mipi®
DEVCON

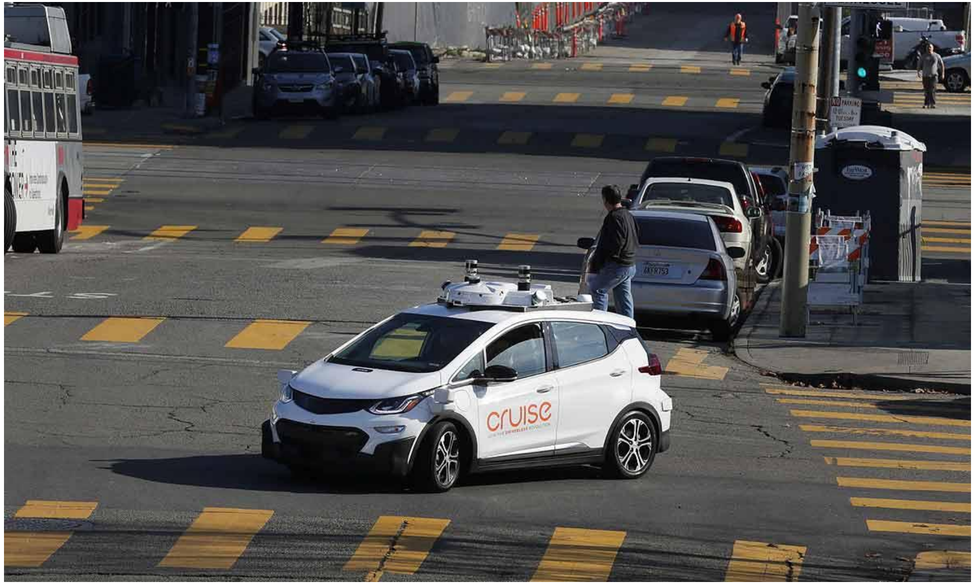
Matt Ronning
MIPI Alliance Automotive Work Group Chairman

MIPI Alliance Automotive Interface Standards Development Update

MIPI ALLIANCE DEVELOPERS CONFERENCE

19 OCTOBER 2018
SEOUL

Auto Industry Transformation



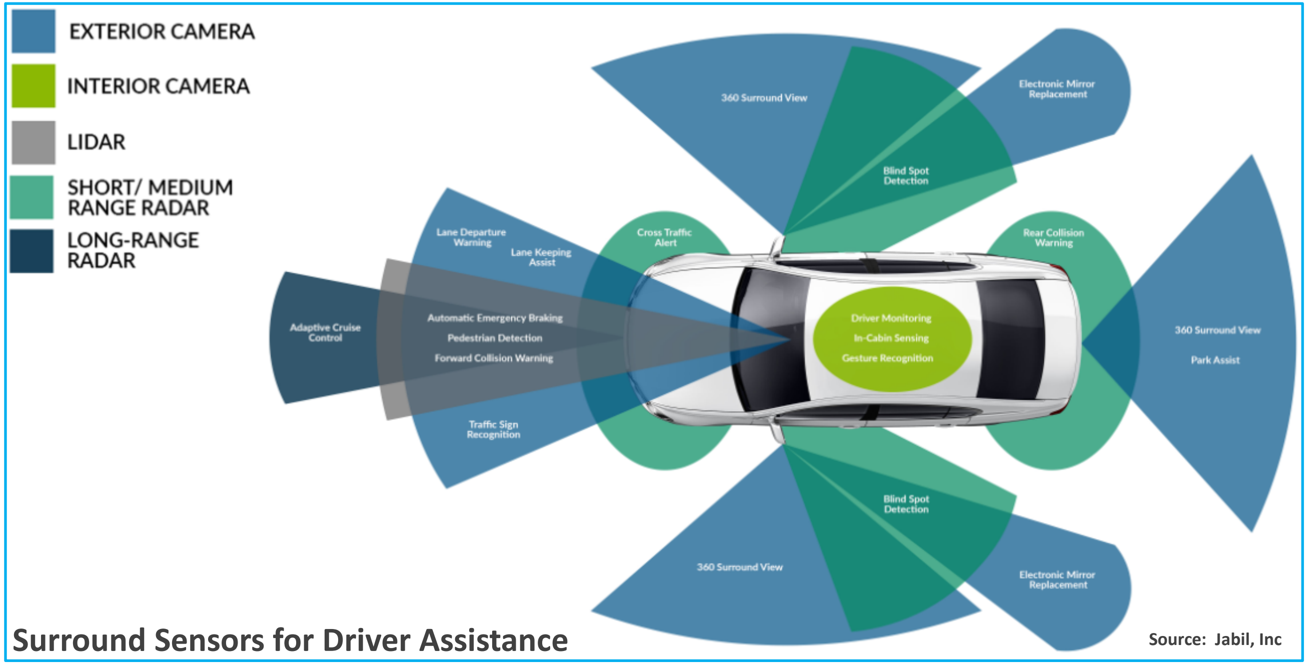
Honda & GM Partner to Develop Mass Produced, Driverless Cars.
Source: October 4, 2018 Automotive News

<u>**Huge Changes in Auto Industry**</u>:

– Worldwide New Car Assessment Program (Government Safety Reg's), inc: FCWS, AEBS, RVS, LDWS, etc.
– Aggressive Fuel Economy Regulations
– Electrification of Car
– New OEM's, New Business Models, New Alliances
– Autonomous Driving Systems
– Car Connectivity

MIPI ALLIANCE DEVELOPERS CONFERENCE
19 OCTOBER 2018
SEOUL

NCAP Regulations Driving Sensors & Display Adoption



Surround Sensors for Driver Assistance

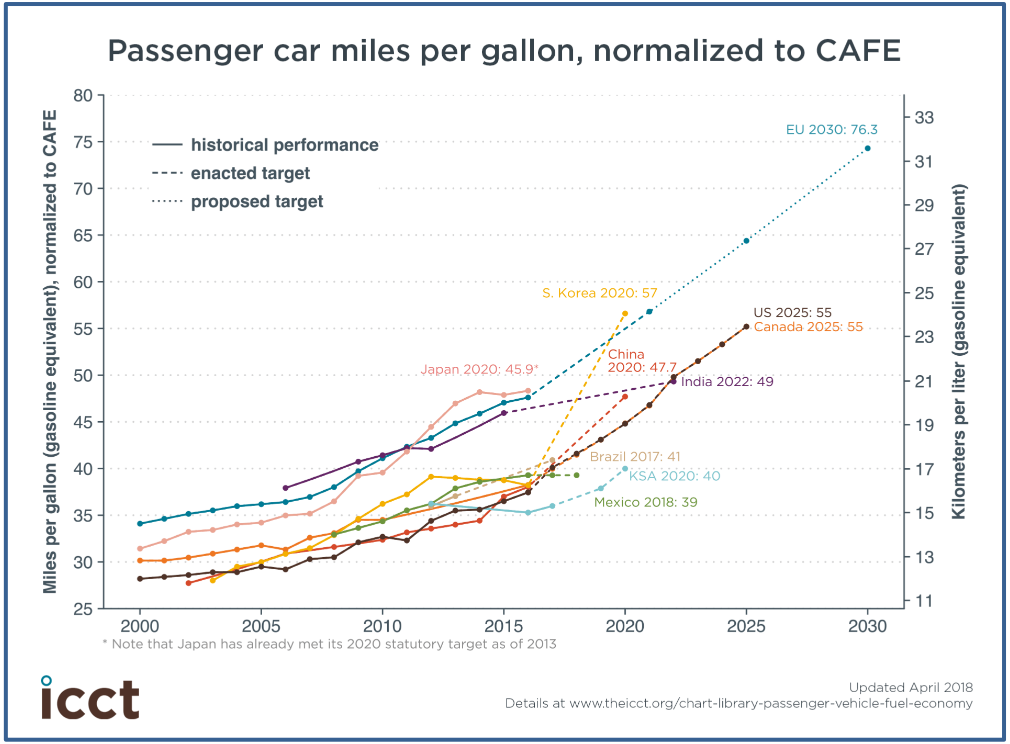
Source: Jabil, Inc

- Worldwide NCAP ADAS Standards driving adoption of multiple High Data Rate "Surround Sensors"
- Displays for Driver Viewing of Assistance Imaging & Information also Required

ADAS Displays

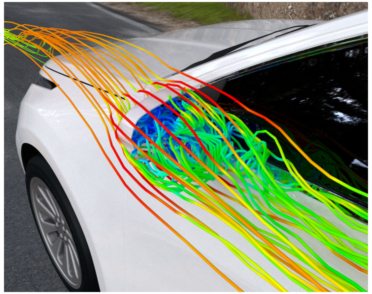
NCAP: New Car Assessment Program

Fuel Economy a Market Force



Source: International Council for Clean Transportation, 2018 Updates

- Fuel Economy Regulations drive Auto Tech: Mild Hybrids, Mirror Replacement Cameras (MRC), etc.
- MRCs weigh less & reduce side-mirror drag 2~7%, resulting in improved fuel economy (with improved safety too)



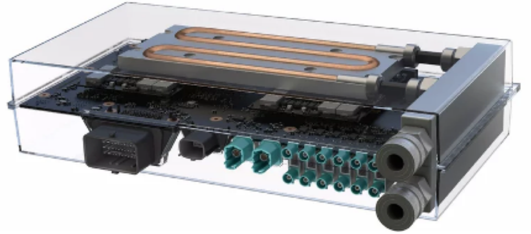
- "Today's average car burns a full tank of fuel every year, just by transporting its mirrors." Brad Duncan, Sr. Director, Exa Corp.
- Japan/EU regulatory approval for mirrorless cars as of 2016, US Approval Pending.
- Japan New Vehicle 2023 projections*:
  - Digital Rear-View mirrors 29%
  - Digital Side-View mirrors 12%

* Source: Ichikoh

Automated Driving Levels

SAE Level	SAE Name	SAE Narrative Definition	Execution of Steering/ Acceleration/ Deceleration	Monitoring of Driving Environment	Fallback Performance of Dynamic Driving Task	System capability (driving modes)	BASt Level	NTHSA Level
Human Driver monitors the driving environment								
0	No Automation	the full-time performance by *the human driver* of all aspects of the *dynamic driving task*	Human Driver	Human Driver	Human Driver	N/A	Driver only	0
1	Driver Assistance	the *driving mode-specific* execution by a driver assistance system of either steering or acceleration/deceleration	Human Driver and Systems	Human Driver	Human Driver	Some Driving Modes	Assisted	1
2	Partial Automation	Part-time or driving mode-dependent execution by **one or more driver assistance systems** of both steering and acceleration/deceleration. Human driver performs all other aspects of the *dynamic driving task*.	**System**	Human Driver	Human Driver	Some Driving Modes	Partially Automated	2
Automated driving system ("system") monitors the driving environment								
3	Conditional Automation	*driving mode-specific performance by an automated driving system of all aspects of the dynamic driving task - human driver* does respond appropriately to a *request to intervene*	System	**System**	Human Driver	Some Driving Modes	Highly Automated	3
4	High Automation	*driving mode-specific performance by an automated driving system of all aspects of the dynamic driving task - human driver* does not respond appropriately to a *request to intervene*	System	System	**System**	Some Driving Modes	Fully Automated	3/4
5	Full Automation	**full-time** *performance by an automated driving system of all aspects of the dynamic driving task* under all roadway and environmental conditions that can be managed by a *human driver*	System	System	**System**	Some Driving Modes		

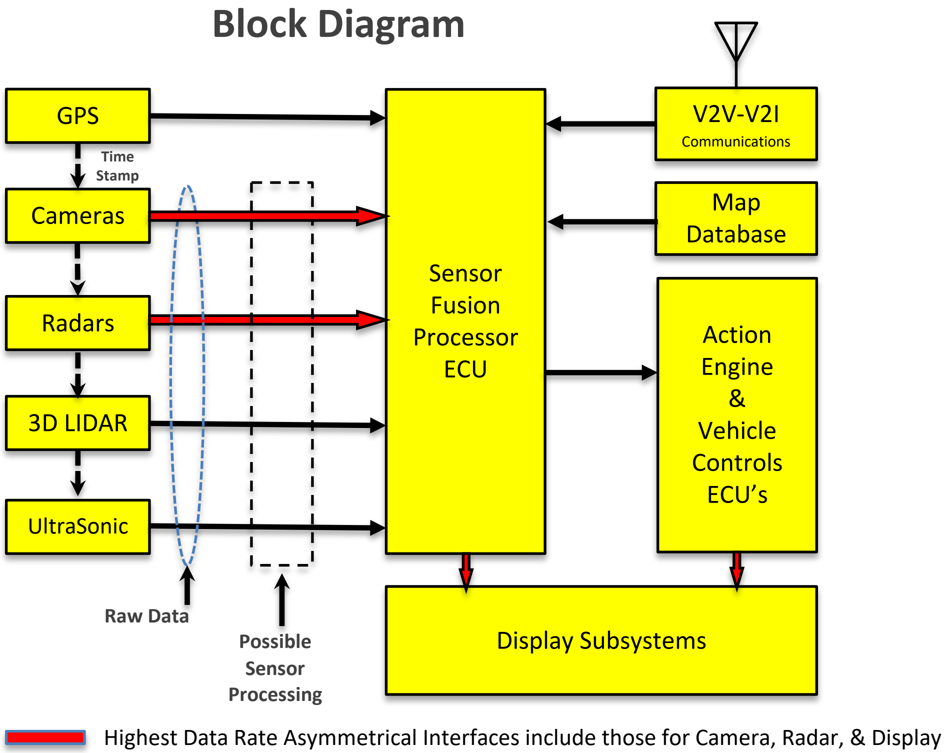
World's First In-Car AI Super-Computer Announced at CES-2016



nVidia's Drive PX2
8 Teraflops of Processing Power

Source: *Sensors Online*, Nov 10, 2017, SAE
Federal Highway Research Institute

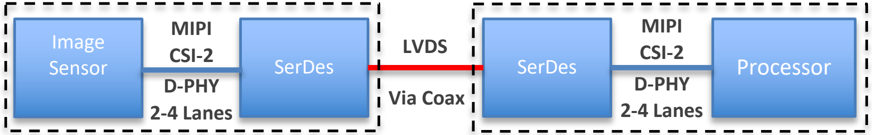
Autonomous Driving System



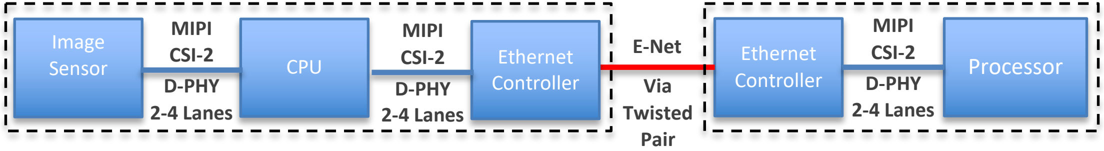
- Central Challenge - transport Raw Image Sensor &/or Radar Data to Fusion Processor, and Processor/other generated data to the Displays
- For Image Sensors, 10Gbps link could support:
  - RAW16 10MP 1 Max Exposure Channel @ 60fps
  - RAW 16 2MP 4 Max Exposure Channel @ 60fps
- For Radar, 12.5Gbps link could support:
  - Four "Typical" 4-RX-Channel (50MS/sec, 12b res)
  - Two "Max" 4-RX-Channel (80MS/sec, 16b res)
- For Display Subsystems, 16Gbps link could support:
  - Ultra-HD 3840x2160 24-bits/pixel RGB 4:4:4 60 Hz

Why MIPI for Automotive?

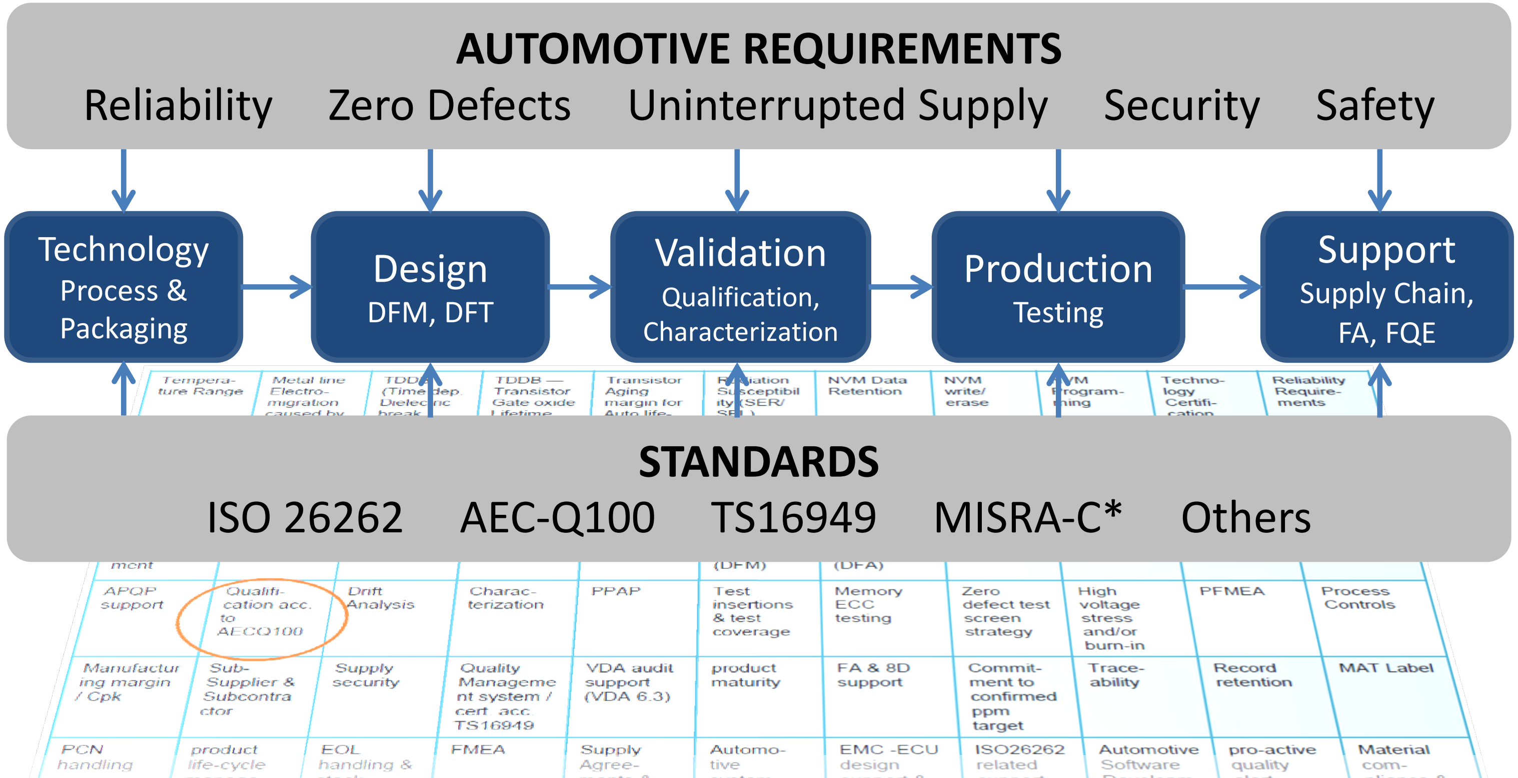
- MIPI can provide Auto OEMs with a Standard I/F, vs current incompatible proprietary LVDS solutions



- MIPI Asymmetric & Low Complexity Automotive I/F's complimentary w/ Automotive Ethernet Solution

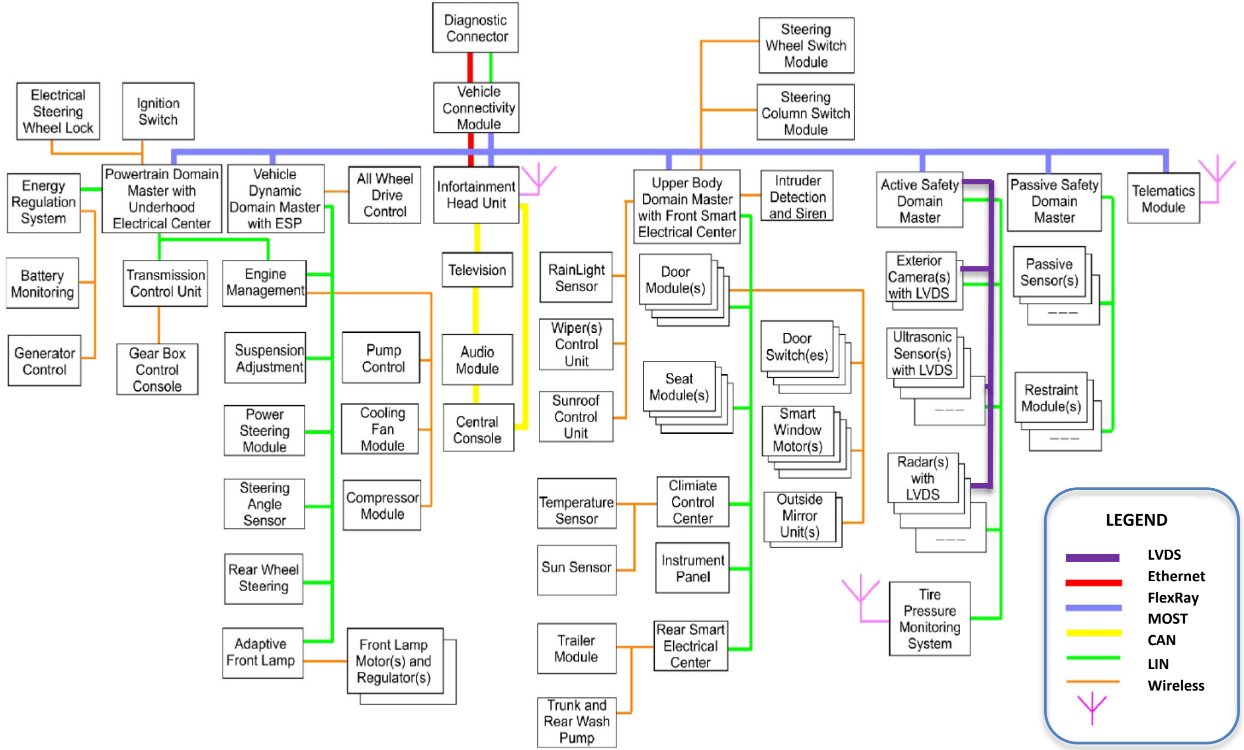


- High Market Growth, driving MIPI Member Interest. Leverage economies of scale: Mobile -> Automotive
- Physical Layer investigations using Auto Channels (<15m) as targets indicate technically feasible.
- Cautionary Points:
  - Migration from Consumer to Automotive not trivial
  - MIPI Alliance not trying to replace existing auto network standards: CAN, LIN, MOST, etc.
  - MIPI C/D-PHY, MIPI CSI-2, MIPI DSI currently short range – board level interface for automotive



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

Automotive System Interfaces



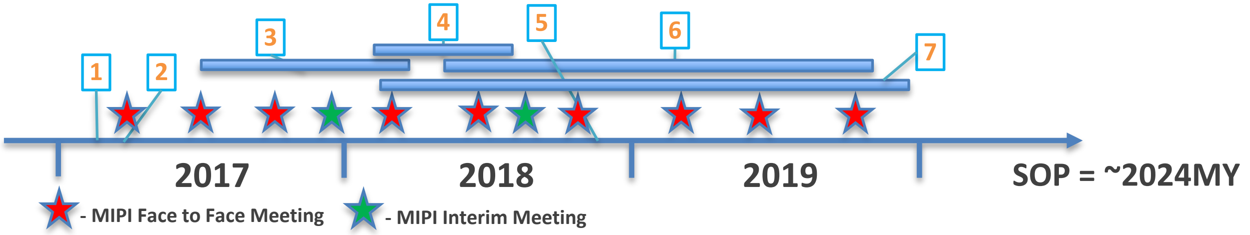
Example BMW Wiring Harness

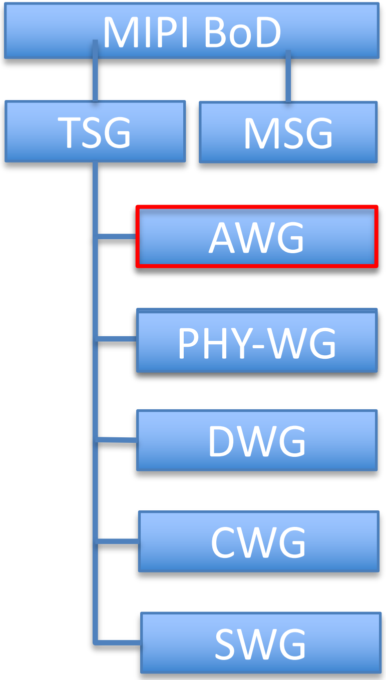
Network Topology Graphic adapted from Zeng, Khalid, & Chowdhury IEEE Comm, VOL. 18, NO. 3, Q3-2016

MIPI ALLIANCE DEVELOPERS CONFERENCE
19 OCTOBER 2018
SEOUL

MIPI Auto I/F Development Org & Timeline

1. MIPI Automotive Activities Started Jan. 2017
2. Req. Gathering Kickoff Barcelona F2F (March, 2017)
3. MIPI Auto sub-Group opened to non-members (invitations & BoF) for webex's June 2017 ~March 2018
4. MIPI Auto Req. Doc (ARD) to v1.0.1 releases Feb.~July 2018
5. MIPI ARD v1.1 Expected by Seoul Face-to-Face Meeting
6. MIPI A-PHY spec development April 2018~Nov. 2019
7. Camera/Display WG protocol spec development 2018~19



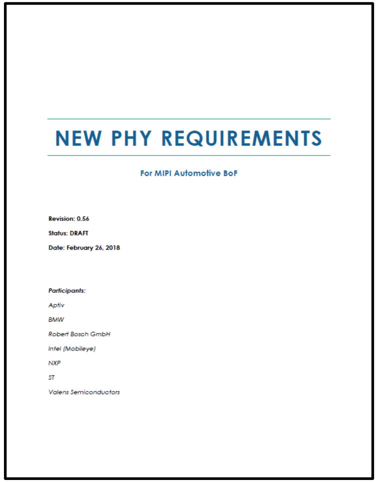


Not approved Org Chart

AWG Chair Team: Matt Ronning (Sony), Uwe Beutnagel-Buchner (Bosch), Michael Kaindl (BMW), Hugo Pereira Santos (Synopsys)

MIPI ALLIANCE DEVELOPERS CONFERENCE
19 OCTOBER 2018
SEOUL

MIPI Automotive Requirements Document Progress



NEW PHY REQUIREMENTS

For MIPI Automotive BoF

Revision: 0.56

Status: DRAFT

Date: February 26, 2018

Participants:

Aptiv

BMW

Robert Bosch GmbH

Intel (Mobileye)

NXP

ST

Valens Semiconductors

v0.56 Feb. 26, 2018

mipi alliance

DRAFT High Level Requirements for MIPI Automotive PHY

Version 0.80
Revision 1
28 March 2018

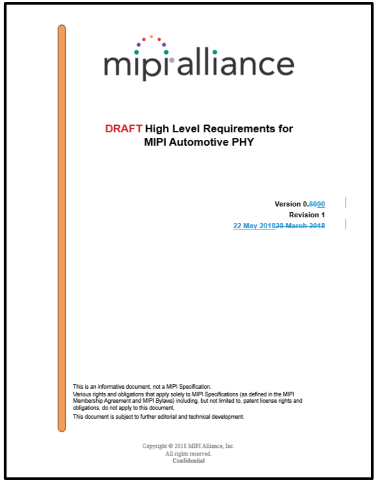
This is an informative document, not a MIPI Specification.

Various rights and obligations that apply solely to MIPI Specifications (as defined in the MIPI Membership Agreement and MIPI Bylaws) including, but not limited to, patent license rights and obligations, do not apply to this document.

This document is subject to further editorial and technical development.

Copyright © 2018 MIPI Alliance, Inc.
All rights reserved.
Confidential

v0.8 March 28, 2018



mipi alliance

DRAFT High Level Requirements for MIPI Automotive PHY

Version 0.~~80~~90
Revision 1
22 May 2018~~28 March 2018~~

This is an informative document, not a MIPI Specification.

Various rights and obligations that apply solely to MIPI Specifications (as defined in the MIPI Membership Agreement and MIPI Bylaws) including, but not limited to, patent license rights and obligations, do not apply to this document.

This document is subject to further editorial and technical development.

Copyright © 2018 MIPI Alliance, Inc.
All rights reserved.
Confidential

v0.9 May 30, 2018

mipi alliance

High Level Requirements for MIPI Automotive PHY

Version 1.0.1
21 July 2018

This is an informative document, not a MIPI Specification.

Various rights and obligations that apply solely to MIPI Specifications (as defined in the MIPI Membership Agreement and MIPI Bylaws) including, but not limited to, patent license rights and obligations, do not apply to this document.

This document is subject to further editorial and technical development.

Copyright © 2018 MIPI Alliance, Inc.
All rights reserved.
Confidential

v1.0.1 July 21, 2018

- AWG Currently working on v1.1 of the Specification

MIPI ALLIANCE DEVELOPERS CONFERENCE
19 OCTOBER 2018
SEOUL

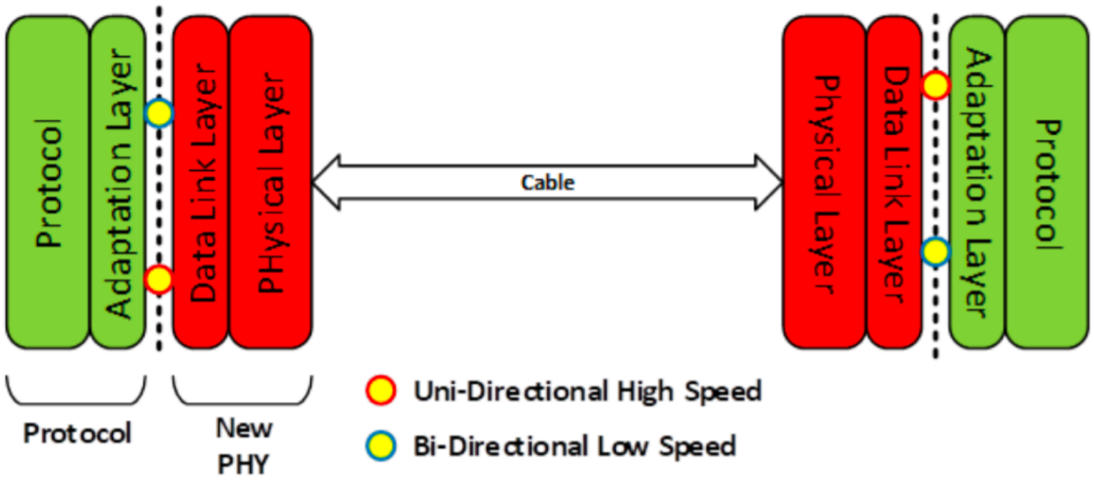
Automotive PHY Requirements Overview

Data and Power Logical Structure

- Focus is on High Throughput Data to & from the system CPU over high speed links with optimal wiring, cost and weight.
- The high speed data, control data, & optional power share the same physical wiring.

Automotive PHY Requirements Overview

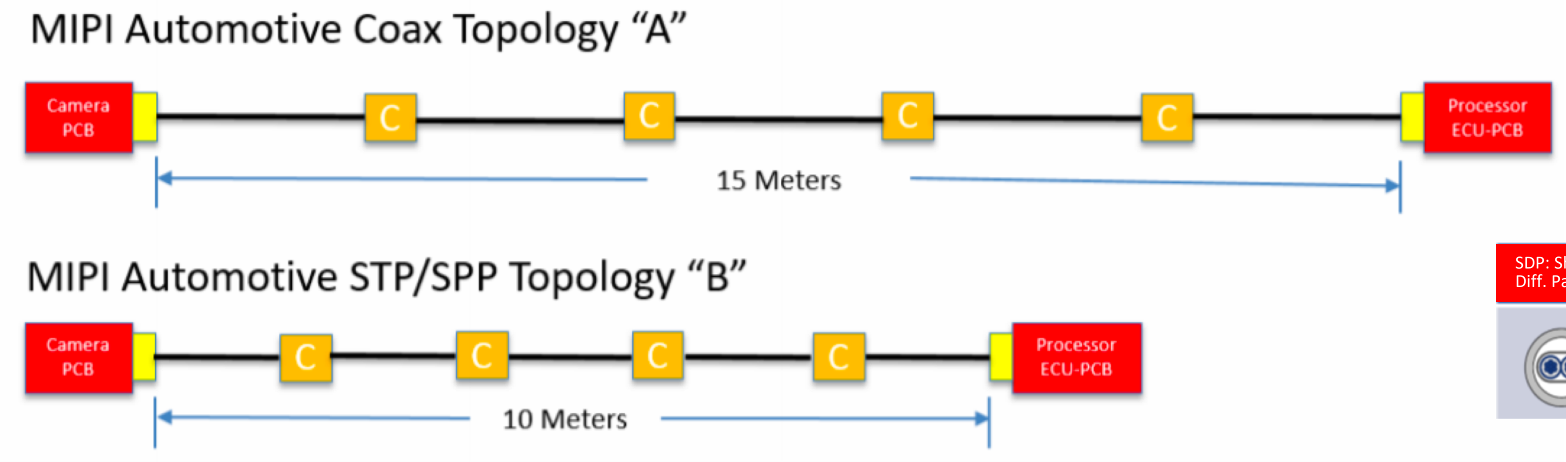
High Level A-PHY Structure

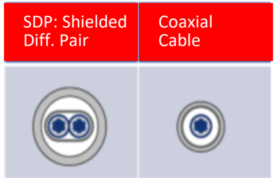


- A-PHY design shall include a generic Data Link Layer & shall accommodate different protocol adaptation layers (i.e. MIPI and non MIPI).
- A-PHY Use Cases include: Camera Module to ECU, Camera ECU to ECU, Lidar, Radar, Display including Touch & Controls, & A-PHY Links Over PCB Interconnect.

Automotive PHY Requirements Overview

Cable Type & Topology





- Topology "A": 50 Ω Coax cable up to 15 m, with up to 4 inline connectors with minimum segment of 30 cm.
- Topology "B": 100 Ω SDP cable up to 10 m, with up to 4 inline connectors with minimum segment of 30 cm

Automotive PHY Requirements Overview

Channel Throughput

- Forward Channel Throughput & Gear Definition

Gear	Raw Data Rate	Effective Data Rate
1	≤ 2 Gbps	≥ 1.6 Gbps
2	≤ 4 Gbps	≥ 3.2 Gbps
3	≤ 8 Gbps	≥ 6.4 Gbps
4	≤ 12.5Gbps	≥ 10 Gbps
5	≤ 16 Gbps	≥ 12.8 Gbps

- Reverse Channel, which shall operate in full duplex with forward channel, shall support the following data rates:
  - Low Speed: 20 Mbps (Aimed for camera and sensors products)
  - High Speed: 100 Mbps (Aimed for display and touch-screen products)

Automotive PHY Requirements Overview

Miscellaneous Other Requirements

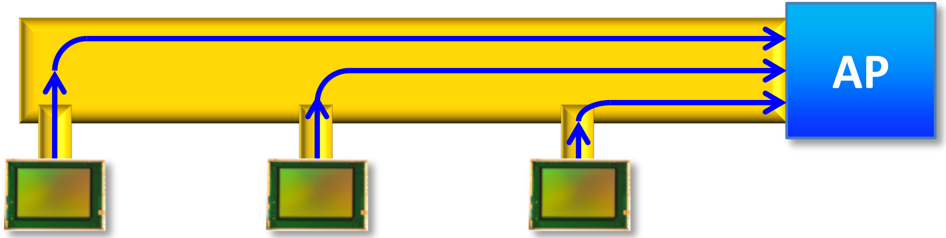
- Bit Error Rate shall be less than 10^{-12} for both data & control streams
- Latency (Data Link Layer to Data Link Layer) shall be less than 16 µSec
- Design shall support DC power over the data lines with a maximum current limit of 0.5 A
- System shall operate with GND voltage offsets of up to ±1.0 V
- A-PHY shall provide the following modes: Shutdown, Start-up, Active, Sleep, & Safe State
- The A-PHY Data Link Layer shall be agnostic to the higher-level protocols & with an overhead of 20% maximum
- Protocol Adaptation Layer shall MIPI protocols w/ minimal changes needed
- It shall be possible to aggregate multiple links for increased HS data BW
- A-PHY solution shall support BIST & System Diagnostics (eg. Link Quality)
- A-PHY shall support system designs at the ASIL D level according to ISO26262:2018
- System clock shall be both embedded & asynchronous (i.e. decoupled from data rate clock)
- System cabling shall meet certain IL, RL, & Coupling Requirements
- System operation shall be supported with specified Automotive EMC requirements.

Current Areas of Work

- Updating of Automotive Requirements Document to v1.1
- Requirements for Higher Data Rate Interfaces: 16Gbps → 24Gbps
- Derived Channel Requirements, including Noise & Interference
- Link & Adaptation Layer Requirements
- Functional Safety Req's (ISO26262)
- Cable type, size, weight, connector limitations
- Sensor Working Group (I3C) Discussions Starting
- Monitor C/D/M-PHY for possible new ideas (next two slides)

MIPI D-PHY Multi-drop solution

Point-to-point



Multi-drop

MIPI CSI-2/D-PHY

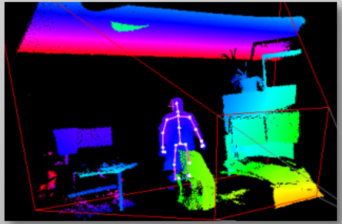
- Connect 2 or more sensors per a RX port

Multi-drop Expected Applications

Drone

HMD

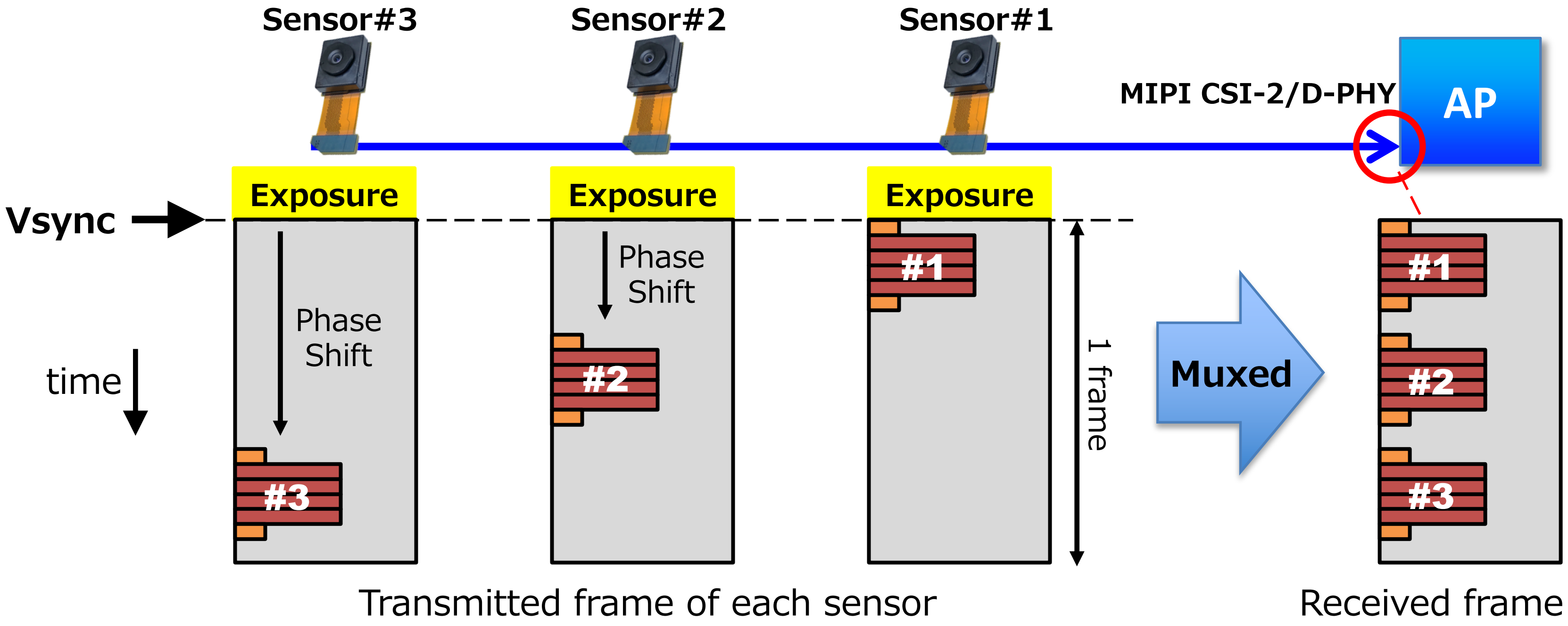
SLAM
(Simultaneous Localization and Mapping)



MIPI ALLIANCE DEVELOPERS CONFERENCE
19 OCTOBER 2018
SEOUL

MIPI D-PHY Multi-drop solution

- MIPI CSI-2/D-PHY receiver port of existing APs Available
- Image data are dynamically multiplexed on a physical lane.



Final Comments

- There continues to be 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 MIPI Automotive groups

ADDITIONAL RESOURCES

- https://mipi.org/automotive
- https://mipi.org/groups/automotive-working-group

mipi®
DEVCON

THANK YOU

MIPI ALLIANCE
DEVELOPERS
CONFERENCE

19 OCTOBER 2018
SEOUL

MIPI.ORG/DEVCON