




MIPI in Automotive

Mixel, Inc., Ashraf Takla, CEO
NXP, Thomas Wilson, Automotive Radar Product Marketing Manager
NXP, Christian Tuschen, Automotive Systems Engineering




Mixed-Signal Excellence



Outline

- Why MIPI in automotive
 - What is similar
 - What is different
- Overview of information flow in auto and where MIPI is used
 - Telematics and In-Vehicle Infotainment (IVI)
 - Advanced Driver Assist Systems (ADAS)
 - Intelligent Transportation Systems (ITS)
 - Autonomous Driving Systems (ADS)
- Safety and Reliability
- RX+: Optimized MIPI configuration
- Use case: NXP ADAS processor
- Future trends
- Q&A

2



Why MIPI in Automotive


- **What's similar**
 - Need to use high bandwidth sensors (e.g. high resolution image sensors)
 - Traditionally are closed (vendor controlled) system interfaces
 - Historically use many non-standardized specifications, both benefiting from standards that create open competitive landscape
 - Low cost
 - High Volume
 - The "nervous system" is being connected both wired and wirelessly
 - Same capabilities are required: collection, transmission, and processing of a wide variety of information at a wide range of speeds
 - Low power exceptionally important for mobile, and very important for automotive
- **What's different**
 - Reliability and safety are paramount for many automotive applications
 - 1ppm vs. 100ppm field failure
 - Functional safety (ISO 26262)
 - Product life-cycle: tens of years, vs. a couple of years

3



Electronics in automotive

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




4

Information Flow in Auto & MIPI Usage

- **Vehicle Telematics**
 - Vehicle tracking, location monitoring
 - Interfacing with GPS to navigation display
 - Includes display, touch and audio
- **In-Vehicle Infotainment (IVI)**
 - Audio and video, voice control
 - Bluetooth connectivity, Wi-Fi, in-car internet
 - Display Serial Interface (MIPI DSI)



Information Flow in Auto & MIPI Usage

- **Advanced Driver Assistance Systems (ADAS)**
 - **Features**
 - Collision Avoidance
 - Adaptive cruise control
 - Automatic braking
 - Lane detection
 - Proximity detection
 - **Electronics**
 - Vision interfaces
 - Radar
 - Ultrasound
 - Lidar (Light Detection and Ranging)
 - Image/signal processing
 - **MIPI Usage**
 - Camera Serial Interface (MIPI CSI), most prevalent MIPI usage in automotive
 - MIPI DSI's adoption is accelerating

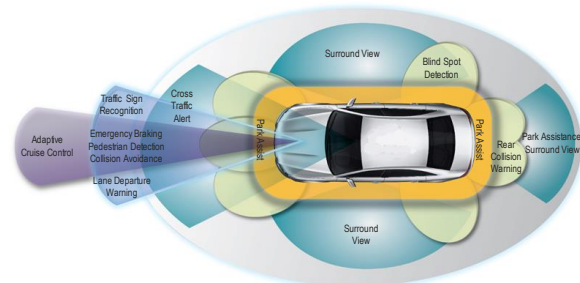


Information Flow in Auto & MIPI Usage

- **Intelligent Transportation Systems (ITS)**
 - Vehicle-to-everything (V2X) connections:
 - Vehicle-to-infrastructure (V2I)
 - Vehicle-to-vehicle (V2V)
 - Vehicle-to-pedestrian (V2P)
 - Vehicle-to-device (V2D)
 - Vehicle-to-Grid (V2G)
 - Connections, bridging to RF modems that support a number of different wireless (802.11p, ac, ah, Bluetooth) and cellular (LTE, GSM) standards
- **Autonomous Driving Systems (ADS)**
 - The ultimate goal
 - Happening faster than anticipated
 - The race is on

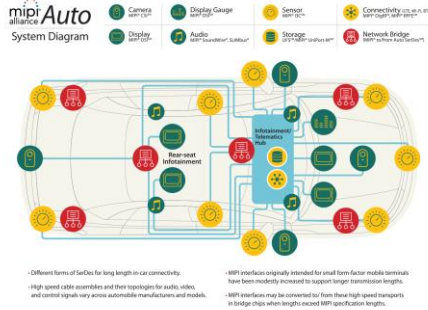


ADAS and the Sensor Shield



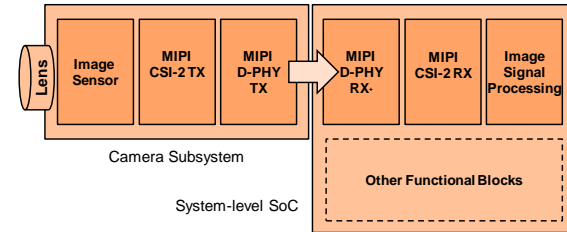
Courtesy of NXP

MIPI Use in Automotive



Courtesy of MIPI Alliance

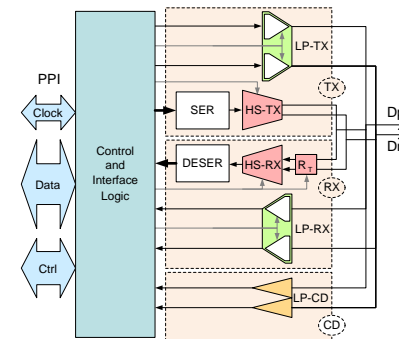
Camera-to-Processor Connection



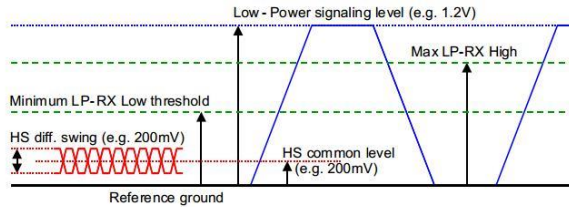
Safety and Reliability

- Operational reliability and robustness are of paramount importance
 - 1ppm in field failure over tens of years
 - Wider range of temperature (-40C to 125C)
 - Wider range of process variation tolerance (5+ sigma)
- Rigorous and demanding reliability standards: AEC-Q100, IEC61508, and ISO26262 (Road Vehicles - Functional Safety)
- AEC-Q100: different temperature Grades (Grade 1: -40 C to 125 C, though Grade 4: 0 C to 70 C)
- Testability & diagnostics are key to ensure continued safe operation
 - Full speed production testing
 - In-system test capability
 - RX+ configuration was developed to optimally address this challenge

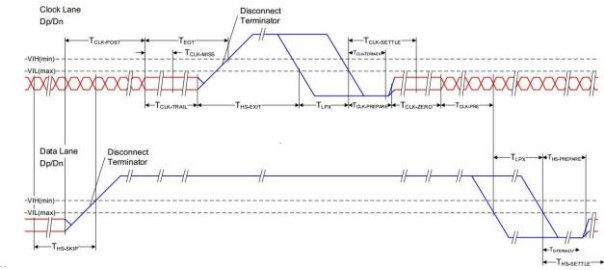
Traditional Solution: Universal Lane



MIPI D-PHY LP/HS operation



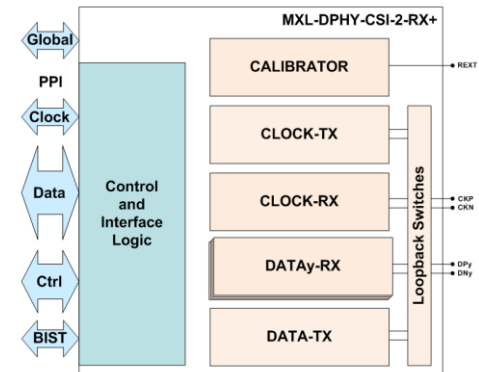
MIPI D-PHY LP/HS operation



MIPI D-PHY Optimized for Automotive

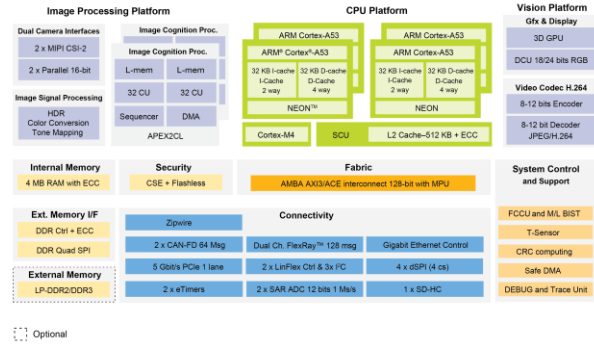
- Receiver usage is widely adopted on the chips receiving camera data stream
- RX+ is a D-PHY configuration that enables
 - Full-speed, full function, comprehensive
 - Production test
 - In-system test
 - Independent of external load (patent pending)
 - Supports higher data rates at lower BER
 - Lower serial interface capacitive loading
 - Small footprint
 - Eliminate multiple high-speed transmitters, area reduction: ~35 %
 - Lower inactive power
 - Leakage Power reduction: ~50 %

RX+: Optimized for Automotive



RX+ in NXP S32V234 ADAS Processor

S32V234 BLOCK DIAGRAM



©MIPi ALLIANCE. ALL RIGHTS RESERVED.

NXP S32V234 features

- High performance automotive processor
- Supports safe computation-intensive vision and sensor fusion applications
- Target applications:
 - Front Camera: pedestrian detection, object detection, lane departure warning, smart head beam control and traffic sign recognition
 - Surround view applications where the image data can be received in raw formats via the MIPI CSI-2
 - Smart rear view camera applications
 - Sensor fusion computing in communication with a radar MCU
- Satisfies ISO 26262 ASIL B functional safety requirements

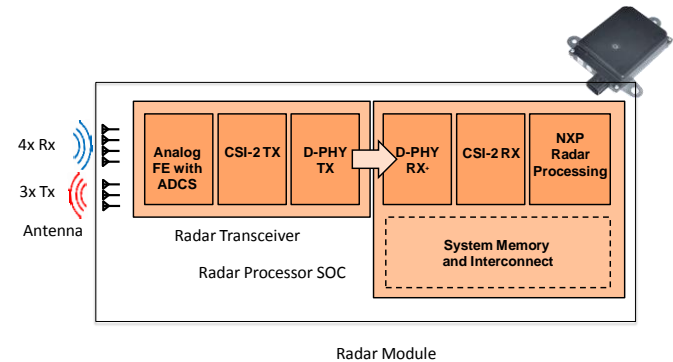
©MIPi ALLIANCE. ALL RIGHTS RESERVED.

NXP S32V234 MIPI features

- It integrates Mixel's RX+ D-PHY
- Four data lanes, configurable to operate as 1, 2, 4 lanes
- Aggregate data rate of up to 6 Gbps
- Supports CSI-2
- Supports full speed testing at wafer level
- Eliminates the need for high speed ATE

©MIPi ALLIANCE. ALL RIGHTS RESERVED.

Radar Transceiver to Radar Processor



©MIPi ALLIANCE. ALL RIGHTS RESERVED.

Future Trends

- Suppliers are moving to extend ADAS into ADS
- MIPI is evolving to support automotive requirements
 - Considering longer reach channels
- Combination of different sensor types is required for ADS
- Accelerating Radar use with MIPI as high-bandwidth transceiver interconnect with Radar Signal Processor
 - Key in Autonomous Driving Systems
- New players jumping into deployment
- Traditional players are accelerating their adoption
- Exciting future lies ahead for consumers as well as many opportunities for early adopters

Conclusion

- The electronic content in automotive is increasing substantially
- Automotive electronics providers are increasingly adopting MIPI standards
- The MIPI Alliance and its members are collaborating and coordinating to maximize MIPI adoption in Automotive
- The transition from Advanced Driver Assistance to Autonomous Driving is accelerating and happening faster than expected
- The race is on, and MIPI is in!

Contact



Mixed-Signal Excellence

97 East Brokaw Road, Suite 250
San Jose, CA 95112
P: (408) 436-8500
F: (408) 436-8400
marketing@mixel.com
www.mixel.com