



**Matt Ronning**  
Automotive sub-Group Chairman

## **MIPI Alliance Extends Interface Standards to Support Automotive Market**

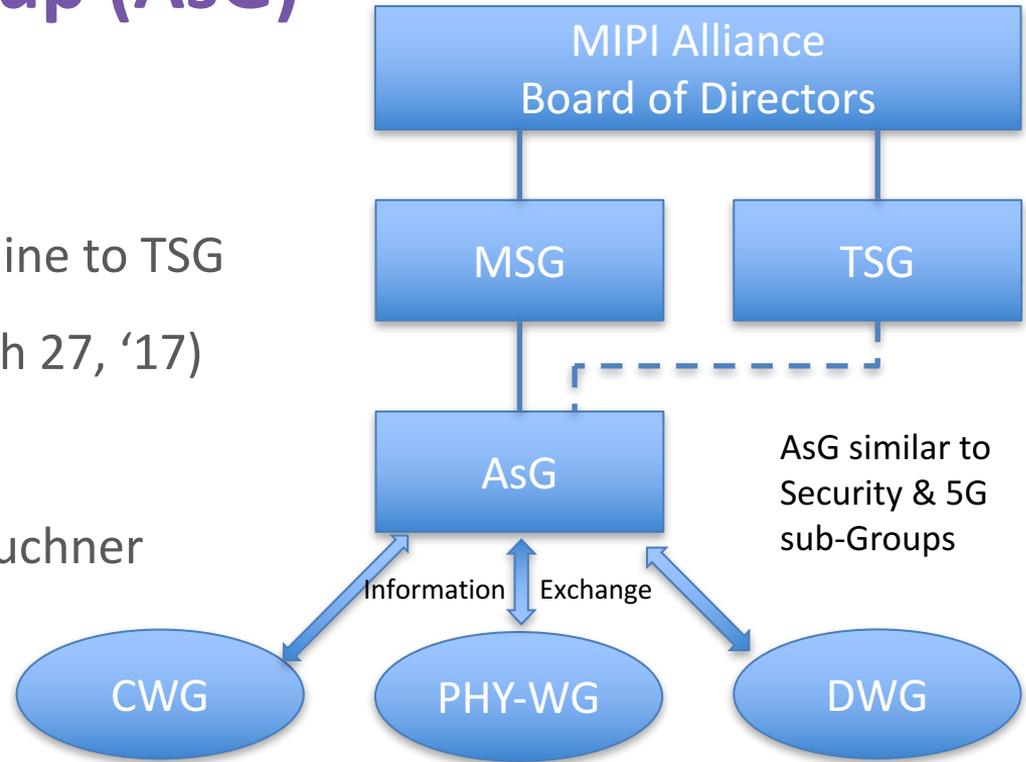
**BANGALORE, INDIA**  
[MIPI.ORG/DEVCON](http://MIPI.ORG/DEVCON)

The background features a large, abstract graphic on the right side composed of overlapping geometric shapes in purple, orange, and teal. A blurred photograph of a crowd of people is visible within the purple section of the graphic.

**2017**  
MIPI ALLIANCE  
DEVELOPERS  
CONFERENCE

# 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)



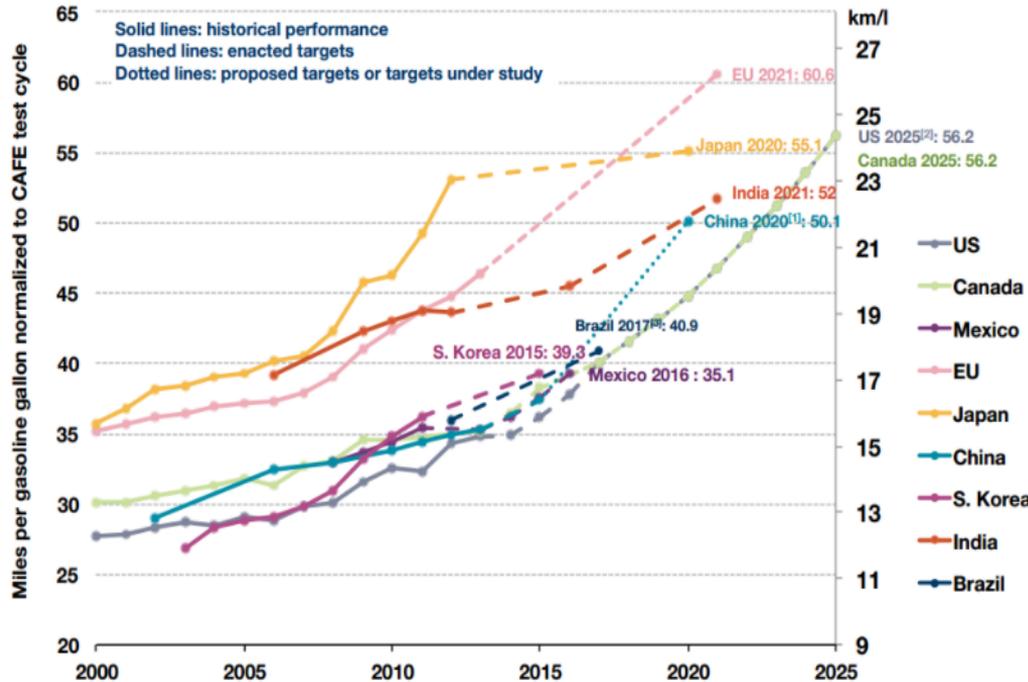
Not approved Org Chart

# Auto Industry Transformation



- 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



[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

- 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

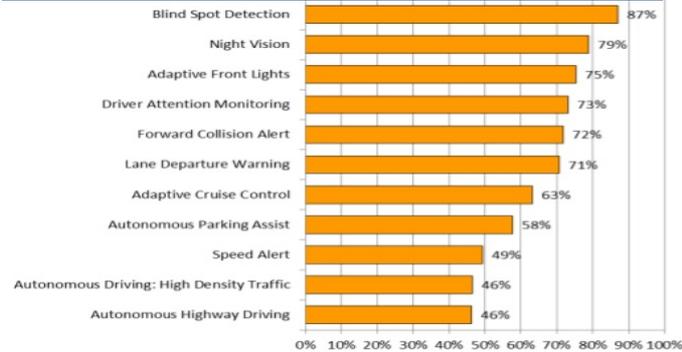
\* Source: Ichikoh

# Market Demand for Active Safety

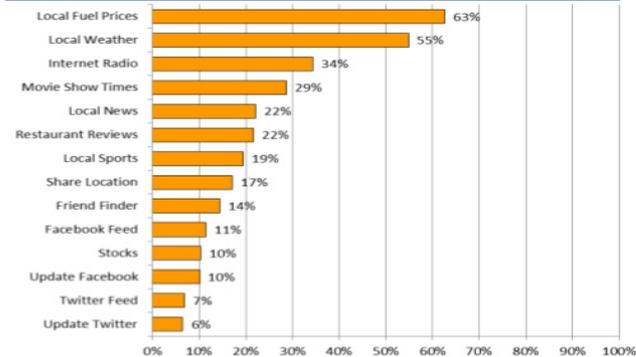
Source: Strategy Analytics 2014



## Interest in Safety Features



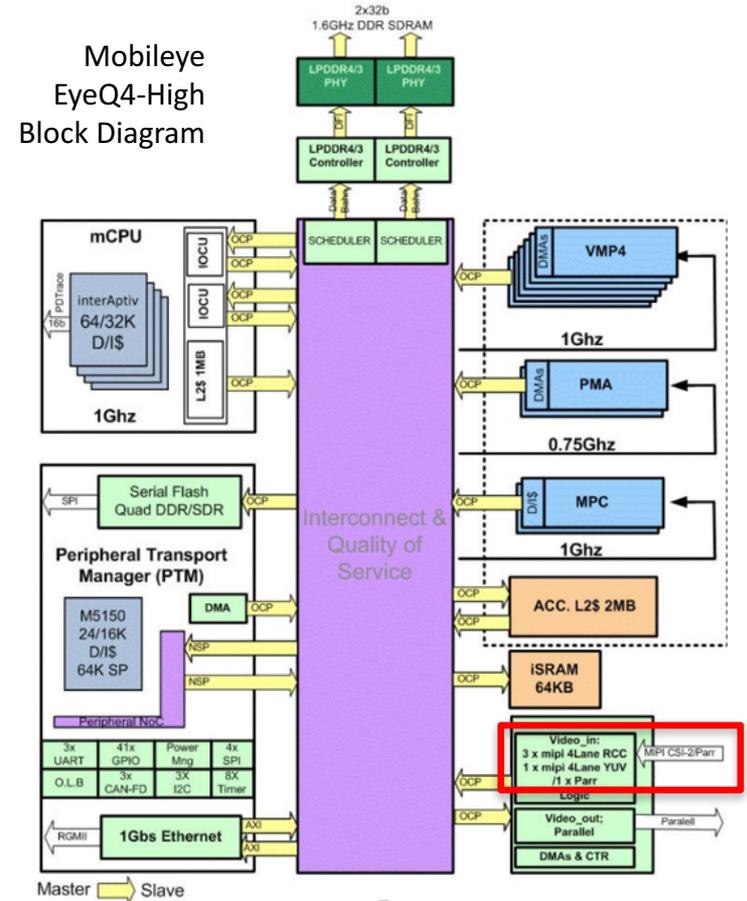
## Interest in Infotainment



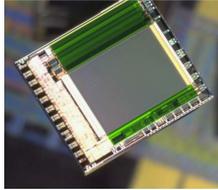
US Consumers Interest in Active Safety Features, Compared to Convenience/Entertainment

# 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

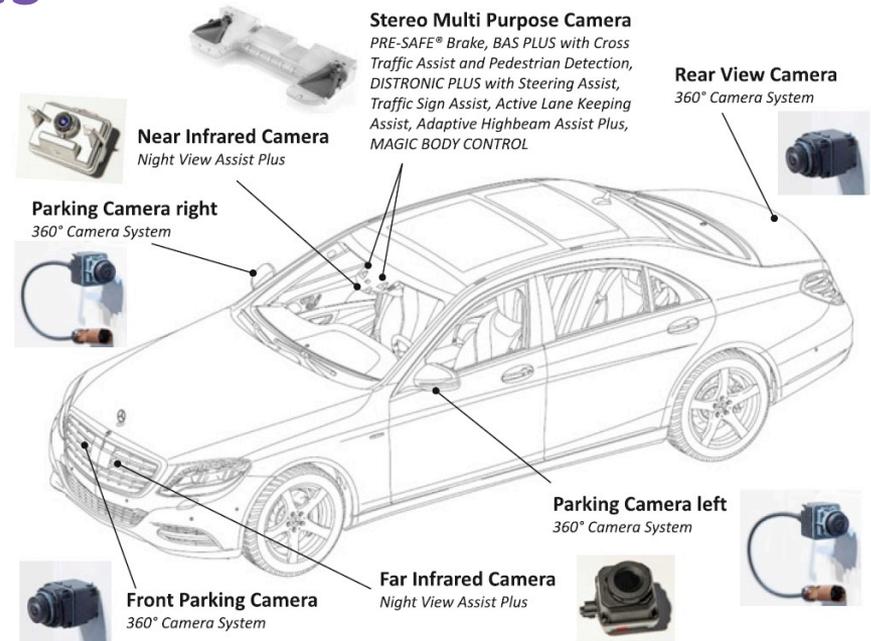


# High Market Growth Rates



- *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



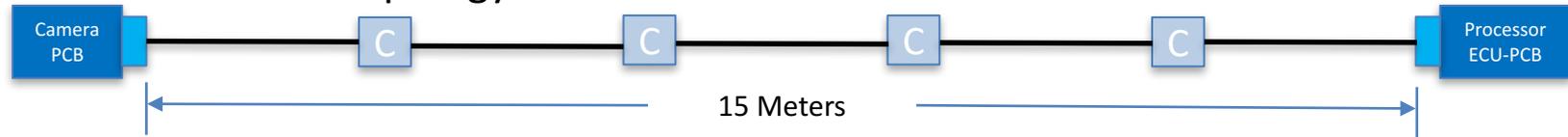
Cameras in the Mercedes-Benz S-class (V222)\*

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

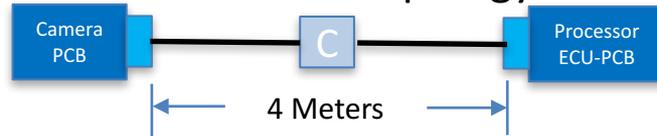
# MIPI Automotive Topology & Cable Type Investigation

Underway Now

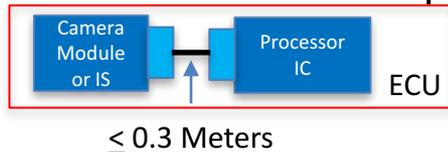
## MIPI Automotive Topology A



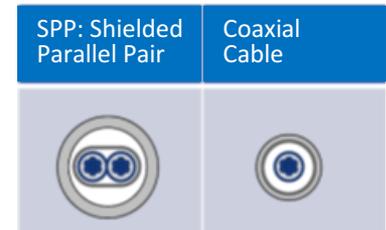
## MIPI Automotive Topology B



## 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    VM Programming    Technology Certification    Reliability Requirements

## STANDARDS

ISO 26262    AEC-Q100    TS16949    MISRA-C\*    Others

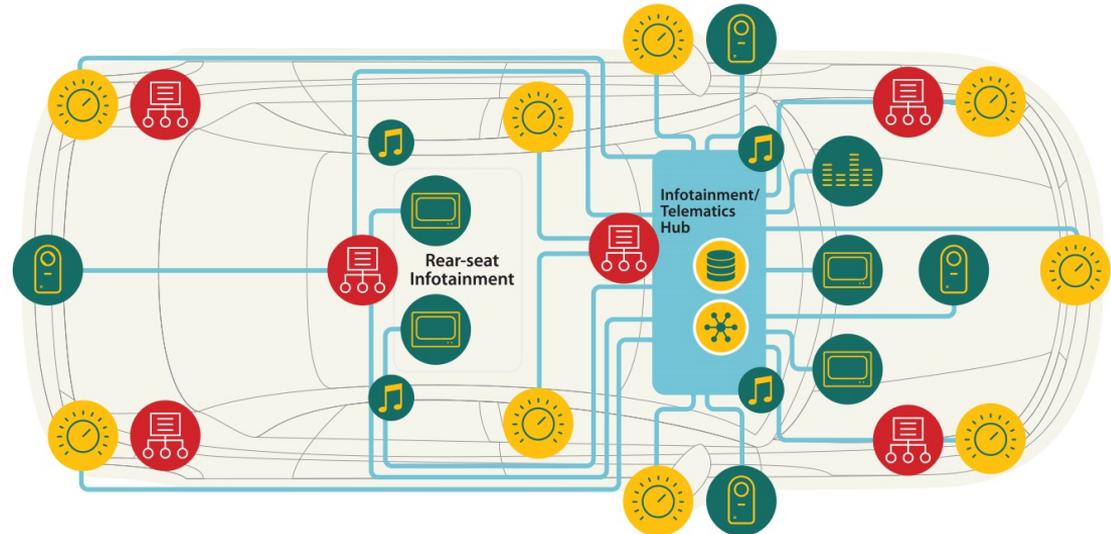
|                            |                               |                      |  |                             |                                 |                               |                                    |                                    |                          |                           |
|----------------------------|-------------------------------|----------------------|--|-----------------------------|---------------------------------|-------------------------------|------------------------------------|------------------------------------|--------------------------|---------------------------|
| ment                       |                               |                      |  |                             | (DFM)                           | (DFA)                         |                                    |                                    |                          |                           |
| 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 support & ... | 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

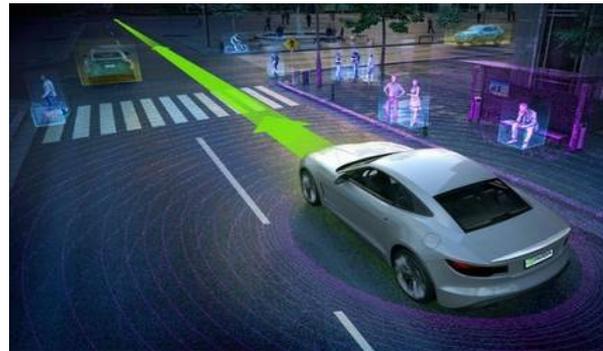
World's First In-Car AI Super-Computer Announced at CES-2016



## nVidia's Drive PX2

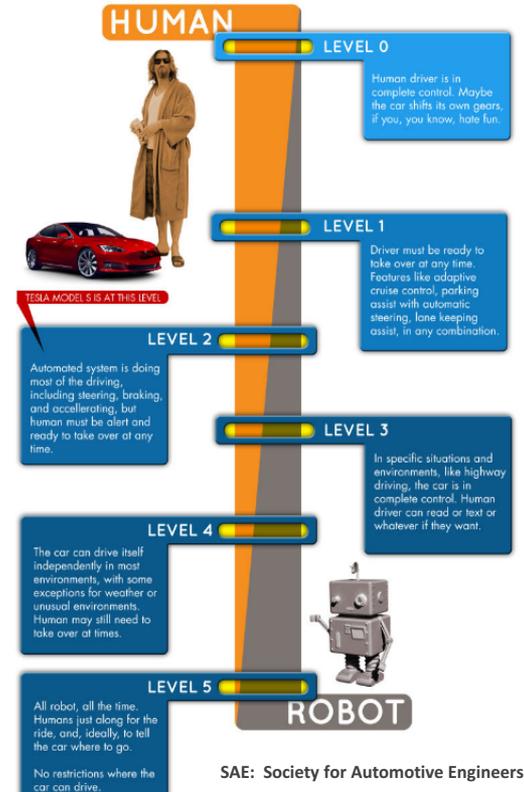
8 teraflops of processing power

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



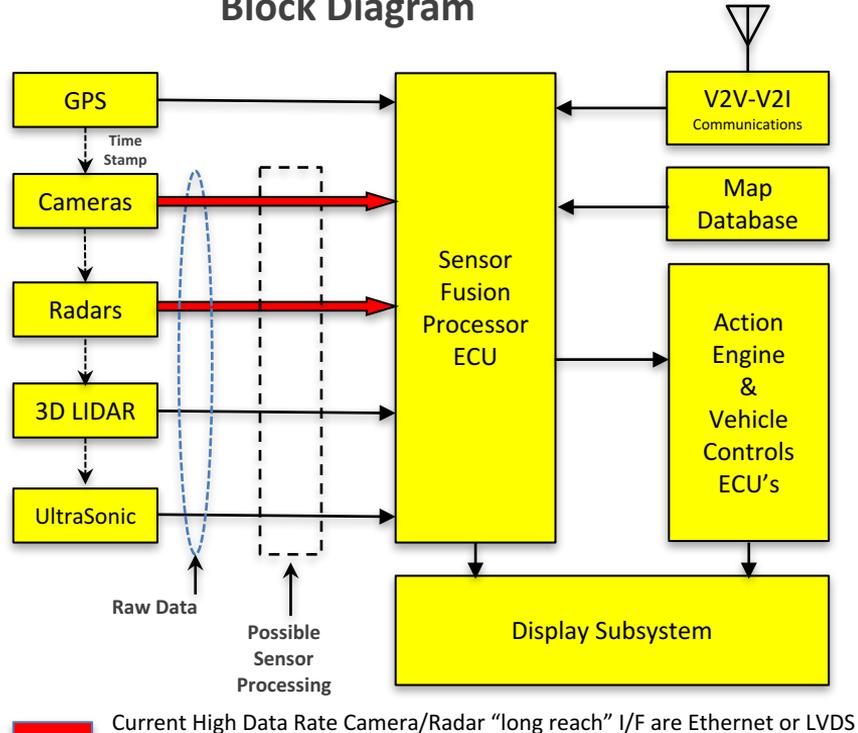
Process data from 12 video cameras, ultrasonic sensors, radar & LiDAR

## 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



miipi<sup>®</sup>  
**DEVCON**

THANK YOU

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