



Alain Legault
Hardent

**Create Higher Resolution
Displays With VESA Display
Stream Compression**

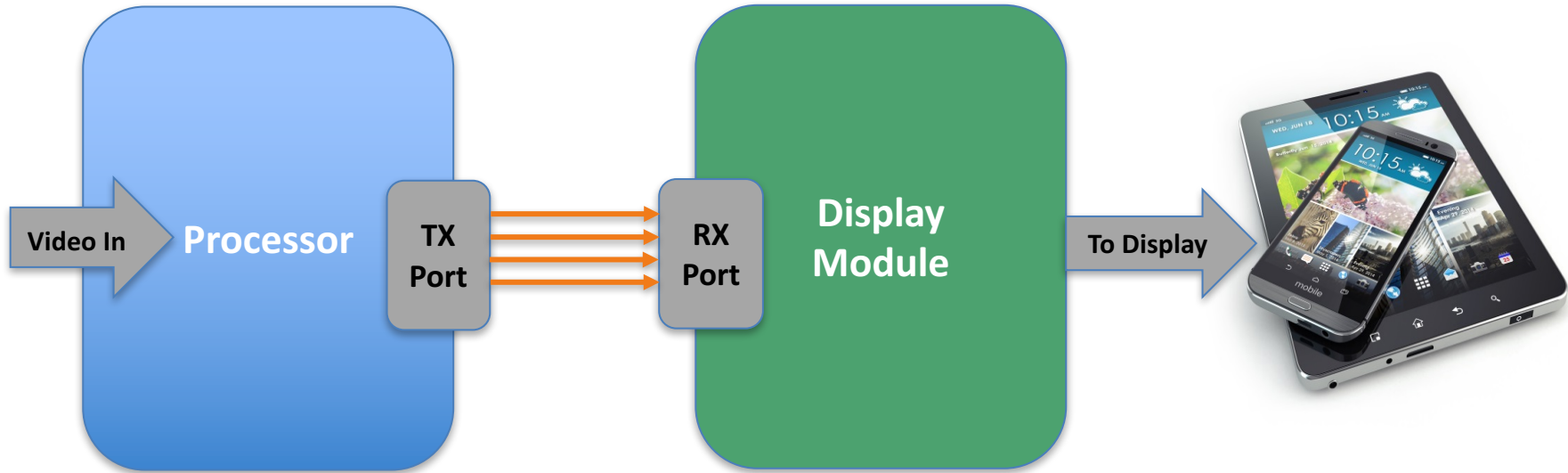
HSINCHU CITY, TAIWAN
MIPI.ORG/DEVCON

The background of the slide features a large, abstract graphic on the right side composed of several overlapping geometric shapes in shades of purple, orange, and teal. Within the purple shape at the top, there is a faded, high-angle photograph of a crowd of people, likely at a conference or event.

2017
MIPI ALLIANCE
DEVELOPERS
CONFERENCE

What Is VESA DSC?

Why Is VESA DSC Needed?



Mobile application processor

MIPI DSISM

DDIC

Computer GPU card

DisplayPort cable

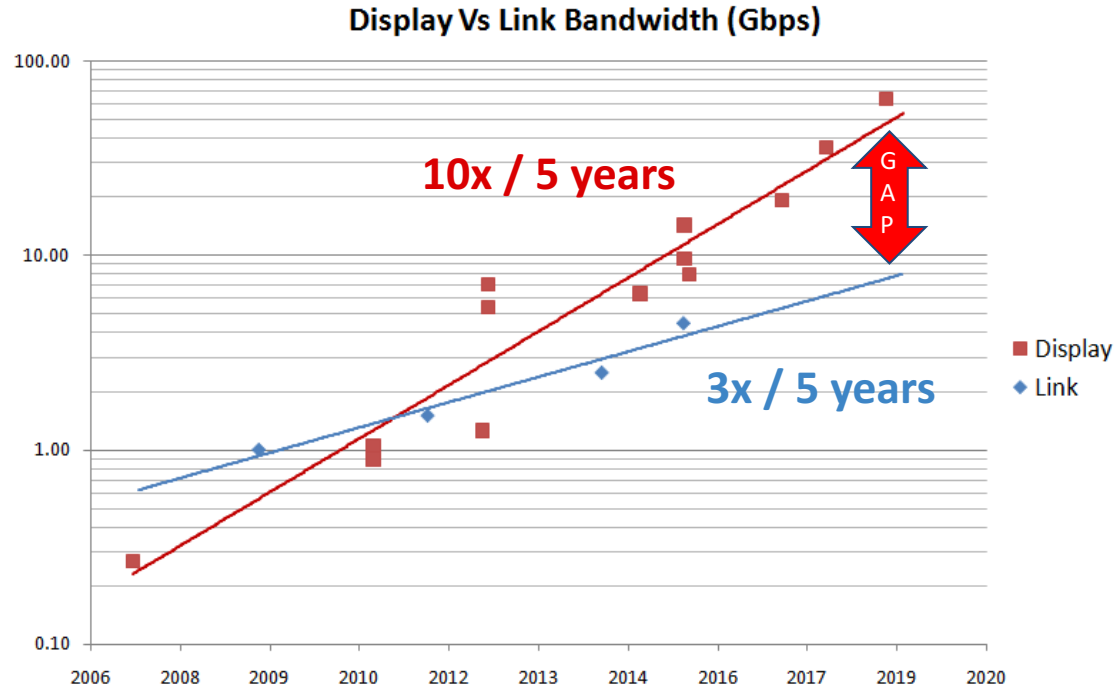
Computer monitor

Car application processor

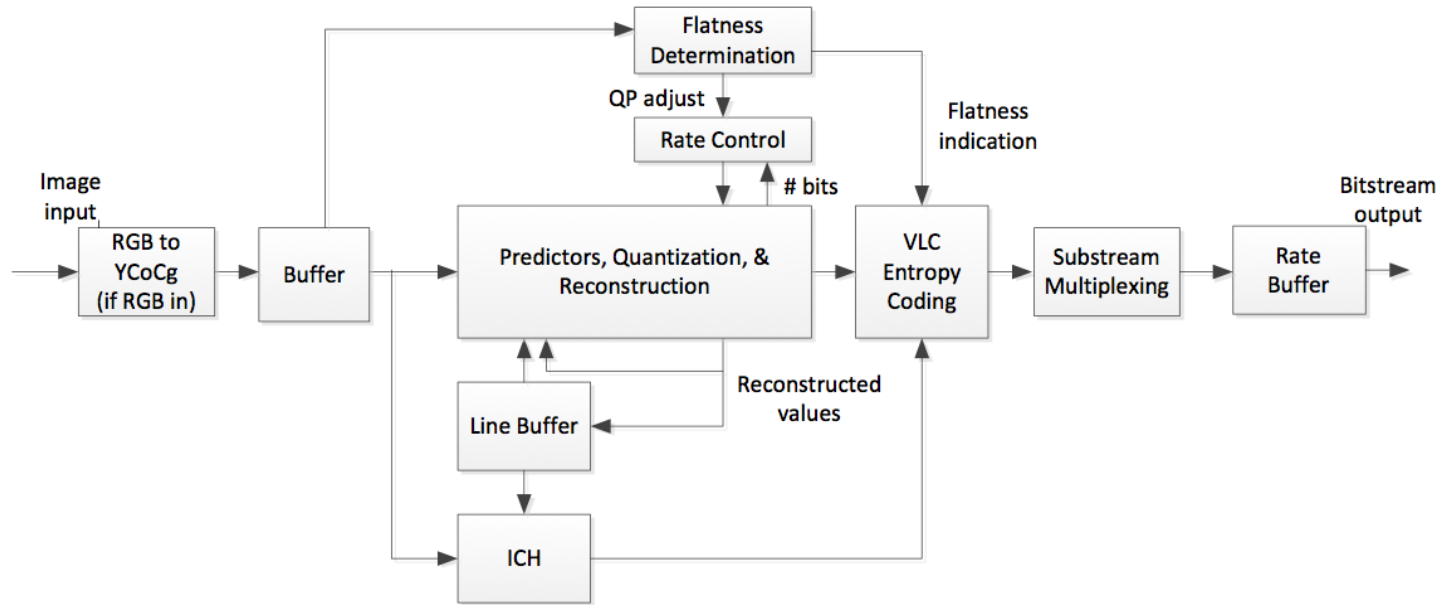
Proprietary transport

Car infotainment display

Display Resolution Growth



VESA DSC Block Diagram



Source: VESA DSC white paper

VESA DSC Algorithm

- Intra-frame Constant Bit Rate (CBR) encoder
- Based on Delta Pulse Code Modulation (DPCM)
- Mid Point (MPP), Block Predictor (BP)
- Modified Median Adaptive Predictor (MMAF)
- Indexed Color History (ICH)
- Requires a single line of pixel storage + rate buffer
 - Ultra-low latency
- Visually lossless compression between 2x – 3x
- Video quality excellent with all types of content
 - Natural and test images, text, and graphics

PHY Speed / Display Resolution

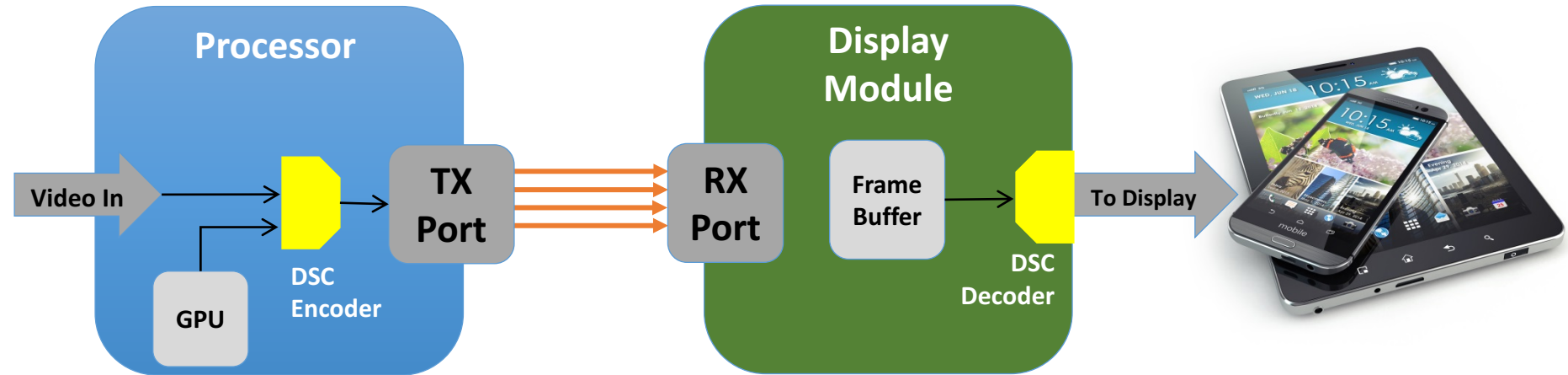
MIPI D-PHYSM v1.1 1.5 Gbps / lane

Resolution	FHD (1080x1920)	WQHD (1440x2560)	WQXGA (1600x2560)	UHD (2160x3840)	WQUXGA (2400x3840)	5K (2880x5120)	8K (4320x8192)
Bandwidth	3.58Gbps	6.37Gbps	7.08Gbps	14.33Gbps	15.93Gbps	25.49Gbps	61.16Gbps
No compression	3 lanes	6 or 8 lanes	6 or 8 lanes	N/A	N/A	N/A	N/A
2x compression	2 lanes	3 lanes	3 lanes	8 or 6 lanes	8 or 6 lanes	N/A	N/A
3x compression	1 lane	2 lanes	2 lanes	4 lanes	4 lanes	8 lanes	N/A

MIPI D-PHY v1.2 2.5 Gbps / lane

Resolution	FHD (1080x1920)	WQHD (1440x2560)	WQXGA (1600x2560)	UHD (2160x3840)	WQUXGA (2400x3840)	5K (2880x5120)	8K (4320x8192)
Bandwidth	3.58Gbps	6.37Gbps	7.08Gbps	14.33Gbps	15.93Gbps	25.49Gbps	61.16Gbps
No compression	2 lanes	3 lanes	3 lanes	8 or 6 lanes	8 lanes	N/A	N/A
2x compression	1 lane	2 lanes	2 lanes	3 lanes	4 lanes	8 or 6 lanes	N/A
3x compression	1 lane	1 lane	1 lane	2 lanes	3 lanes	4 lanes	N/A

MIPI DSI Link Compression



VESA DSC Task Group 2017



VESA DSC Standard Availability and Support

Table 1: Display Stream Compression (DSC) Comparison: v1.1 and v1.2

	DSC 1.1	DSC 1.2
Intraframe coding for images and video	✓	✓
Visually lossless performance verified by subjective testing	✓	✓
Detailed standard description	✓	✓
Normative encoder and normative decoder	✓	✓
Normative C language code and WIN32 binary	✓	✓
High Dynamic Range (HDR)/ Wide Color Gamut (WCG)-ready	✓	✓
8, 10, 12 bits per color support	✓	✓
14 and 16 bits per color support		✓
RGB and YCbCr 4:4:4 native coding	✓	✓
YCbCr 4:2:2 native coding		✓
YCbCr 4:2:0 native coding		✓

Source: VESA

Transport Standards Using VESA DSC



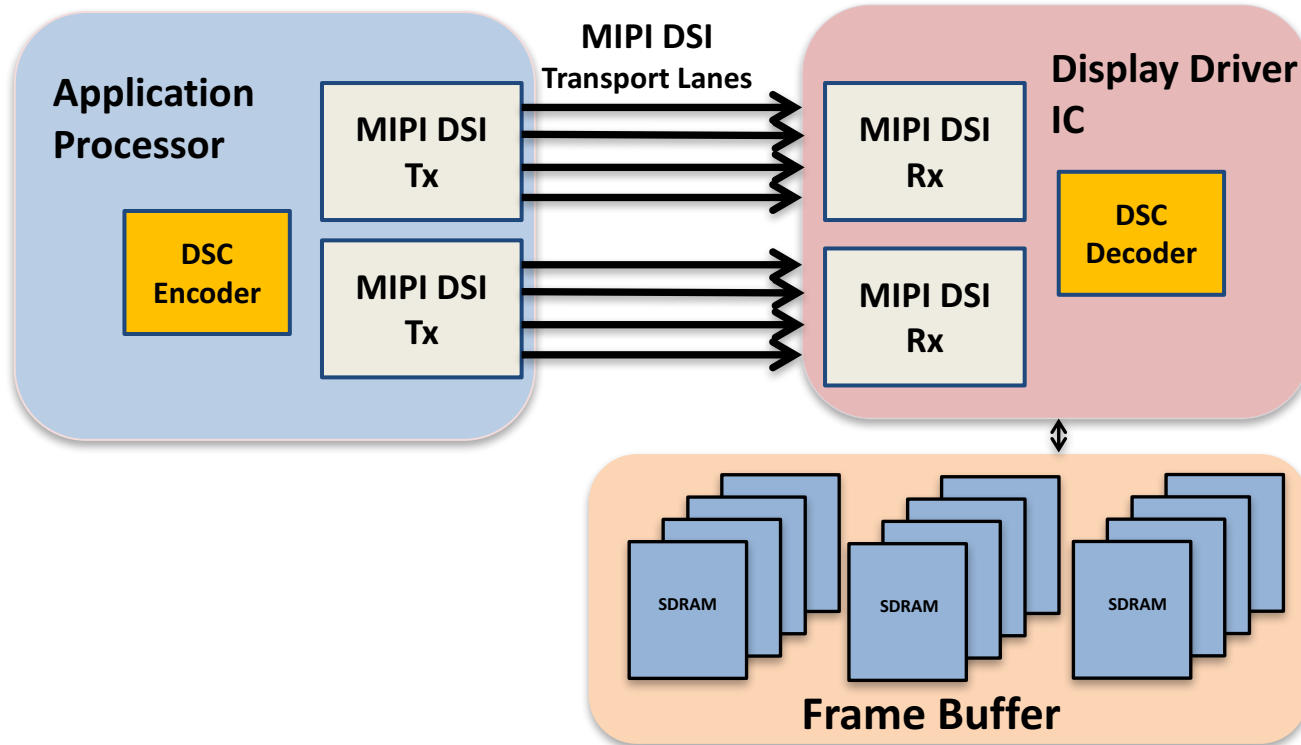
- MIPI DSI 1.2
- eDisplayPort 1.4b
- DisplayPort 1.4
- HDMI 2.1



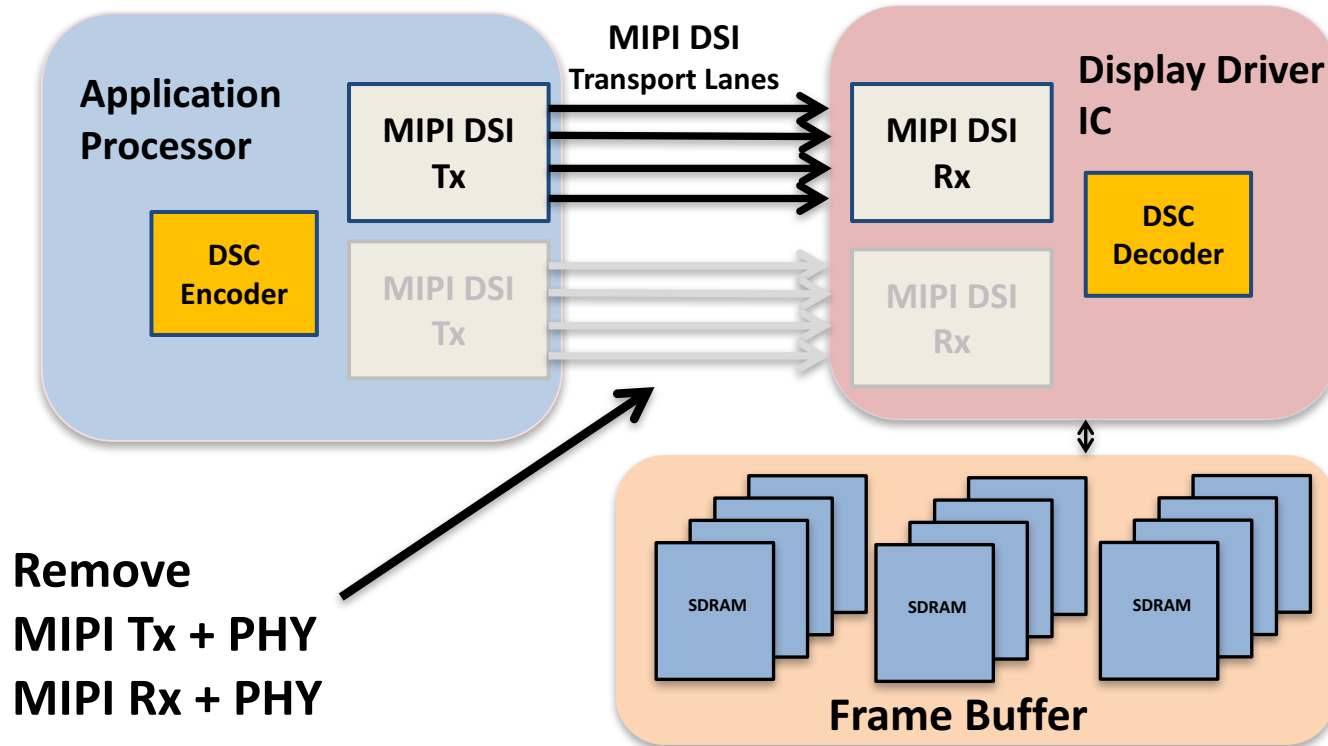
Why Adopt VESA DSC?

- Visually lossless picture quality for all content
 - Photos, videos, text, graphics, and test patterns
- Increases data transport capacity by up to 3X
- Compatible with major transport standards
 - MIPI DSI, DisplayPort 1.4, HDMI 2.1
- Ultra-low latency
- Scalable display resolution, frame rate, and colour depth
 - Up to 8K @ 120Hz with HDR
- Reduces power consumption, system costs, and EMI

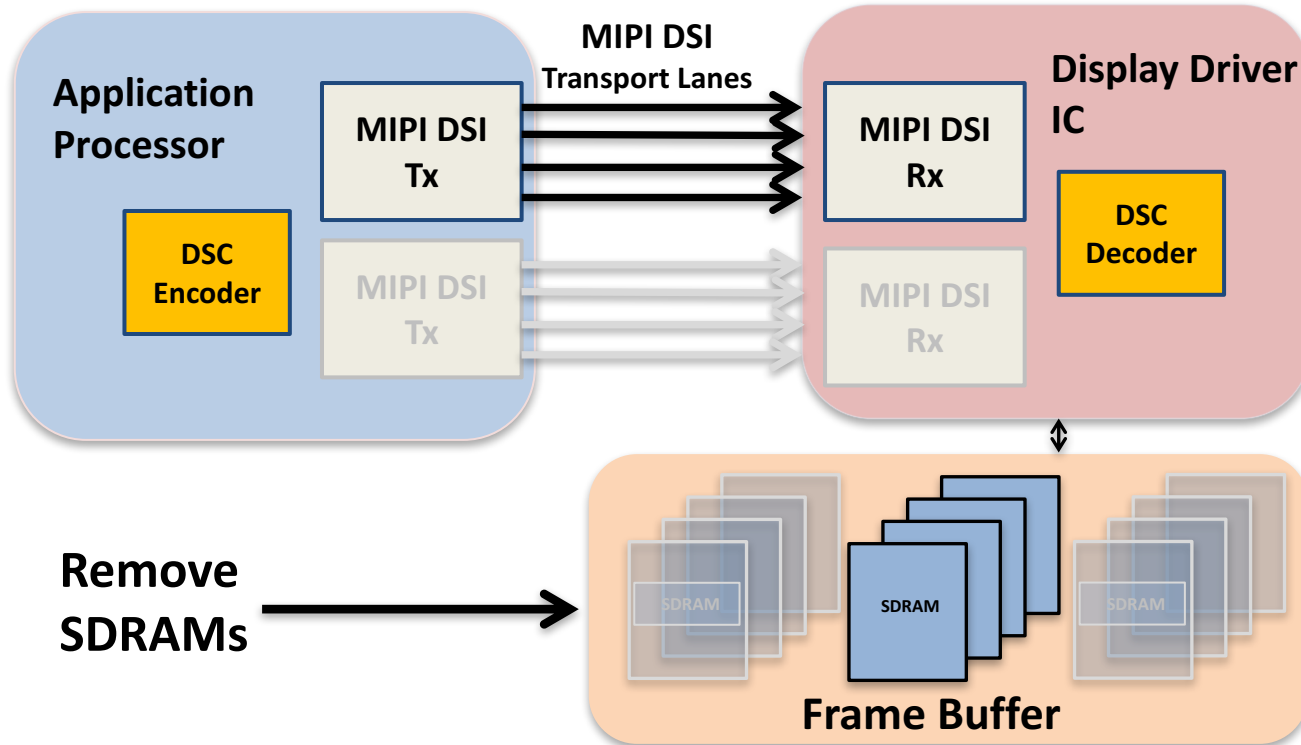
DSC Helps Save Power, Area, and Cost



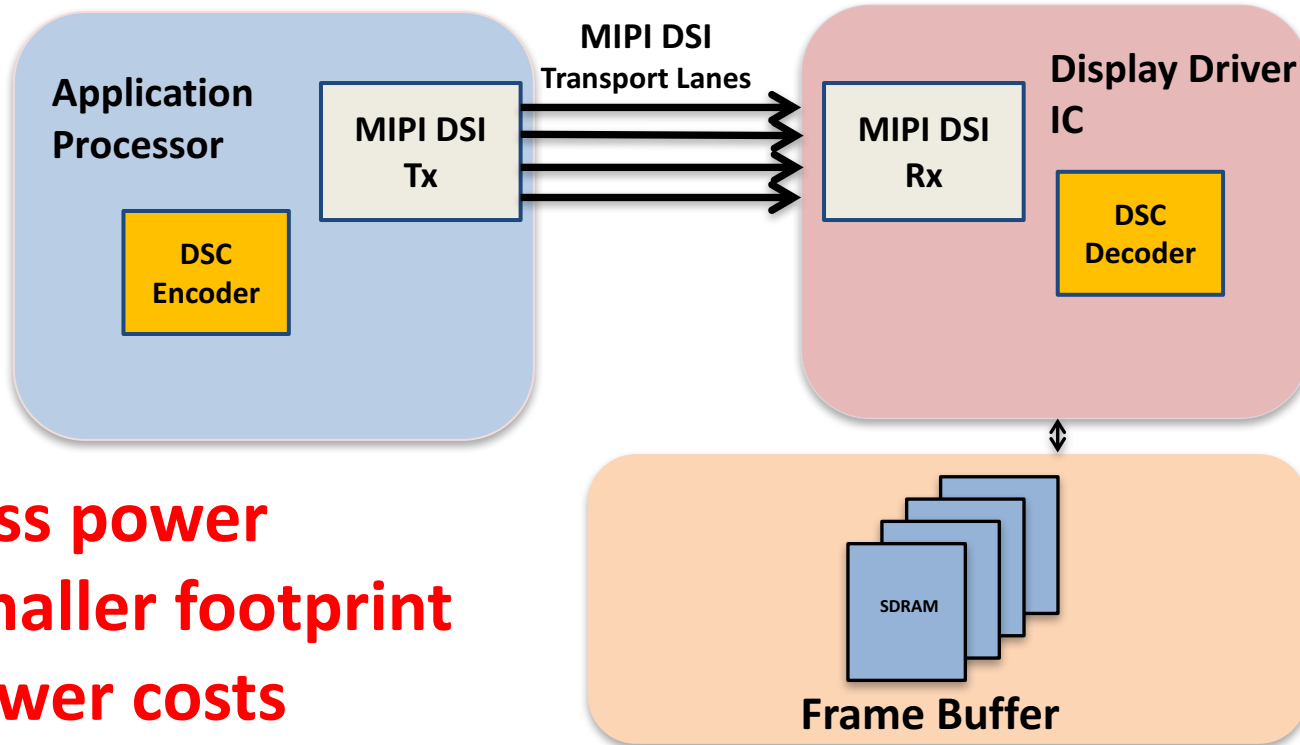
DSC Helps Save Power, Area, and Cost



DSC Helps Save Power, Area, and Cost



DSC Helps Save Power, Area, and Cost



Less power
Smaller footprint
Lower costs

Products Using VESA DSC



Qualcomm Snapdragon 820



NVIDIA Tegra X1

VESA DSC in Consumer Electronics Applications

Use Case: Mobile and Tablet Applications

- Application processor
- DDIC (Display Driver IC) and touch panel controller

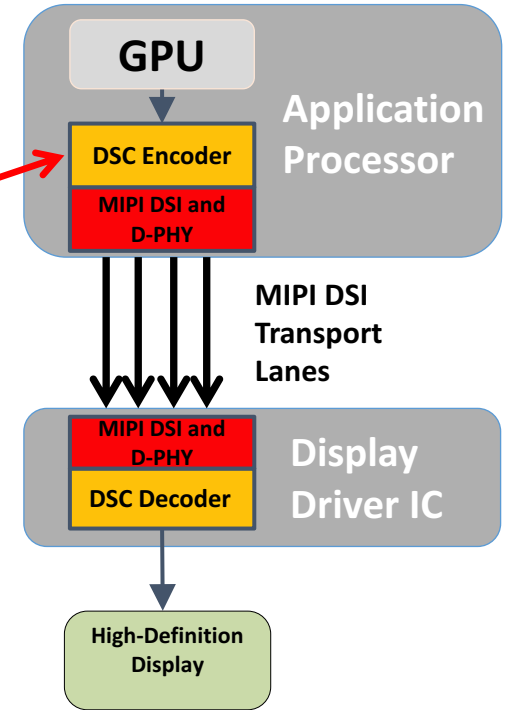
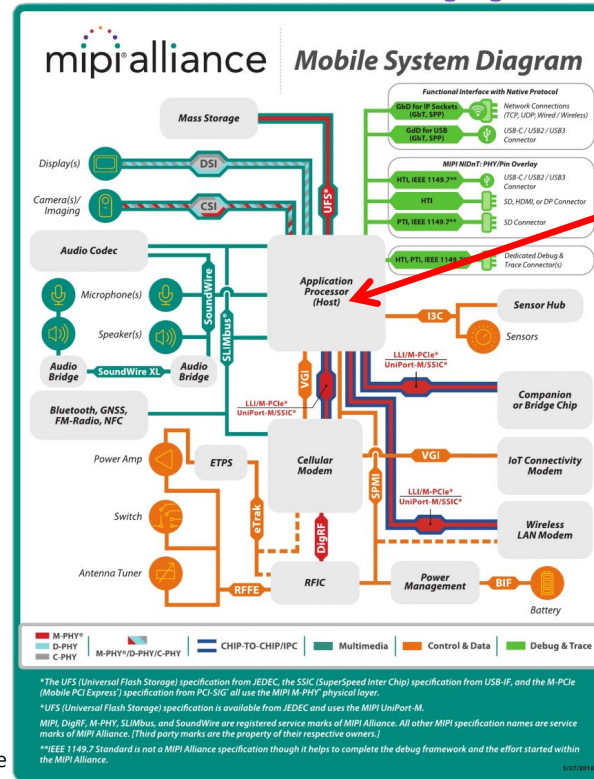
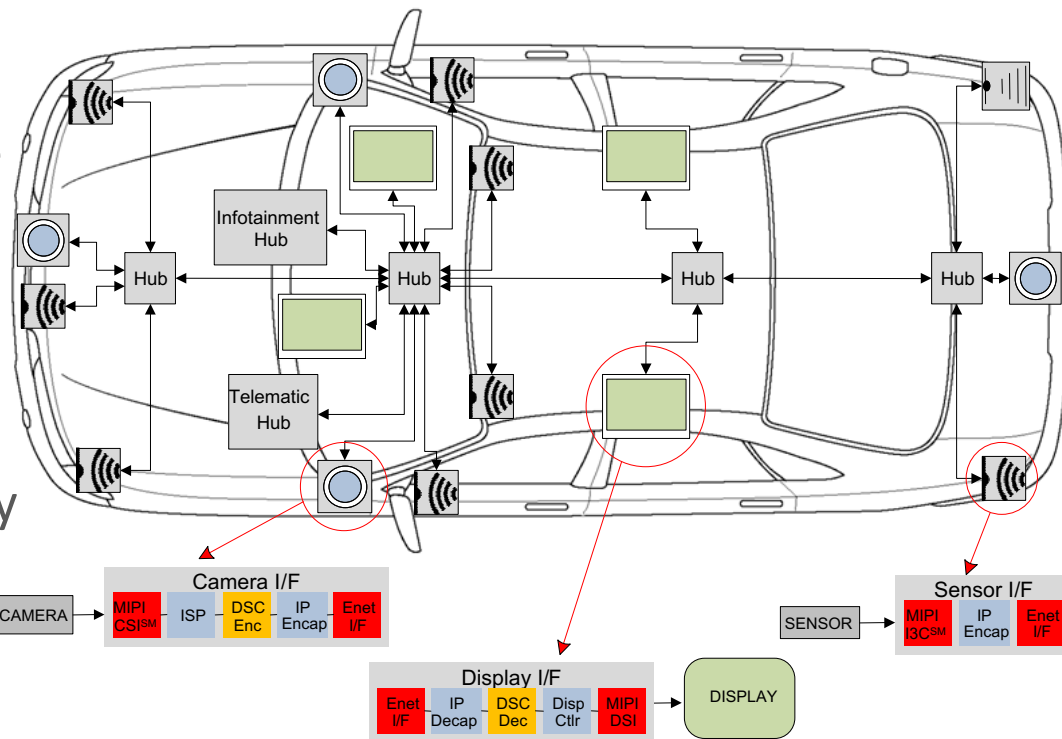


Image Source: MIPI Alliance

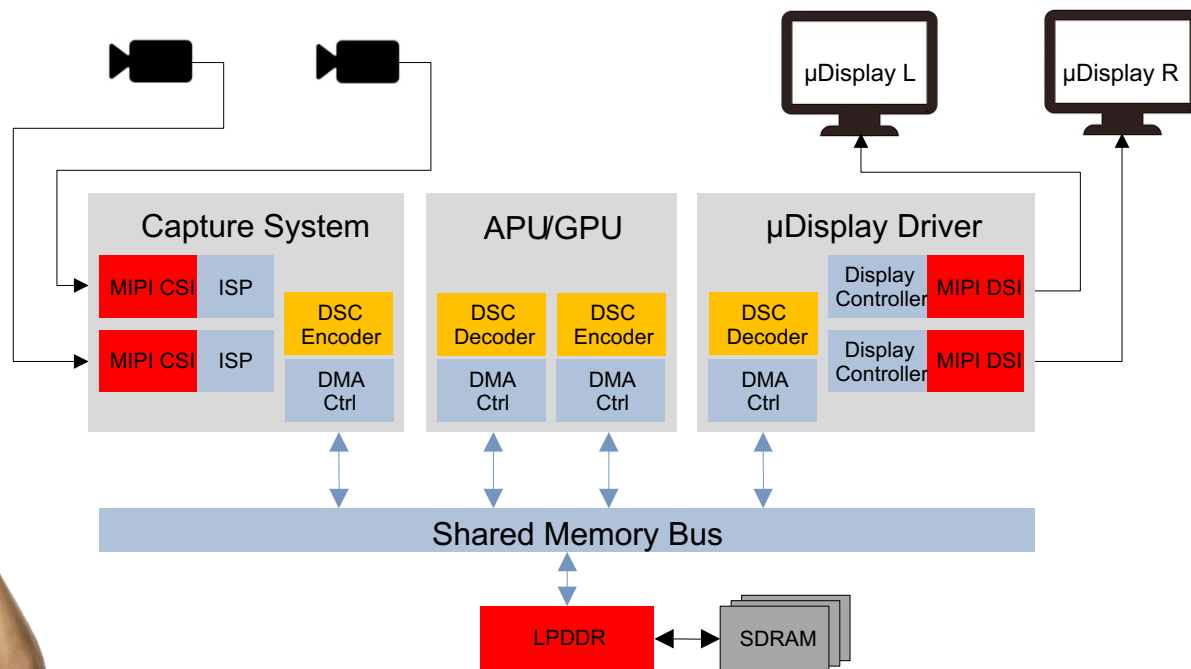
Use Case: In-Car Video Applications

- Application processor
- Infotainment display module
- Video cameras
- HDMI sources
- Ability to transport multiple video sources simultaneously
- Automotive serial interfaces and transport



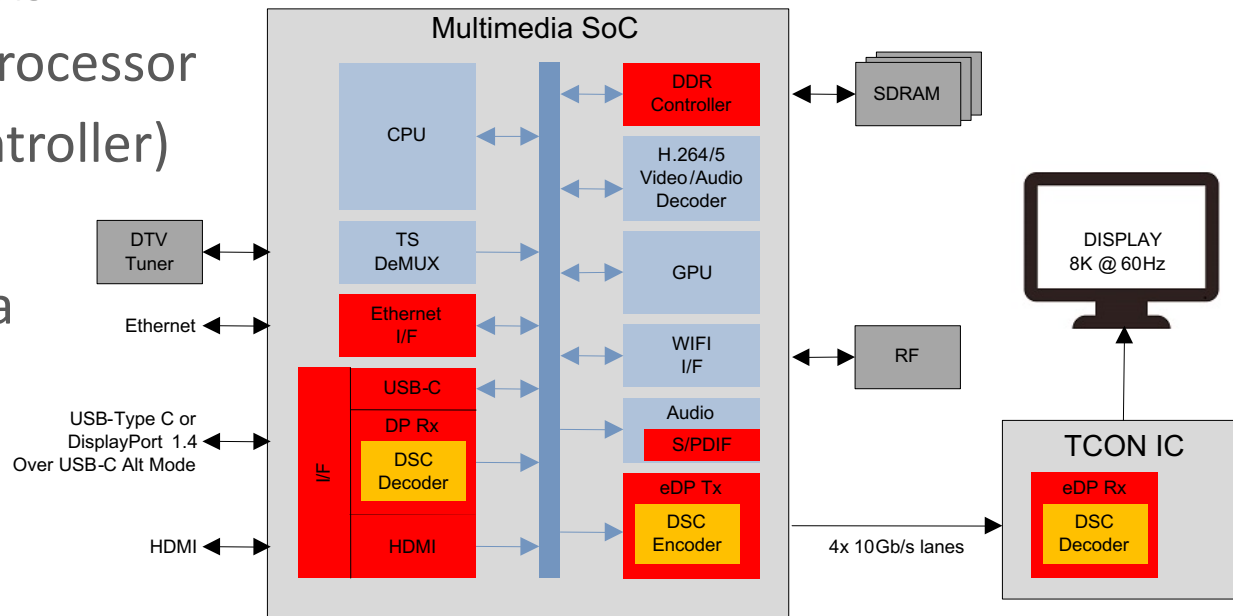
Use Case: AR / VR Head-Mounted Display

- Video capture
- Application processor and GPU
- Micro-display driver IC



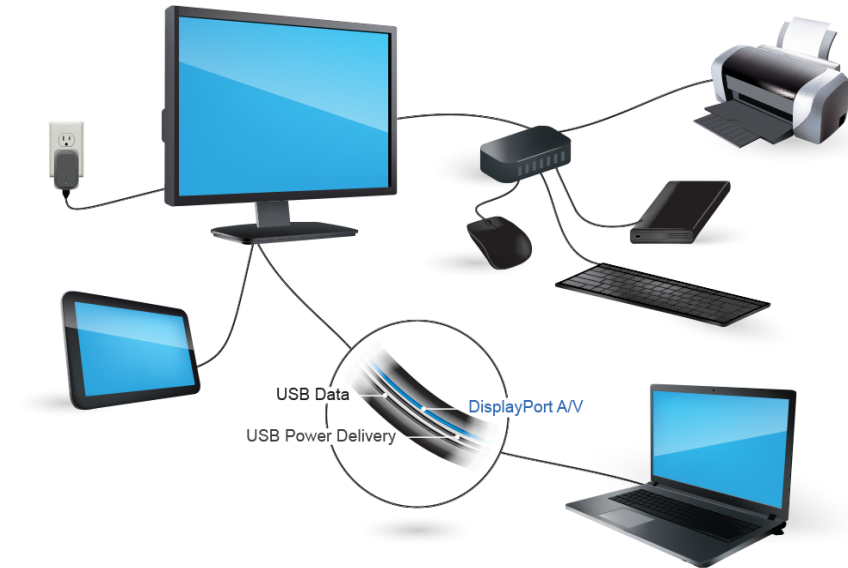
Use Case: 8K Digital TV

- TVs, STBs, and DVRs
- Multimedia SoC processor
- TCON (Timing Controller)
- Inside 8K TV
- Based on DSC 1.2a



Use Case: USB Type-C Laptop & Extended Display

- USB Type-C triple use
 - Peripheral
 - DisplayPort (Alt Mode)
 - Power delivery
- Shared bandwidth
 - Ex. Dual external monitors
 - USB Type-C DP 1.4 transport
 - Storage
 - Networking
- DSC usage saves bandwidth for other external devices (storage, networking)

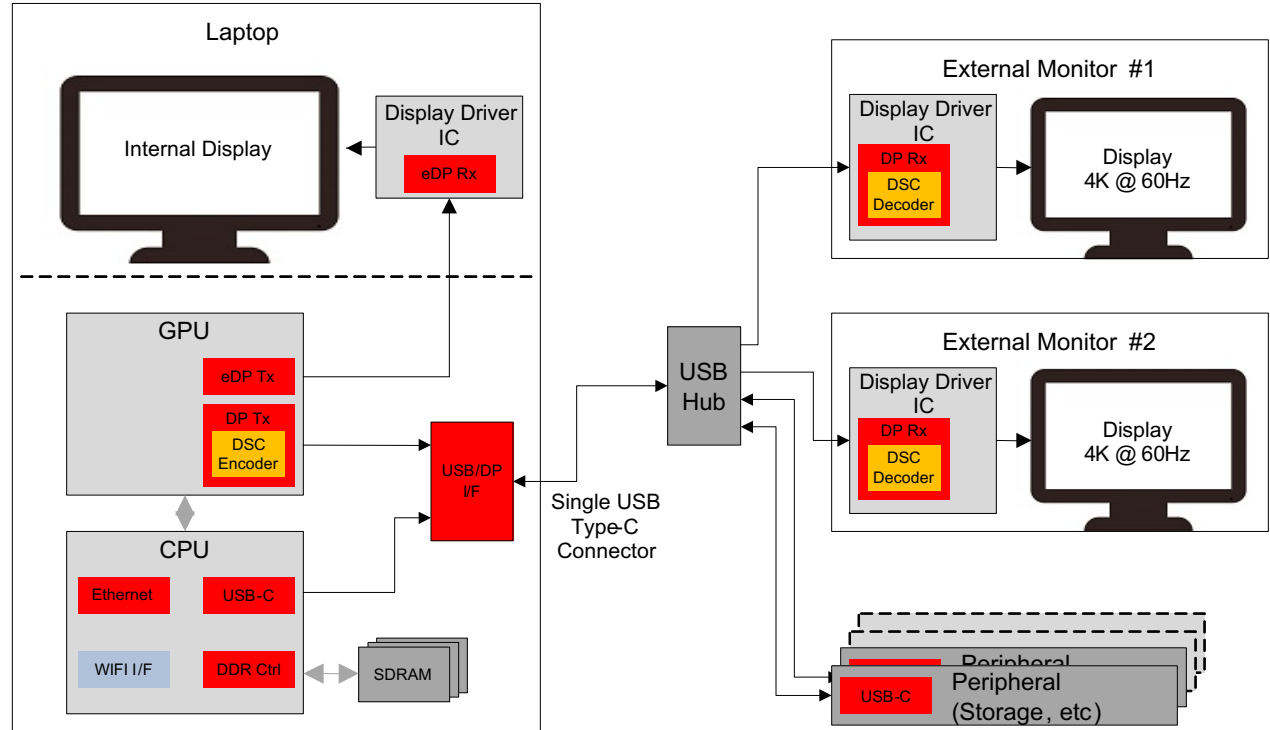


DisplayPort Alt-Mode for USB Type-C

Image Source: Cadence

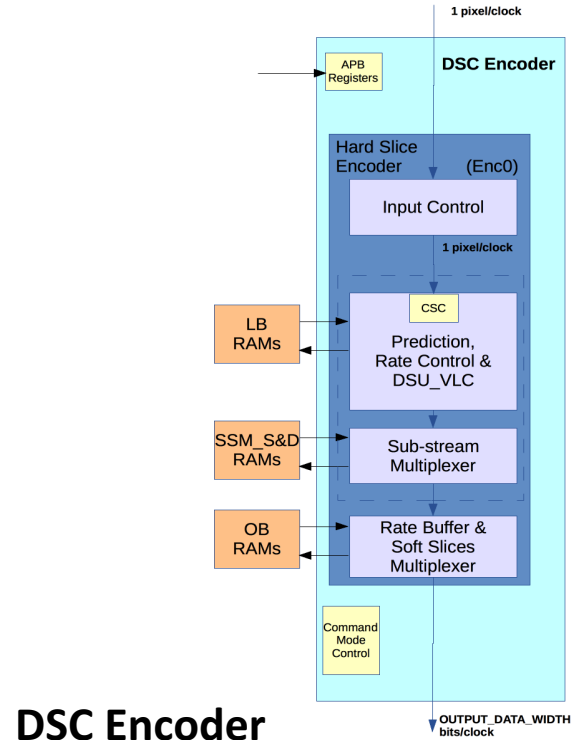
Use Case: USB Type-C Laptop & Extended Display

- Laptop with GPU
- Dual external monitors
- USB Type-C DisplayPort 1.4 transport

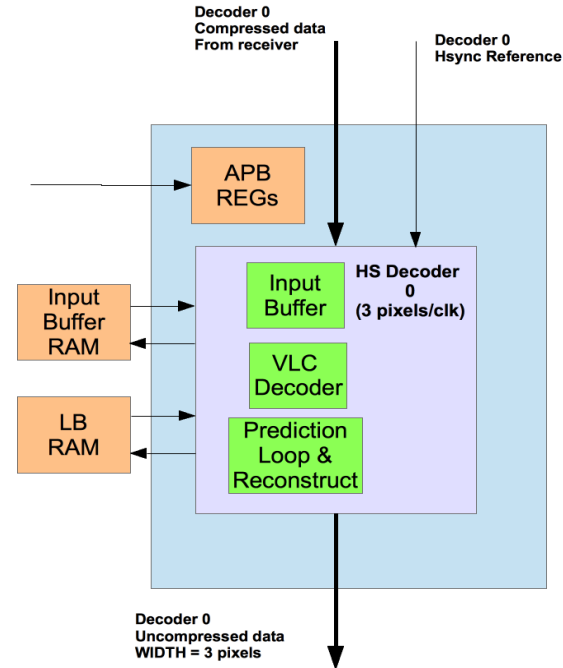


How to Integrate VESA DSC in Your Next Design

VESA DSC Encoder and Decoder IP



DSC Encoder

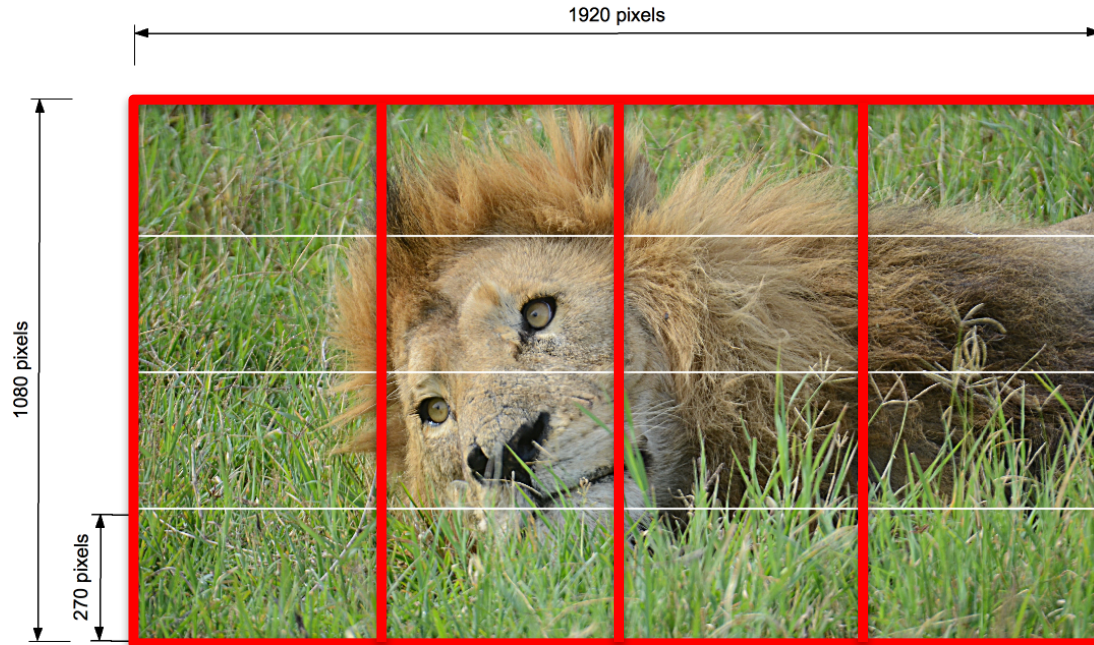


DSC Decoder

How Are Images Processed by VESA DSC?

DSC Image Slicing

1920x1080 image divided in 16 slices of 480x270 pixels

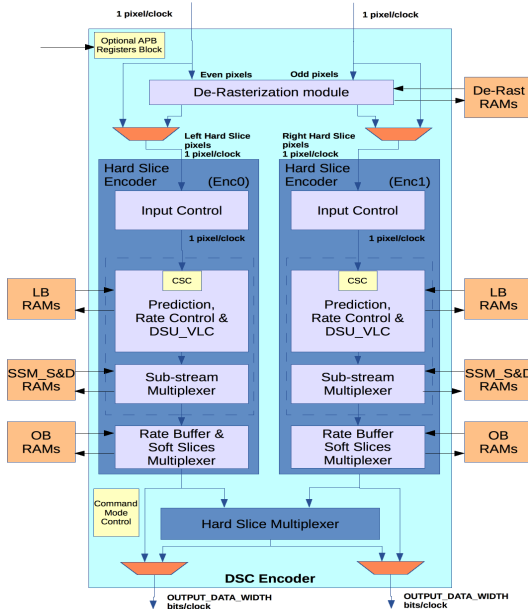


4 Vertical Slices

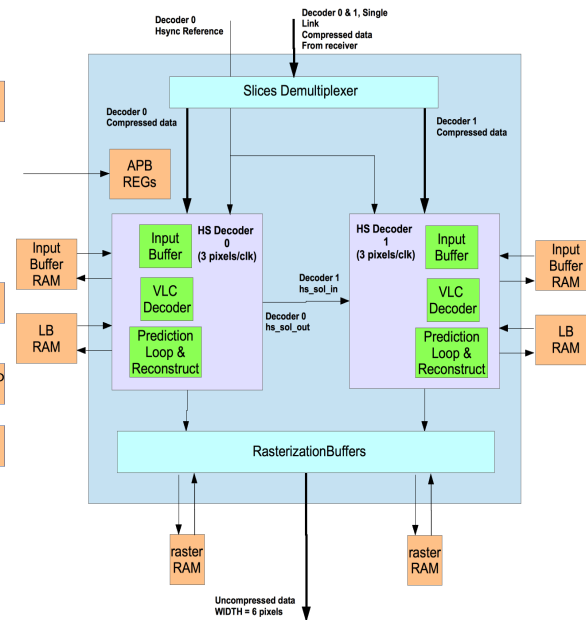
Use Case: Two Vertical Slices

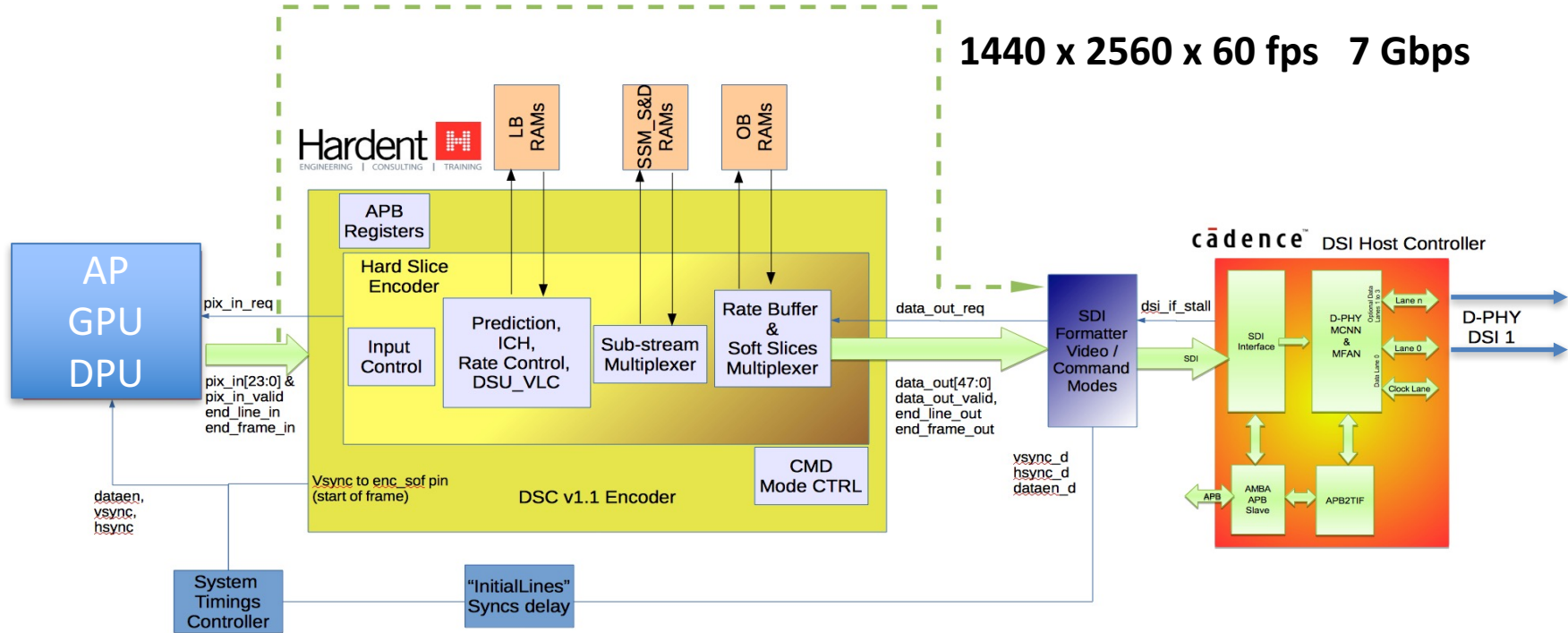
- Example: 4K video 60 fps
- ASIC with pixel clock at 350 MHz
- Each slice = 350 Mpixels / sec
- Two vertical slices are needed
- Number of slices need to match between DSC Encoder and Decoder

DSC Encoder

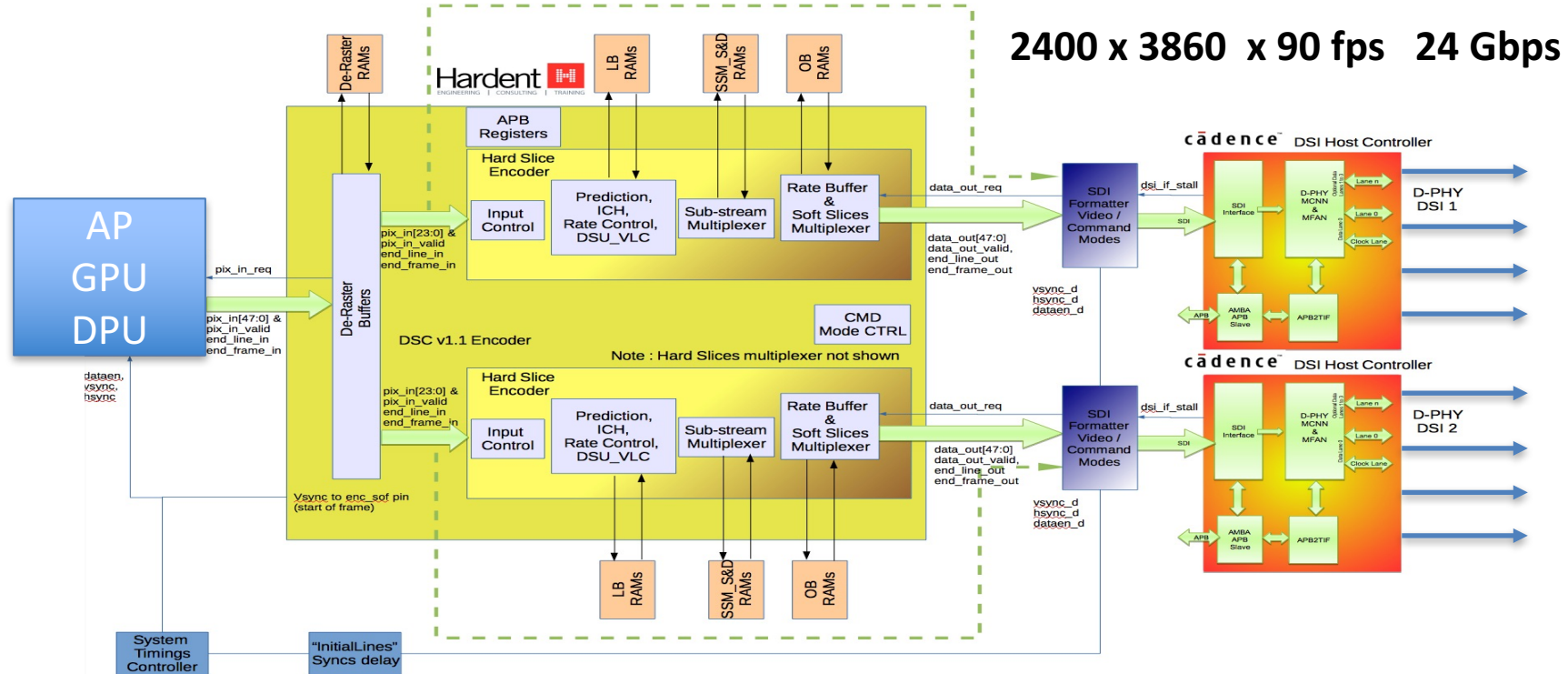


DSC Decoder

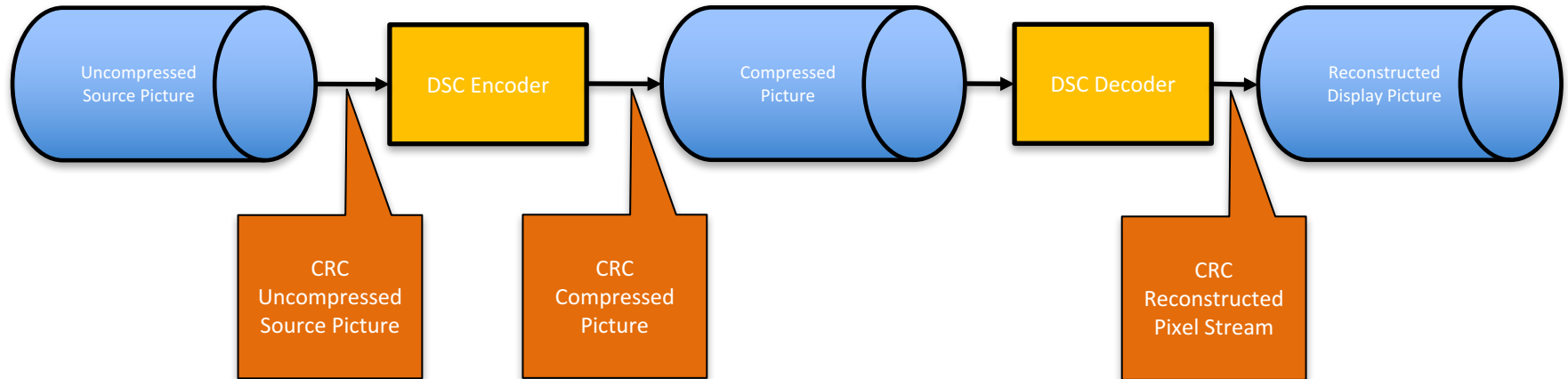




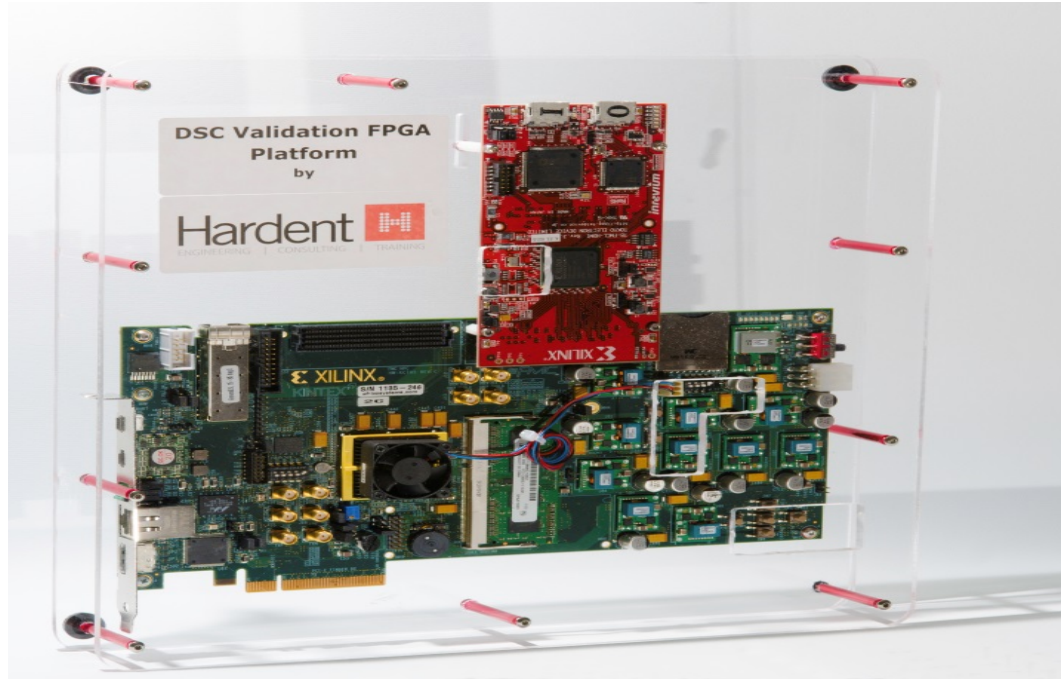
WQUXGA VR Mobile Application



Conformance Test Guideline (CTG)



FPGA Prototyping

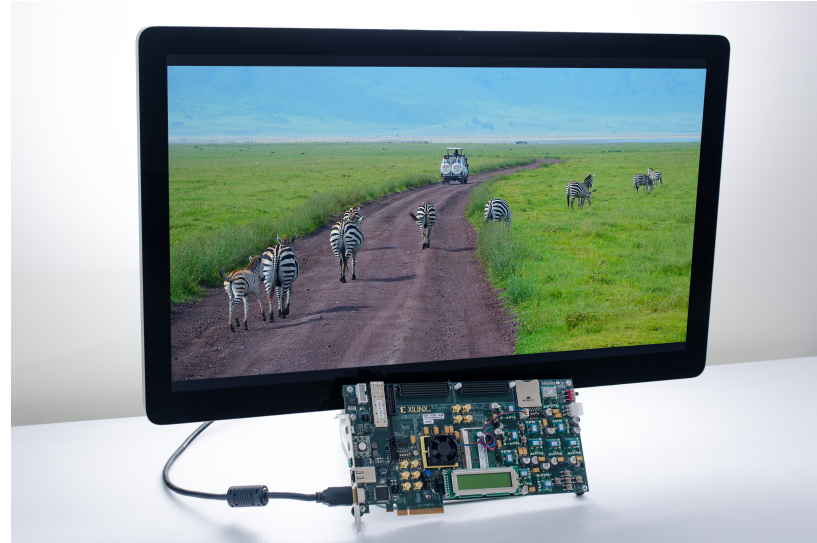


More Information

- VESA DSC white paper
 - www.vesa.org/wp-content/uploads/2014/04/VESA_DSC-ETP200.pdf
- VESA DSC standard overview
 - www.vesa.org/vesa-standards
- VESA membership
 - www.vesa.org/join-vesamemberships
- A Quick Guide To VESA DSC
 - www.hardent.com/vesa-display-stream-compression-guide

Live Demo of VESA DSC

- Visit Hardent in the exhibitor area to see a live 4K demo of VESA DSC!





THANK YOU

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