DisplayPort
Future Proofing Display Connectivity for VR and 8K HDR

Syed Athar Hussain
VESPA Vice Chair
AMD Display Domain Fellow
VESA REPRESENTS THE DISPLAY ECOSYSTEM

GLOBAL INDUSTRY ALLIANCE WITH MORE THAN 200 INDUSTRY-LEADING MEMBERS

VESA REPRESENTS THE DISPLAY ECOSYSTEM
VESAs has developed empowering display interface technologies enabling innovative display solutions across a range of platforms:

- DisplayPort Interface
  - 8.1 Gbps/lane link bandwidth
  - Scalable lane count 1, 2, 4 lanes
  - Multi-stream transport
- AdaptiveSync
- Display Stream Compression (DSC)
- Frame aligned dynamic meta transportation
- DisplayID
- Co-ordinated Video Timing (CVT)
Progression of Display Experiences with DisplayPort

**DP 1.0/1.1 (4/2007) – HBR1**
- A setup driven by 6 Mini-DP connectors at 2560x1600@60 Hz on a single graphics card

**DP 1.2 (12/2009) – HBR2**
- UHD – 4k
- 30 bit color; 3840x2160 @ 60 Hz
- Tiled Display – 4k x 2k MST single cable
- Tiled Display - 5k x 3k Dual Cable
- AdaptiveSync

**DP 1.3 (9/2014) – HBR3**
- HDR, PQ gamma, BT 2020
- HDCP 2.2, 420
- Tiled Display – 8k 444 Dual Cable
- 5kx3k@60 and 4k@120 Hz Single Cable
- A single connector connectivity with DP A/V, power and data via DP alt mode on USB-C

**DP 1.4 (3/2016) – HBR3 & DSC**
- UHD – 8k
- 30 bit color; 8k 444 (7680 x 4320) @ 60Hz – Single Cable
- VR – 4k+ @120Hz+, USB 3.1
- Multi Display Docking with USB-C
- Dynamic HDR Meta
What is DisplayPort? An Overview...

- High-speed **packet based** interface
  - Enables multiple independent streams on single cable, and allows DisplayPort streams to be tunneled over alternate transport layers such as Thunderbolt and Wigig Display Extension.

- Spread-spectrum clocking and pseudo random coding for RFI mitigation

- With DisplayPort, the following fixed rates can be selected

<table>
<thead>
<tr>
<th>Main Link Configuration</th>
<th>Raw Bit Rate (includes coding overhead) - Gbps</th>
<th>Application Bandwidth Throughput - Gbps</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 lane</td>
<td>1.62, 2.7, 5.4, <strong>8.1</strong></td>
<td>1.296, 2.16, 4.32, 6.48</td>
</tr>
<tr>
<td>2 lanes</td>
<td>3.24, 5.4, 10.8, 16.2</td>
<td>2.592, 4.32, 8.64, 12.96</td>
</tr>
<tr>
<td>4 lanes</td>
<td>6.48, 10.8, 21.6, <strong>32.4</strong></td>
<td>5.184, 8.64, 17.28, <strong>25.92</strong></td>
</tr>
</tbody>
</table>

- **Flexible pixel packing**; Stream rate is decoupled from link rate

- **Display Stream Compression** enables a low-overhead, low-latency visually lossless compression scheme that provide up to 3:1 compression

- **Flexible lane configuration** allows 1, 2, or 4 lanes to be enabled depending on A/V stream requirements
  - DP alternate mode in USB type C connector; 2 lanes are used for A/V data and remaining 2 lanes to steer USB 3.1 traffic
AdaptiveSync – enables low latency & power efficient transport of varying source content frame rate over DisplayPort interface

- Frame rate varies with content type
- AdaptiveSync provides a flexible frame work to transport variable frame rate
  - EDID & DisplayID provides sink refresh rate range capability
  - Source optimizes the frame transport for power efficient transport and lower latency frame update
  - Enables seamless video playback at different rates and power savings for static screen.
Lower latency gaming experience with AdaptiveSync

- Gaming surface render time varies with scene complexity
- With traditional fixed refresh rate display, new frame is delayed causing added latency and stutter or tearing
- With AdaptiveSync, frame period is seamlessly extended to accommodate longer rendering time.
  - Leading to lower latency frame update and smoother gameplay experience
Frame aligned Dynamic Meta Transportation

- Source content may seamlessly switch between SDR and HDR
- DisplayPort Video Stream Configuration Extension (VSC Ext) data packet provides a flexible chaining framework to transport 2k+ byte of dynamic meta aligned with the frame
- DisplayID would provide sink luminance and gamut capability for efficient tone mapping based on capability of source and sink
USB-C single cable connectivity with DisplayPort A/V, Power Delivery & DATA

- Clutter free single cable connectivity using USB Type-C with DisplayPort Alternate Mode
  - Provides backward compatibility with legacy interfaces via convertors (DP to VGA, DP to DVI/HDMI)
  - Power the PC, Tablet, Smart Phone or VR headset
  - Accommodate touch, ambient, proximity, head/eye tracking sensors with USB 3.1 data along with 2 lane of DisplayPort
  - Multi-display PC docking with DisplayPort Multi-Stream Transport
    - 2 lane at HBR3 can support 2 x 2560x1440@60Hz using CVT Reduced Blank 1
    - 2 lane at HBR3 with DSC can support 3 x 3840x2160@60Hz using CVT Reduced Blank 2
    - 2 lane at HBR3 with DSC can support 30bpp 3840x2160@120Hz+ for VR application with USB 3.1 data
8k x 4k 444 Plug & Play experience with DP 1.3 dual cable

- Automatically configures multiple stream or cable displays without manual user intervention
- DisplayID “Tiled Display Topology Data Block” describes additional display capabilities:
  - Identifies the display as a Tiled Display
  - Associates each individual stream with a particular tile
  - Describes the tiled topology
  - Describes location of each individual tile within the topology
8k x 4k 444 Scalable resolution support with Tiled Display configuration

- Coordinated Video Timing optimizes the blank timing overhead by reducing the blank
- Display Stream Compression enables single cable 8k x 4k connectivity

<table>
<thead>
<tr>
<th>TIMING</th>
<th>TILED</th>
<th>INTERFACE</th>
<th>TIMING DEFINITION</th>
<th>PIXEL RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>3840 x 2160 60 Hz IT,</td>
<td>No</td>
<td>DP 1.2a</td>
<td>VESA CVT RB 1 CEA</td>
<td>533.250 MHz</td>
</tr>
<tr>
<td>3840 x 2160 60 Hz TV</td>
<td></td>
<td></td>
<td></td>
<td>594.000 MHz</td>
</tr>
<tr>
<td>5120 x 2880 30 Hz IT</td>
<td>No</td>
<td>DP 1.2a</td>
<td>VESA CVT RB1</td>
<td>462.500 MHz</td>
</tr>
<tr>
<td>5k x 3k - Half frame 2560 x 2880 60 Hz IT</td>
<td>Yes (2x1)</td>
<td>2 x DP 1.2a</td>
<td>VESA CVT RB1</td>
<td>483.250 MHz</td>
</tr>
<tr>
<td>8k x 4k - Half frame 3840 x 4320 30 Hz IT</td>
<td>Yes (2x1)</td>
<td>2 x DP 1.2a</td>
<td>VESA CVT RB 2</td>
<td>515.205 MHz</td>
</tr>
<tr>
<td>5120 x 2880 60 Hz IT</td>
<td>No</td>
<td>DP 1.3</td>
<td>VESA CVT RB 2</td>
<td>924.144 MHz</td>
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<tr>
<td>7680 x 4320 30 Hz IT</td>
<td>No</td>
<td>DP 1.3</td>
<td>VESA CVT RB 2</td>
<td>1019.896 MHz</td>
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<tr>
<td>8k x 4k - Half frame 3840 x 4320 60 Hz IT</td>
<td>Yes (2x1)</td>
<td>2 x DP 1.3</td>
<td>VESA CVT RB 2</td>
<td>1044.993 MHz</td>
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<tr>
<td>7680 x 4320 60 Hz IT</td>
<td>No</td>
<td>DP 1.4 (DSC)</td>
<td>VESA CVT RB 2 CEA</td>
<td>2068.660 MHz</td>
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<tr>
<td>7680 x 4320 60 Hz CEA</td>
<td></td>
<td></td>
<td></td>
<td>2376.000 MHz</td>
</tr>
</tbody>
</table>
Summary of DisplayPort Advantages:

- DisplayPort offers a high performance interface with a flexible architecture
- DisplayPort includes key technologies to enable high resolution, 8k HDR displays and high frame rate VR displays

Key DisplayPort Technologies:

- Display Stream Compression (DSC) Technology for bandwidth constrained links
  - 8kx4k@60 deep color over a single cable
  - 4kx2k@120Hz deep color + USB 3.1 data using USB Type C with DisplayPort alternate mode
- Tiled Display operation for high resolution + high refresh rate display solutions
- AdaptiveSync for optimum utilization of content frame rendering
- Scalable HDR support using DisplayID and Frame-aligned dynamic Meta Transportation