



Peter Lefkin

Managing Director, MIPI Alliance

MIPI Alliance Extends Interface Standards to Support Automotive Market

2017

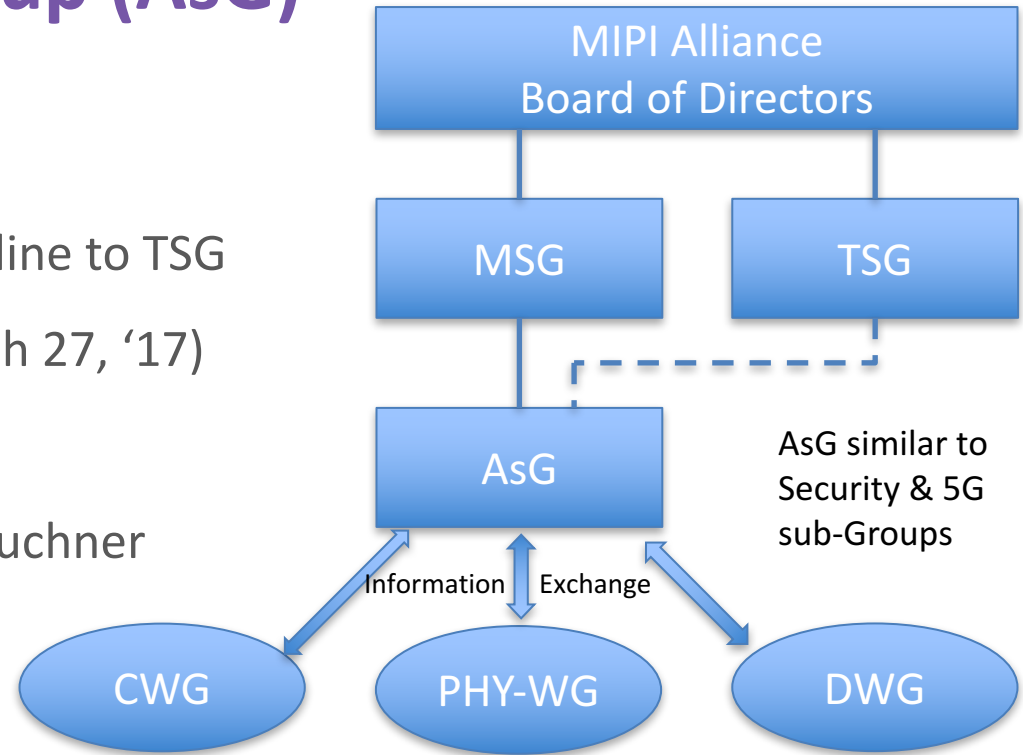
**MIPI ALLIANCE
DEVELOPERS
CONFERENCE**

HSINCHU CITY, TAIWAN

MIPI.ORG/DEVCON

Automotive sub-Group (AsG)

- AsG Formed Jan. 31, '17
- AsG Reports to MSG, dotted line to TSG
- AsG Kickoff at BCN F2F (March 27, '17)
- Chair: Matt Ronning (Sony)
- Vice-Chair: Uwe Beutnagel-Buchner (Bosch)



AsG similar to Security & 5G sub-Groups

Not approved Org Chart

Auto Industry Transformation

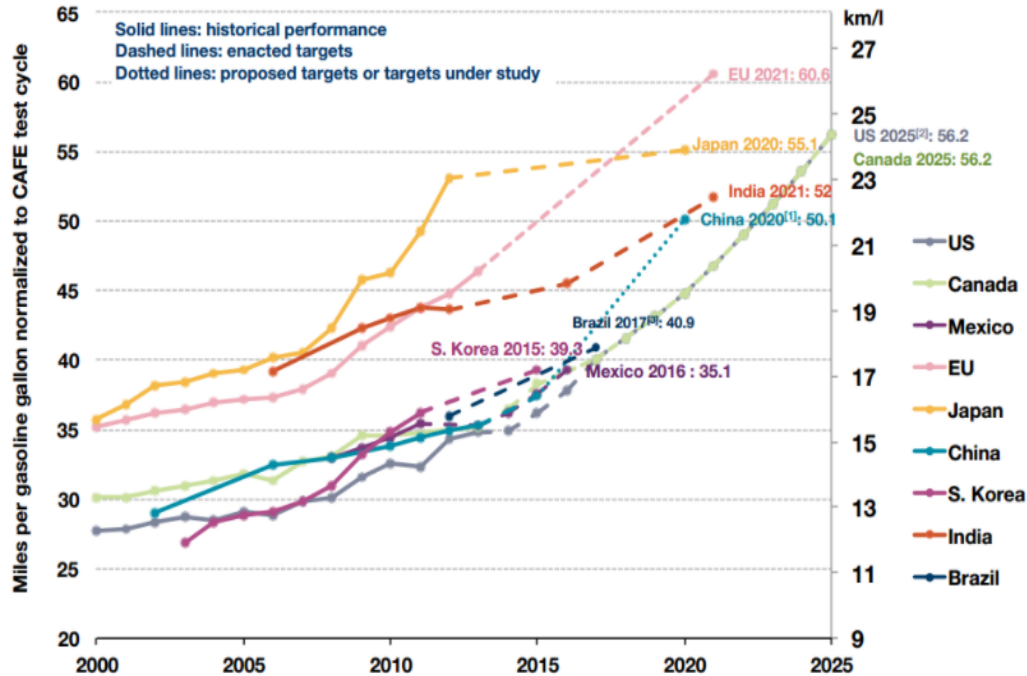


SF is HQ for Many Major Car-Sharing services

Silicon Valley is “Ground Zero” for Next-Gen Automotive Innovation

- Huge changes in the Automotive Industry
- Aggressive New Fuel Economy Standards
- Electrification of Car
- Car Connectivity
- New OEM’s
- New Business Models
- Demand for Driver Safety Systems: ADAS, Autonomous Driving Systems (ADS), etc.

Fuel Economy a Market Force



- Fuel Economy Requirements drive Auto Tech: mild hybrids, Mirror Replacement Cameras (MRC), etc.
- Improve Fuel Economy: MRC's weigh less, reduce side-mirror drag 2~7%
- Added Benefit - Improved Safety: wider view angle, blind spot coverage, comp for glare, darkness, rain
- Activity in US & Europe, but Japan's regulators passed new rules allowing for mirrorless cars as of June 17, 2016.
- Japan New Vehicle 2023 projections*:
 - digital rear-view mirrors 29%
 - digital side-view mirrors 12%
- WW Fuel Economy Requirements:

• EU 2021:	60.6 MPG equivalent
• Japan 2020:	55.1 MPG
• China 2020:	50.1 MPG
• USA/Canada:	56.2 MPG

* Source: Ichikoh

[1] China's target reflects gasoline vehicles only. The target may be higher after new energy vehicles are considered.
 [2] The U.S. standards are fuel economy standards set by NHTSA, which is slightly different from GHG standards due to A/C credits.
 [3] Gasoline in Brazil contains 22% of ethanol (E22), all data in the chart have been converted to gasoline (E00) equivalent
 [4] Supporting data can be found at: <http://www.theicct.org/info-tools/global-passenger-vehicle-standards>

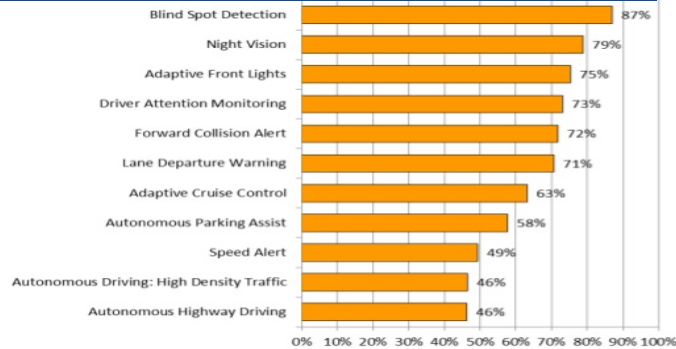
Source: International Council for Clean Transportation, 2014 Updates

Market Demand for Active Safety

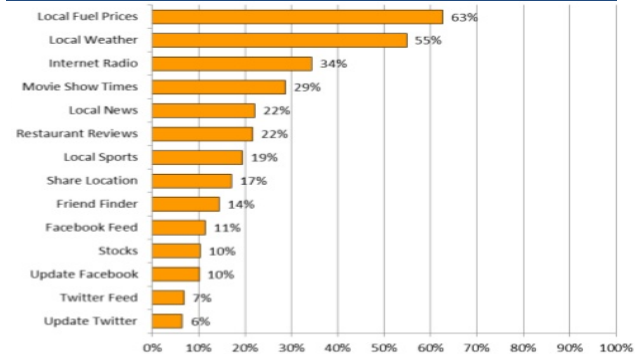
Source: Strategy Analytics 2014



Interest in Safety Features



Interest in Infotainment

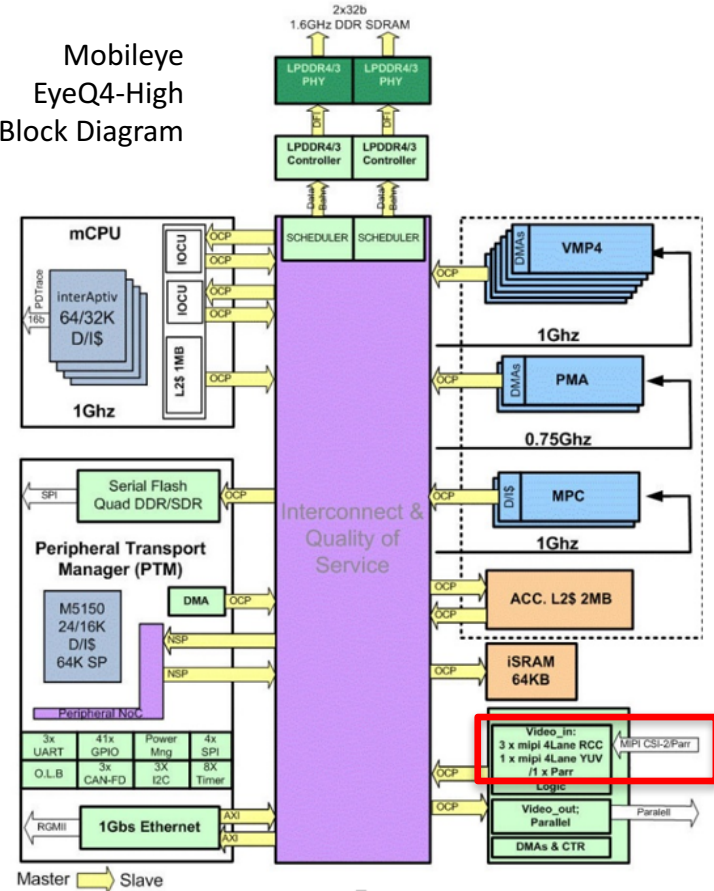


US Consumers Interest in Active Safety Features, Compared to Convenience/Entertainment

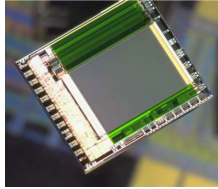
Why MIPI for Automotive?

- MIPI can Solve Auto Problems, Already used in Auto Systems
- **Market growth rates high, driving MIPI Member Interest**
- Board Authorized Formation of AsG at Singapore F2F, Chair chosen (January, 2017)
- “PHY Investigation” includes Auto Channels (4m & 15m) as Targets vs. ~0.3m for current MIPI PHY’s
- Cautionary Points:
 - **Migration of Consumer Devices to Automotive not trivial**
 - MIPI Primarily Mobile Device Standard, this will not change
 - MIPI Alliance not trying to replace existing auto networks
 - MIPI C/D-PHY, MIPI CSI-2, MIPI DSI currently short range – board level interface for automotive

Mobileye EyeQ4-High Block Diagram

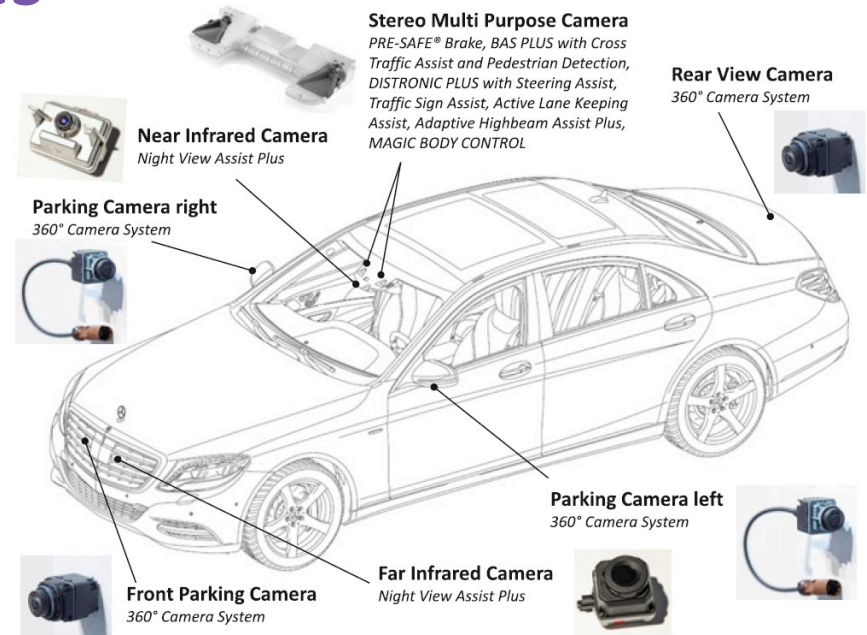


High Market Growth Rates



- *Mobileye CEO Amnon Shashua, March 2017 MIT Center for Brains, Minds & Machines Talk*
 - Current Cameras in Automotive Use: ~1.3Mpixel (XGA)
 - 2018/19 target spec: ~8Mpixel
 - Analog binning for low light: 2x2, 3x3
 - ADS Req. 7~8 cameras/vehicle
 - 60fps capture raw, 30~10fps semi-processed
 - By 2020 “basically all” US/Euro cars will have front facing cameras

* Source: Daimler AG



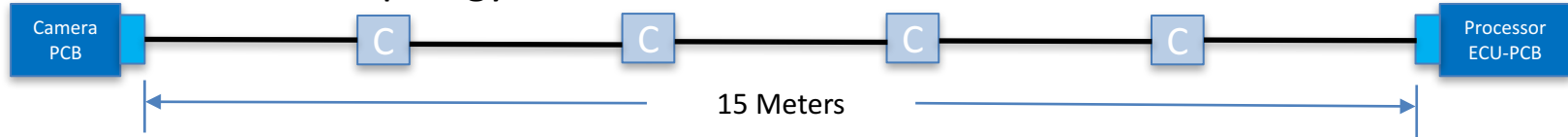
Cameras in the Mercedes-Benz S-class (V222)*

Electronics BOM in Cars Increasing, Number of Image Sensors Growing Significantly

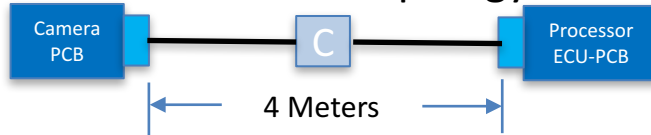
MIPI Automotive Topology & Cable Type Investigation

Underway Now

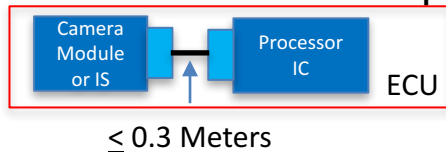
MIPI Automotive Topology A



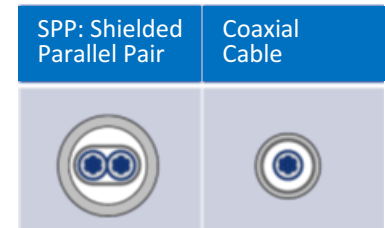
MIPI Automotive Topology B



MIPI Automotive Topology C

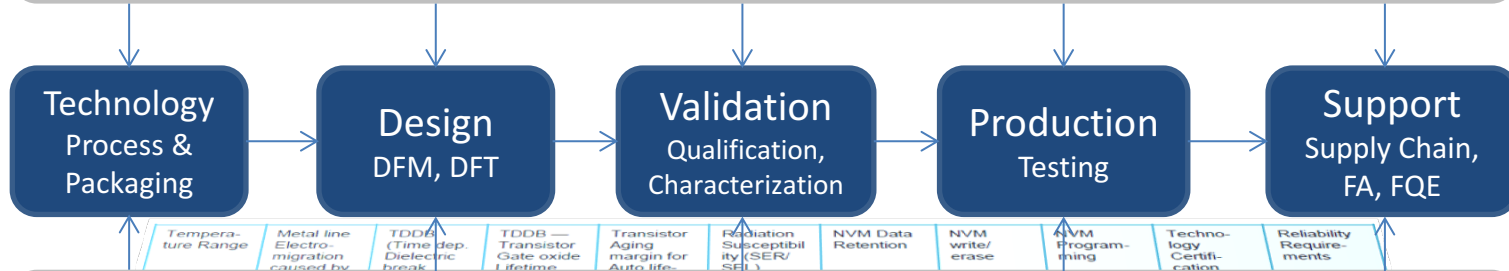


- Topology A is worst case w/ 4 equidistant in-line connectors camera to ECU interface
- Topology B is representative of side mirror replacement
- Approximately 65% of Auto Gbps+ I/F are less than 4m in length in representative car (IEEE RTPGE estimate)
- Topology C is representative of Image Sensor within the same ECU as the processor
- Cable Types must also be selected (SPP, Coax, others?)
- 8Mpixel HDR Camera may require 12Gbps



AUTOMOTIVE REQUIREMENTS

Reliability Zero Defects Uninterrupted Supply Security Safety



Temperature Range	Metal line Electromigration caused by	TDDs (Time dep. Dielectric break)	TDDb — Transistor Gate oxide Lifetime	Transistor Aging margin for Auto life	Radiation Susceptibility (SER/SEL)	NVM Data Retention	NVM write/erase	NVM Programming	Technology Certification	Reliability Requirements
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STANDARDS

ISO 26262 AEC-Q100 TS16949 MISRA-C* Others

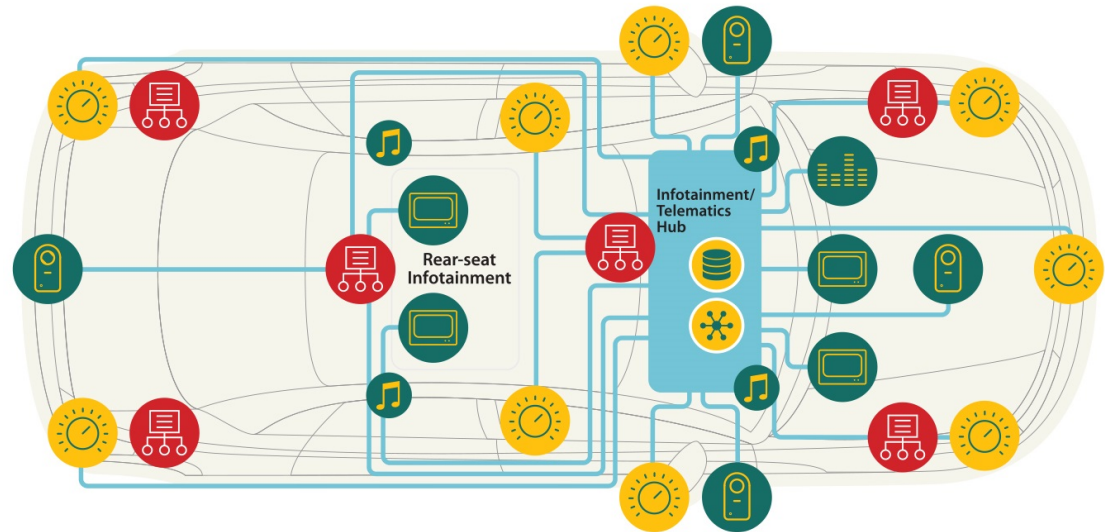
ment	APOP support	Qualification acc. to AECQ100	Drift Analysis	Characterization	PPAP	Test insertions & test coverage	Memory ECC testing	Zero defect test screen strategy	High voltage stress and/or burn-in	PFMEA	Process Controls
Manufacturing margin / Cpk	Sub-Supplier & Subcontractor	Supply security	Quality Management system / cert. acc. TS16949	VDA audit support (VDA 6.3)	product maturity	FA & 8D support	Commitment to confirmed ppm target	Traceability	Record retention	MAT Label	
PCN handling	product life-cycle	EOL handling & stock	FMEA	Supply Agreements & ...	Automotive System ...	EMC -ECU design support & ...	ISO26262 related support	Automotive Software Development	pro-active quality alert	Material compliance & ...	

Over 50 Differences Between Automotive & Consumer Semiconductor Support Covered by Standards

MIPI Applicable sub-Systems

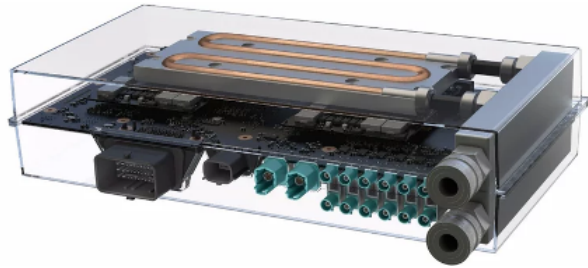
- Telematics & In-Vehicle Infotainment (IVI)
- Advanced Driver Assist Systems (ADAS)
- Intelligent Transportation Systems (ITS)
- **Autonomous Driving Systems (ADS)***
- Others...

*** Focus on ADS as first subsystem to review**



SAE Autonomy Levels

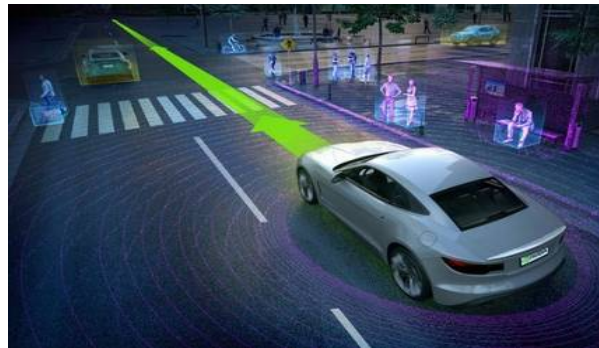
World's First In-Car AI Super-Computer Announced at CES-2016



nVidia's Drive PX2

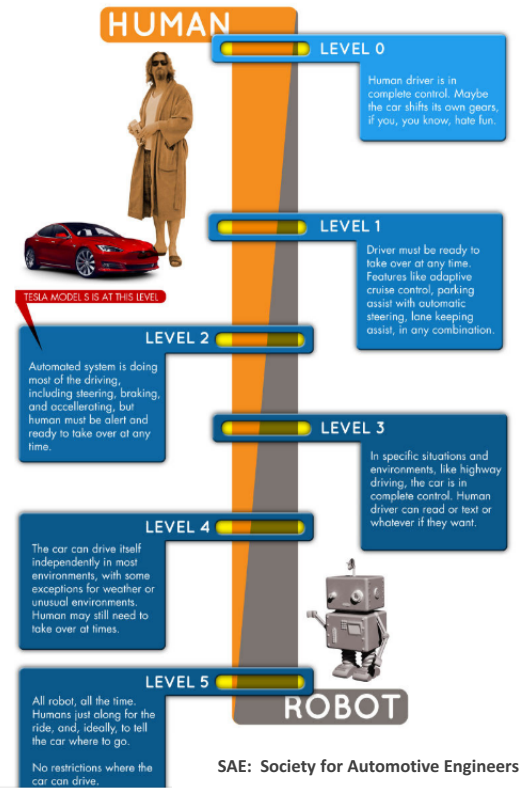
8 teraflops of processing power

two Tegra SoCs plus two liquid cooled GPUs, including eight ARM Cortex A57 cores and four "Denver" cores



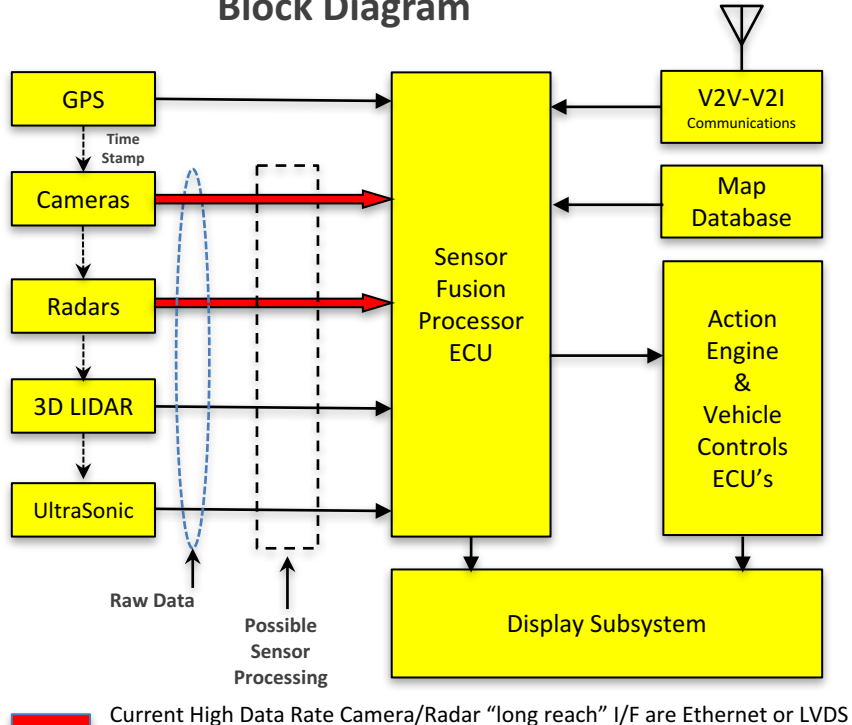
Process data from 12 video cameras, ultrasonic sensors, radar & LiDAR

SAE AUTONOMY LEVELS



Autonomous Driving System

Block Diagram



- Central Challenge is getting Possibly Raw Image Sensor &/or Radar Data to Fusion Processor
- For Image Sensors, 10Gbps link could support:
 - RAW16 10MP 1 Max Exposure Channel @ 60fps
 - RAW 16 2MP 4 Max Exposure Channel @ 60fps
- For Radar Systems, 12Gbps link could support:
 - Four "Typical" 4-RX-Channel Radars (50MS/sec, 12b resolution)
 - Two "Max" 4-RX-Channel Radars (80MS/sec, 16b resolution)

Current Areas of Investigation

- Data Rates Required for Automotive Camera Interfaces
- BER Requirement
- Channel Definition (including Interference)
- Capacitively Coupled I/F Requirement
- Power Constraints: TX, RX
- Functional Safety Req's (ISO26262) & Security
- Latency & Sync (i.e., multiple cameras) & ID
- Cable size, weight, connector limitations

Final Comments

- Lots of interesting work to do!
- Selection/prioritization of topics will be member driven
- Companies with experience and/or interest in Automotive are encouraged to join



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THANK YOU

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