MIPI Alliance Extends Interface Standards to Support Automotive Market
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)
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.

SF is HQ for Many Major Car-Sharing services

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

Source: International Council for Clean Transportation, 2014 Updates
Market Demand for Active Safety

Source: Strategy Analytics 2014

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

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
- Camera PCB
- Processor ECU-PCB
- 15 Meters
- 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

MIPI Automotive Topology B
- Camera PCB
- Processor ECU-PCB
- 4 Meters

MIPI Automotive Topology C
- Camera Module or IS
- Processor IC
- ECU
- ≤ 0.3 Meters

SPP: Shielded Parallel Pair
Coaxial Cable
AUTOMOTIVE REQUIREMENTS

Reliability  Zero Defects  Uninterrupted Supply  Security  Safety

Technology Process & Packaging  Design DFM, DFT  Validation Qualification, Characterization  Production Testing  Support Supply Chain, FA, FQE

STANDARDS

ISO 26262  AEC-Q100  TS16949  MISRA-C*  Others

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

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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
  - RAW16 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