DisplayPort

Future Proofing Display Connectivity for VR and 8K HDR

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VESA REPRESENTS THE DISPLAY ECOSYSTEM

VESA 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)
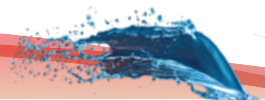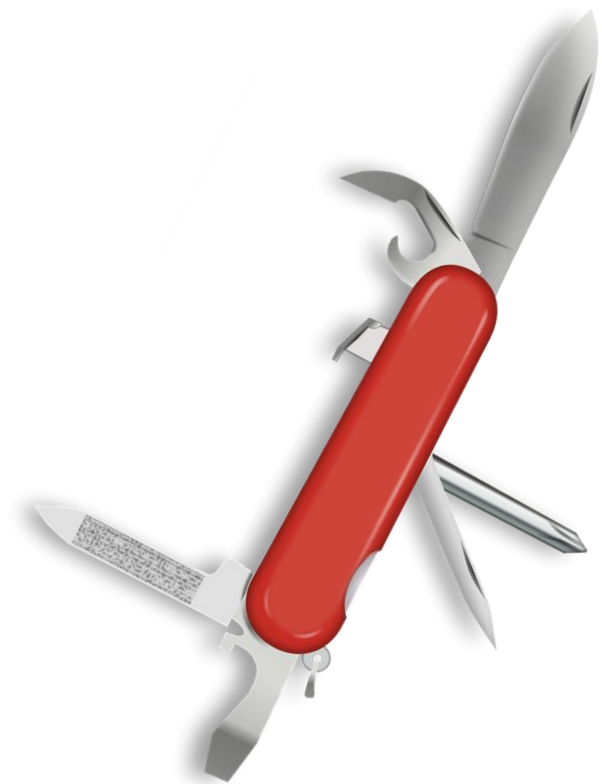
Progression of Display Experiences with DisplayPort

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
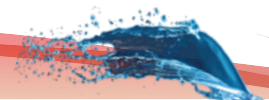
What is DisplayPort ? An Overview…
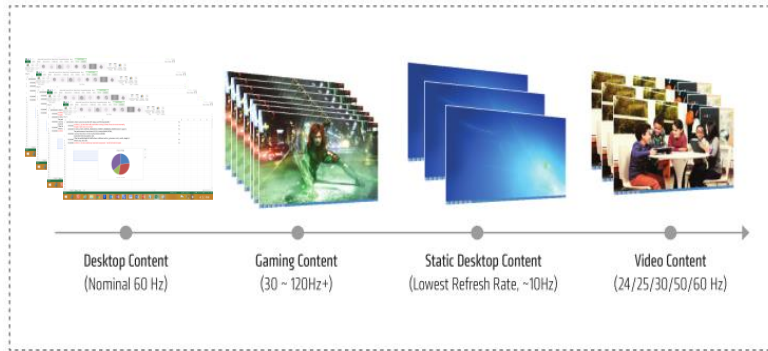
DisplayPort

- ❏ 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
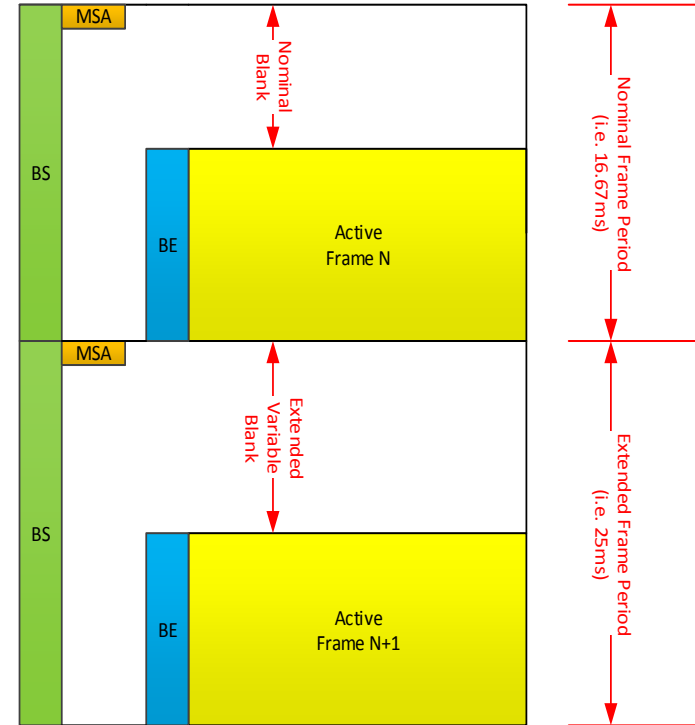- ❏ With DisplayPort, the following fixed rates can be selected

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

- ❏ **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
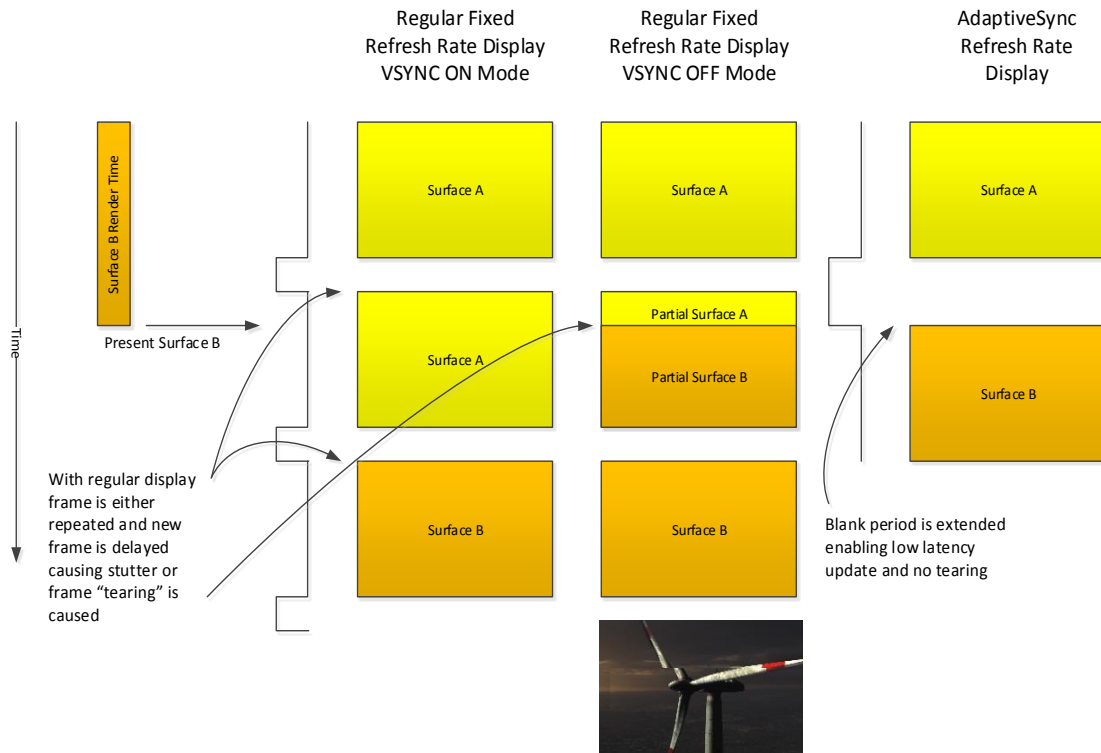

Desktop Content (Nominal 60 Hz) — Gaming Content (30 ~ 120Hz+) — Static Desktop Content (Lowest Refresh Rate, ~10Hz) — Video Content (24/25/30/50/60 Hz)

❑ 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.

MSA
BS
BE
Active Frame N
Nominal Blank
Nominal Frame Period (i.e. 16.67ms)

MSA
BS
BE
Active Frame N+1
Extended Variable Blank
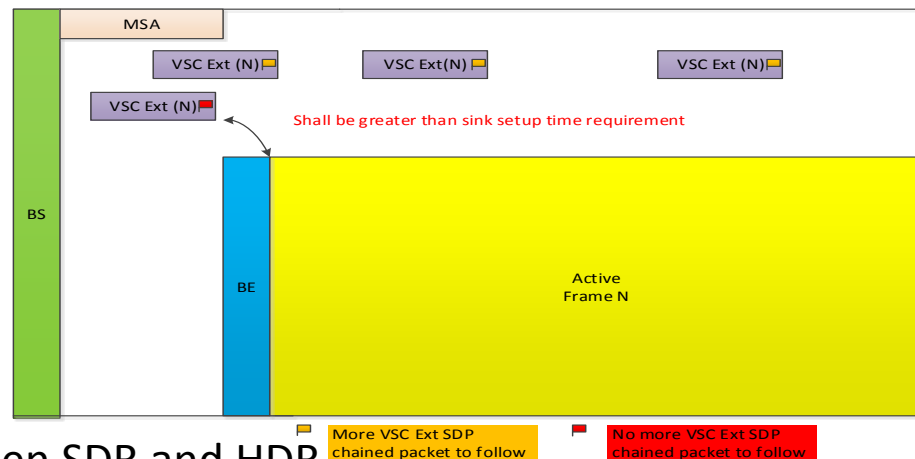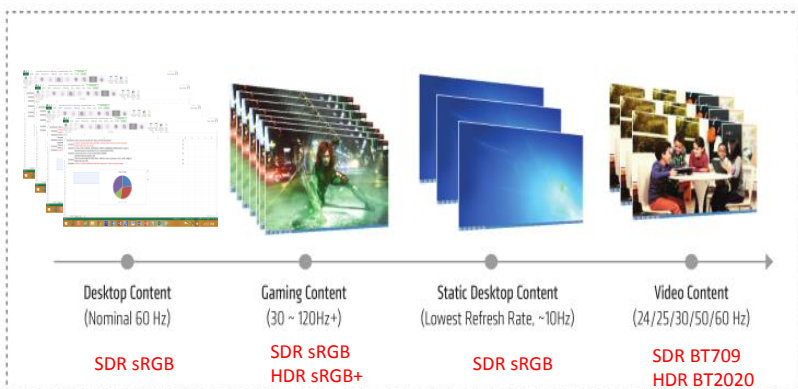Extended Frame Period (i.e. 25ms)

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 game play experience

Surface B Render Time

Time

Present Surface B

With regular display frame is either repeated and new frame is delayed causing stutter or frame "tearing" is caused

Regular Fixed
Refresh Rate Display
VSYNC ON Mode

Surface A

Surface A

Surface B

Regular Fixed
Refresh Rate Display
VSYNC OFF Mode

Surface A

Partial Surface A

Partial Surface B

Surface B

AdaptiveSync
Refresh Rate
Display

Surface A

Surface B

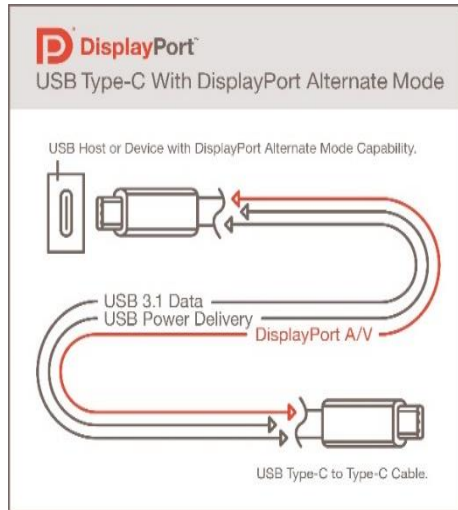Blank period is extended enabling low latency update and no tearing

Frame aligned Dynamic Meta Transportation

- ❑ Source content may seamless 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

DisplayPort™
USB Type-C With DisplayPort Alternate Mode

USB Host or Device with DisplayPort Alternate Mode Capability.

USB 3.1 Data
USB Power Delivery

DisplayPort A/V

USB Type-C to Type-C Cable.

❑ 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

DisplayPort 1   **DisplayPort 2**
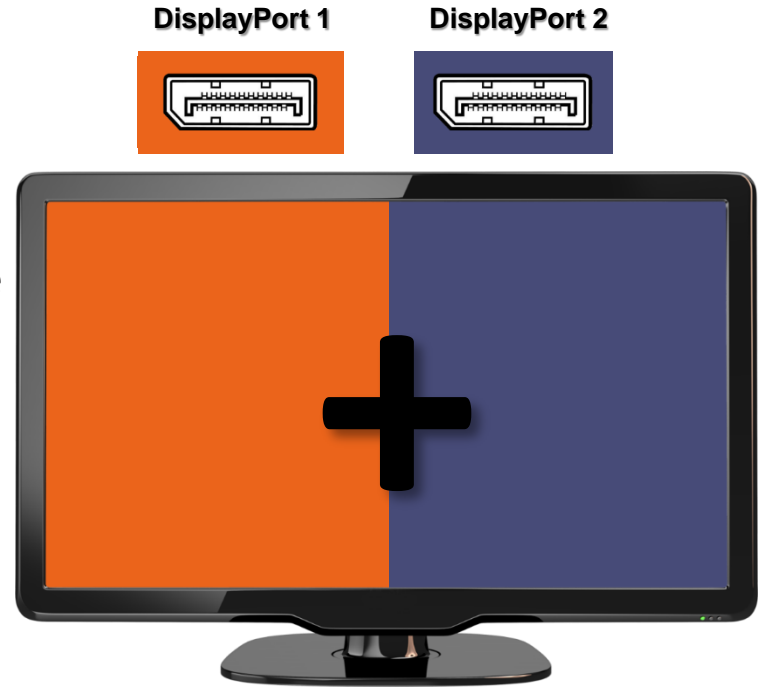
8k x 4k 444 Scalable resolution support with Tiled Display configuration

❑ Coordinated Video Timing optimizes the blank timing overhead by reducing the blank

❑ Display Stream Compression enables single cable 8k x 4k connectivity

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

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