14.2: Net2Display™: A Proposed VESA Standard for Remoting Displays and I/O Devices over Networks

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Abstract: *The proposed Net2Display™ VESA standard is intended for remoting displays and USB I/O devices with responsiveness, performance and motion video user experience comparable to a local PC. This proposed standard will enable client displays to connect over wired or wireless networks to host computers located centrally in businesses or homes or remotely at service facilities.*

Keywords: thin client; display remoting; network attached display.

Introduction

The objective of the VESA Net2Display™ standard task group is to create a standard which allows host server computers to send display data over a high speed data channel which both the host and the client display make available. The standard is agnostic to the physical and datalink channels used. Typical interfaces include but are not limited to Ethernet, IEEE 1394, USB, etc. The proposed Net2Display™ standard protocol should be designed to operate at the most primitive level and should provide enablement for remoting I/O devices, for example, keyboard, mouse, audio, and storage. For the display remoting, it will provide facilities which closely mirror the capabilities typically provided by the display subsystem.

The proposed Net2Display™ standard is being developed to avert the shortcomings of existing remoting approaches and to provide enhanced performance at a lower cost through standardization. The features and attributes of the proposed Net2Display™ standard are described herein.

Background

A number of approaches for remoting displays over networks currently exist, including Microsoft Remote Desktop Protocol (RDP), Citrix MetaFrame ICA protocol, VNC, Sun Ray, and X [1, 2, 3, 4, 5]**.** While each of these approaches is capable of remoting displays over networks, each has distinct disadvantages and collectively, the multiplicity of protocols presents problems as well.

All of the existing approaches have limitations in supporting full motion video, supporting WAN latencies and in providing desktop PC-like responsiveness for the richly enhanced GUI provided by modern operating systems [7]. The existing remoting approaches were all designed before motion video was prevalent on the PC. Motion video quality is currently inadequate due to server pull models, lazy display update or synchronization issues [7]. The lack of responsiveness for VNC over WANs is due to a pull protocol where the client requests updates from the server. Additionally, RDP version 6.0, the latest version of RDP requires high end graphics hardware and the Vista OS on both the host server and client to support the full feature Vista Aero interface [8].

One additional disadvantage of existing remoting approaches is that customers may be locked into one OS, remoting and/or virtualization and have limited flexibility on other options. This disadvantage becomes magnified when the customer-selected remoting protocol is acquired by another company, upgraded incompatibly or discontinued leaving future direction in doubt.

Consequently, there is an opportunity for a remoting standard that is designed at the onset to support motion video and provides the interoperability benefits of a standard, allowing the innovations in performance and low cost implementations that an open standard promotes.

Remoting Approach

The proposed Net2Display™ standard's goals are to develop a new remoting protocol that minimizes the complexity of the client, is an open standard, and supports long distances, high quality motion video and low response times. The proposed Net2Display™ standard makes two simplifying assumptions: the interconnection supports the Internet Protocol (IP) networking protocol, and attached I/O Devices are remoted using the Universal Serial Bus (USB) protocol.

The proposed Net2Display™ standard remotes displays by: 1) remoting the display from the Net2Display™ host to the Net2Display™ client display and 2) optionally remoting I/O devices attached to the client to the host using USB. Integrated keyboard and mouse support may be provided at the client either via USB or by directly remoting the keyboard and mouse. Additionally, a Connection Management block is present at each end of the connection

to manage the connections between Net2Display™ hosts and clients. These elements are shown in Figure 1.

The Net2Display™ host is a computer, OS instance or application capable of sourcing Net2Display™ traffic over a network. The Net2Display™ host may be an entire computer system that is interfaced remotely using the Net2Display™ remoting protocol or may be certain users, operating system partitions or applications that are remoted.

The network can be any homogeneous or heterogeneous computer interconnect, as long as that interconnect is capable of carrying Internet Protocol (IP) network traffic. The network may include Ethernet segments, WAN links, wireless networks and DSL links, or any other networking segment that supports Internet Protocol (IP) traffic.

The Net2Display™ client is a system, device or software that translates the Net2Display™ protocol into display output signals and provides for the attachment of user I/O devices. The Net2Display™ client may be a standalone display device or a software application that runs on a conventional PC.

An optional Connection Management Server provides the service of locating Net2Display™ host Computer resources for Net2Display™ clients. The network attached Connection Management Server provides the location of an available Net2Display™ host computer for a given Net2Display™ client and may be capable of processing or network load balancing across Net2Display™ hosts.

Standardization: Standardization of the display and I/O remoting will provide several benefits. One advantage that comes with the widespread adoption of the protocol is that only one remoting protocol would need to be supported, allowing simplification of the client and more commitment of functions to hardware. Currently, many thin clients support multiple remoting protocols, often RDP and ICA, preventing optimization for either. For example, full motion video bandwidth and performance could be improved by standardization to a common video compression approach supported in hardware.

Standardization allows other customer benefits. For example, Net2Display™ clients could work with a range of host server architectures and operating systems and would allow a universal means for remote computer access to PCs, workstations, server blades, and mainframes. This would provide a level playing field for innovative implementations, encouraging healthy cost and performance competition.

In addition, the proposed Net2Display™ standard would encourage the defacto standardization of USB I/O remoting. Currently, other remoting approaches make use of USB remoting, without explicitly characterizing remoting distance or performance limitations.

Simple Client: The proposed Net2Display™ standard focuses on a remoting design that makes the client as thin as possible, basically a frame buffer with support for networking, decompression and decryption, and remote USB I/O. Thus, the very thin client can be thought of as a network attached display, the reason for development of this standard within the VESA display standards group.

The concept of a network attached display simplifies home installations where many clients could share the same server or where the client could be significantly more mobile. This allows a Net2Display™ client to be built with no OS and minimal state, simplifying the client, minimizing upgrades and patches and minimizing potential viral infection. This minimization of the client will reduce maintenance and move/change/add costs and lower deskside service costs.

With an objective of providing a display-like very thin client, a simple client design will allow the lifespan of the Net2Display™ client to approach that of a conventional display. The simple client would be is independent of the host O/S and the host processor, and would only be replaced when the I/O requirements exceed the capabilities of the current client, such as adding an I/O device that requires USB 3.0 or a display resolution of 4k x 3k.

The simple design point of the Net2Display™ client reduces the client cost by reducing complexity. The simpler design also reduces the client desktop footprint and power, allowing it to be integrated into the back of displays or into adapter boxes.

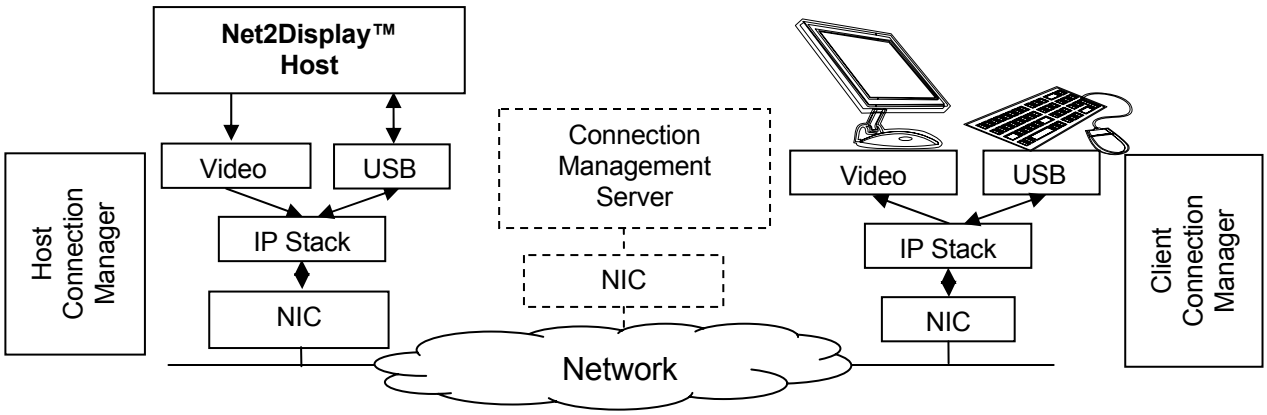

Figure 1: Net2Display(TM) Block Diagram

Despite all of the benefits of simplifying the client, simplification can also be achieved while providing increased performance. Comparisons of thin client remoting protocols have shown that simpler remoting protocols perform as well as more complex remoting protocols [7].

Higher Potential Performance: Simplification and standardization enable higher performance remoting. When a single remoting approach is selected for standardization, optimizations in implementation can be committed to hardware. While many current remoting approaches perform all server graphics in software, a standardized graphics remoting approach could work with graphics chip vendors to utilize graphics chips in the server system. This could be part of pipeline of hardware resources in the server that provide graphics, compression, encryption and networking at a higher performance.

Additionally, when the standard specifies a compression approach for full motion video, such as MPEG-4, it can be implemented in hardware, lessening the processor load and potentially providing higher performance motion video with lower network bandwidth.

If a single encryption approach can be negotiated, encryption, likewise, can be committed to hardware. With compression and encryption committed to hardware, processor loading is decreased and potential remoting performance is increased, giving lower latencies and desktop PC-like responsiveness. Additionally, as the performance approaches PC-like responsiveness, the very thin client will start penetrating more into the PC space.

Security and Robustness: The proposed Net2Display™ standard will be specified with security as a consideration. The communications channel will be protected using standardized secure networking technology. The very thin Net2Display™ client will typically be more secure than a current PC because it has no OS for exploitation by viruses or Trojan horses and the USB ports of the Net2Display™ client can be disabled for storage devices selectively by an administrator. The Server can be kept secure in a secure data center and by centrally managing OS patching and virus protection. The proposed Net2Display™ standard robustness can be enhanced over PCs by providing for hardware failover of server blades, which the Connection Management enables.

Targeted Scenarios: The proposed Net2Display™ standard is intended to support a full range of display applications from simple remote signage displays to graphics work stations. It is expected that a range of server and client implementations will be built to support the wide range in performance that is envisioned.

Net2Display™ will enable new remote display applications and will simplify the maintenance of such devices. While today, a PC or thin client often needs to be collocated with the displays and maintained, proposed Net2Display™ standard displays will incorporate the Net2Display™ client function and will simplify the remote maintenance. Some of these remote display applications include: advertising walls, airport display walls, store kiosks, ATM machines, and point of sale devices.

The proposed Net2Display™ standard is intended to be well suited for Medical environments because it does not place any of the sensitive medical data on the Net2Display™ client viewing station. A medical viewing station will typically be a display with integrated keyboard and no local patient information or external I/O ports.

Client Configurations: The proposed Net2Display™ standard client can range from an integrated display, where the client is incorporated into the display, to a full PC running the proposed Net2Display™ standard application.

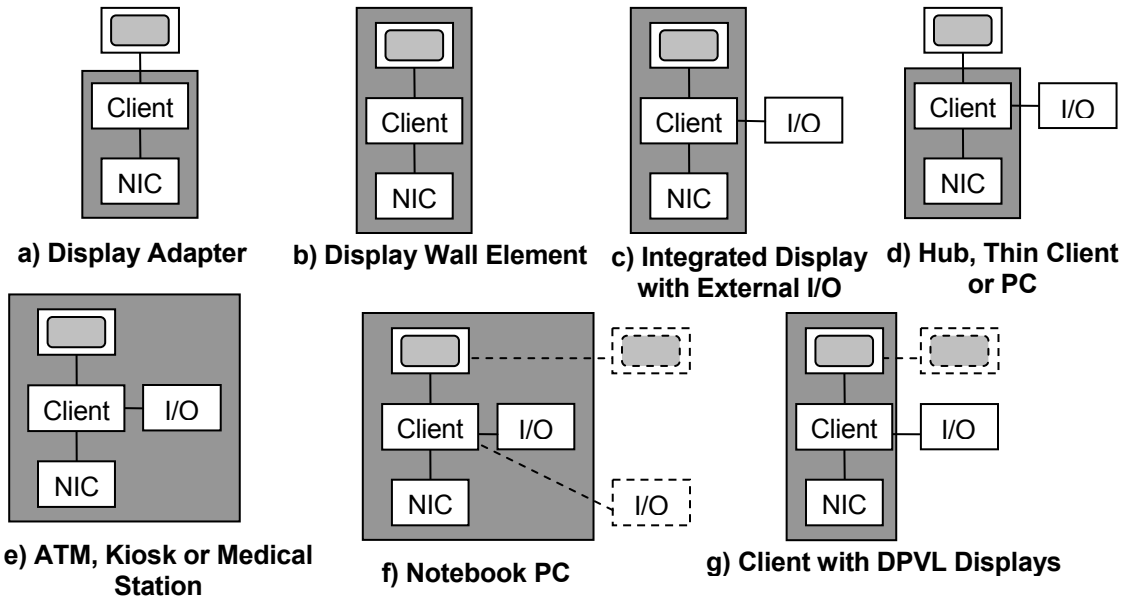

Figure 2: Client Configurations

A range of proposed Net2Display™ standard clients will be supported by specifying a number of optional features in the standard that allow a range of performance. It is intended that Net2Display™ clients can be either integrated in displays or built as a power adapter sized unit. These clients are intended to be low power, with no cooling fan required, and a footprint of less than ten square inches. The costs of these Net2Display™ clients will typically be significantly less than those of PCs or existing thin clients that often require software licenses or additional resources to support the software footprint, approaching the costs of today's displays. There will be no OS or software to be upgraded and no permanent storage in the client other than basic configuration data. Examples of Client Configurations are shown in Figure 2.

Since these Net2Display™ clients are intended to replace displays, it is imperative that these clients have a long life cycle. Typically, these Net2Display™ clients will support 100 Mbps or 1 Gbps Ethernet to provide for future compatibility. Net2Display™ clients will be designed to support a resolution and I/O bandwidth that will be sufficient for 5 to 10 years and any firmware updates to Net2Display™ client are optional and less frequent than typically every 3 years.

For compatibility in support of existing PC systems, it is intended to release an open source software version of the Net2Display™ client that will run on a standard PC as an application. It is envisioned that PCs will be able to display Net2Display™ client sessions from multiple remote Servers. Existing displays and I/O will be supported for use with the very thin clients, buy providing a sub-$100 power adapter sized Net2Display™ client box.

Higher performance clients will be possible through implementing additional Net2Display™ client options. These options include support of mouse movements locally on the Net2Display™ client via hardware cursor support. Additionally, hardware implementations of compression/ decompression and encryption/decryption will enable higher performances. Higher performance Net2Display™ clients will also allow simultaneous sessions to multiple Servers either displayed through switching or concurrently. Higher performance Net2Display™ clients will support motion video at higher resolutions and keep responsiveness well below the 100 milliseconds from mouse click to simple data updates that keep delay unnoticeable to the typical user [9]. Motion Video buffering in high performance Net2Display™ clients will allow more resiliency in the presence of high network loads.

Net2Display™ clients will use USB remoting for I/O device connections and optionally for keyboard and mouse. This will allow typical USB accessories to be connected to the Net2Display™ client, allowing most typical PC accessories, such as printers, scanners, removable storage, DVD drives, speakers and microphones. System administration can limit types of USB devices to limit removable storage for secure environments and can allow remote Server booting via client attached USB devices.

Conclusions

With these principles in mind, the proposed Net2Display™ standard has been proceeding in development through the gathering of requirements and high level architecture in the Net2Display™ Task Group. We will then progress through defining the managed information, display remoting protocol and USB transport protocol to specify the elements needed for interoperability.

We are targeting having an open software reference implementation available late in 2006 to assist in characterizing the protocols and to aid in promoting interoperability. We are working towards having a completed approved standard in 2007.

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