raw sensor data

~100Million 10G+ ports by 2030



Source: McKinsey's "Automotive revolution – perspective towards 2030" study, 2016 and internal estimates

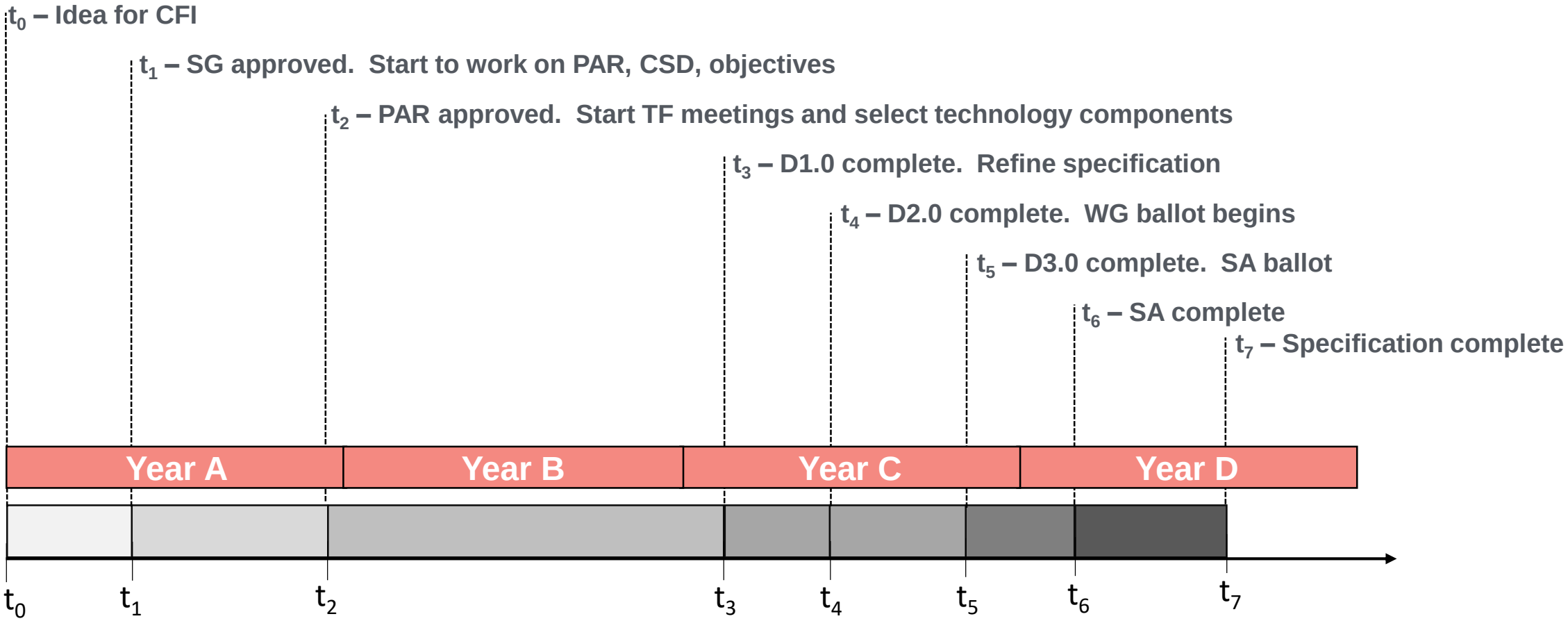
Why Now?

Car OEM test vehicles already using enterprise class Ethernet devices supporting 25 Gb/s & 50 Gb/s

OEMs require automotive variants before mass production for model year 2025

Timeline

Expected timeline to complete specification



Why IEEE?

It’s Ethernet --- it belongs in IEEE 802.3

- IEEE 802.3 is recognized as the international standard for Ethernet
    - Responsible for Ethernet physical layers
- The automotive industry wants the same level of international recognition for 10G+ Automotive Electrical Ethernet PHYs as exists for the rest of IEEE 802.3

Q & A


GOOD ?4SG

Straw Polls

Straw Polls

120 - Number of people in the room

73 - Individuals who would attend and contribute to a
10G+ Automotive Ethernet Electrical PHYs Study Group

44 - My organization would support participation in the
10G+ Automotive Ethernet Electrical PHYs Study Group in IEEE 802.3

Straw Polls

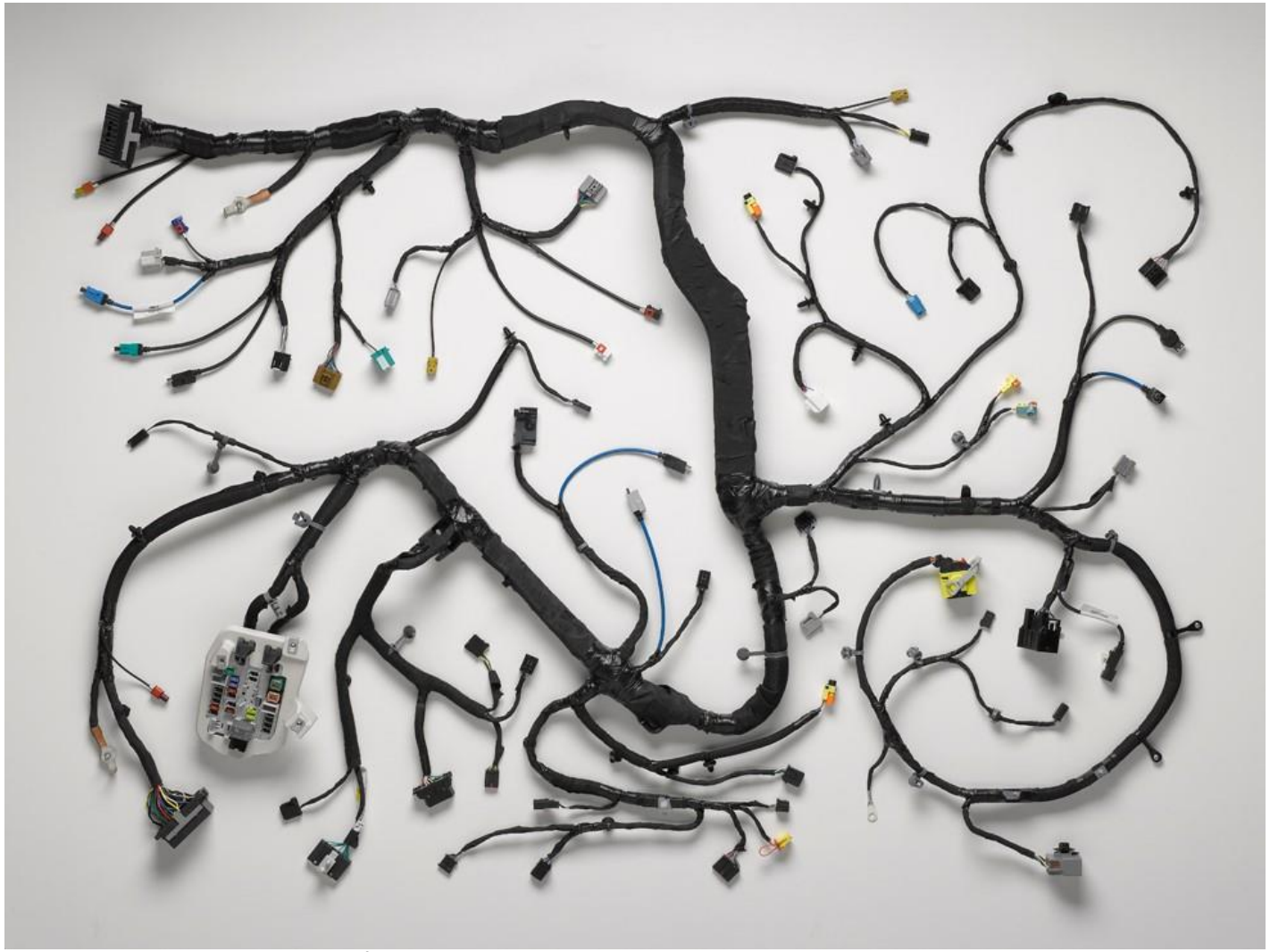
Request that IEEE 802.3 WG form a study group to develop a PAR and CSD for a:

10G+ Automotive Ethernet Electrical PHYs

People in the Room	802.3 Voters Only
Y: 104	Y: 61
N: 0	N: 0
A: 20	A: 13

Backup

Wiring Harness – from RTPGE CFI



Used with permission from Molex

Cabling is the 3rd highest cost component in a car

- Engine (1st)
- Chassis (2nd)

Harnesses are built **ONE** at a time with 50% of cost in labor

Cabling is the 3rd heaviest component in a car

- Chassis (1st)
- Engine (2nd)

Reducing cable weight has a direct impact on fuel economy!