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**MIPI CSI-2SM for Multi-camera,
Long Range Use Cases and
Implementation Methods Using
FPGAs**

2017
MIPI ALLIANCE
DEVELOPERS
CONFERENCE

BANGALORE, INDIA
MIPI.ORG/DEVCON

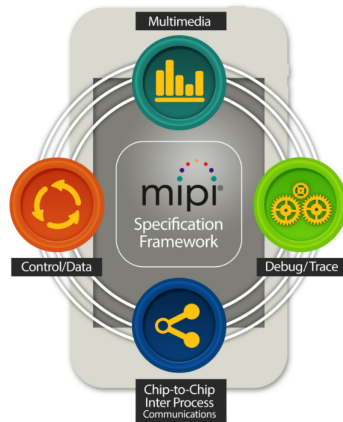
Agenda

- **MIPI CSI-2 Introduction & Features**
- **Camera Market & Projections**
- **Multi-camera & Long Distance Use Case(s)**
- **System Requirements**
- **Value of FPGA for MIPI CSI-2**
- **Q & A**

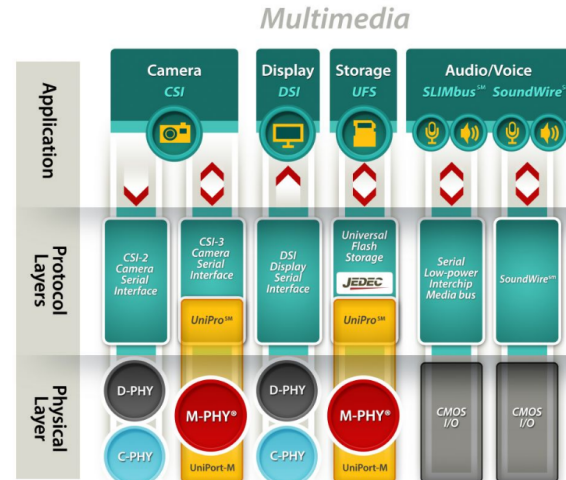
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mipi.org

- **MIPI Alliance:** Developing the world's most comprehensive set of interface specifications for mobile and mobile-influenced products.



Source: mipi.org



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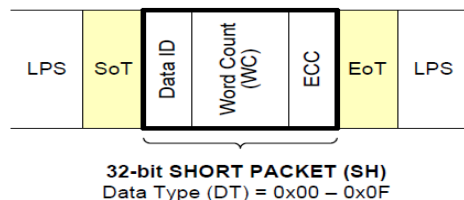
MIPI CSI-2 Features

Note: *MIPI CSI-2SM 1.1, MIPI D-PHYSM 1.1 considered in this presentation.*

- **Multi-lane support (1.5Gbps/Lane)**
- **Multiple data types (RAW,RGB,YUV)**
- **Interleaving (VC , Data type)**

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MIPI CSI-2 Features



DATA IDENTIFIER (DI):

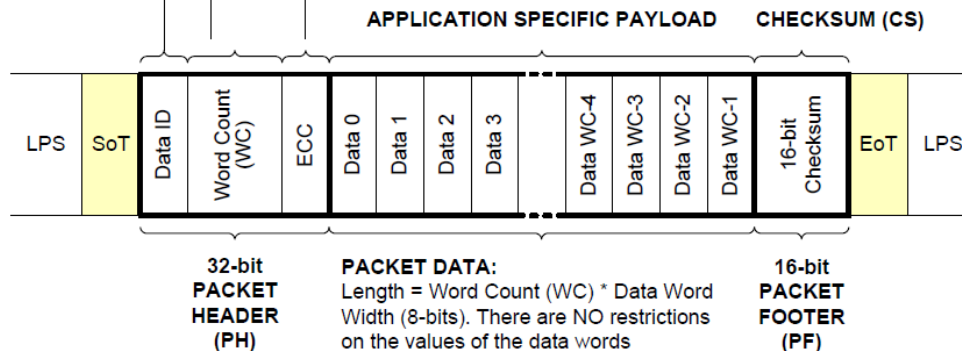
Contains the Virtual Channel Identifier and the Data Type Information
Data Type denotes the format/content of the Application Specific Payload Data.
Used by the application specific layer.

16-bit WORD COUNT (WC):

The receiver reads the next WC data words independent of their values.
The receiver is NOT looking for any embedded sync sequences within the payload data. The receiver uses the WC value to determine the end of the Packet

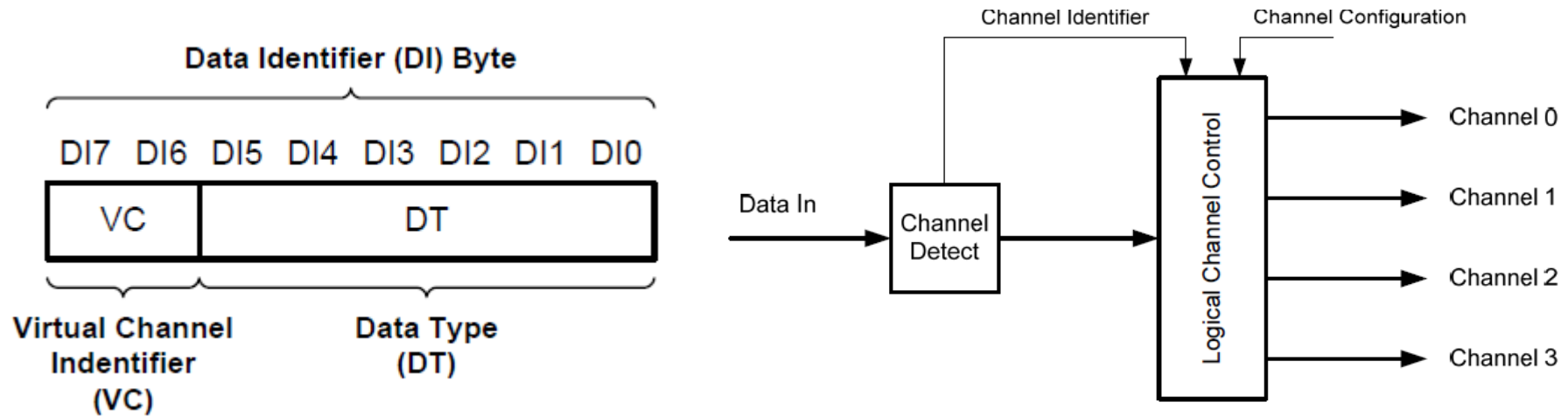
8-bit Error Correction Code (ECC) for the Packet Header:

8-bit ECC code for the Packet Header. Allows 1-bit errors with the packet header to be corrected and 2-bit errors to be detected



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MIPI CSI-2 Features

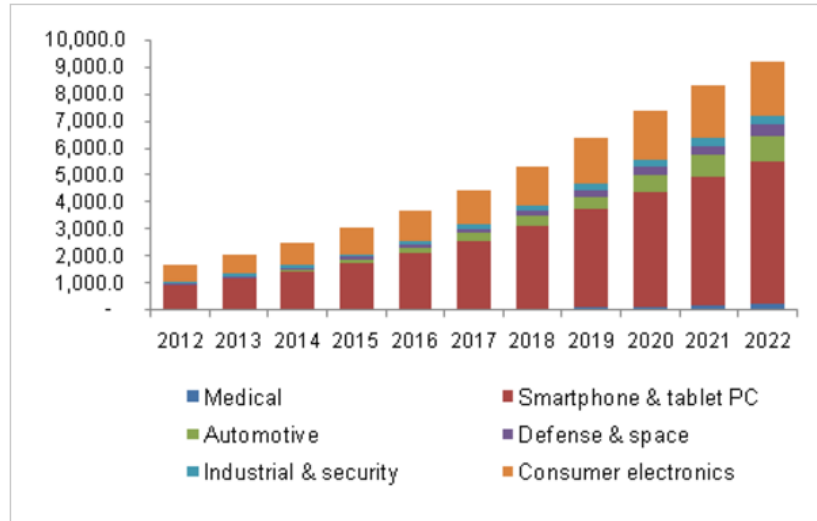


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Camera Projections

- Camera market by application

North America camera module market by application, 2012 - 2022, (USD Million)

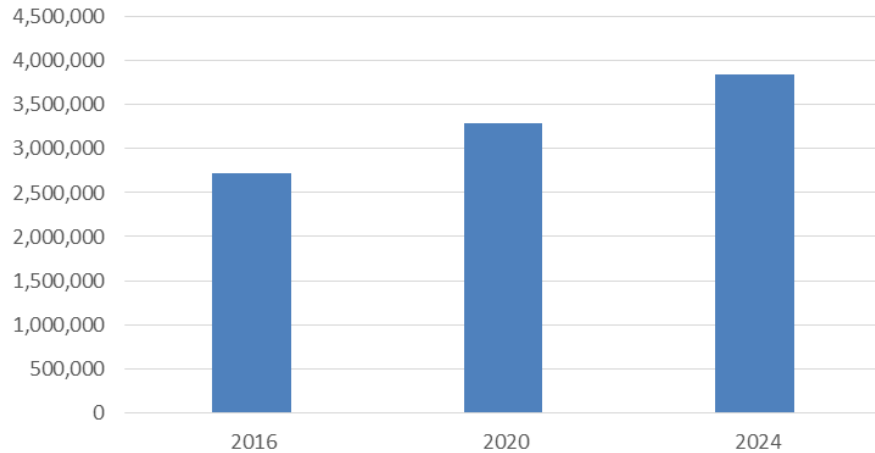


Source: [grandviewresearch.com](https://www.grandviewresearch.com)

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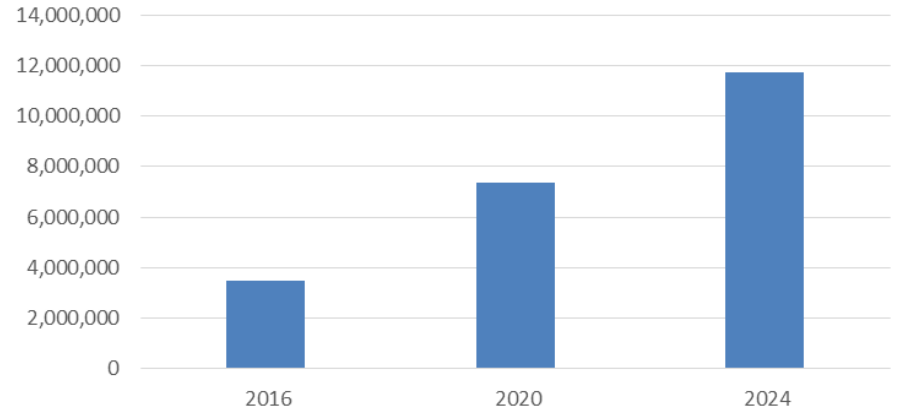
Automotive-ADAS Projections

ADAS Sensor growth(1000s)



Source: IHS

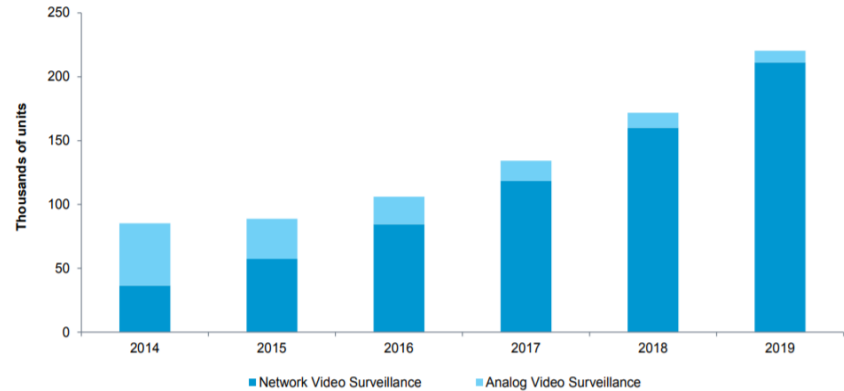
ADAS Semiconductor forecast(1000s), Image Sensors not included



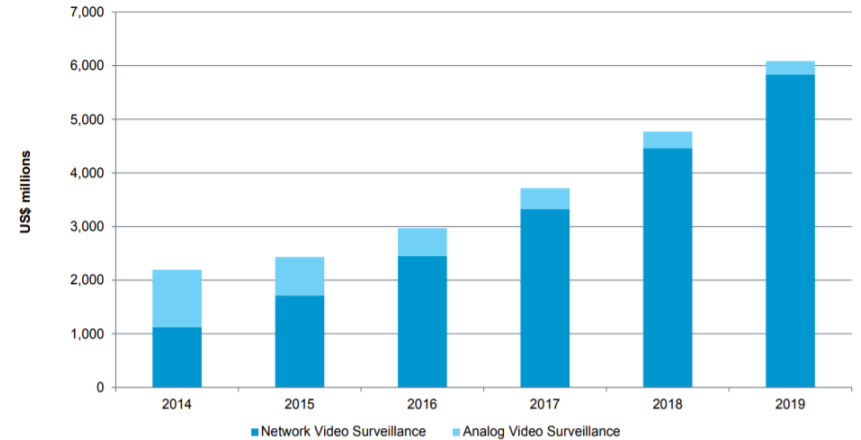
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Video Surveillance Projections

Global shipments of security cameras



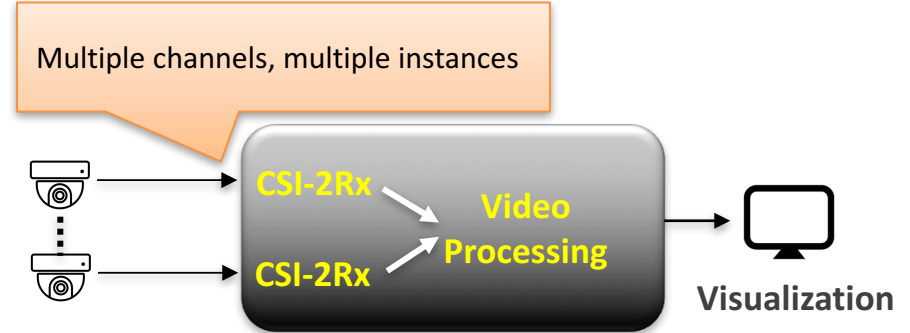
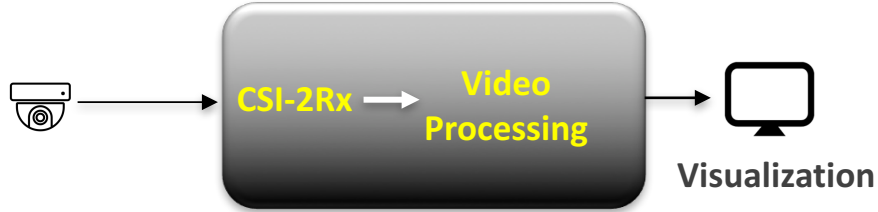
Global semiconductor revenue forecast for video surveillance equipment



Source: IHS

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Multi-camera Systems

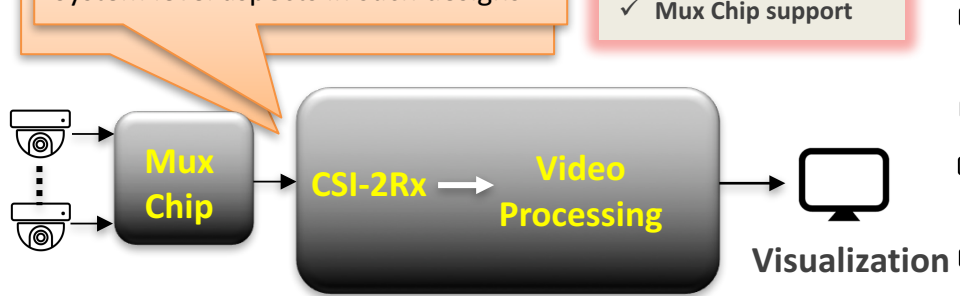


How many cam's can be supported?
System level aspects in such designs

- ✓ Bandwidth
- ✓ Protocol support
- ✓ Mux Chip support

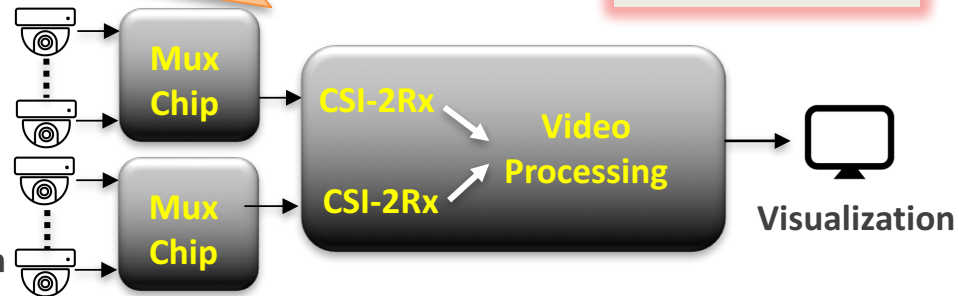
How many cam's can be supported?
System level aspects in such designs

- ✓ Bandwidth
- ✓ Protocol support
- ✓ Mux Chip support
- ✓ IO Support



Type-1

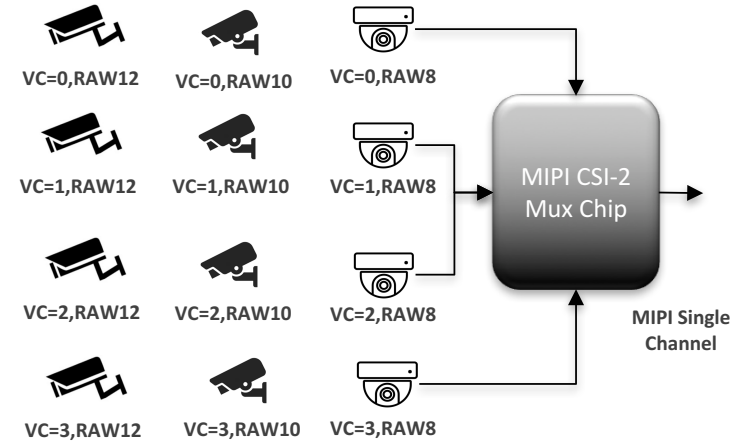
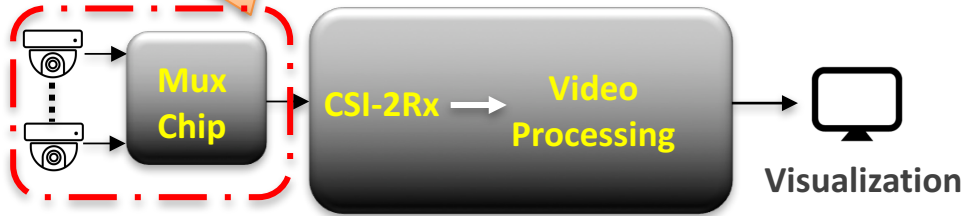
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Type-2

System aspects-Type1

How many cam's can be supported?
System level aspects in such designs



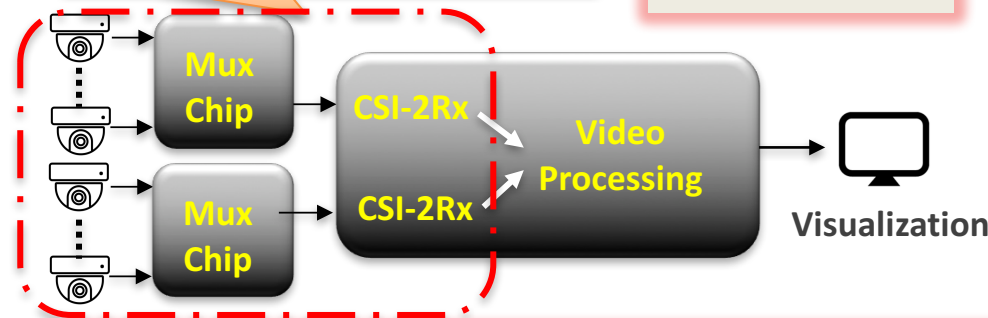
- ✓ Total bandwidth available
- ✓ Interleaving as supported MIPI CSI-2 Specification
- ✓ Maximum input channels supported by mux chip

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System aspects-Type2

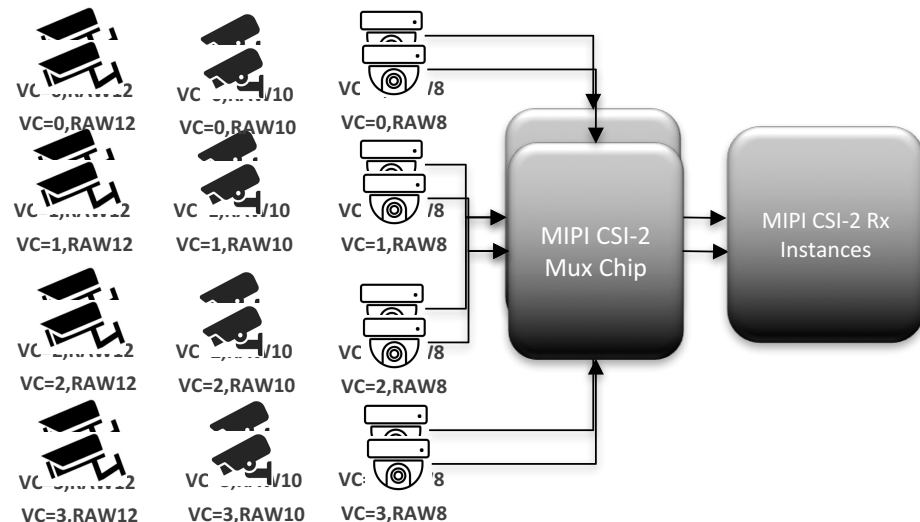
How many cam's can be supported?
System level aspects in such designs

- ✓ Protocol support
- ✓ Mux Chip support
- ✓ IO Support



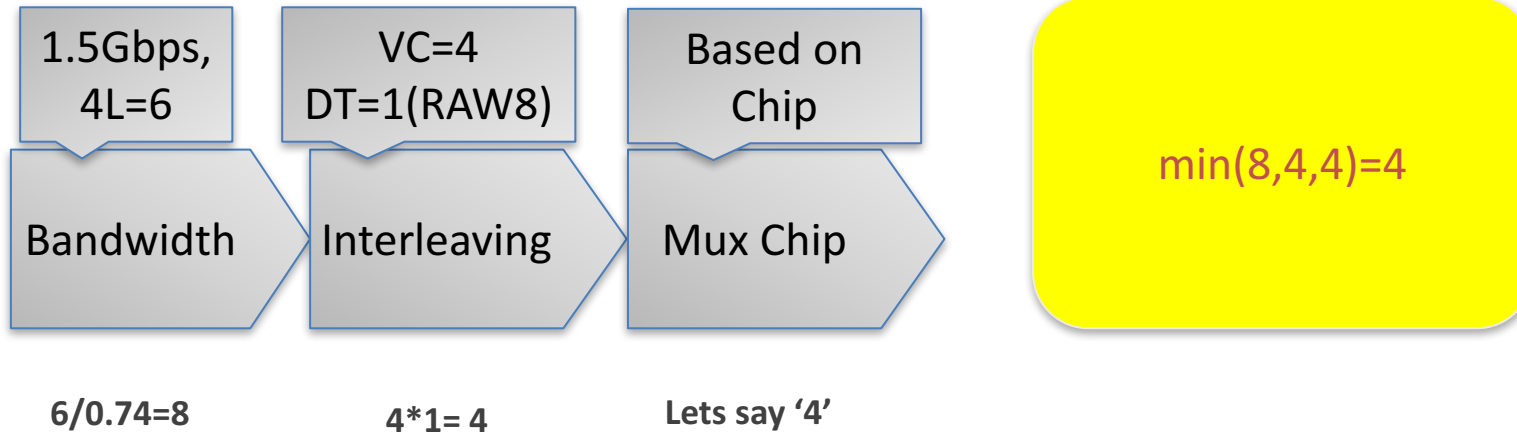
- ✓ Total bandwidth available
- ✓ Interleaving as supported MIPI CSI-2 Specification
- ✓ Maximum input channels supported by mux chip
- ✓ Maximum CSI-2 Instances that can be implemented on the chip

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System Requirements-Type1

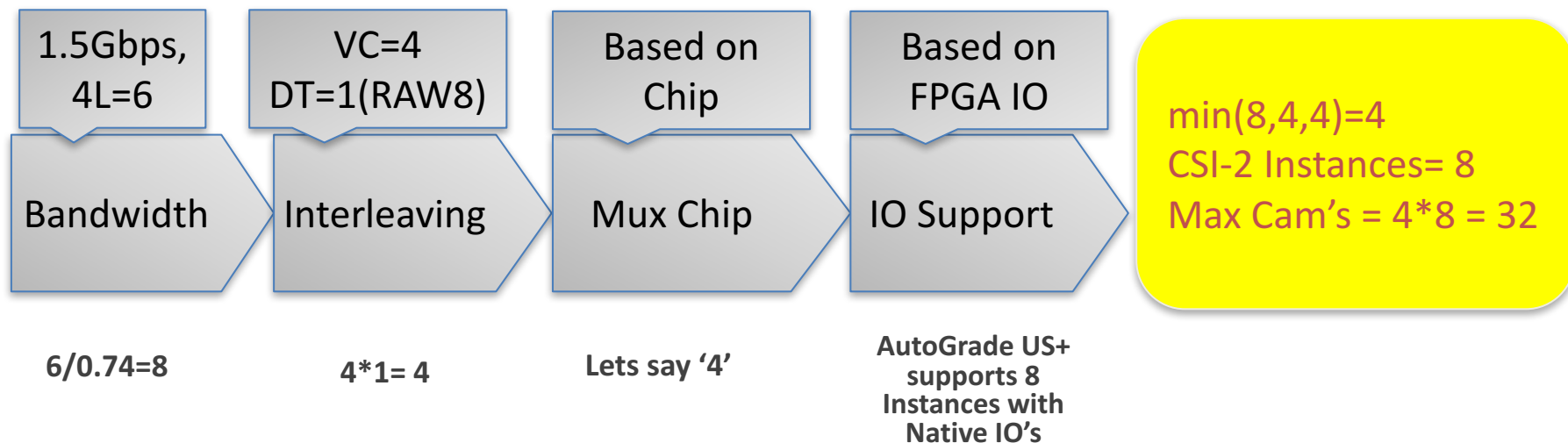
- 1920x1080 @ 30fps, RAW8 -> Requires ~0.74Gbps



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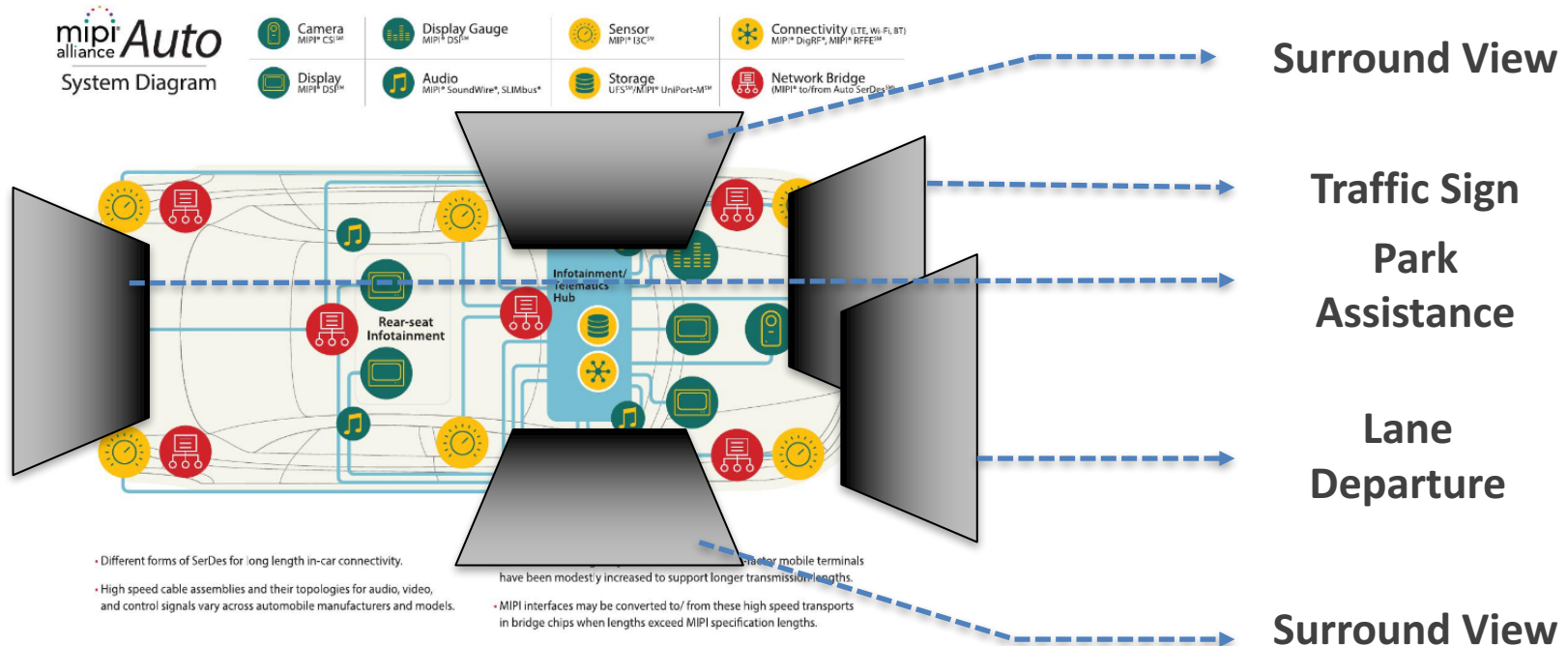
System Requirements-Type2

- 1920x1080 @ 30fps, RAW8 -> Requires ~0.74Gbps



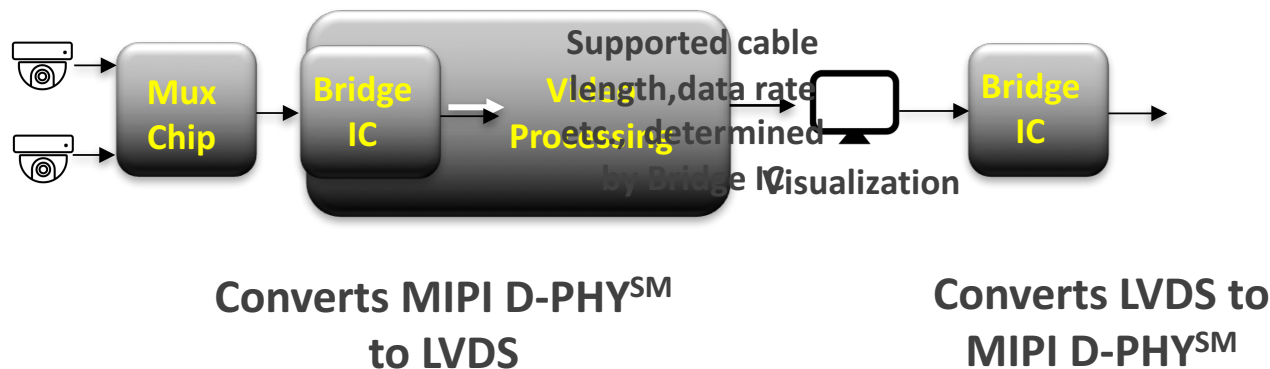
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Multi-camera & Long Distance Use Case(s)



Long Distance Using Bridge IC's

MIPI Interfaces may be converted to/from these high speed transports in bridge chips when length exceed MIPI Specification lengths



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Value of FPGA for MIPI CSI-2

- Most flexible & scalable platform for maximum reuse and best TTM
 - ✓ *Implement End-to-End systems with ease*
- Latest FPGAs can speak MIPI D-PHY
 - ✓ *Single Chip(PHY+Controller), reduces BOM. More D-PHY interfaces per chip (> 16)*
 - ✓ *Flexible interfaces: Lanes (1,2,3,4), Data rates, VC filtering etc..*
- Latest FPGAs built on a common real-time processor and programmable logic equipped platform enables unlimited possibilities for next generation ADAS applications
 - ✓ *Innovative ARM® + FPGA architecture for differentiation, analytics & control*

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Q & A

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THANK YOU

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