



## **WHITE PAPER**

# **THE FOURTH WAVE IN BUSINESS COMPUTING**

*And why you should be riding it!*

## **The Four Generations of Business Computing**

Mainframe computers of the 1950's and 60's ran batches of data and produced printed reports that were distributed to management some hours or days later. Interactive computing used text-based display terminals as well as printers and produced more timely results. Client Server brought a rich graphical environment that many users prefer, but also brought poor reliability and higher overall costs. The fourth wave, Network Computing and Thin Client Terminals, promises to improve performance, reduce cost, and vastly improve reliability of Windows applications.

### **BATCH**

Batch processing was the norm in the early days of mainframe computers. The process involved data entry by typists using card punch machines or key-to-magnetic tape, and later, key-to-magnetic disk systems. The media -- cards, tapes, or disks -- contained the input data, such as sales order information, inventory receipts, and other transactions. Programs were also stored on the same type of media. The system operator would first load the programs, then the data, and finally execute the programs, which would process the data. The output was printed on line printers and the voluminous reports were delivered to managers, usually the next day or later depending on one's rank in the organization and the priorities assigned by management.

Batch processing was slow to deliver information, but was generally reliable and accurate.

### **INTERACTIVE**

Real-time, on-line transaction processing was pioneered by Mini-Computers and was quickly followed by mainframes like the IBM System 370. The advent of Cathode Ray Tube (CRT) terminals provided the ability to display information immediately, and many printed reports were no longer necessary. The high cost of green screen CRT terminals, more than \$2000 each, limited the availability of real-time information to a relative few VIP users and data entry operators. As costs declined, CRT terminals became more popular, especially in businesses that depended heavily on real time information, such as airlines. Many large organizations, such as banks, continue to utilize a combination of batch and interactive processes to this day.

Interactive On-Line Transaction Processing (OLTP) systems were a giant step forward but used text-based, green screen displays with a limited view, 80 characters wide by 25 lines from top to bottom. This limited view was dictated by the CRT technology of the day, and display screen information was less easily read than a printed report. Many pundits predicted the demise of printers back in the 1970's, but it never happened.

Interactive Data Processing depended on large, complex machines that were able to deliver up-to-date information to relatively few users, but that information was accurate and reliable.

## **CLIENT SERVER**

Personal Computers (PCs) made their way into business environments beginning in the early 1980's. Productivity applications, such as Spread Sheets, Word Processors, and Data Base programs, allowed users to create their own reports and documents without having to deal with the "Data Processing" personnel, who could be elitist and slow to respond to end user's needs. It soon became apparent that the PC needed to access data from the central mainframe machines and to share resources such as data files and printers. Local Area Networks (LAN) became commonplace, and most users were connected to their mainframe and mini-computer host systems and the corporate database.

A few significant problems arrived with this distributed approach to data processing. Multiple versions of the corporate data existed due to manipulation by end users. Another problem was the security of that data. Data created by users was often lost because of a lack of discipline regarding backups. There is no doubt that data will be lost when a hard drive fails. The only unknown is when it will fail.

Microsoft operating systems became the standard, and with each successive version the user interface was improved, but reliability and support costs became significant problems. End users failed to manage the powerful systems deployed on their desktops and often used unauthorized and/or unlicensed software. While there is no doubt that PC applications provide the opportunity to improve worker productivity; there certainly is an equal challenge in managing these systems and how they are used.

Many people view Client Server as a failure due to the very high support costs, problems with data security, lost productivity from unauthorized applications, and fundamental lack of reliability with most Microsoft operating systems. Most of us have experienced the dreaded General Protection Faults (GPF) of Windows 3X. Microsoft Windows reliability greatly improved with the advent of XP and 2000/2003 Server, all of which evolved from Windows NT with its superior memory management capability.

Unfortunately, many of the resources freed up by reliability improvements are now being consumed by security issues and regulatory requirements, such as the federally mandated Health Industry Portability & Privacy Act (HIPPA) and Sarbanes Oxley. These laws are difficult to comply with in Client Server environment where data may be spread across multiple computers.

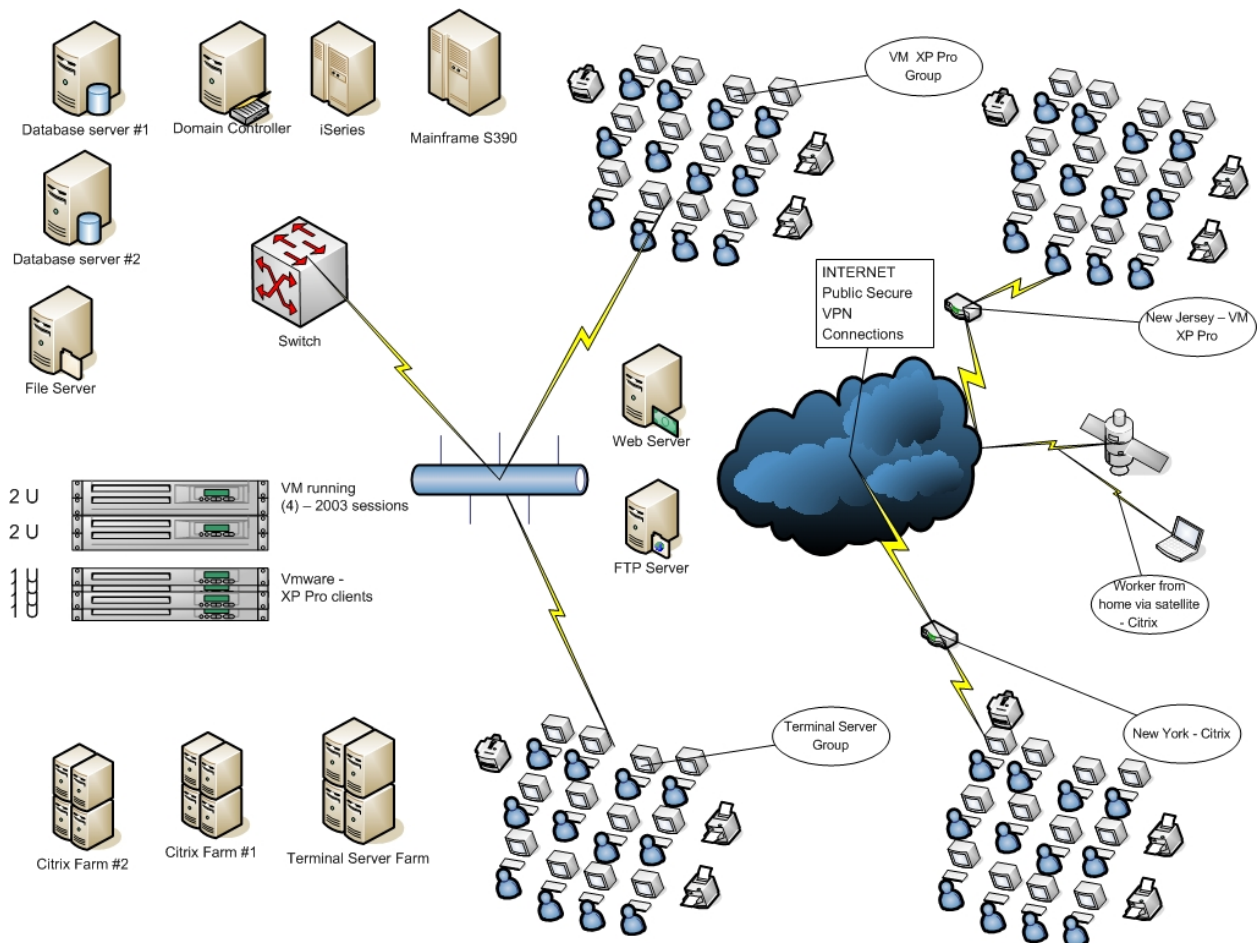
## **NETWORK COMPUTING aka THIN CLIENT COMPUTING**

Network Computing returns to the architecture of the past by deploying terminals, or Thin Clients, on the desktop instead of PCs, also known as Fat Clients. Data is stored and managed in central databases rather than being distributed across hundreds or thousands of personal computers. Thin Client terminals can take many forms. A multi-user Windows Server can support and allow conversion of Fat PCs to Thin Clients by installing software that collects inputs, such as keyboard and mouse maneuvers, and displays the screen updates processed by Windows Terminal Server. The 3270, 5250, VT, and other terminal emulations resident in the Thin Client terminal support traditional host/servers such as IBM and UNIX systems. This architecture is identical to the Interactive terminals of yesteryear, except the data is presented as a Graphical User Interface (GUI) and the communication protocol is Transmission Control Protocol/Internet Protocol (TCP/IP). Programs and data reside on one or more servers maintained by Information Technology (IT) staffers. End users are no longer responsible for data backup and applications deployment, yet they are able to run the same application programs as PC users.

Thin Client dedicated hardware platforms are small footprint machines that support industry standard PC peripherals, such as keyboard, mice, monitors, and printers. There are no local hard drives or any other moving parts. Consequently, these small units are silent and extremely reliable replacements for desktop or mobile PCs. Since all data resides on one or more servers, there is no need for the user to save or backup files. Thin Clients simply display and/or print data that has been processed by central servers so there is no chance of data loss or corruption. Dedicated Thin Client hardware is also immune to Virus and Spyware that target MS Windows PCs. Updates are infrequent and can be performed over the network and even automated if desired. Application software updates are required only at the servers, eliminating the need to upgrade each desktop system. Tech Support requirements for Thin Clients are 40 to 80% lower than PCs.

**The fourth wave, Network computing, has many hosts, now referred to as servers. Some servers are company private (Intranet), external (Extranet) or public (Internet).**

See figure 1.



**Figure 1: Fourth Wave Network Supports a Wide Variety of Servers and Clients**

Terminal-resident Thin Client software typically includes a Remote Display Protocol (RDP) client for use with Windows NT 4.0 Terminal Server Edition and Windows 2000/2003 Servers with Terminal Services, an ICA Client for use with Citrix Servers, and one or more terminal emulation clients for accessing Mainframe and Midrange-hosted applications. The RDP protocol is supported by Windows Servers and Windows XP Professional. The server versions support multiple concurrent users, typically 75 to 150, while XP supports only a single remote user.

IBM, with the OS/2 Operating System, pioneered multi-user Windows in the late 1980's. Later, the founder of Citrix left IBM and made an alliance with Microsoft, in 1989, to develop Winframe, a multi-user Windows Server based on NT 3.0. Citrix also developed Thin Client software for DOS, Windows, UNIX, and Apple PCs, allowing users to run MS Windows Applications on virtually any PC. The fundamental beauty of the Winframe server design was the fact that all applications and data files remained on the server and only screen updates and input data traversed the network. This very low bandwidth requirement was further enhanced by Citrix data compression technology allowing Windows applications to run well over low bandwidth connections, including dial-up.

Initially, Thin Client terminals were converted PCs and MACs. 1995 brought the first dedicated Thin Client terminal hardware based on small hardware boxes, usually without moving parts, with support for PC peripherals including keyboards, mice, printers, modems, etc.. These small boxes are now known as Windows Based Terminals (WBT) if they run on Windows CE; Linux Based Terminals (LBT) if they run on embedded Linux; or Network Computers (NC) if they run a different OS. WBTs account for about 70% market share.

The Thin Client market is growing at a compound annual rate of nearly 66%. That growth rate compares to 15% and declining for PCs. According to the Gartner Group, 80% of corporate PC users could take advantage of Thin Clients and do not need PCs.

## **MICROSOFT OPERATING SYSTEM SOFTWARE EVOLUTION**

Microsoft (MS) acquired and further developed its Disk Operating System (DOS) in the early 1980's. Its first major customer was IBM, who used DOS with its PC, XT, and AT machines. Later, IBM and MS parted ways briefly as MS developed Windows and IBM developed OS/2. While OS/2 had many technical innovations, IBM eventually went back to MS operating systems due to market demand.

DOS is much maligned, but it was, in fact, a very reliable OS when used, as intended, as a single-user, single-task Operating System. The trouble was with Windows 3X and Terminate and Stay Resident (TSR) programs that attempted to make multi-tasking work.

***There are only four Microsoft Windows Versions that will exhibit reasonable reliability in multi-user, multi-tasking environments: Windows NT 4.0, Windows 2000, Windows Server 2003, and Windows XP. All of the others will fail on a regular basis because of poor memory management.***

Windows 3X, 95, 98, and ME are doomed to fail because they do not properly manage the memory space used by application programs. Intel enabled "Protected Mode" memory management in 1983. PM, when enabled by the OS, absolutely prevents an application program from writing in memory outside its authorized address space. Microsoft has enabled PM on Windows NT 4.0, Windows 2000, Windows Server 2003, and XP. All of the other Windows versions will suffer from General Protection Faults and Fatal Exception Errors, especially when many windows have been opened. Protected Mode is absolutely required for reliable operation, but MS has ignored that fact while IBM and others have used a similar concept, known as Virtual Machine (VM), since the 1960's.

Microsoft Terminal Services and Citrix MetaFrame run on Windows NT Terminal Server Edition (TSE), a specially tuned version that operates as an application server as opposed to a file server.

Windows 2000 Server and Server 2003 also support multi-user Windows as application servers when the Terminal Services feature is activated. MS Terminal Services is a basic application server suitable for use over local area networks, while Citrix extensions provide better performance over low-speed networks and more sophisticated server management tools. Citrix works best in a heterogeneous environment that supports a wider variety of operating systems, hardware platforms, and connections. Remote Display Protocol (RDP) is less costly and less sophisticated than the Citrix Independent Computing Architecture (ICA) protocol.

## **TOTAL COST OF OWNERSHIP**

Total Cost of Ownership (TCO) of PCs deployed in IBM Midrange and Mainframe environments is now being recognized as a huge expense. There are a number of reasons why you should evaluate TCO in your organization:

- 1) Personal Computers and personal-computer technologies are widely used in IBM-Hosted Networks. As PCs have evolved from personal productivity tools to office automation platforms and often run mission-critical applications, the money spent on the purchase and maintenance of these desktop systems gets increased attention from the CFO and CEO in most organizations.
- 2) Industry analysts, including the Gartner Group, Meta, Forrester, and Giga are focusing on the rising costs of owning and managing PC platforms. Their reports focus on the difficult task of managing more complex and powerful PC systems performing an increased number of business-critical tasks.
- 3) Proponents of the Thin Clients position Network Computers (NC) and WBTs as solutions that require minimal management and radically reduce the cost of desktop computing, while improving reliability by deploying NT 4.0, Windows 2000, and Windows XP instead of Windows 95, 98 and Millennium Edition (Me).
- 4) PC-industry participants, such as Dell Computer, believe that lower purchase prices lead to the best value for the customer. Such vendors attempt to focus on initial purchase price alone, while ignoring the impact of life-cycle costs that increase the total cost of ownership.
- 5) Network Terminals and Windows Based Terminals using the TCP/IP communications protocol dramatically reduce wide-area network communications costs and reduce network complexity at all levels. The elimination of SNA/SDLC controllers reduces equipment costs as well as ongoing communication costs. Only a simple (inexpensive) TCP/IP router is needed at remote sites. The public Internet or a virtual private network can be used for terminal and PC traffic.
- 6) Windows NT 4.0 and Windows 2000/2003 servers are vastly more reliable than other MS Windows versions.
- 7) Thin Clients will end the technology treadmill associated with traditional PCs, which become obsolete every two years as faster and higher-capacity systems are introduced. Install Thin Clients and you will never need to upgrade the hardware, move it, or worry about theft of the device or your data. Adding or upgrading servers as necessary will accommodate new applications in the future. Performance, particularly program loading, is faster than any PC, and there will be no more Fatal Exception Errors.

## VIRTUALIZATION AND THIN CLIENTS

Virtualization is among the hottest topics in computing today. Virtual Windows desktop computers are typically created using software known as a hypervisor that partitions the hardware in a way that allows several instances of operating systems, Windows XP for example, to run a single physical machine. Now a single physical machine appears as multiple XP desktops that can be accessed by remote users running Thin Clients via the Remote Desktop Protocol (RDP). In the Virtual machine (VM) environment there is a one-to-one relationship between VM and Client. Each VM has its own IP address, MAC address, operating system, and application software. Windows Terminal Services, on the other hand, is a single machine supporting multiple users. Some software may run better in the VM environment and the user will see the more familiar XP desktop rather than a server desktop. VM is considerably more complex but offers a familiar user interface and compatibility with applications that may not run in the Windows Terminal Server environment.

The leaders in the Virtualization market are VMware, Microsoft, XENSource, SWsoft (Virtuoso), and Provision Networks (Virtual Access Suite). Thin Clients are ideal for working with virtual machines and provide security for data files and immunity from malware like viruses, worms, and spyware.

***The most important fact revealed by TCO studies is that 5-year capital costs, including hardware, software, and upgrades, are only 21% of the total costs. The initial purchase price may only be 10% of the TCO!***

## WHAT IS THIN AND WHAT IS NOT?

There is some confusion as to characteristics of a “true” Thin Client. Here are a few points that clarify the differences between Thin Client Terminals and Network PCs, like the Compaq Ipaq, for example.

<u>Feature</u>	<u>Thin</u>	<u>Fat</u>
Run any Windows Application	Yes	Yes
Access OS/400, Mainframe, UNIX and Web servers	Yes	Yes
Hard Drive	No	Yes
Run Windows 95/98/Me/NT/2000 /XP at the desktop	No	Yes
Moving parts, such as a cooling fan	No	Yes
Process data at the desktop	No	Yes
Files are transferred from the server to desktop & back	Never	Yes
Access to Windows Control Panel	Optional	Yes
Require hardware upgrades as technology changes	No	Yes
Need to be moved when the user moves	No	Yes
User needs to perform file maintenance	No	Yes

## **COMPARE 100 PCs WITH 100 WINDOWS BASED TERMINALS**

We know that Windows NT 4.0 and Windows 2000 are reasonably reliable due to the implementation of the memory management technique known as Protected Mode. Therefore, our comparison assumes a deployment of Windows 2000 because Windows 35/95/98/Me are not reliable and will experience GPF and FPE problems, lock ups, and numerous tech support calls.

### **100 PC NETWORK**

102 Pentium processors, 2 on servers, 100 on desktops  
54GB Total RAM  
4.5TB Total disk storage  
Windows XP Pro license cost = \$29,900  
MS Office licenses = 100  
Upgrade locales = 101  
Upgrade time = 19 days  
Users with access to OS settings = 100  
Mechanical devices = 500+

### **100 WBT NETWORK**

8 on 2 x 4 way servers  
21GB RAM  
1TB total disk storage  
Client Access Licenses = \$8,000  
MS Office licenses = 100  
Upgrade locales = 1  
Upgrade time = 1 day  
Users with access = 0  
Mechanical devices = 26

The above comparison reveals significant initial and long-term savings when using WBTs to deploy reliable Windows XP applications, and to access traditional 3270, 5250, DEC and UNIX hosts. WBTs can also work with Web-enabled applications by using a local browser option. Significant communication savings and network simplification results from the use of the TCP/IP Internet protocol instead of IBM's System Network Architecture (SNA).

Affirmative Computer Products specializes in products for the IBM AS/400/iSeries and Mainframe user, as well as mobile wireless devices used with data collection applications. We manufacture, sell, and support specialty keyboards and Thin Client Terminals, and we provide related consulting services.



**202 South River Drive  
Tempe, AZ 85281**

**TOLL FREE (888) 353-5250**  
**PHONE (480) 946-1444**  
**FAX (480) 946-9250**  
**EMAIL [sales@affirmative.net](mailto:sales@affirmative.net)**  
**WEB [www.affirmative.net](http://www.affirmative.net)**