White Paper | See More and Do More with AMD Eyefinity Multi-Display Technology

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AMD Eyefinity multi-display technology launches a new era of panoramic computing, helping to boost productivity and multitasking with innovative graphics display capabilities supporting massive desktop workspaces, creating ultra-immersive computing environments with super-high resolution gaming and entertainment, and enabling easy configuation and supporting up to six independent display outputs simultaneously.[1]

Introduction

In the past, multi-display systems catered to professionals in specific industries such as financial, oil & gas, and medical where multi-display systems are not only desirable, but a necessity. Today, graphic designers, CAD engineers and programmers are attaching more than one display to their workstation. A major benefit of a multi-display system is simple and universal – it enables increased productivity. This has been demonstrated in industry studies which have shown that attaching more than one display device to a PC can signficantly increase user productivity.[2,3]

The early multi-display solutions were non-ideal. Bulky CRT monitors claimed too much desk space, thinner LCD monitors were very expensive, and external multi-display hardware was inconvenient and also very expensive. These issues are much less of a concern today. LCD monitors are very affordable and current generation GPUs can drive multiple display devices independently and simultaneously, without the need for external hardware.

Despite the advancements in multi-display technology, AMD engineers still felt there was room for improvement, especially regarding the display interfaces. VGA carries analog signals and needs a dedicated DAC per display output, which consumes power and GPU die area. Dual-Link DVI is digital, but requires a dedicated clock source per display output and uses too many IO pins from our GPU. If we were to overcome the dual display per GPU barrier, it was clear that we needed a superior display interface.

What is AMD Eyefinity Multi-Display Technology?

AMD Eyefinity multi-display technology provides advanced multiple monitor technology delivering an incredibly immersive graphics and computing experience with innovative display capabilities, supporting massive desktop workspaces and super-high resolution graphics rendering environments.

Legacy GPUs have supported up to two display outputs simultaneously and independently for more than a decade. Until now graphics solutions have supported more than two monitors by combining multiple GPUs on a single graphics card, or by using two or more cards in a system; both of these options come with added cost and complexity (in the form of slot usage, heat dissipation etc). With the introduction of AMD's next-generation graphics product series supporting DirectX® 11, a single GPU now has the advanced capability of simultaneously supporting up to six independent display outputs.

Immersive Panoramic Computing

- → Extreme multiple monitor support enabling enhanced productivity for commercial and workstation solutions
- → Operate multiple displays independently or create one massive display surface spanning multiple monitors

In 2004, a group of PC companies collaborated to define and develop DisplayPort, a powerful and robust digital display interface. At that time, engineers working for the former ATI Technologies Inc. were already thinking about a more elegant solution to drive more than two display devices per GPU, and it was clear that DisplayPort was the interface of choice for this task.

In contrast to other digital display interfaces, DisplayPort does not require a dedicated clock signal for each display output. In fact the data link is fixed at 1.62Gbps or 2.7Gbps per lane, irrespective of the timing of the attached display device. The benefit of this design is that one reference clock source can provide the clock signals needed to drive as many DisplayPort display devices as there are display pipelines in the GPU. In addition, with the same number of IO pins used for Single-Link DVI, a full speed DisplayPort link can be driven which provides more bandwidth and translates to higher resolutions, refresh rates and color depths compared to prior technologies. All these benefits perfectly complement AMD Eyefinity multi-display technology.

Expansive Desktop Space for Enhanced Productivity

- → Delivers a massively immersive workspace, helping you to be more productive
- → The perfect solution for office productivity, making multi-tasking easier, keeping all your critical data right at your finger tips

Multi-Display Flexibility and Upgradability

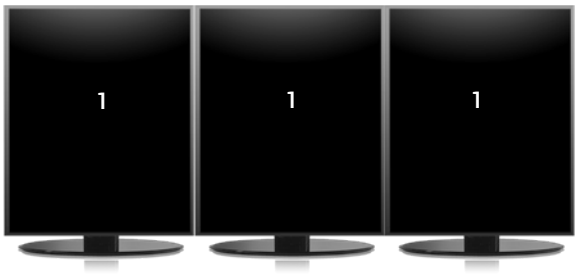
- → Exponential expansion by adding multiple monitors
- → Expand the number of displays within a systems with multiple GPUs

AMD Eyefinity multi-display technology offers professionals the flexibility to expand their system and experience on their own schedule. They can purchase one display now and upgrade as their budget permits. AMD professional graphics products are designed to offer a tremendous feature set, and a great upgrade path so that in six months, an end-user can add another two panels without changing the rest of their workstation. Also, from a cost perspective, it is currently less expensive to buy multiple panels than it is to buy one large, high resolution monitor. Today 19 inch DisplayPort monitors* sell for as low as $200 USD, so for a three panel configuration it would cost around $600 USD which is far below the price of a single, large display with another few monitors. Also, with AMD Eyefinity multi-display technology, there is a flexible upgrade path. End-users can purchase an AMD graphics card, use it with one monitor and then in a few months upgrade with another few monitors.

AMD Eyefinity Multi-Display Technology Usage Scenarios

AMD Eyefinity multi-display technology is defined as two or more display outputs operating simultaneously and independently from each other. Support is available for Duplicated (Clone) and Extended multiple monitor modes, with new support for the capability to group displays into a massive single large surface spanning across multiple displays for use with your desktop workspace, video playback, with support for both windowed and full screen 3D applications.

Below are some key AMD Eyefinity multi-display technology configurations:



3x1 Portrait Display Group

3x1 Landscape Display Group

*Dell E1909WDD 19-inch Widescreen Flat Panel Monitor

3x2 Landscape Display Group

3x1 Display Group Plus 1 Extended

3x1 Portrait Display Group

3x1 Landscape Display Group

Technical Details

Number of Monitors:

- Up to six dependent on graphics card configuration[1]

Aggregate Screen Resolution:

- Maximum in Extended mode: subject to operating system
- Maximum in Display Group mode:
  8192 x 8192 (67.1 megapixel resolution) per display group

Examples:

- 4800 x 2560 resolution grouping three displays wide x one display high with portrait orientation using 2560x1600 display resolution for each monitor (12.3 megapixel resolution)
- 7680 x 3200 resolution grouping three displays wide x two displays high with landscape orientation using 2560x1600 display resolution for each monitor (24.6 megapixel resolution)

Monitors:

- DisplayPort is highly recommended offering optimal flexibility with the highest number of display outputs
- Two display outputs of either DVI, HDMI, or VGA can be combined with DisplayPort outputs up to a total of six monitors per GPU

Operating Systems:

- Microsoft Windows® 7
- Windows Vista®
- Linux®
- Windows® XP support for AMD Eyefinity multi-display technology is limited to 2 simultaneous displays at any time

Hardware:

- AMD FirePro™ professional graphics with support for DirectX® 11, with appropriate display outputs

Bandwidth Requirements:

- Conditional on monitor resolution.
  Increased resolution requires a higher performance GPU.

Display Combinations

AMD Eyefinity multi-display technology is closely aligned with AMD's DisplayPort implementation providing the flexibility and upgradability modern user's demand. Up to two DVI, HDMI, or VGA display outputs can be combined with DisplayPort outputs for a total of up to six monitors, depending on the graphics card configuration.

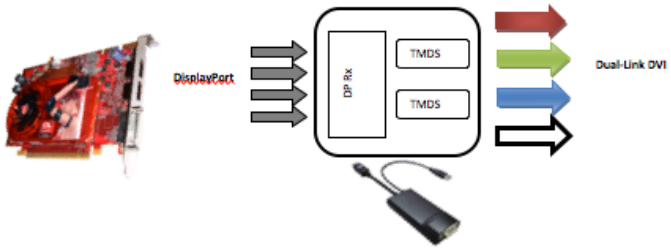
Example configuration options based on a graphics card with four display outputs:

	DVI Connector	DVI Connector	DP Connector	HDMI Connector
Example #1	Yes	Yes	Yes	No
Example #2	Yes	No	Yes	Yes
Example #3	No	Yes	Yes	Yes

Wider display connectivity is possible by using display adapters that support active translation from DisplayPort to DVI or VGA. These adapters require complex circuitry to convert the DisplayPort signal from the graphics card, modify it to the new display signal required for the attached monitor, and for transmission.

These active adapters typically have the following components:

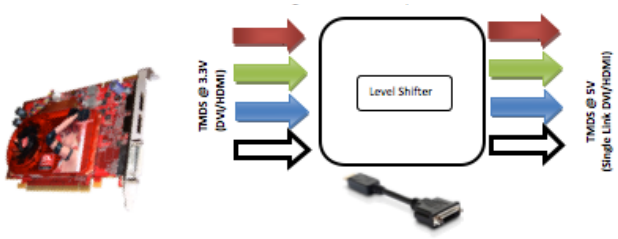
- DisplayPort Receiver
- Digital to Analog Converter (DAC) for VGA
- TMDS transmitter for DL-DVI



The following active adapters are available in the market today:

- DisplayPort to Dual-Link DVI
- DisplayPort to VGA
- Mini-DisplayPort to Dual-Link DVI
- Mini-DisplayPort to VGA

If only one or two DVI/HDMI monitors are attached through a DisplayPort connector, then only simple passive adapters are required. With a passive adapter the GPU outputs the display signal required for the monitor with no conversion occurring within the adapter itself.



The following passive adapters are available in the market today :

- → DisplayPort to HDMI
- → DisplayPort to DVI
- → Mini-DisplayPort to HDMI
- → Mini-DisplayPort to DVI
- → Mini-DisplayPort to DisplayPort

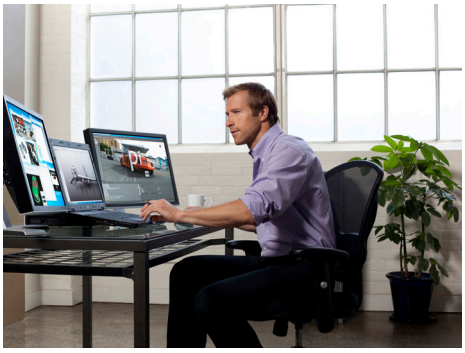
Productivity

Improving employee productivity is always an ongoing key goal for any organization. Computers have become critical to workforces with desktop real estate management a key area of improvement over the last few decades.

A research study undertaken by The Pfeiffer Group claims that under certain conditions efficiency gains of up to 65% can be achieved using larger monitors with higher resolutions. These gains can be seen in many varied markets including general office productivity, digital imaging, and video. The Pfeifer report also suggests that large display resolutions could lead to a yearly return on investment of thousands of dollars when measured in terms of increased productivity.[4]

Microsoft researchers discovered that using a multiple monitor configuration was one of the easiest ways to optimize productivity, with gains of up to 50%. It was noted that with "overwhelming consensus" once a user switches to multiple monitors they will never switch back to using only a single monitor.[5,6]

How can more displays and more desktop real estate improve my efficiency?
The more screen real estate you have with multiple monitors and larger resolutions the more data and applications that can be displayed and seen at once.



There are many productivity benefits.

- With multiple monitors you can work on the entire document visualizing all the data at once with many more ways to view the things being worked on.
- Comparison of data becomes much easier without the need to continually scroll through the document.
- Running multiple applications such as email, web browser, word processor, and spreadsheet at the same time becomes much more efficient. Accuracy improves as data is visualized simultaneously without the need to constantly alt-tab between applications.
- Menus and toolbars can stay onscreen at the same time while retaining a large viewport or multiple viewports. A larger viewport equates to fewer mouse clicks and reduces the time it takes to search data when working with many applications at once.
- With a larger resolution desktop much more of any document, spreadsheet, dataset, model or image can be viewed. Six 30" monitors with each offering up to 2560x1600 pixels of resolution, 4.1 megapixels, can be configured as a group consisting of three monitors wide by two monitors high giving the user a single large aggregate desktop surface with a pixel resolution of up to 7680x3200. This is the equivalent of 24.6 megapixels of screen real estate!

Switching to multiple monitors and using a larger desktop footprint will allow users to see more of any document or image natively, allowing users to work more efficiently with a holistic increase in their peripheral vision of the dataset, and can dramatically improve the ability to multitask across many applications simultaneously.

The benefits to using AMD Eyefinity multi-display technology in the workplace are obvious, extensible and immediately useful in improving user productivity and efficiency.

Commerical and Workstation

AMD Eyefinity multi-display technology provides the commercial and workstation customers new levels of support and functionality across a range of different segments.

CAD and DCC Markets

Users in computer aided design and digital content creation spaces are accustomed to using complex applications to do their work, and increasingly, full suites of applications that represent their workflows.

In CAD such a workflow might include using a core design application on one display, while viewing a simulation of their assembly on another. At the same time, the user needs access to part/assembly specifications, engineering reference material, email and collaboration tools.

In DCC a typical workflow is to have an animation package open at the same time as a painting/image editing application. The user interface elements in either or both of these can easily dominate two displays each.

Many users today are already using two displays to accommodate the viewports, menus, toolbars, output windows and other rich user interface options in the one or more applications they use

Acquiring more than two displays.
Today, users wanting to break through the limitations imposed by two displays have to consider two key challenges:

- → Cost of the additional display
- → Cost and complexity of adding an additional graphics card.

Users, and the management and/or IT departments find it difficult to overcome the above, but a combination of AMD Eyefinity multi-display technology, can remove the cost and complexity of needing additional GPUs, and the low cost of high-grade monitors, today means that any additional costs may be able to pay for themselves in a very short time.

Financial

AMD FirePro™ (and, earlier, ATI FireMV™) graphics cards have been deployed in some of the largest trading floors in some of the largest financial enterprises. AMD Eyefinity multi-display technology can offer these users new solutions to problems that continue to persist in their environment.

Power
Power usage per trader is a constant struggle for trading floor IT managers. Usually located in dense urban centers in dense office towers, these traders can often be packed several hundred per floor. Often the power mains to a floor or a building or a city section cannot keep up with the power these users demand. This can limit growth for these companies.

AMD Eyefinity multi-display technology-based quad output cards (a "quad card") can offer power savings of over 50% when compared to other current competitive quad cards without sacrificing any performance or features.[7] Such savings across thousands of users helps ensure that companies are not forced to reduce capacity or efficiency of their site assets due to structural power constraints.

Operational Efficiencies
The vast majority of quad monitor users today use two dual output cards (each a "dual card") rather than one single quad card. The simple reason for most of them is that two dual cards cost significantly less than one quad card. Quad cards can cost anywhere from 50%-100% more than two dual cards due to custom components, an added bridge chip, complexity of manufacturing and lower volume efficiencies.

With an AMD Eyefinity multi-display technology-based solution AMD will be able for the first time offer a quad solution that will be comparable to the cost of two dual cards. For large enterprise deploying one card in a system rather than two offers the following benefits:
1. Easy and quick install
2. Fewer PCIe slots which can lead to a smaller system taking us less space
3. Fewer cards to stock
4. Lower MTBF for the solution (i.e. two cards represent two potential points of failure rather than one)

Many IT staff that might normally prefer a quad card for their users will balk at paying double the premium for that solution. By offering a cost effective quad card solution, AMD mitigates that concern while providing the additional benefits listed above.

Large Screens in a Little Package

Financial traders also live by how much information they can see and react to. It is not uncommon to find some with 10, 12 or 16 screens. But arguably they don't necessarily need that many screens; rather what they need is that many pixels.

With AMD Eyefinity multi-display technology, AMD is able to output 16 megapixels from 4 large display port panels from a single small form factor board. This would be the equivalent of 8 1600x1200 panels which would have normally required at least two quad cards and most likely a larger system to house them. Now with a single small card which can fit into a single small system customers can easily support massive pixel output while helping to save space and power.

Medical

The medical diagnostic workstation user is among the most demanding in terms of image quality and stability but also have some unique needs that can be addressed with AMD Eyefinity multi-display technology.

Usage Model

A typical medical diagnostic setup involves two specialty high resolution medical displays to examine x-rays, CT Scan, PET scan images with a third lower resolution monitor which display the controls for the image application itself. This setup would normally use one high end graphics card tuned specifically for the medical displays plus a second entry level workstation card to handle the third screen.

Using AMD Eyefinity Multi-Display Technology

With AMD Eyefinity multi-display technology, AMD plans to leverage its current medical hardware and software driver features into an integrated high end triple output medical graphics card. AMD FirePro™ graphics accelerators are being designed with three display outputs in order to drive the two required high resolution high end 3D displays while also offering a third output for the application controls.

By combining all of this functionality in one card with AMD Eyefinity multi-display technology can enable the following benefits for the medical market.

1. Save the cost of buying two cards
2. Reduce inventory
3. Shorten the qualification cycle
4. Simplify shipping and installation

Digital Signage

The digital signage market has been creeping its way into more and more retail outlets, restaurants and common areas. This market is defined by multiple screens being controlled by a single system outputting multiple instances of active content.

AMD Eyefinity multi-display technology enables this market the ability to output more screens from a single card by increasing the capacity of a single system thereby helping to simplify install, reduce costs and expand content choice and flexibility.

The power of the GPU behind these multiple screens will also enable a level of graphics and video activity that can easily be spanned across multiple screens or multiple zones which was not possible before. This can open up a new stage of dynamic eye catching content that is the key to any successful public information display environment.

EcoSystem

Application Support

AMD Eyefinity multi-display technology offers software developers a great ability to differentiate using multiple display technology. With the graphics performance of the latest AMD FirePro™ professional graphics products it is now possible to drive extremely high resolutions with varied usage scenarios at frame rates users have come to expect.

For AMD Eyefinity multi-display technology, AMD sees the key commercial market segments being financial, medical, display signage, CAD and DCC markets. Display signage and visual collaboration vertical markets are already moving quickly to multiple display usage scenarios. AMD Eyefinity multi-display technology offers an economical high performance solution that's difficult to match.

DisplayPort Monitors

All DisplayPort monitors should function with AMD Eyefinity multi-display technology-enabled graphics boards. Monitors supporting DisplayPort are available from most major display vendors, including Hewlett Packard, Dell, Lenovo, Samsung, LG Display, Apple, ViewSonic and NEC.

Looking Forward

In 2009, AMD first announced AMD Eyefinity multi-display technology. This differentiating feature has been well received by reviewers and end-users alike. While the appeal in professional graphics is mainly the ability for users to dramatically increase their productivity through multi-monitor configurations, it is also extremely useful for ultra-wide screen and high resolution computing usage scenarios.

In early 2010, the DisplayPort 1.2 specification was ratified in VESA. This new revision of the standard adds support for new and exciting features including high bit-rate audio, even higher bandwidth, and multi-stream transport capabilities. Combined, the new features in DisplayPort 1.2 complement the AMD Eyefinity multi-display technology very well. Just as AMD was the first to integrate DisplayPort technology into professional graphics with the ATI FirePro™ 2260, the AMD FirePro™ V7900 and V5900 professional graphics integrate support for the new revision 1.2 of the standard.

Multi-Stream Transport (MST), commonly referred to as daisy-chaining, is the ability to address and drive multiple display devices through one connector. This technology, coupled with AMD Eyefinity multi-display technology, is a revolutionary advancement to multi-display technology with AMD being at the forefront of this transition.

AMD combines DisplayPort 1.2 and AMD Eyefinity multi-display technology to deliver the productivity edge you expect with the most flexible and expansive multi-display experience. DisplayPort 1.2 greatly enhances AMD's multi-display leadership with Multi-Stream Transport and enables ultra-high bandwidth applications such as Full HD 120Hz stereoscopic 3D, multiple monitors per display connector, with higher resolution and refresh rates than ever before possible from a PC display technology.

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[1] AMD Eyefinity multi-display technology can support multiple displays using a single enabled AMD FirePro™ professional graphics card; the number of supported displays varies by card model. Microsoft® Windows® 7, Windows Vista®, or Linux® is required in order to support more than 2 displays. Depending on the card model, native DisplayPort connectors and/or certified DisplayPort active or passive adapters to convert your monitor’s native input to your card’s DisplayPort or Mini-DisplayPort connector(s) may be required. See www.amd.com/firepro for details

[2] PC World - Tips & Tweaks: Two Monitors Are Way Better Than One, Steve Bass, 2005.

[3] Hewlett-Packard - Go big! Large screen displays and multiple displays for workstation applications, Hewlett-Packard Development Company, LP, 2006

[4] The Pfeiffer Group – The 30-inch Apple Cinema HD Display Productivity Benchmark, Pfeiffer Consulting, 2005.

[5] Microsoft Research – Partitioning Digital Worlds: Focal and Peripheral Awareness in Multiple Monitor Use, Jonathan Grudin, 2002.

[6] Microsoft Research – Two Screens Are Better Than One, Suzanne Ross, 2003.

[7] 208W planned max power consumption for ATI FirePro™ V8800 vs. 640W max for Nvidia Quadro Plex 2200 D2. See http://www.amax.com/CS_ProductDetail.asp?cs_id=QP2200D2.