

## DISPLAYPORT: NEXT-GENERATION DIGITAL DISPLAY INTERFACE

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In late 2003, Dell brought together a group of leading PC, graphics, and semiconductor companies to plan a new digital display interface standard to meet future demands on the interface and to reduce display cost and complexity. The goal was to develop an open-standards based, royalty-free, and extensible interface suited for both external desktop monitor and internal display interfaces, and to have it ready for implementation in products in 2006. The new interface would replace the proprietary digital visual interface (DVI) used between the PC and an external display, as well as the legacy low-voltage differential signaling (LVDS) interface used inside notebook computers, monitors, and TVs to connect to LCD panels.

Rather than manage and license the specification itself, as was the case with DVI, the group took the unusual step of relinquishing control of the specification to an established display industry standards organization—the Video Electronics Standards Association (VESA®)<sup>1</sup>. The DisplayPort proposal was introduced to the VESA in August 2005 and the resulting standard was published May 3, 2006.

The open standards-based DisplayPort interface offers advantages over the proprietary DVI and legacy LVDS interfaces because it enables more-affordable liquid crystal display (LCD) monitors, scales in performance to meet requirements across the whole range of PC display applications from entry level displays to high performance upsells, and supports future display innovation through its micropacket architecture.

### Why do we need a new digital display interface standard for PCs?

The current version of DVI, which cannot be updated, has physical, functional, and cost limitations that inhibit its suitability for future needs. The DVI 1.0 specification is effectively frozen because its creator, the Digital Display Working Group, has disbanded.

Physically, the DVI connector is too large to fit on small notebook computers. Functionally, DVI's resolution and color-depth support are fixed, and the required voltage levels prevent integration into sub-90-nanometer silicon process geometries, adding cost to platforms. In addition, DVI's use of a forwarded clock signal introduces electromagnetic interference (EMI) and validation issues. Moreover, emerging high-performance display and source capabilities cannot be supported on single-channel DVI or, in many cases, the higher-bandwidth dual-channel DVI. Emerging display capabilities include:

- Higher resolutions such as QXGA (2048x1536 pixels).
- Sequential color LCD panels, which need higher frequencies and bandwidth to deliver color data in sequential order to the display. This approach eliminates today's LCD color filter that lowers display brightness. The result is brighter, more vivid LCD displays.
- 30 bits-per-pixel (bpp) color depth.
- Videoconferencing monitors that connect via a single interface and cable to the PC, and that accommodate two-way audio and video for built-in speakers, microphone, and camera.
- Multiple display streams over a single cable for picture-in-picture support and daisy-chained, addressable displays.
- High-bandwidth lossless audio.

1. Learn about VESA at [www.vesa.org](http://www.vesa.org).

Finally, the DVI license agreement prevents integration of the receiver into an LCD panel, which requires in most cases that discrete silicon be used to implement the specification. This restriction adds unnecessary silicon cost and complexity to the monitor.

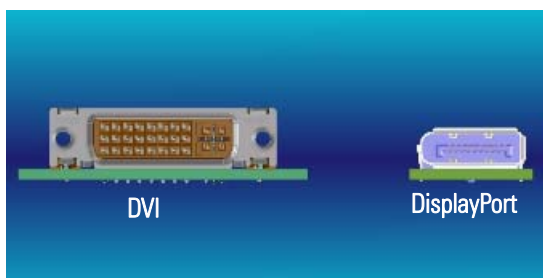
Because of these limitations, Dell believes that a new digital display interface is required to meet the broad needs of the PC industry.

## What is the DisplayPort Interface?

The DisplayPort standard specifies a high-bandwidth, bidirectional display interconnect that enables a common interface approach for internal and external display connectivity. It replaces both DVI and LVDS, addresses the current issues with DVI and its derivatives, and ensures significant future extensibility to meet customer needs.

The interface features a "micropacket" architecture that enables high-bandwidth delivery of any multimedia data type, including multiple video streams<sup>2</sup> and audio. Unlike DVI, the DisplayPort interface uses an embedded clock architecture to minimize EMI and validation issues.

The electrical layer is based on PCI Express and works well with current and upcoming PC and LCD silicon process geometries. Thus, the interface can operate at low voltages and be easily integrated into the graphics chip set and LCD panel without limitation. The DisplayPort interface also features optional audio capability and a small external connector that is about the size of a USB port. As currently proposed, the interface is interoperable with DVI and high-definition multimedia interface (HDMI) through methods that can be implemented easily at the manufacturer's discretion.



**Figure 1. Comparison of DVI and DisplayPort**

The DisplayPort 1.0 specification provides over twice the capacity of HDMI-A or single-channel DVI over the same number of wires. Its design enables the eventual doubling of this capacity through frequency bumps with full backward compatibility with initial implementations. The interface can be scaled to accommodate low- or high-bandwidth applications. A DisplayPort interface made up of a single video differential pair, referred to as a "lane," accommodates entry-level monitors or notebook panels with low bandwidth requirements. A single lane supports up to WSXGA+ (1680x1050 pixels) display resolution. This implementation significantly lowers costs and reduces the size of the panel interface cabling and frees up "through-hinge" space occupied by the relatively bulky LVDS interface in notebook computers. Implementations can be scaled by adding lanes up to a maximum of four. Four lanes support up to QXGA resolution, 30-bpp color, and also can support color sequential LCD panel technology.

Effective content protection—a requirement for any PC digital display interface—is under development and is expected to be released in the second half of 2006.

## Advantages

The new display interface meets key requirements of customers, content owners, and the PC industry:

- Designed to enable more-affordable LCD monitors because it can be integrated into current-generation LCD panels to replace LVDS. This approach enables less-complex and lower-cost "direct drive" monitors.<sup>3</sup> The DisplayPort interface can also be easily integrated into current and future generations of chip sets, enabling broad adoption by the PC industry that is not possible with DVI.
- Will help ensure standards-based path to future performance upgrades, feature enhancements, and

3. Traditional PC monitors support a broad range of video timings and formats associated with current analog video and digital interfaces. This support requires that monitors include fairly sophisticated built-in scaling, frame-rate conversion, and analog-to-digital conversion capabilities. With the DisplayPort interface, system designers can develop a "direct-drive" monitor model in which the standard PC video interface is routed directly to the panel, with no intermediate electronics. The image scaling and compositing burden resides in the host's graphics subsystem. This model is already used in notebook computers and will help simplify and lower the cost of LCD monitors.

2. Multiple video streams will be supported in version 2 of the DisplayPort specification.

support for innovations such as emerging sequential color LCDs, daisy-chained monitors, multiple video streams, and videoconferencing monitors.

- Provides scalable performance.
- Provides advanced content protection that can meet the needs of content owners.

### Why not use HDMI?

The proprietary HDMI interface is a superset of DVI, but is maintained by a group of consumer electronics companies known as the HDMI Founders ([www.hdmi.org](http://www.hdmi.org)). HDMI has been successful in digital TV applications and is likely to continue in many consumer electronics products. However, there has been little adoption of HDMI as a PC monitor interface because HDMI has many of DVI's limitations, and its licensing terms are even more costly and restrictive.

### Industry Transition

DisplayPort silicon is expected to begin appearing in 2006, followed by product adoption in 2007. During the transition from DVI to the new display interface, dual-mode implementations via a single connector on the PC will be available to support connectivity to both DisplayPort and DVI displays. This dual-mode support will also be available for DisplayPort and LVDS implementations.

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***DisplayPort silicon will begin to appear in 2006, and products in 2007.***

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### Conclusion

The VESA DisplayPort standard has broad PC industry support from companies such as Dell, HP, Lenovo, ATI, Nvidia, Samsung, Philips, and Genesis Microchip. The standard provides an open and extensible royalty-free specification that meets the current and future needs of the PC industry without the restrictions associated with DVI technology and its derivatives. As a result, the DisplayPort interface should enable LCD monitors to be more affordable to customers and provides an open industry path to future display innovations that meet emerging customer needs.

### For More Information

- VESA: [www.vesa.org](http://www.vesa.org)
- "Top PC Companies Support New VESA DisplayPort Standard," joint Dell, HP, and Lenovo press release, [www1.us.dell.com/content/topics/global.aspx/corp/pressoffice/en/2006/2006\\_05\\_03\\_rpa\\_000?c=us&l=en&s=corp](http://www1.us.dell.com/content/topics/global.aspx/corp/pressoffice/en/2006/2006_05_03_rpa_000?c=us&l=en&s=corp)

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