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Building Intelligent, High-Speed Sensor Connectivity with MIPI I3C℠ – Design Examples

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Agenda

- MIPI I3C overview
- MIPI I3C use cases
- MIPI I3C eco-system: enablers
I3C Overview

- Two wire serial interface up to **12.5 MHz**
- Only **current master** can drive SCL
- Supports legacy **I2C slave** devices and messages.
  - FM(+): Fast mode (Plus)
- **I3C Single Data Rate (SDR) Mode**
- **I3C High Data Rate (HDR) Modes**
  - DDR: Dual Data Rate
  - TSL: Ternary Symbol Legacy
  - TSP: Ternary Symbol Pure

<table>
<thead>
<tr>
<th>I2C Mode</th>
<th>Throughput</th>
</tr>
</thead>
<tbody>
<tr>
<td>I2C FM</td>
<td>Upto 400Kbps</td>
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<tr>
<td>I2C FM+</td>
<td>Upto 1Mbps</td>
</tr>
<tr>
<td>I3C SDR</td>
<td>11.1 Mbps*</td>
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<tr>
<td>I3C HDR-DDR</td>
<td>22.2 Mbps*</td>
</tr>
<tr>
<td>I3C HDR-TSL</td>
<td>25.6 Mbps*</td>
</tr>
<tr>
<td>I3C HDR-TSP</td>
<td>33.4 Mbps*</td>
</tr>
</tbody>
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* SCL@12.5Mhz
I3C Device Roles

- I3C secondary master
- I3C slave
- I2C slave

SDA
SCL

I3C main master

I3C slave

I3C peer-to-peer slave

I3C slave

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I3C Use cases

- Automotive
- Mobile
- IoT
- Touch
- Debug Ports
I3C Use Cases: Automotive

Sensor Hub

- Secondary master, apart from the main master connected to multiple sensors as an I3C hub
- As soon as the secondary master has the relevant sensor data available in its I3C bus, it can communicate to the main master, which propagates the data to the CPU
I3C Use Cases: Mobile (1/2): Sensor Subsystem

Sensor Subsystem

- Multiple sensor devices, based on their capabilities, are connected to the I3C bus, which can operate in different modes and speeds of operations.

- Typical examples of such sensors are the touchpad sensor in a mobile device, gyroscopes, and camera interface, all of which use the I3C bus to communicate back to the CPU in the SoC.

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I3C Use Cases: Mobile (2/2): Image Sensors

Image Sensors

• Replace I2C with the side band control channel - the Camera Control Interface (CCI)

• Image sensors can utilize I3C’s higher performance capability to communicate control information and to actually transmit image data
I3C Use Cases: IoT: Weather Telemetry

- IoT enables other sensor applications such as:
  - Auto sensing
  - Access control
  - Image recognition
I3C for Touch

Single Touch
Stylus
400kbps
Smartphone, Tablets < 6”

Multi Finger Touch
Smartphone
0.4 to 1 Mbps
Smartphone, Tablets > 6”

Multi Touch
Two different displays with simultaneous stylus and multi finger
1.5 Mbps to 32 Mbps
(eg:- > 15” advanced usage models)
I3C for Debug Ports

External Debug & Test System (DTS)
Connected to all existing system (i.e., Modem, Power Management IC, etc.) of smartphone through Debug connector

Capabilities of Debug for I3C
- Debug over 2 Pins
- Multi Master / Drop capable
- Include debug devices Use (i.e. Hot Join) via generic CCC
- Debug messaging via dedicated debug CCC
- Event indication and detection via the in band interrupt method
- Debug and event capable slaves are able to passively detect debug IBIs
- DTS implemented as bus master

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Courtesy: MIPI
Interested in I3C? Eco System is Ready!

• IP, VIP solutions are available
• FPGA-based prototypes available for HW validation & early SW development
• Multiple Interoperability events
• Already being adopted in mobile APs, drone, IoT, sensors, etc.

Smooth transition path from I2C/SPI to I3C

I2C/SPI → I3C “lite” → I3C

- SDR mode IBI w/o payload
- Up to HDR ternary modes IBI with payload
- Timing control - time stamp
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