Licinio Sousa
Synopsys

Why an Integrated MIPI C-PHY/
D-PHY IP is Essential
## MIPI Camera and Display Market Trends

- [ ] Tablets
- [ ] Drones
- [ ] Security cameras
- [ ] Cars
- [ ] TVs
- [ ] VR
- [ ] IoT
- [ ] Robotics

## MIPI Camera & Display Standards

### MIPI CSI-2
- D-PHY
- C-PHY

### MIPI DSI/DSI-2
- D-PHY
- C-PHY

## MIPI for Consumer & Automotive: Implementation Examples

- [ ] Smartphones
- [ ] Drones
- [ ] Cars

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Camera Innovations for Growing Vision Processing Needs

For Human Vision and Machine Vision

• 100+ mega-pixel image sensors
• AI-enabled image sensors
• Mobile: More pixels, more and bigger image sensors
• Vision systems - the heart of automotive ADAS/IVI
  – HDR, SNR, NIR, resolution, size, power, ASIL x /Grade x
  – Multiple IS combined with other sensing technologies
• IoT, edge, MCUs with machine vision capabilities
  – Face recognition for home appliances
Display Innovations Driven by Mobile and Automotive

Dual Display, Foldable, 120Hz, Higher Resolutions
MIPI Camera and Display Specifications

Evolving to Address Growing Imaging Needs
MIPI Physical Layers

**MIPI D PHY**
- Source synchronous architecture
- High-speed and low-power modes for efficiency
- Proven, mature and widely adopted

**MIPI C PHY**
- Higher bandwidth transmission on restricted channels – CoG, CoF, CoP
- Key concepts: trios and 3-phase encoding
- Bitrate ~2.28x the signaling rate
- Single ended drivers; differential receivers

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Timeline:
- v1.1: 1.5G
- v1.2: 2.5G
- v2.1: 4.5G
- v2.5: 4.5G aLP/FBTA
- v3.0: 9G

Timeline:
- v3.2: 2.5G
- v3.2: 3.5G
- v2.0: 6G
Integrated MIPI C-PHY/D-PHY Solution

The Best of Both Worlds

• Electrical specs are similar
• Low-power modes are identical
• Most of the of the circuits are re-used
  — Aside from line drivers/receivers,
• C-PHY and D-PHY pins can co-exist in 10 pins
  — 4 lanes and 3 trios

• Satisfies most important KPI
  — Maturity
  — Backwards compatibility
  — Flexibility
  — Performance
  — Power efficiency
  — EMI
# MIPI CSI-2 Going From Mobile to a Vision Platform

Evolving to Address Growing Vision Processing Needs

<table>
<thead>
<tr>
<th>MIPI CSI-2 V1.x</th>
<th>MIPI CSI-2 V2.x</th>
<th>MIPI CSI-2 V3.x</th>
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**Mobile**

![Mobile Icon]

**Vision Platform**

![Vision Platform Icons]
MIPI DSI/DSI-2: Defacto Interface for Embedded Displays

MIPI DSI V1.x
- RES
- FPS
- BPP
- VESA DSC1.1

MIPI DSI-2 V1.1
- PSD
- VESA VDC-M

MIPI DSI-2 V1.2
- CONTENT
- MIPI A-PHY
- FSAF
- OTHER

Mobile

Embedded Display

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Use Case with DesignWare MIPI C-PHY/D-PHY IP Solution

Case Studies: Enabling Camera ISP and Enhanced Mobile Display Quality

- MIPI CSI-2 Host Combo Controller
- MIPI CSI-2 Device Combo Controller
- Application Processor
- Video/Image processing path
- AI enabled Video/Image processing path
- DSI2 Device Combo Controller
- DSI2 Host Combo Controller
- Video/Image processing path
DJI use case with DesignWare C-PHY/ D-PHY IP Solution

Interop With State-Of-The-Art Image Sensor & DJI SoC Platform

- To satisfy challenging camera interface bandwidth requirements for the next generation camera drone products
- DJI’s SoC platform successfully interoperating with advanced 64 mega-pixel sensor up to 3.5 Gsps

Synopsys DesignWare C-PHY/D-PHY IP in 12nm + 64MP image sensor

Synopsys HW setup
Example of MIPI In An Automotive Application
MIPI CSI-2 Sensors & DSI Displays

ECU/ADAS/IVI
Automotive Grade IP Essentials
Reduce Risk and Accelerate Qualification for Automotive SoCs

- **Functional Safety**: Accelerate ISO 26262 functional safety assessments to help ensure designers reach target ASIL levels.

- **Reliability**: Reduce risk & development time for AEC-Q100 qualification of SoCs.

- **Quality**: Meet quality levels required for automotive applications.
Valens use case with DesignWare C-PHY/D-PHY IP Solution

For Next-Generation Long-Reach CSI-2 Connectivity

Valens automotive technology enables in-vehicle high-speed links for cameras and sensors with long-reach CSI-2
Summary
DesignWare MIPI IP Solution for Camera & Display

- D-PHY v1.2
- Integrated C-PHY v1.2 / D-PHY v2.1
- Controllers supporting key features of the latest specifications
- 2.5 Gbps & 4.5 Gbps / 3.5 Gsps
- Available in 40-nm - 5-nm
- ASIL B Ready ISO 26262 certified IP
- 500+ licenses; 30+ test chips
- Adopted by tier1s
- Mobile/drone/DSC/ surveillance/IoT
- Interoperability with wide range of devices
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THANK YOU

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MOBILE & BEYOND