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DEVCON

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Imaging Systems Design for Mixed Reality Scenarios

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MIPI ALLIANCE
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MIPI.ORG/DEVCON

Agenda

- Mixed Reality (MR) – Introduction
- Key Use Cases
- MR System Design Overview
- Imaging Sensors for MR
- Use Case Decomposition
- Opportunities

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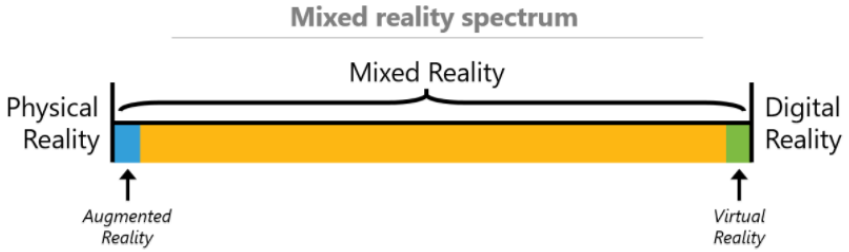
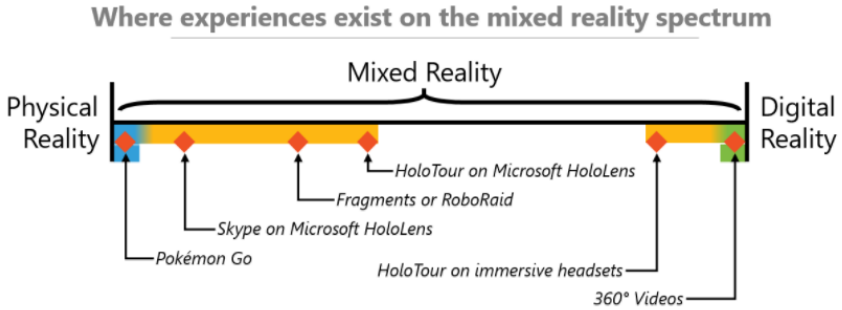
Mixed Reality - Introduction

- Experiences that overlay graphics on video streams of physical world are Augmented Reality
- Experiences that occlude your view to present a digital experience are Virtual Reality
- Experiences enabled between these two extremes are Mixed Reality, which is blending of the physical world and digital world





Diagrams from Microsoft Mixed Reality Academy
https://developer.microsoft.com/en-us/windows/mixed-reality/academy

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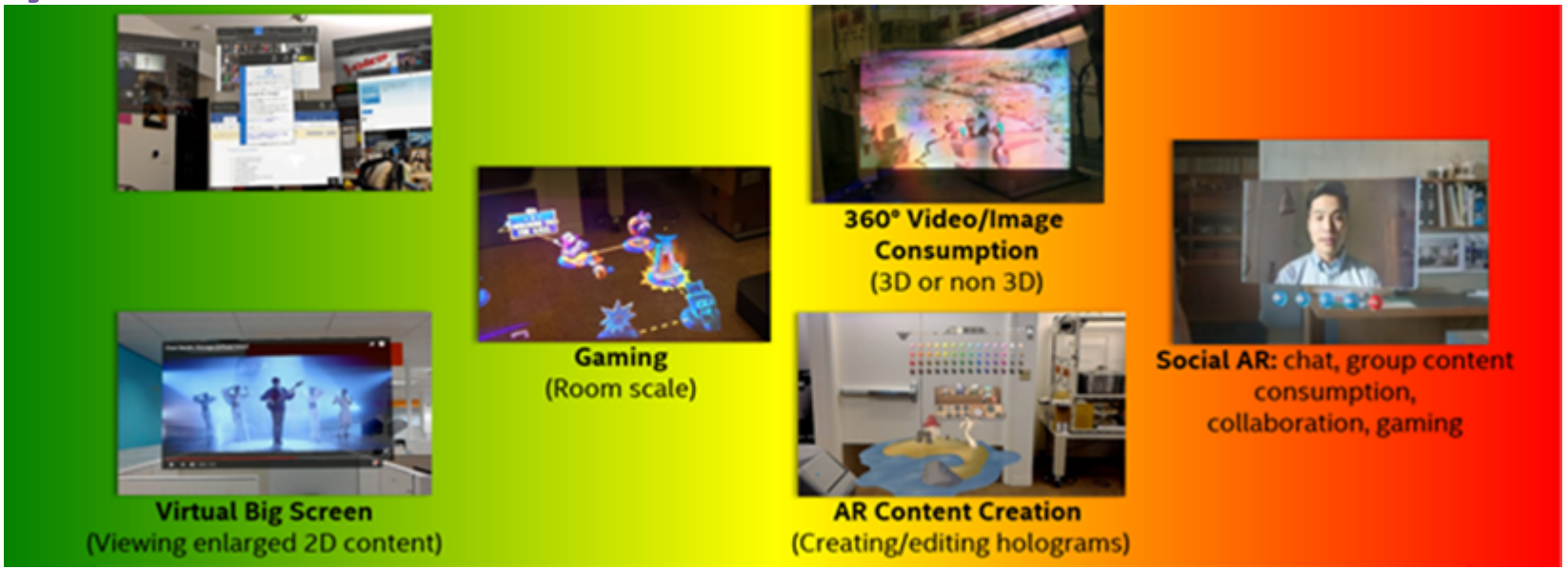
Key Use Cases



Experience Vectors

Optical See Through vs Video See Through HMD

All Day vs Limited Time

Wired vs Wireless

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System Design Overview

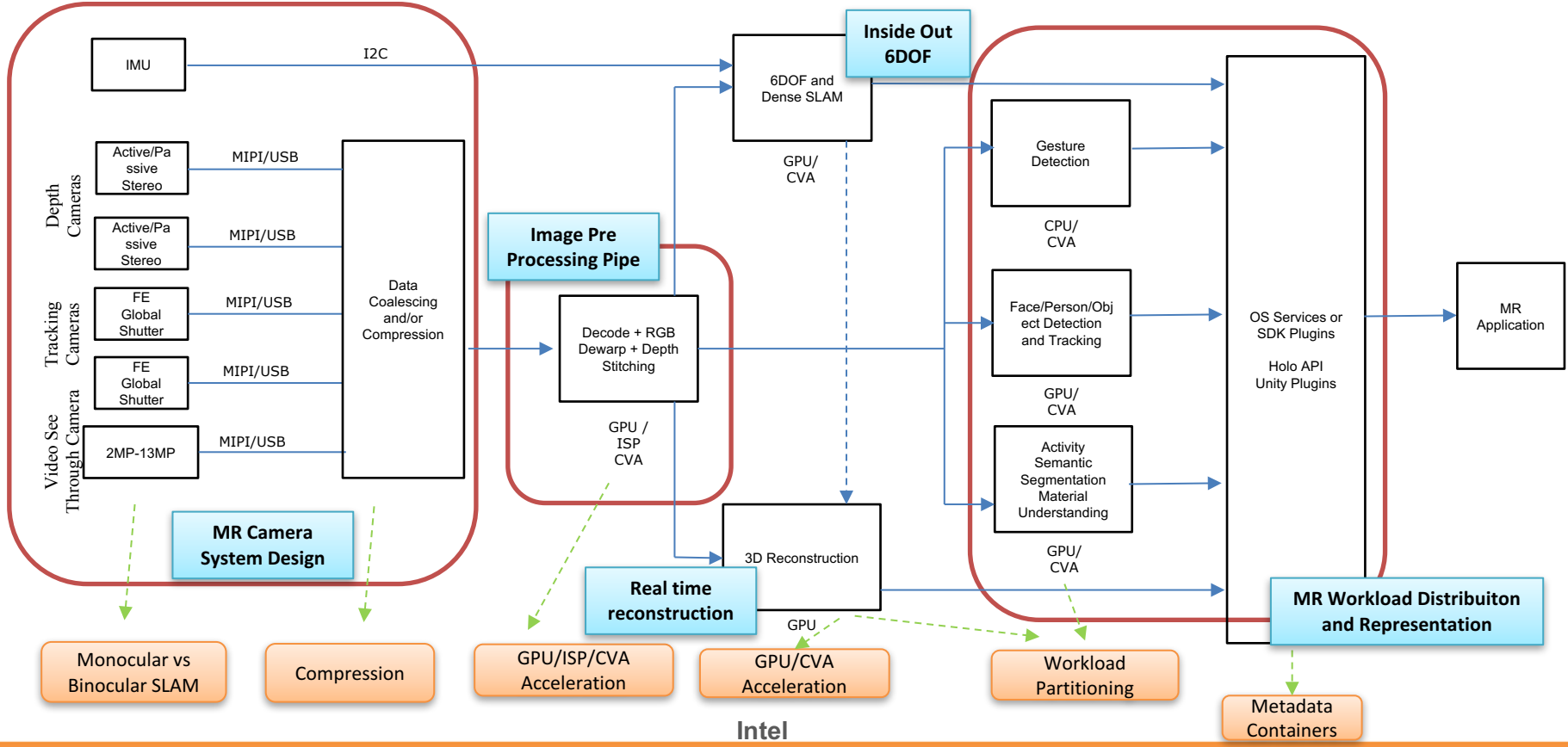

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Image Sensors for MR

Type of Sensor	Application	Typical Specification for MIPI CSI-2℠ Imaging Sensors	System Design Considerations
Tracking Sensor	Inside out 6DOF	WFOV, Fish Eye, Global Shutter, Monochrome, >120fps, >720p	Wider FOV than display to track in periphery
Depth Sensor	3D Reconstruction, Semantic, Gestures	Active vs Passive, Upto 1080p/30fps,0.3m-5m, few mm error	Independent of tracking sensor
RGB Sensor	Texture, See Through Mode	Upto 13MP/30fps for high texture Match Display Resolution & fps for See Through Mode (trending 4k/120fps)	Configurable ISP processing for simultaneous high quality texture and video see through
Event Sensor	Inside out Tracking, Object Tracking	QVGA @ 2k fps, FOV matching depth camera	Augmented with RGB and Depth camera
Hyper Spectral or Thermal Sensors	Fast Classification	RGB-NIR/LWIR Sensor, QVGA @ 30fps	Low power ROI or event generation

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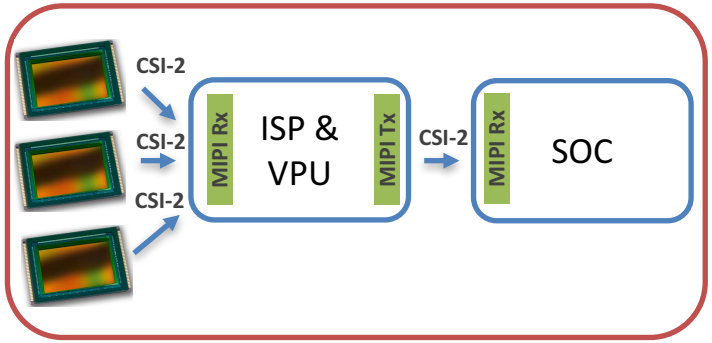
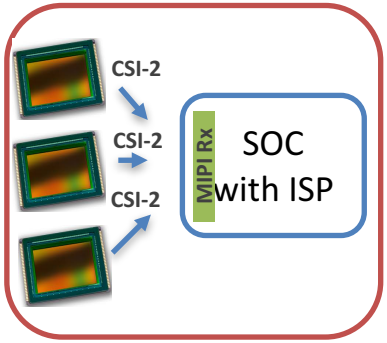
MIPI CSI-2SM Advantages in MR

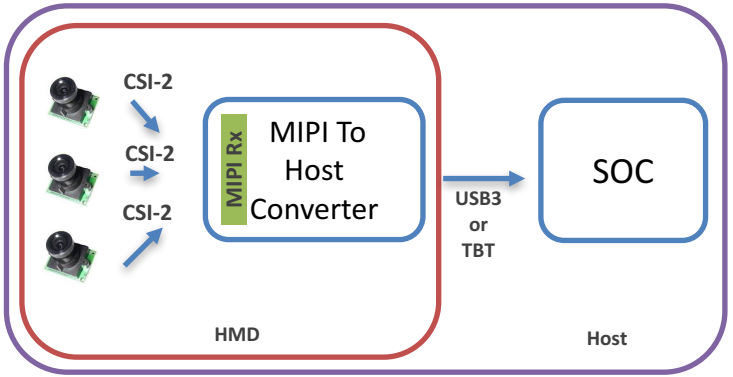
- Allows flexible ISP, Vision Accelerator and Host SOC combinations in MR enabling segmentation and mobility



All in One MR HMD with vision processing distributed between a host and a vision processing unit



All in One MR HMD with all vision processing on host



MR HMD tethered to a host PC

VPU -> Vision Processing Unit, typically consists of CV and Neural Network accelerators

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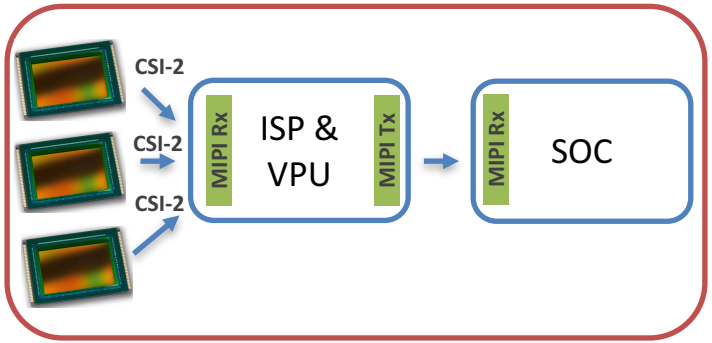
MIPI CSI-2 Advantages in MR

- Total power consumption on HMD, especially for optical see through or AIO HMD with MIPI CSI-2

CSI-2 Camera Type	Typical Power
Depth Camera	300mW - 1.5W
RGB Camera	300mw - 1W
Tracking Camera	300 - 500 mw



Total power dissipated on a AIO HMD can be anywhere from 10-25W. Camera power starts to play a significant portion of the same

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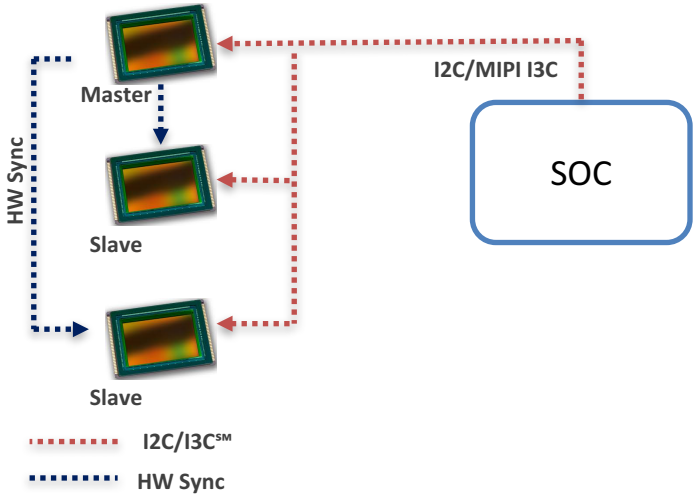
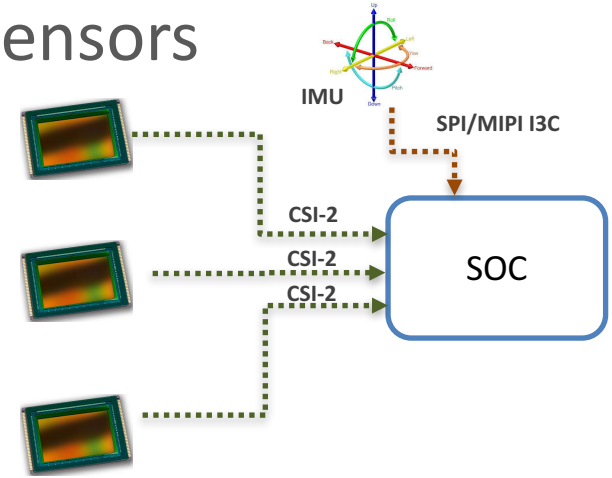
MIPI CSI-2 Advantages in MR

- Easier synchronization between sensors



HW Synchronization



SW Synchronization between cameras and I3C Sensor Hub

Time Stamping between MIPI frames synchronized with host or SOC HW time and sensor hub

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MIPI CSI-2 Future Opportunities for MR

- Custom camera modules for MR
  - Different combinations that can be integrated into MR HMD's
- Metadata Containers
  - Standardized Metadata for MR vision analytics from on board HMD for consumption by host
- MIPI to USB/TBT/Wifi Reference Designs for MR Headsets
  - Enables users to buy off market lower cost HMD's to be used with PC's increasing adoption
- Low power event sensing for MR
  - Standardized event triggers from event sensors to feed into other sensors for better power management
- Adoption of Beyond Visible Cameras
  - Adoption of MIPI based Thermal, Hyperspectral sensors for MR use cases

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