



MIPI ALLIANCE DEVELOPERS
CONFERENCE

Licínio Sousa
Synopsys

**Real Examples of MIPI
Interfaces in AR/VR,
Mobile, and Other Image
Applications**

20-21
SEPTEMBER
2022

Agenda

- Market Trends
- Evolution of MIPI Specifications
- Real Examples of MIPI Use Cases
 - Novatek
 - Inuitive

Enhancement to the “Eye” of Your Device Never Ends

- Camera continues to be a key focus in mobile handsets
- Video quality under high frame rate (60/120Hz) and dark light are highlighted and addressed by dedicated ISP ASICs
- Future XR device demands more cameras, 4K4K 90Hz and higher resolution/refresh rate are required for main stereo cameras
- Shifting from distributed to domain/centralized architecture brings more & specialized cameras for automotive display and sensing applications



Source: Xiaomi, HTC, OPPO, AFP.com

Mobile & Automotive Driving Display Innovations

Fold Display, 4K OLED Micro Display, 8K IVI Panel, 120+Hz Refresh Rate

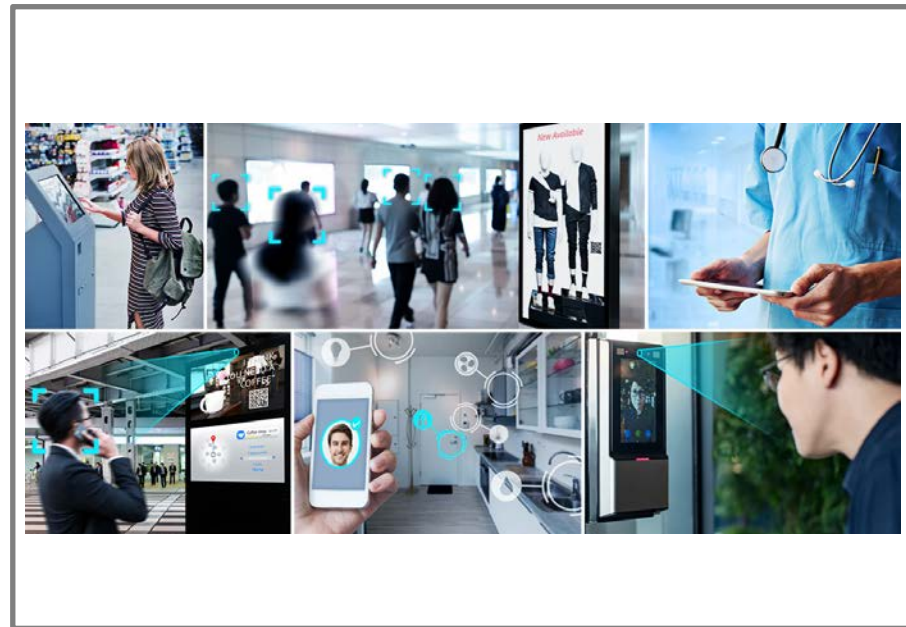
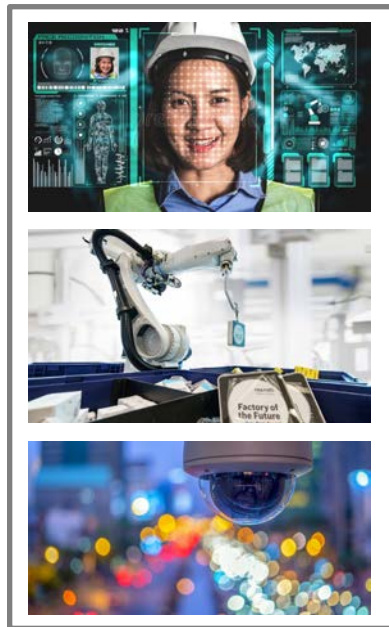


Image source: OPPO, Samsung, SONY, LG, Cadillac, BMW, Audi, Megna, designhmi.com, confindustries.com

Innovations at the Edge Driving a Smarter Experience



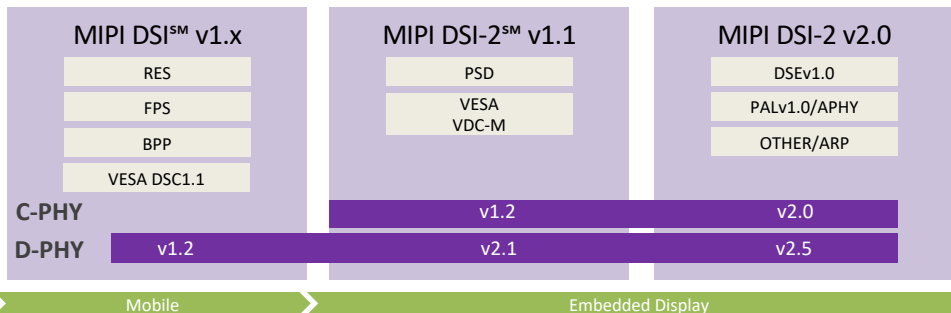
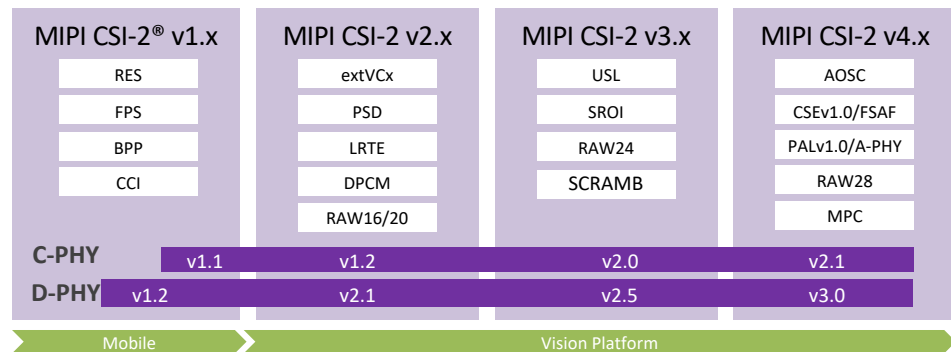
Image source: OPPO, Samsung, SONY, LG, Cadillac, BMW, Audi, Megna. designmi.com, confuindustries.com



<https://www.cyberlink.com/faceme/insights/articles/214/alot-and-facial-recognition-applications>

MIPI Camera/Display Spec Is In the Middle of It All

Continues to Evolve



MIPI D-PHY SM			
Version	Adoption Date Standard channel	Data Rate (Per Lane)	PHY Interface (Per Lane)
1.0	Sep 2009	1.0 Gbps*	8 bit
1.1	Dec 2011	1.5 Gbps*	8 bit
1.2	Sep 2014	2.5 Gbps*	8 bit
2.1	March 2017	4.5 Gbps	8/16/32 bit
2.5	October'19	4.5 Gbps	8/16/32 bit
3.0	October'21	9 Gbps	8/16/32 bit

MIPI C-PHY SM			
Version	Adoption Date Standard channel	Data Rate (Per Lane)	PHY Interface (Per Lane)
1.0	Oct 2014	1.7 Gbps*	16 bit
1.1	Feb 2016	2.8 Gbps	16/32 bit
1.2	March 2017	3.5 Gbps	16/32 bit
2.0/2.1	September 2019/21	6 Gbps	16/32/64 bit

* Specifications released up to 2014 provide rate guidance based on the Legacy Channel.





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MIPI Use Cases

Real Examples Including Novatek and Inuitive

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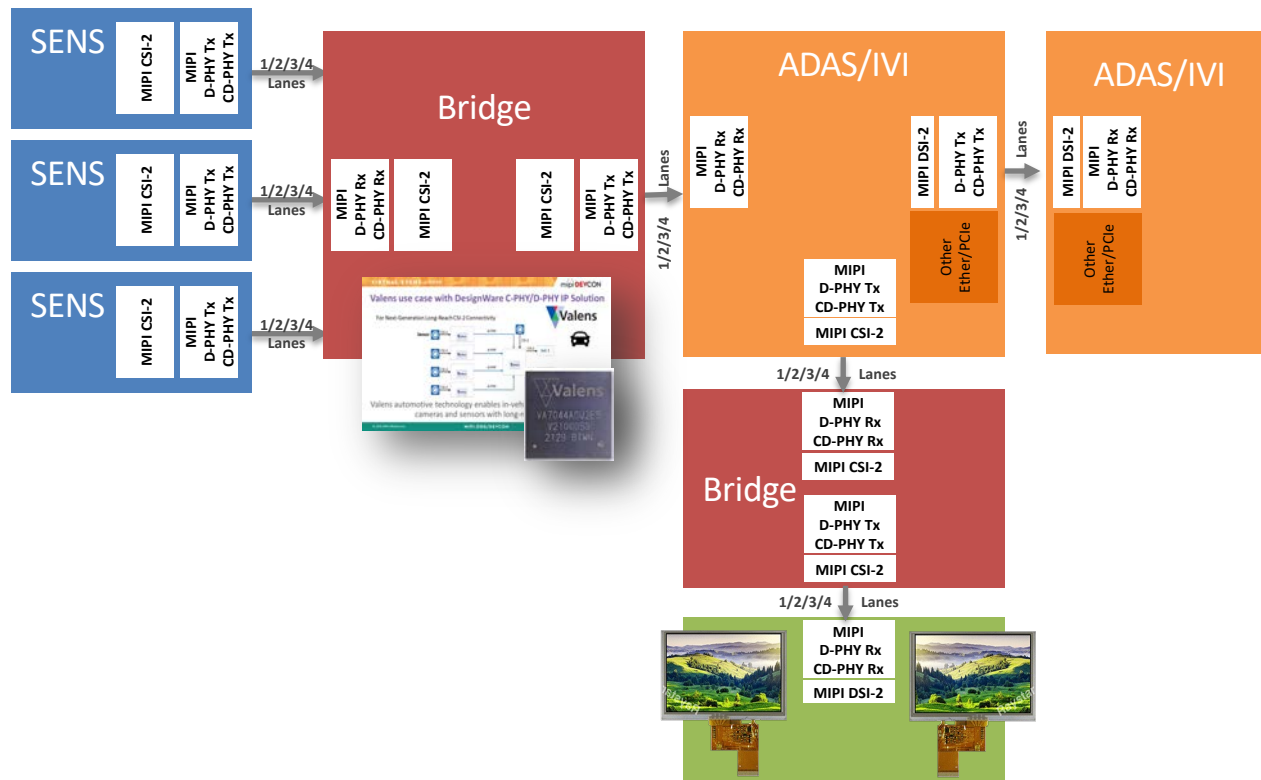
Automotive Use Cases

Different Sensing Modalities

- Lidar
- Thermal
- Radar
- Image

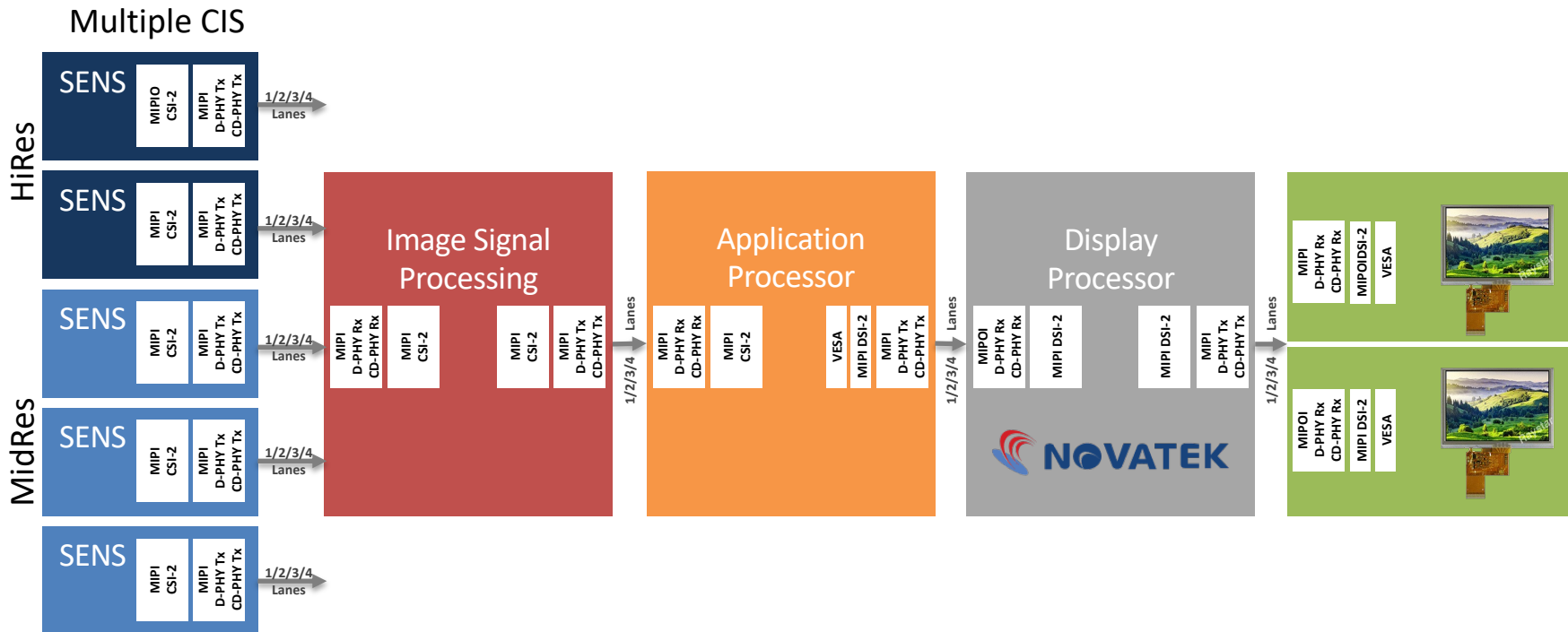
Relevant Attributes

- RAW
- CSESM/DSESM
- Aggregation
- Auto grade IP
- Bandwidth



Mobile Use Cases

Low Power, Aggregation, Bandwidth, MPC, ARP



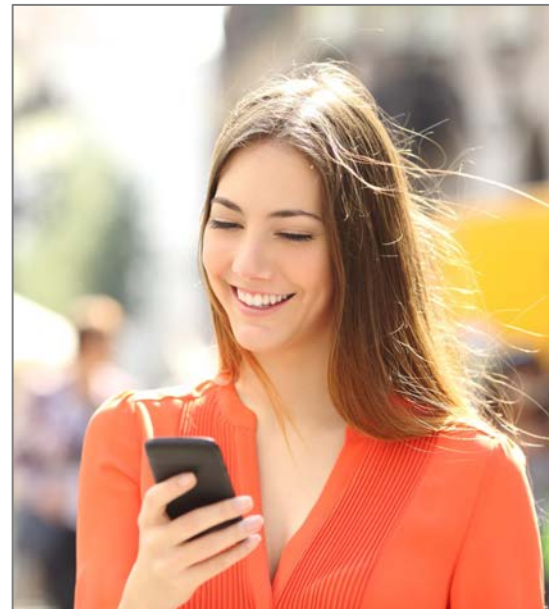
Smartphone Display is as Important as Camera

- Shift from LCD to AMOLED
- Upscaling SDR to HDR
- Higher refresh rates
- Reduce system power consumption
- Enable better user experience



Enabling Better User Experience

- **Picture Quality AI**
 - Scene detection – Faces vs Landscape/outdoor
 - Automatically adjust image settings for better quality
- **Motion Smoothing with MEMC for Gaming**
 - Artificially add frames to a video with a low frame rate
 - Play 24/30fps content at a higher fps
- **Dynamic refresh rate (1-120Hz) with LTPO**
 - Extended battery life



Example From Vivo X80 and X80Pro

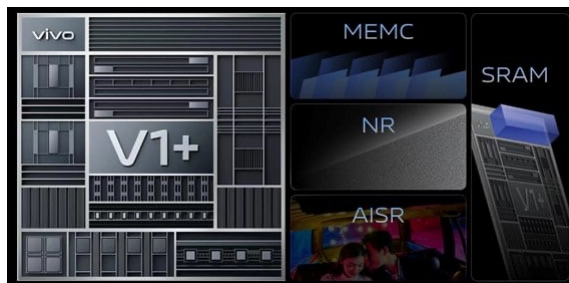


Image source: VIVO, tech.net gsmarena.com

Novatek's Mobile Display SoC

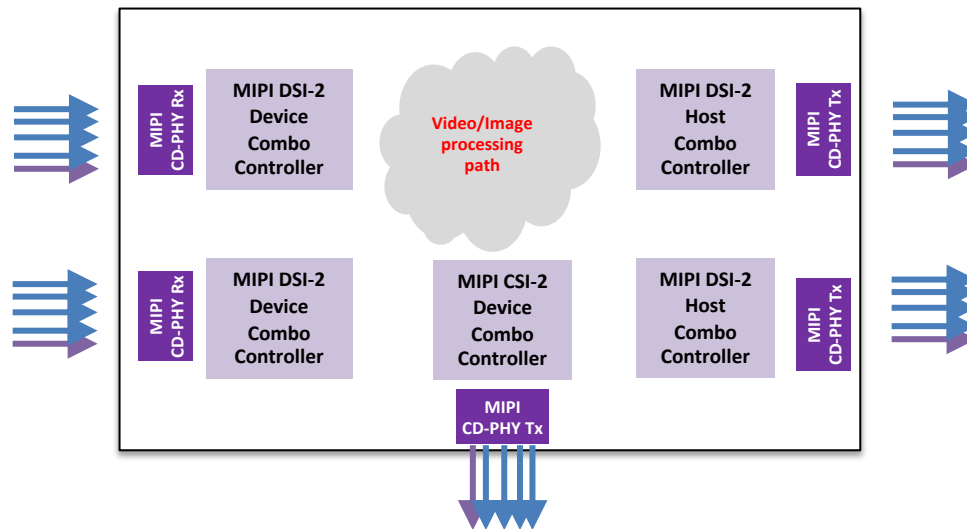
Success with MIPI C-PHY/ D-PHY IP on FinFET Process



- Leading fabless company specializing in display driver IC & SoC solutions
- Novatek's chips help companies meet emerging needs for sophisticated flat-panel display and audio/video applications for all digital devices

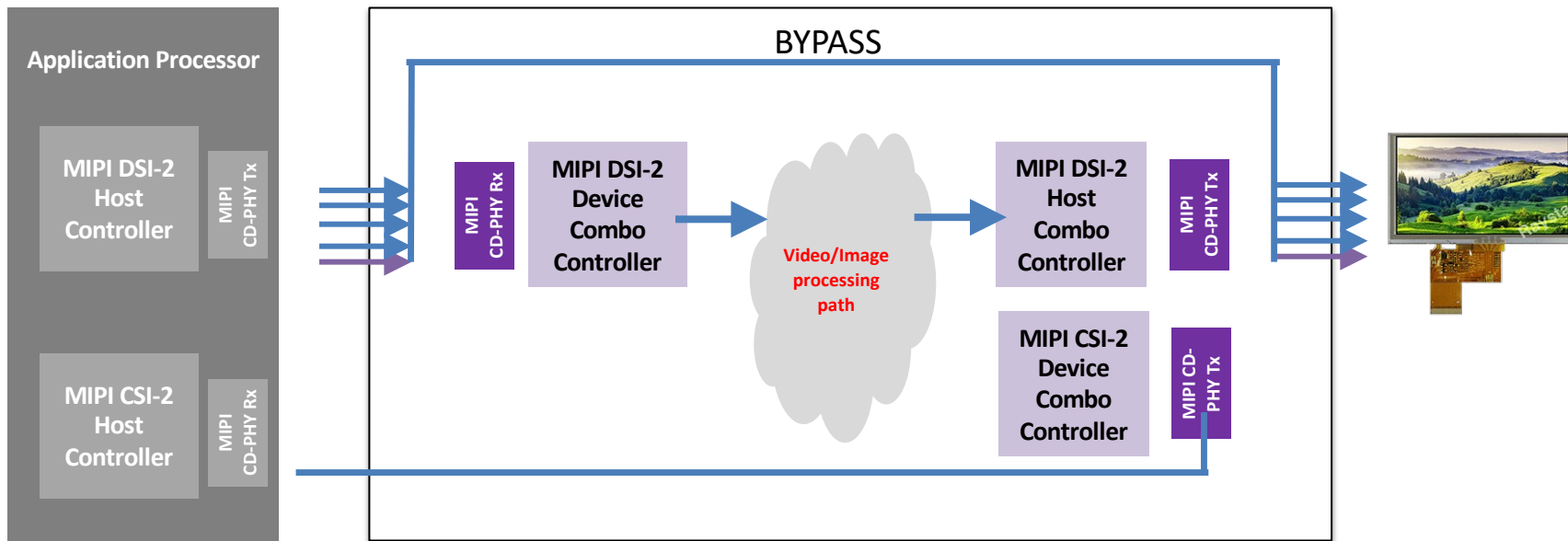


Improving Mobile Display Quality



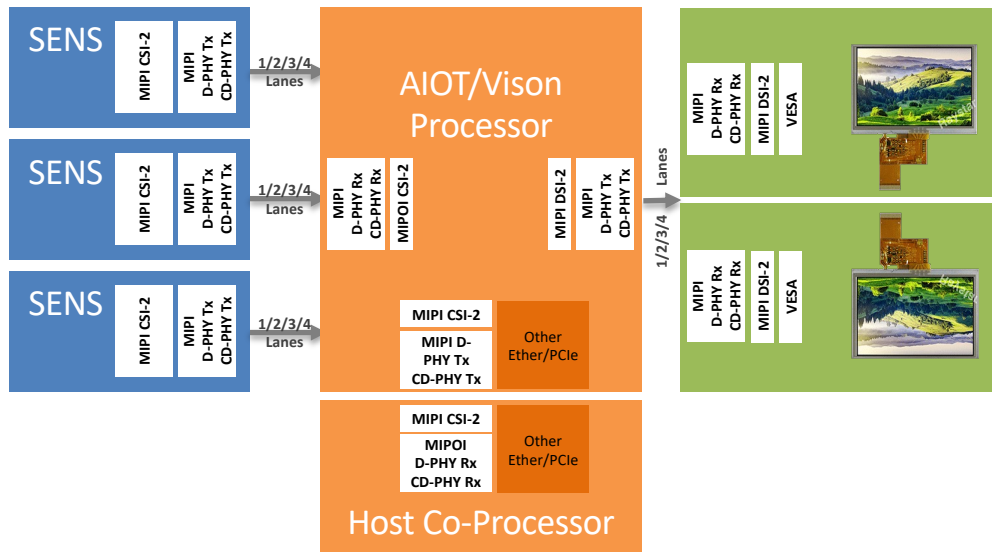
Improve video and image quality
Refresh-rates of up to 120Hz and Beyond

Meeting Power & Picture Quality Requirements



MIPI Use Cases in AIOT/Edge/Imaging SoCs

RAW, Aggregation, Bandwidth, Low Power



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DJI use case with DesignWare C-PHY/ D-PHY IP Solution
 Integrate With State-Of-The-Art Image Sensor & DSI 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 Gbps



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GrAI VIP
 P8N457-16S

GrAI Core
 NeuroNet analysis

Camera Interfaces
 High-speed access to cameras

System Interfaces
 High-speed access to host, sequencers and host systems



SiMa.ai

SiMa.ai MLSoC
 A new class of products

EMBEDDED PCIE
 DRIVING

COMPUTATION PROCESSORS
 HLA

NETWORK ON CHIP

COMPUTER VISION IP
 SECURITY
 SAFETY
 SO COMPLEX

Camera inputs
 Configuration
 External Display

Image source: <https://www.graimatterlabs.ai> si.ma.ai

Inuitive's Vision Processor SoC

Success with MIPI D-PHY IP on 12nm FinFET Process



INUITIVE

- NU4000AI is a superior multi-core vision processor for 3D imaging, deep learning and computer vision processing
- For augmented reality and virtual reality, drones, robots, and many other applications
- High quality depth sensing, SLAM on-chip, computer vision and deep learning (CNN) capabilities
- Advanced low power 12nm silicon process
- Connectivity to 6 cameras and 2 displays



Common Challenges with xR Use Cases



I N U I T I V E

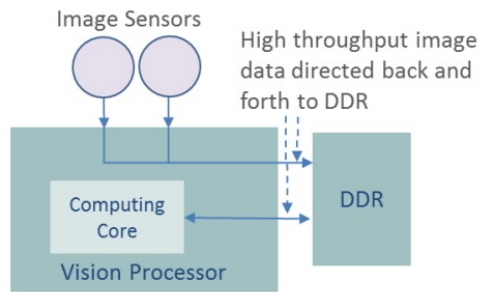
- Multiple sensors (6-10 CIS), loads of pixels, tight synchronization and fusion
- Heavy computer vision processing and extreme memory bandwidth needed
- xR requires low latency for optimal user experience
- xR use cases are mobile/battery powered - low power

Reducing Memory Bottlenecks with Dedicated Imaging/Vision Pipelines

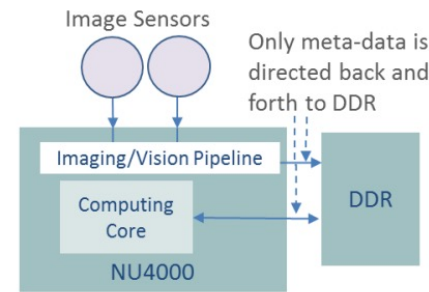


- Route image from 6 CIS to processing pipelines
- Solely compact meta-data is directed to memory

Typical Implementation – high memory bandwidth needs



Inuitive Implementation – reduces memory bandwidth needs

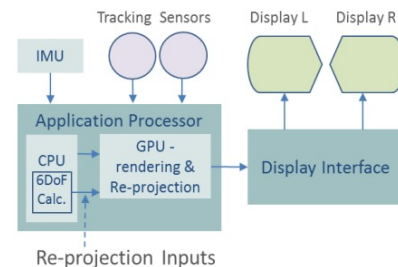


Reducing Motion-to-photon Latency

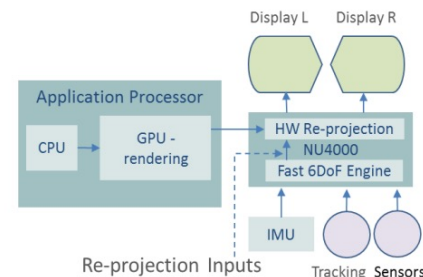
- Time between detection of user's movement and appropriate image refresh
- Up to 1ms with "Time-warp"
 - 6DoF engine
 - HW pipeline enabling image re-projection on-the-fly
 - Fast "loop-closure" between tracking and re-projection



Typical Implementation – 40-80msec latency



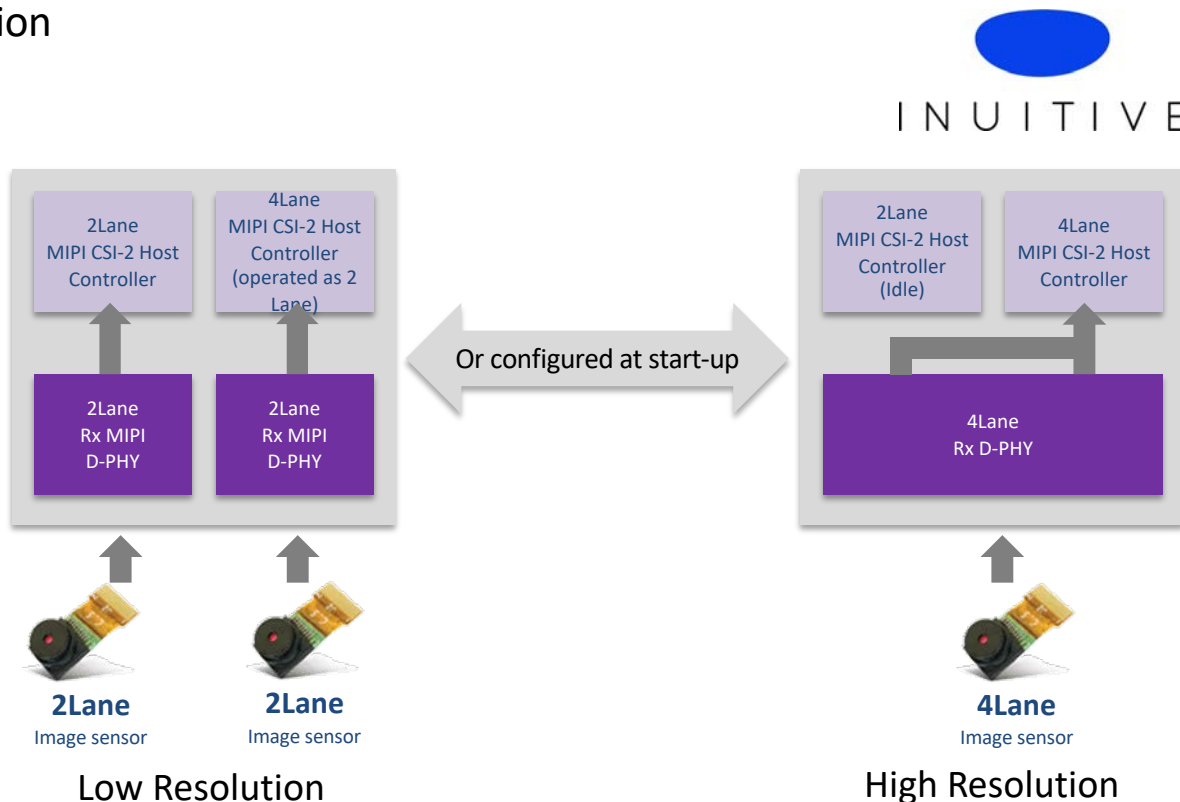
Inuitive Implementation – ~1msec latency



Handling Multiple CIS with Different Resolutions

Flexible MIPI D-PHY Configuration

- Same MIPI D-PHY GDS can connect to (i) 1x4L CIS or (ii) 2x2L CIS
- Same set of pins

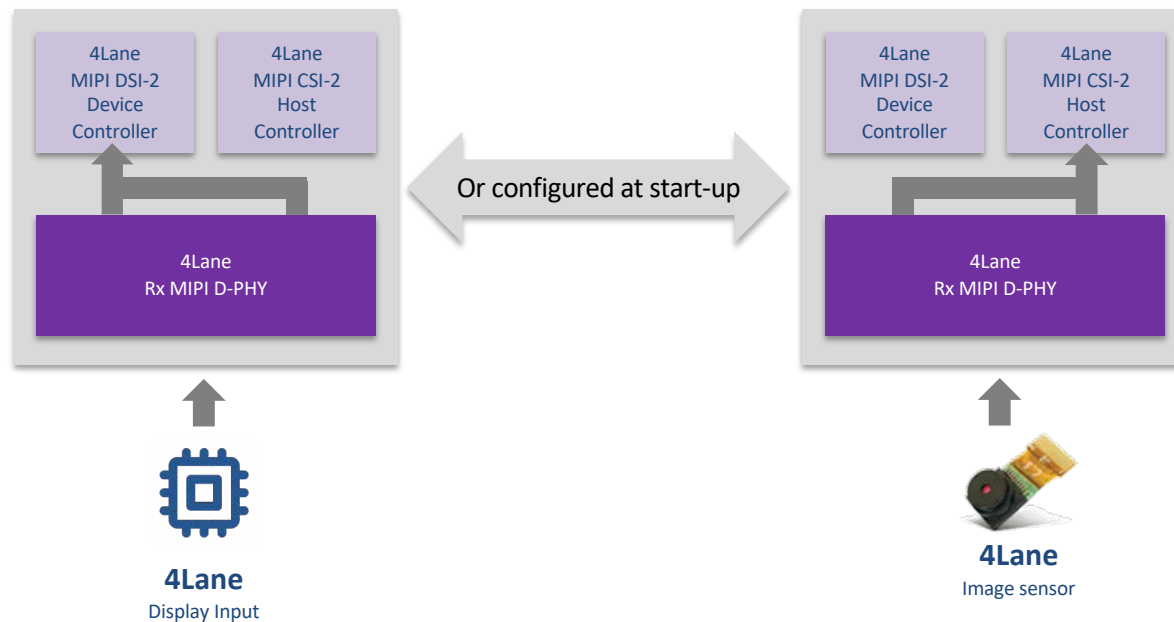


Single Porting CSI-2 for CIS and DSI-2 for Display

Flexible MIPI D-PHY Configuration



I N U I T I V E

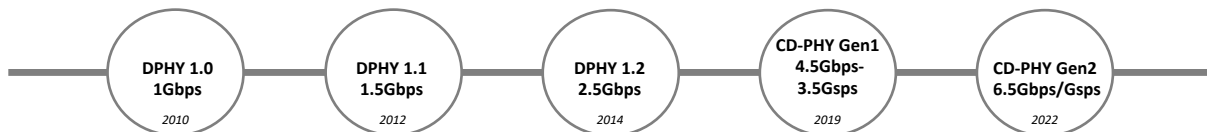
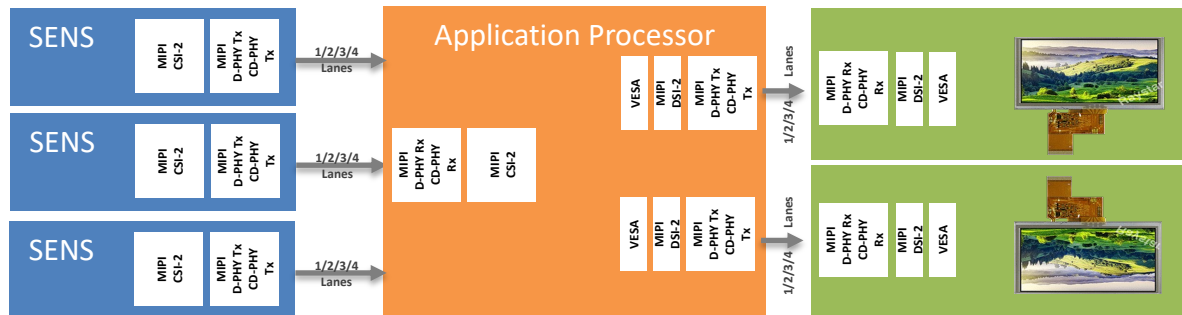


Conclusion

- Camera and display continue to be the focal point of mobile/consumer devices and automotive applications
- Driving requirements for higher resolution (4K/8K) and higher refresh rates (60-120Hz), use cases for multiple displays
- MIPI is the de-facto interface for consumer/mobile devices, and evolving to be the interface of choice for automotive camera and display
- Synopsys offers a portfolio of MIPI IP products from CSI-2 and DSI-2 controllers to D-PHY and C-PHY/D-PHY with over 70% market share
- On the board of MIPI Alliance and leading several workgroups, helping to drive development and adoption of the MIPI specifications

Synopsys MIPI IP Solution for Camera and Display

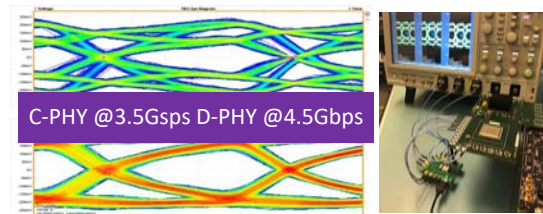
For Mobile/Consumer and Automotive applications



Customer Success with Synopsys MIPI IP



- Integrated MIPI C-PHY v2.0 / MIPI D-PHY v2.1
- MIPI D-PHY v1.2
- Available in 40-nm - 3-nm
- MIPI CSI-2/DSI-2 IP Controllers supporting key features of the latest specifications
- 2.5Gbps, 4.5Gbps/3.5Gbps, **6.5Gbps/Gsps**
- ASIL B Ready ISO 26262 certified IP
- 900+ licenses; 35+ test chips
- Production proven by tier1s
- Mobile/drone/auto/ surveillance/IoT
- Interoperability with wide range of devices



ADDITIONAL RESOURCES

- Web page: <https://www.synopsys.com/designware-ip/interface-ip/mipi.html>



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THANK
YOU!

20-21
SEPTEMBER
2022

The logo for MIPI DEVCON. It features the word "mipi" in a lowercase, sans-serif font with a multi-colored dot matrix above the letters. Below it, the word "DEVCON" is written in a bold, uppercase, sans-serif font, with "DEV" in red and "CON" in black.

mipi[®]
DEVCON

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Q&A

20-21
SEPTEMBER
2022