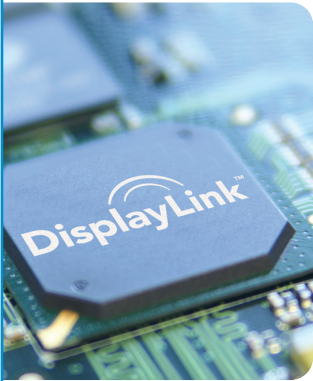




Multiple Monitor Energy Use

USB monitors deliver simple and cost-effective multi-monitor computing with significantly reduced power requirements compared to traditional discrete graphics solutions.



Whitepaper

Multiple Monitor Energy Use

Introduction

As people move from a physical desk to a digital one, one of the limitations that they encounter is their digital desktop size. Often limited to a single display, they are only able to view one digital document or application at a time, which can make many simple tasks very time consuming. By adding more displays to their computers, these users can quickly increase their productivity up to 50% depending on the nature of their work while at the same time making fewer mistakes. Additional displays are also important for people who need to monitor information from multiple sources simultaneously as it allows them to view several applications at once.

“By adding more displays to their computers, these users can quickly increase their productivity up to 50%...”

However, with more displays comes more power consumption which is a concern for power-conscious consumers on many levels. Not only does the extra power cost them more in energy costs, but it also translates to more heat, which leads to higher building cooling costs. In an office setting this can lead to very large power loads both on the local surge protectors and general circuit breakers.

But now, with the availability of USB displays, consumers are able to take advantage of multiple monitors while avoiding most of the disadvantages that those systems traditionally had in regards to power consumption.

The Inherent Energy Problems

While adding a new monitor to ones desk provides added convenience and productivity, it also adds to the overall power consumption. The first part of the extra consumption comes from the monitor itself, and is directly related to its size and characteristics (MFM vs. Simple monitor, CRT vs. LCD, USB Hub, Audio, etc...). The second part of the extra consumption comes from the changes that are needed on the computer side to drive the new monitor. These changes can be as small as having new software use some CPU cycles, or as big as adding internal hardware to render the image for the new monitor.

The power consumption of several sample monitors of varying sizes can be seen in the table below for reference purposes:

LCD Monitor Power Consumption

LCD Monitor Size	Low End Power Consumption	High End Power Consumption	Average Power Consumption
17" CRT	75 Watts	85 Watts	80 Watts
19" SXGA	25 Watts	30 Watts	27.5 Watts
20" MFM WSXGA+	23 Watts	43 Watts	33 Watts
22" WSXGA+	19 Watts	41 Watts	30 Watts
24" MFM WUXGA	80 Watts	103 Watts	91.5 Watts

Multiple Monitor Energy Use

On the computer side however, the changes necessary to support an additional monitor vary greatly in the extra power that they require, and can range from several watts to a couple hundred watts depending on the implementation. As there is such a wide range of power consumption for the various options, they are individually benchmarked and compared below.

The Possible Solutions

Multiple display setups have traditionally only been available for desktop computers since to add additional displays, a graphics card with multiple video connectors needed to be physically added to the system. If the computer doesn't have any available expansion slots (in the case of a laptop or small form-factor PC) then it is not possible to expand the graphics capabilities of that computer.

These discrete graphics cards are often expensive to purchase and require technical knowledge to perform the installation. Since these discrete graphics cards are dedicated pieces of hardware added to the computer, they require a fair amount of power to run.

Using USB on the other hand to connect a display to your computer with the help of DisplayLink technology is quick and easy. It doesn't require any hardware to be added to the computer, so it can be used with laptops or other computers that can't easily be physically be expanded. USB ports are on virtually all new computers being made and in use, so there are very little connectivity conflicts.

The software drivers are easy to install, requiring almost no "down-time" of the host computer. The USB graphics adapters are also entirely bus-powered, which means that the power they require from the system is minimal.

Energy Consumption Analysis

Since different internal system configurations can support the same number of displays, how much power the system consumes in each configuration is an important differentiator.

For the tests below, dual-DVI discrete graphics card are used (as those are the most common multi-display graphics cards), and for the USB graphics commonly available USB-to-DVI adapters are paired with standard LCD displays. Power consumption is measured at the entry to the computer power supply, so that it measures the combined system power (CPU + graphics card + USB bus + disk).

The power consumption of each computer configuration is measured while it is under different system loads: running at idle, having a window moved around the screens, rendering a 3D screen-saver, and playing a digital movie. For USB, we started with the integrated graphics and added up to 3 USB adapters for a total of 4 displays.

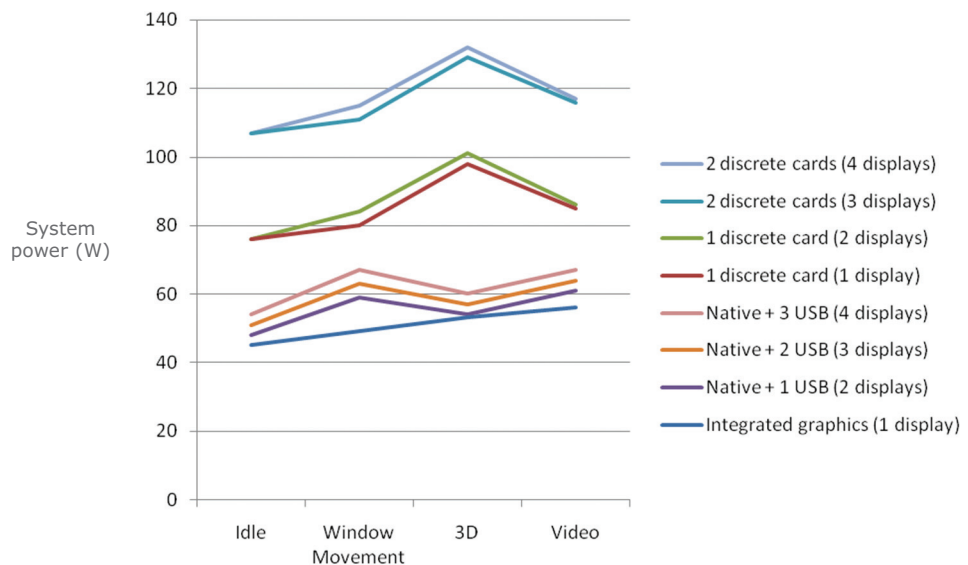
Multiple Monitor Energy Use

For the discrete graphics, we started with adding one discrete graphics card which provided us with up to 2 displays, and then added a second discrete graphics card for a total of up to 4 displays. All the displays used in these tests are WSXGA+ (1680x1050 resolution) LCDs as they are at the intersection of useable screen size and low power use.

The power consumption of the desktop computer in its various configurations and under various loads can be seen below:

LCD Monitor Power Consumption

Hardware configuration	Number of Displays	Idle	Window Movement	3D	Video	Average
Integrated graphics	1	45	49	53	56	50.75
1 discrete graphics card	1	76	80	98	85	84.75
Integrated + 1 USB adapter	2	48	59	54	61	55.5
1 discrete graphics card	2	76	84	101	86	86.75
Integrated + 2 USB adapters	3	51	63	57	64	58.75
2 discrete graphics cards	3	107	111	129	116	115.75
Integrated + 3 USB adapters	4	54	67	60	67	62
2 discrete graphics cards	4	107	115	132	117	117.75



Multiple Monitor Energy Use

On one hand, DisplayLink's USB integrated graphics solution requires additional power in an incremental manner, so that the power required by the system is directly related to the number of USB adapters connected to it. Adding a display with a USB adapter to the system only incurs an average power consumption increase of 3-5 Watts, which in this case only represents a 5-9% power consumption increase (see Appendix A for relative power consumption). Furthermore, when three extra displays are connected to the system using USB adapters to provide a total of 4 displays, the system is only using 22% more power (62 Watts total) than when it only had the one integrated display.

On the other hand, the discrete graphics solution uses much more power due to the dedicated hardware that needs to be installed in the computer. When it is only driving a single display, it uses on average an extra 34 Watts of power compared to the integrated graphics solution, which is a 67% consumption increase with no additional displays to benefit from. Moreover, when the system is configured to drive 4 displays, the power consumption jumps to an average of 117 Watts, or an increase of 132% compared to the integrated single display configuration.

Overall, the power consumption of DisplayLink's USB graphics solution is minor compared to both the consumption of the computer in the integrated single display configuration, as well as the power consumption of the extra LCD displays. In contrast, the discrete graphics solution consumes as much if not more power than an extra LCD display. This causes the overall system power consumption to more than double for any configuration that uses the discrete solution to drive 3 or more displays (128% more power).

Conclusion

Using multiple monitors with DisplayLink's USB technology offers:

- A small power consumption increase, average of 4 Watts per display.
- Up to 80% less power needed to drive an extra display than a discrete graphics solution.
- Power consumption is incremental, so power requirements are directly proportional to the number of displays in use.
- Doesn't need to install hardware in the computer, as opposed to a discrete graphics solutions.
- Extra displays can be added and removed quickly via USB auto-install to achieve the optimum configuration, whereas a discrete graphics solution needs expert resources to set the system
- The USB bus can be easily expanded with a USB hub, which is not an option with analog or digital video connectors.
- Easy plug and play installation, no need technical knowledge needed.
- Works with laptops and small form-factor PCs, where a discrete graphics solution is not possible.

Multiple Monitor Energy Use

References

Productivity, Screens and Aspect Ratios

James A. Anderson, University of Utah
http://www.necdisplay.com/gowide/NEC_Productivity_Study_0208.pdf

Productivity and Multi-Screen Computer Displays

Janet Colvin, University of Utah
http://www.humis.utah.edu/humis/docs/organization_951_1147817063.pdf

Two Screens Are Better Than One

Suzanne Ross
<http://research.microsoft.com/displayarticle.aspx?id=433>

The Multiple Display Market and Consumer Attitudes

Jon Peddie Research
<http://www.jonpeddie.com/special/MultDisp.shtml>

Appendix A

Power Consumption as a percentage of the baseline primary display configuration.

Hardware configuration	Idle	Window Movement	3D	Video	Average
Integrated + 1 USB display	6.7	20.4	1.9	8.9	9.4
Integrated + 2 USB displays	13.3	28.6	7.5	14.3	15.8
Integrated + 3 USB displays	20.0	36.7	13.2	19.6	22.2
AIB with 1 display	68.9	63.3	84.9	51.8	67.0
AIB with 2 displays	68.9	71.4	90.6	53.6	70.9
2 AIBs with 3 displays	137.8	126.5	143.4	107.1	128.1
2 AIBs with 4 displays	137.8	134.7	149.1	108.9	132.0

© 2008 DisplayLink Corp. All rights reserved.

All company and product names may be trademarks of their respective companies. Whilst every effort is made to ensure the information given is accurate, DisplayLink does not accept liability for any errors or mistakes which arise. Specifications and other information in this document may be subject to change without notice.
DL-WP-MMEU-0908.