[Template:Use dmy dates](/wiki/Template:Use_dmy_dates" \o "Template:Use dmy dates) [Template:Lead too short](/wiki/Template:Lead_too_short) [Template:Infobox connector](/wiki/Template:Infobox_connector)

**DisplayPort** is a digital display interface developed by the [Video Electronics Standards Association](/wiki/VESA) (VESA). The interface is primarily used to connect a video source to a [display device](/wiki/Display_device) such as a [computer monitor](/wiki/Computer_monitor), though it can also be used to carry [audio](/wiki/Audio_signal), [USB](/wiki/USB), and other forms of data.[[1]](#cite_note-1) VESA designed it to replace [VGA](/wiki/VGA_connector), [DVI](/wiki/Digital_Visual_Interface), and [FPD-Link](/wiki/FPD-Link). DisplayPort is backwards compatible with VGA, DVI and [HDMI](/wiki/HDMI) through the use of passive and active adapters.

## Contents

* 1 Overview[[edit](/index.php?title=(none)&action=edit&section=1)]
* 2 Versions[[edit](/index.php?title=(none)&action=edit&section=2)]
  + 2.1 1.0 to 1.1[[edit](/index.php?title=(none)&action=edit&section=3)]
  + 2.2 1.2[[edit](/index.php?title=(none)&action=edit&section=4)]
  + 2.3 1.3[[edit](/index.php?title=(none)&action=edit&section=5)]
  + 2.4 1.4[[edit](/index.php?title=(none)&action=edit&section=6)]
* 3 Specifications[[edit](/index.php?title=(none)&action=edit&section=7)]
  + 3.1 Technical specifications[[edit](/index.php?title=(none)&action=edit&section=8)]
  + 3.2 Resolution and frame rate for displayport revision[[edit](/index.php?title=(none)&action=edit&section=9)]
  + 3.3 Digital Rights Management (DRM)[[edit](/index.php?title=(none)&action=edit&section=10)]
  + 3.4 Dual-mode[[edit](/index.php?title=(none)&action=edit&section=11)]
  + 3.5 {{Anchor|Multi-Stream Transport|MST}}Multiple displays on single DisplayPort connector[[edit](/index.php?title=(none)&action=edit&section=12)]
  + 3.6 Cost[[edit](/index.php?title=(none)&action=edit&section=13)]
* 4 {{Anchor|Advantages over legacy standards}}Advantages over DVI, VGA and FPD-Link[[edit](/index.php?title=(none)&action=edit&section=14)]

## Overview[[edit](/index.php?title=(none)&action=edit&section=1)]

DisplayPort is the first display interface to rely on packetized [data transmission](/wiki/Data_transmission), a form of digital communication found in technologies including [Ethernet](/wiki/Ethernet), USB, and [PCI Express](/wiki/PCI_Express). It allows both internal and external display connections and, unlike legacy standards where differential pairs are fixed to transmitting a clock signal with each output, the DisplayPort protocol is based on small [data packets](/wiki/Data_packet) known as *micro packets*, which can embed the clock signal within the data stream, allowing higher resolutions with fewer pins.[[2]](#cite_note-2) The use of data packets also allows DisplayPort to be extensible, meaning additional features can be added over time without significant changes to the physical interface itself.[[3]](#cite_note-3) DisplayPort can be used to transmit audio and video simultaneously, but each one is optional and can be transmitted without the other. The video signal path can have six to sixteen bits per [color channel](/wiki/Channel_(digital_image)), and the audio path can have up to eight channels of 24-bit 192[Template:NbspkHz](/wiki/Template:Nbsp) uncompressed [PCM](/wiki/Pulse-code_modulation) audio or can encapsulate compressed audio formats in the audio stream.[[1]](#cite_note-1) A bi-directional, half-duplex auxiliary channel carries device management and device control data for the Main Link, such as VESA [EDID](/wiki/Extended_display_identification_data), [MCCS](/wiki/Monitor_Control_Command_Set), and [DPMS](/wiki/VESA_Display_Power_Management_Signaling) standards. In addition, the interface is capable of carrying bi-directional USB signals.[[4]](#cite_note-4) The DisplayPort [LVDS](/wiki/LVDS) signal protocol is not compatible with DVI or HDMI. However, [Dual-mode DisplayPorts](/wiki/#Dual-mode_DisplayPort) are designed to transmit a [single-link](/wiki/Digital_Visual_Interface#Single-link_DVI) DVI or HDMI 1.2/1.4 [TMDS](/wiki/TMDS) protocol across the interface through the use of an external *passive* adapter that selects the desired signal and converts it from 3.3 volts to 5 volts. Analog [VGA](/wiki/VGA) and [dual-link DVI](/wiki/Dual-link_DVI) require powered *active* adapters to convert the protocol and signal levels and do not rely on Dual-Mode. VGA adapters are powered by the DisplayPort connector, while dual-link DVI adapters may rely on an external power source (see [Dual-mode](/wiki/#Dual-mode)).[[5]](#cite_note-5) The DisplayPort connector can have one, two, or four differential data pairs (lanes) in a Main Link, each with a raw bit rate of 1.62, 2.7, 5.4, or 8.1[Template:NbspGbit](/wiki/Template:Nbsp)/s per lane with self-clock running at 162, 270, 540, or 810[Template:NbspMHz](/wiki/Template:Nbsp). The effective data rates after decoding are 1.296, 2.16, 4.32, or 6.48[Template:NbspGbit](/wiki/Template:Nbsp)/s per lane (or 80% of the total), since data is [8b/10b encoded](/wiki/8b/10b_encoding) so each eight bits of information are encoded with a ten-bit symbol.

## Versions[[edit](/index.php?title=(none)&action=edit&section=2)]

### 1.0 to 1.1[[edit](/index.php?title=(none)&action=edit&section=3)]

The first version, 1.0, was approved by VESA on 3 May 2006.[[6]](#cite_note-6) Version 1.1a was ratified on 2 April 2007.[[7]](#cite_note-7) DisplayPort 1.0 allows a maximum of 8.64[Template:NbspGbit](/wiki/Template:Nbsp)/s data rate over a 2-meter cable.[[8]](#cite_note-8) DisplayPort 1.1 also allows devices to implement alternative link layers such as [fiber optic](/wiki/Optical_fiber), allowing a much longer reach between source and display without signal degradation,[[9]](#cite_note-9) although alternative implementations are not standardized. It also includes [HDCP](/wiki/HDCP) in addition to DisplayPort Content Protection (DPCP). The DisplayPort 1.1a specification can be downloaded for free from the VESA website.[[10]](#cite_note-10)

### 1.2[[edit](/index.php?title=(none)&action=edit&section=4)]

DisplayPort version 1.2 was approved on 22 December 2009. The most significant improvement of the new version is the doubling of the effective bandwidth to 17.28[Template:NbspGbit](/wiki/Template:Nbsp)/s in High Bit Rate 2 (HBR2) mode, which allows increased resolutions, higher refresh rates, and greater color depth. Other improvements include multiple independent video streams (daisy-chain connection with multiple monitors) called Multi-Stream Transport, facilities for [stereoscopic 3D](/wiki/Stereoscopy), increased AUX channel bandwidth (from 1[Template:NbspMbit](/wiki/Template:Nbsp)/s to 720[Template:NbspMbit](/wiki/Template:Nbsp)/s), more color spaces including [xvYCC](/wiki/XvYCC), [scRGB](/wiki/ScRGB) and [Adobe RGB 1998](/wiki/Adobe_RGB_1998), and Global Time Code (GTC) for sub 1[Template:Nbsp](/wiki/Template:Nbsp)µs audio/video synchronisation. Also [Apple Inc.'s](/wiki/Apple_Inc.) [Mini DisplayPort](/wiki/Mini_DisplayPort) connector, which is much smaller and designed for [laptop computers](/wiki/Laptop_computer) and other small devices, is compatible with the new standard.[[1]](#cite_note-1)[[11]](#cite_note-11)[[12]](#cite_note-12)[[13]](#cite_note-13) DisplayPort version 1.2a may optionally include VESA's *Adaptive Sync*.[[14]](#cite_note-14) [AMD's](/wiki/Advanced_Micro_Devices) [*FreeSync*](/wiki/FreeSync) utilizes the DisplayPort Adaptive-Sync feature for operation. FreeSync was first demonstrated at CES 2014 on a Toshiba Satellite laptop by making use of the Panel-Self-Refresh (PSR) feature from the Embedded DisplayPort standard,[[15]](#cite_note-15) and after a proposal from AMD, VESA later adapted the Panel-Self-Refresh feature for use in standalone displays and added it as an optional feature of the main DisplayPort standard under the name "Adaptive-Sync" in version 1.2a.[[16]](#cite_note-16) As it is an optional feature, support for Adaptive-Sync is not required for a display to be DisplayPort 1.2a-compliant.

### 1.3[[edit](/index.php?title=(none)&action=edit&section=5)]

DisplayPort version 1.3 was approved on 15 September 2014.[[17]](#cite_note-17) This standard increases overall transmission bandwidth to 32.4[Template:NbspGbit](/wiki/Template:Nbsp)/s with the new HBR3 mode featuring 8.1[Template:NbspGbit](/wiki/Template:Nbsp)/s per lane (up from 5.4[Template:NbspGbit](/wiki/Template:Nbsp)/s with HBR2 in version 1.2), for a total data throughput of 25.92[Template:NbspGbit](/wiki/Template:Nbsp)/s after factoring in 8b/10b encoding overhead. This bandwidth is enough for a [4K UHD](/wiki/Ultra-high-definition_television) display (3840×2160) at 120 Hz, a 5K display (5120×2880) at 60 Hz, or an [8K UHD](/wiki/Ultra-high-definition_television) display (7680×4320) at 30 Hz, with 24-bit RGB color. Using Multi-Stream Transport (MST), it can support two 4K UHD (3840×2160) displays at 60[Template:NbspHz](/wiki/Template:Nbsp), or up to four WQXGA (2560×1600) displays at 60 Hz in 24-bit RGB mode. The new standard includes mandatory [Dual-mode](/wiki/#Dual-mode) support for DVI and HDMI adapters, with support for the [HDMI](/wiki/HDMI) 2.0 standard and [HDCP](/wiki/HDCP) 2.2 content protection.[[18]](#cite_note-18) The [Thunderbolt 3](/wiki/Thunderbolt_3) connection standard was originally to include support for DisplayPort 1.3, but the final release ended up only including support for version 1.2.

### 1.4[[edit](/index.php?title=(none)&action=edit&section=6)]

DisplayPort version 1.4 was published March 1, 2016.[[19]](#cite_note-19) No new transmission modes are defined, so HBR3 (32.4[Template:NbspGbit](/wiki/Template:Nbsp)/s) as introduced in version 1.3 still remains as the highest available mode. DisplayPort 1.4 adds support for Display Stream Compression 1.2 (DSC), [Forward Error Correction](/wiki/Forward_Error_Correction), HDR extension defined in CTA-861.3, the [Rec. 2020](/wiki/Rec._2020) color space, and extends the maximum number of inline audio channels to 32.[[20]](#cite_note-20) DSC is a "visually lossless" encoding technique with up to 3:1 compression ratio.[[19]](#cite_note-19) Using DSC with HBR3 transmission rates, DisplayPort 1.4 can support 8K UHD (7680×4320) at 60 Hz with 10-bit color and HDR, or 4K UHD (3840×2160) at 120 Hz with 10-bit color and HDR. 4K at 60 Hz with 10-bit color and HDR can be achieved without the need for DSC. On displays which do not support DSC, the maximum limits are unchanged from DisplayPort 1.3 (4K 120 Hz, 5K 60 Hz, 8K 30 Hz).[[21]](#cite_note-21)

## Specifications[[edit](/index.php?title=(none)&action=edit&section=7)]

### Technical specifications[[edit](/index.php?title=(none)&action=edit&section=8)]

* Forward link channel with 1 to 4 lanes; effective data rate 1.296 (reduced bit rate), 2.16 (high bit rate), 4.32 (HBR2), or 6.48[Template:NbspGbit](/wiki/Template:Nbsp)/s (HBR3) per lane (total 5.184, 8.64, 17.28, or 25.92[Template:NbspGbit](/wiki/Template:Nbsp)/s for a 4-lane link)†.
* [8b/10b](/wiki/8b/10b_encoding) encoding provides DC-balancing and Embedded Clock within serial channel (10 bit symbols, 20% coding overhead)
* [RGB](/wiki/RGB_color_space) (unspecified) and [YCbCr](/wiki/YCbCr) ([ITU-R](/wiki/ITU-R) [BT.601-5](/wiki/Rec._601) and [BT.709-4](/wiki/Rec._709)) [color spaces](/wiki/Color_space), 4:4:4, 4:2:2, or 4:2:0 [chroma subsampling](/wiki/Chroma_subsampling)
  + sRGB, Adobe RGB 1998, [DCI-P3](/wiki/DCI-P3), RGB XR, scRGB, xvYCC, Y-only, Simple Color Profile (version 1.2)<ref name=DevCon2010/>
* [Color depth](/wiki/Color_depth) of 6, 8, 10, 12 and 16 bits per color component
* Optional 8-channel audio with sampling rates up to 24[Template:Nbspbit](/wiki/Template:Nbsp) 192[Template:NbspkHz](/wiki/Template:Nbsp), encapsulation of audio compression formats
* Bidirectional half-duplex AUX channel, 1[Template:NbspMbit](/wiki/Template:Nbsp)/s (v1.0) or optional 720[Template:NbspMbit](/wiki/Template:Nbsp)/s (v1.2)
* [Stereoscopic 3D](/wiki/Stereoscopy) formats: frame sequential (v1.1a), field sequential, side-by-side, top-bottom, line interleaved, pixel interleaved and dual interface (v1.2)<ref name=DevCon2010/>
* Optional [dual-mode](/wiki/#Dual-mode) facility generates [TMDS](/wiki/Transition_Minimized_Differential_Signaling) and clock for single-link DVI/HDMI signaling using a simple passive dongle for signal level conversion.
* Up to 63 video and audio streams with time-division transport multiplexing and hot-plug bandwidth allocation (from version 1.2)
* 128-bit [AES](/wiki/Advanced_Encryption_Standard) [DisplayPort Content Protection](/wiki/#DRM_protection) (DPCP), 56-bit [High-bandwidth Digital Content Protection](/wiki/High-bandwidth_Digital_Content_Protection) (HDCP) 1.3 from version 1.1 onwards, HDCP 2.2 (128-bit AES) from version 1.3.
* Internal and external connections so that one standard can be used by computer makers reducing costs.[[22]](#cite_note-22)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Sample data rates required by various [display resolutions](/wiki/Display_resolution) using common timing methods in Gbit/s | | | | | | |
| **Resolution** | **Color depth** | **Frame rate** | [**CVT**](/wiki/Coordinated_Video_Timings) | [**CVT-R**](/wiki/Coordinated_Video_Timings#Reduced_blanking) | [**CVT-R2**](/wiki/Coordinated_Video_Timings#Reduced_blanking) | [**CEA-861-F**](/wiki/CEA-861) |
| 1280 × 720 | 24[Template:Nbsp](/wiki/Template:Nbsp)[bpp](/wiki/Color_depth) | 60[Template:NbspHz](/wiki/Template:Nbsp) | 1.79 | 1.54 | 1.45 | 1.78 |
| 1920 × 1080 | 24[Template:Nbspbpp](/wiki/Template:Nbsp) | 60[Template:NbspHz](/wiki/Template:Nbsp) | 4.15 | 3.33 | 3.20 | 3.56 |
| 1920 × 1200 | 30[Template:Nbspbpp](/wiki/Template:Nbsp) | 60[Template:NbspHz](/wiki/Template:Nbsp) | 5.81 | 4.62 | 4.45 |  |
| 2560 × 1440 | 24[Template:Nbspbpp](/wiki/Template:Nbsp) | 60[Template:NbspHz](/wiki/Template:Nbsp) |  | 5.80 | 5.63 |  |
| 2560 × 1600 | 30[Template:Nbspbpp](/wiki/Template:Nbsp) | 60[Template:NbspHz](/wiki/Template:Nbsp) |  | 8.06 | 7.82 |  |
| 3840 × 2160 | 24[Template:Nbspbpp](/wiki/Template:Nbsp) | 30[Template:NbspHz](/wiki/Template:Nbsp) |  |  | 6.18 | 7.13 |
| 3840 × 2160 | 24[Template:Nbspbpp](/wiki/Template:Nbsp) | 60[Template:NbspHz](/wiki/Template:Nbsp) |  |  | 12.54 | 14.26 |
| 4096 × 2304 | 30[Template:Nbspbpp](/wiki/Template:Nbsp) | 60[Template:NbspHz](/wiki/Template:Nbsp) |  |  | 17.81 |  |
| 5120 × 2880 | 24[Template:Nbspbpp](/wiki/Template:Nbsp) | 60[Template:NbspHz](/wiki/Template:Nbsp) |  |  | 22.18 |  |
| 7680 × 4320 | 24[Template:Nbspbpp](/wiki/Template:Nbsp) | 30[Template:NbspHz](/wiki/Template:Nbsp) |  |  | 24.82 | 28.51 |
| 7680 × 4320 | 24[Template:Nbspbpp](/wiki/Template:Nbsp) | 60[Template:NbspHz](/wiki/Template:Nbsp) |  |  | 49.65 | 57.02 |
| [Template:Plain list](/wiki/Template:Plain_list)  For 30, 36, 48 bpp (10, 12, 16 bpc), multiply 24 bit data rate by 1.25, 1.5, 2; divide by 1.5 or 2 for YCbCr 4:2:2 or YCbCr 4:2:0 encodings. | | | | | | |

### Resolution and frame rate for displayport revision[[edit](/index.php?title=(none)&action=edit&section=9)]

{| [Template:Table](/wiki/Template:Table) | colspan=4 align="center" style="background:#f0f0f0;" |**Displayport revisions** | align="center" style="background:#f0f0f0;"|**1.0 & 1.1** | align="center" style="background:#f0f0f0;"|**1.2** | align="center" style="background:#f0f0f0;"|**1.3** | align="center" style="background:#f0f0f0;"|**1.4** |- !Standard!!Resolution!!Frame rate!!Bandwidth||8.64||17.28||32.4||32.4 |- | 720p||1280 x 720||30 Hz||0.83||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes |- | 720p||1280 x 720||60 Hz||1.66||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes |- | 1080p||1920 x 1080||30 Hz||1.87||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes |- | 1080p||1920 x 1080||60 Hz||3.73||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes |- | 1080p||1920 x 1080||120 Hz||7.46||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes |- | 1080p||1920 x 1080||144 Hz||8.96||style="background:red; color: white"| No||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes |- | 1080p||1920 x 1080||165 Hz||10.26||style="background:red; color: white"| No||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes |- | 1080p||1920 x 1080||180 Hz||11.20||style="background:red; color: white"| No||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes |- | 1080p||1920 x 1080||200 Hz||12.44||style="background:red; color: white"| No||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes |- | 1080p||1920 x 1080||240 Hz||14.93||style="background:red; color: white"| No||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes |- | 1440p||2560 x 1440||30 Hz||3.32||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes |- | 1440p||2560 x 1440||60 Hz||6.64||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes |- | 1440p||2560 x 1440||120 Hz||13.27||style="background:red; color: white"| No||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes |- | 1440p||2560 x 1440||144 Hz||15.93||style="background:red; color: white"| No||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes |- | 1440p||2560 x 1440||165 Hz||18.25||style="background:red; color: white"| No||style="background:red; color: white"| No||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes |- | 4K||3840 x 2160||30 Hz||7.46||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes |- | 4K||3840 x 2160||60 Hz||14.93||style="background:red; color: white"| No||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes |- | 4K||3840 x 2160||120 Hz||29.86||style="background:red; color: white"| No||style="background:red; color: white"| No||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes |- | 4K||3840 x 2160||144 Hz||35.83||style="background:red; color: white"| No||style="background:red; color: white"| No||style="background:red; color: white"| No||style="background:yellow;|Yes¹ |- | 5K||5120 × 2880||30 Hz||13.27||style="background:red; color: white"| No||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes |- | 5K||5120 × 2880||60 Hz||26.54||style="background:red; color: white"| No||style="background:red; color: white"| No||style="background:green; color: white"| Yes||style="background:green; color: white"| Yes |- | 5K||5120 × 2880||120 Hz||53.08||style="background:red; color: white"| No||style="background:red; color: white"| No||style="background:red; color: white"| No||style="background:yellow; |Yes¹ |- | 8K||7680 x 4320||30 Hz||29.86||style="background:red; color: white"| No||style="background:red; color: white"| No||style="background:green; color: white"| Yes||style="background:green; color: white"|Yes |- | 8K||7680 x 4320||60 Hz||59.72||style="background:red; color: white"| No||style="background:red; color: white"| No||style="background:red; color: white"| No||style="background:yellow;|Yes¹ |- | colspan=8 | [Template:Plain list](/wiki/Template:Plain_list) |}

### Digital Rights Management (DRM)[[edit](/index.php?title=(none)&action=edit&section=10)]

DisplayPort 1.0 includes optional *DPCP* (DisplayPort Content Protection) from [Philips](/wiki/Philips), which uses 128-bit [AES](/wiki/Advanced_Encryption_Standard) encryption. It also features full authentication and session key establishment (each encryption session is independent). There is an independent revocation system. This portion of the standard is licensed separately. It also adds the ability to verify the proximity of the receiver and transmitter, a technique intended to ensure users are not bypassing the content protection system to send data out to distant, unauthorized users.

DisplayPort 1.1 added optional implementation of industry-standard 56-bit HDCP ([High-bandwidth Digital Content Protection](/wiki/High-bandwidth_Digital_Content_Protection)) revision 1.3, which requires separate licensing from the Digital Content Protection LLC.

DisplayPort 1.3 supports HDCP 2.2, which is also employed by HDMI 2.0.

### Dual-mode[[edit](/index.php?title=(none)&action=edit&section=11)]

[Template:Anchor](/wiki/Template:Anchor)

[150px|left|thumb|Dual-mode DisplayPort logo](/wiki/Image:DisplayPort_plus_plus.svg)

|  |  |
| --- | --- |
| Dual-mode pin mapping | |
|  | DVI 1.0/HDMI mode |
| Main Link Lane 0 | TMDS Channel 2 |
| Main Link Lane 1 | TMDS Channel 1 |
| Main Link Lane 2 | TMDS Channel 0 |
| Main Link Lane 3 | TMDS Clock |
| AUX CH+ | DDC Clock |
| AUX CH− | DDC Data |
| DP\_PWR | DP\_PWR |
| Hot Plug Detect | Hot Plug Detect |
| Config 1 | Cable Adaptor Detect |
| Config 2 | [CEC](/wiki/Consumer_Electronics_Control) *(HDMI only)* |

[Template:Anchor](/wiki/Template:Anchor) *Dual-mode DisplayPort* (also known as DisplayPort++[[23]](#cite_note-23)) can directly output single-link [HDMI](/wiki/HDMI) and [DVI](/wiki/Digital_Visual_Interface) signals using a simple passive adapter that adjusts from the different connector and the lower voltages used by DisplayPort.[[24]](#cite_note-24)<ref name=DP\_Interop>[Template:Cite news](/wiki/Template:Cite_news)</ref> When a dual-mode chipset detects that a DVI or HDMI passive adapter is attached, it switches to DVI/HDMI mode which uses the 4-lane main DisplayPort link and the AUX channel link to transmit three TMDS signals, a clock signal and [Display Data Channel](/wiki/Display_Data_Channel) data/clock. Dual-mode ports are marked with the DP++ logo; most DisplayPort graphics cards support this mode.

In January 2013, a new VESA specification was released called DisplayPort Dual-Mode Standard version 1.1, which brings dual-mode capabilities on par with HDMI 1.4, allowing a TMDS clock rate of up to 300[Template:NbspMHz](/wiki/Template:Nbsp), 1080p deep color, 4K resolution, and stereoscopic 3D formats. Passive adapters and ports which support the new data rate will be marked "Type 2" and will be backwards compatible with existing "Type 1" ports.[[25]](#cite_note-25) In September 2014, DisplayPort 1.3 specification was released, which includes mandatory Dual-mode support for HDMI 2.0 protocol, allowing 14.4[Template:NbspGbit](/wiki/Template:Nbsp)/s of bandwidth and 600[Template:NbspMHz](/wiki/Template:Nbsp) pixel clock.

A notable limitation of dual-mode is that it can only transmit single-link DVI (and HDMI), as the number of pins in the DisplayPort connector is insufficient for dual-link connections. As a result, an active converter is needed for Dual-Link DVI and analog [component video](/wiki/Component_video) such as [VGA](/wiki/VGA). Some of these active adapters can rely on the +3.3 V wire in the DisplayPort connector for the conversion, but other types of active conversion, such as Dual-Link DVI, require external power that is often pulled from an available USB port.[[26]](#cite_note-26) VESA anticipates that HDMI and DVI conversion will eventually be handled by active adapters which act as DisplayPort Sink devices, in order to facilitate easier updates to latest HDMI and DisplayPort specs, and work with dual-link HDMI, DisplayPort connections with either fewer than 4 lanes or different data rates, and multiple DisplayPort streams. It should be noted that DVI 1.0 spec was finalized in 1999 and the DVI industry consortium has since disbanded, so future updates to DVI specification are unlikely; also, although dual-link HDMI *Type B* connector is defined in the HDMI specification, it has not seen any practical use as of 2012.[Template:Citation needed](/wiki/Template:Citation_needed)

[thumb|Picture of a DisplayPort to DVI adapter after removing its enclosure. The chip on the board converts the voltage levels generated by the dual-mode DisplayPort device to be compatible with a DVI monitor.](/wiki/File:DP_to_DVI_converter_unmounted.jpg)

### {{Anchor|Multi-Stream Transport|MST}}Multiple displays on single DisplayPort connector[[edit](/index.php?title=(none)&action=edit&section=12)]

DisplayPort 1.2 added support for Multi-Stream Transport (MST), enabling multiple monitors to be used via a single DisplayPort connector. This function requires either monitors that are capable of DisplayPort 1.2 daisy-chaining, or use of a DisplayPort MST Hub. The first MST hub became available in September 2013, enabling up to 3 displays to be connected to a single DisplayPort connector.[[27]](#cite_note-27) Single Stream Transport (SST) was specified in DisplayPort 1.1a for use between a single Source and Sink Device.

### Cost[[edit](/index.php?title=(none)&action=edit&section=13)]

VESA, which created the DisplayPort standard, states the standard is royalty free to implement. However, VESA also acknowledges that "MPEG LA is making claims that DisplayPort implementation requires a license and a royalty payment. It is important to note that these are only claims. Whether these claims are relevant will likely be decided in a US court." <ref name=DisplayPortFAQ>[Template:Cite news](/wiki/Template:Cite_news)</ref> A press release by [MPEG LA](/wiki/MPEG_LA) states that a royalty rate of $0.20 per unit should apply to DisplayPort products manufactured or sold in countries that are covered by one or more of the patents in the MPEG LA license pool.<ref name=DisplayPortMPEGLicenseMarch2015>[Template:Cite news](/wiki/Template:Cite_news)</ref> As of 1 September 2015, the MPEG LA license includes patents from [Hitachi Maxell](/wiki/Hitachi_Maxell), [Philips](/wiki/Philips), [Lattice Semiconductor](/wiki/Lattice_Semiconductor), [Rambus](/wiki/Rambus), and [Sony](/wiki/Sony).<ref name=MPEGLAPatents>[Template:Cite news](/wiki/Template:Cite_news)</ref>

## {{Anchor|Advantages over legacy standards}}Advantages over DVI, VGA and FPD-Link[[edit](/index.php?title=(none)&action=edit&section=14)]

[Template:Cleanup list](/wiki/Template:Cleanup_list) In December 2010, several computer vendors and display makers including Intel, AMD, Dell, Lenovo, Samsung and LG announced they would begin phasing out FPD-Link, VGA, and DVI-I over the next few years, replacing them with DisplayPort and [HDMI](/wiki/HDMI).[[28]](#cite_note-28)[[29]](#cite_note-29) One notable exception to the list of manufacturers is Nvidia, who has yet to announce any plans regarding future implementation of legacy interfaces.

DisplayPort has several advantages over VGA, DVI, and FPD-Link.[[30]](#cite_note-30)[[45]](#cite_note-46)