Kelvin Xu, Synopsys
Product Marketing Manager

Enabling Long-Reach MIPI CSI-2 Connectivity in Automotive with MIPI IP
Trends & New Applications

- Transition from Distributed ECUs to centralized Domain Compute Modules
- New applications for ADAS, Infotainment, Connected Car & V2X
- Growing number & types of Sensors: Imaging, Lidar, Radar, Infra-Red
- System & SoC level Functional Safety and Reliably
- Requires High Performance FinFET Class Automotive SoCs
Safety-Critical Automotive Applications Using MIPI

• ADAS & IVI – Rear View, eMirror, Park Assist, Surround View
Development Flows for ISO 26262 Functional Safety

- Activities & Work Products for Automotive SoCs & IP

Core Architecture
- ISO 26262 Safety Plan
- HW Safety Requirements
- HW Safety Goals
- FIT Rate Analysis
- HW Safety Features
- RTL Design
- Core Spec
- Digital Spec
- Consumer Flow

FPGA
- Safety Manual
- FMEDA Report
- Fault Injection / Coverage Analysis
- Validation
- IP/SoC Level Verification

ASIC
- Module Design Verification

ASIC
- +Automotive

Design Implementation
Additional Safety Mechanisms to Meet ASIL B & Beyond

- MIPI CSI-2 Lacks Native Functional Safety Capabilities

- Safety Mechanisms to achieve ASIL B Random HW Fault metrics
- Each Safety Mechanism has an associated Reaction Time: Fault Handling Time Interval and Error Flag

**MIPI CSI-2**

- Parity Protection delivered & checked at user interface
- Parity Protection on internal data paths
- ECC for closely coupled SRAMs

**User Interface:**
- Image/Config I/F
- MIPI CSI-2<sup>SM</sup> Protocol
- PPI Interface
- MIPI D-PHY<sup>SM</sup> C-PHY<sup>SM</sup>
- RX TX

**User Interface:**
- ECC added at data path ports
- Parity added for address ports

**Register Space Protection**

**Module Redundancy Protection for critical logic**
Safety Manager for SoC-Level Integration

- Monitoring & Managing Functional Safety Capabilities

- Safety Manager monitors & manages all system failures & real-time faults; safe boot & mission-mode testing
Need to Design for Reliability

- Handling the Stringent Operating Conditions

- Environmental
- Temperature
- Noise
- Vibration
- Long term operation
- Field rate (targeting 0%)

### AEC-Q100 Standard

<table>
<thead>
<tr>
<th>Grade</th>
<th>Ambient Operating Temperature Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-40°C to +150°C</td>
</tr>
<tr>
<td>1</td>
<td>-40°C to +125°C</td>
</tr>
<tr>
<td>2</td>
<td>-40°C to +105°C</td>
</tr>
<tr>
<td>3</td>
<td>-40°C to +85°C</td>
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Need for a Comprehensive Automotive-Grade IP Portfolio

- Saving Time-to-Market

MIPI Automotive-Grade IP Package
22nm - 16nm - 7nm – 5nm

<table>
<thead>
<tr>
<th>Safety</th>
<th>Reliability</th>
<th>Quality</th>
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<tbody>
<tr>
<td>CSI-2 / DSI-2 CONTROLLERS</td>
<td>• Safety Manual</td>
<td>• Mission Profile</td>
</tr>
<tr>
<td>C-PHY / D-PHY</td>
<td>• FMEDA</td>
<td>• Auto PDK/Rules</td>
</tr>
<tr>
<td></td>
<td>• FuSa Certificate</td>
<td>• Grade 2/1</td>
</tr>
<tr>
<td></td>
<td>• Random</td>
<td>• AEC-Q100 Report</td>
</tr>
<tr>
<td></td>
<td>• Systematic</td>
<td>• Work Products</td>
</tr>
</tbody>
</table>

Automotive SoC
22nm - 16nm - 7nm – 5nm

- x12 64-bit Processors
- LPDDR5/4/4X Cache
- Data path
- Embedded Memories
- Logic Libraries
- Security
- Safety & Security
- SD/eMMC
- SPI/QSPI
- Storage

AMBA Interconnect

- Vision Subsystem
- Display Subsystem
- Connectivity

- DSP
- ADCs/DACs
- AI Accelerator
- Graphics Core
- eDP
- HDMI
- MIPI DSI/DSI-2
- MIPI CSI-2
- CAN, CAN-FD
- MOST
- FlexRay
- UFS
- Ethernet AVB/TSN
- XCL
- PCIe
- UART
Valens Design Example
Using Synopsys DesignWare MIPI IP
Valens A-PHY Products

• Valens is the first company to introduce A-PHY℠ compliant products

• It was important to make sure Valens will work with mature and established IP partner in order to focus our efforts on the core technology and meet its goals.

• Valens selected Synopsys as IP partner for their mature MIPI IP and complete automotive package including safety and AEC-Q100 qualification.

• First samples will be available to leading customers by Q4/2021.
  – VA7031 - CSI-2 extension (Serializer) over MIPI A-PHY channel (Up to 8Gbps)
  – VA7044 - Dual-receiver of CSI-2 (Deserializer) over MIPI A-PHY channel (Up to 8Gbps per port)
  – VA7042 - Quad-receiver of CSI-2 (Deserializer) over MIPI A-PHY channel (Up to 8Gbps per port)

• Valens is already working on the next generation of A-PHY products.
Valens Use of Synopsys DesignWare D-PHY/C-PHY IP

CSI-2 RX Controller – ASIL B
C-PHY/D-PHY RX – Grade 2

Sensor

CSI-2

8Gbps A-PHY

SoC1

2X16Gbps

SoC2

CSI-2 TX Controller – ASIL B
C-PHY/D-PHY TX – Grade 2

CSI-2

8Gbps A-PHY

CSI-2

8Gbps A-PHY

CSI-2

8Gbps A-PHY
Summary
Summary

• Trends in the automotive industry are driving new SoC architectures on more advanced FinFET processes

• MIPI IP in Automotive: safety-critical applications require ASIL B/D ISO 26262 Ready MIPI IP with safety package, enabling designers to save time and improve time-to-market

• IP that meets automotive quality requirements and is AEC-Q100 tested accelerates SoC-level qualification and design

• Synopsys’ automotive-grade MIPI camera and display IP helped accelerate Valens’ Automotive SoC design
DesignWare MIPI IP Portfolio for Automotive SoC

MIPI Automotive-Grade IP Package
In 22nm - 16nm - 7nm
ADDITIONAL RESOURCES

• Web page
  • https://www.synopsys.com/designware-ip/interface-ip/mipi.html
• Web page
  • https://www.synopsys.com/designware-ip/ip-market-segments/automotive.html
• Valens automotive
  • https://www.valens.com/automotive-solutions
• Valens VA70xx
  • https://www.valens.com/va7000-family
THANK YOU!