Server-Based Computing: A Scalability Study on Dell Servers

By Fred Gonce

This article presents the results of a scalability study of Citrix® MetaFrame XP™ deployed on Dell® PowerEdge® servers. The study tests the use of Microsoft® Office applications on MetaFrame XP servers to determine the proper server size for the customer's environment.

Citrix® MetaFrame XP™ is an application-serving software that streamlines application management for IT departments. IT administrators install applications—and any updates to those applications—only on the MetaFrame XP server, instead of on each user's system. All users within the network can then access the applications on the MetaFrame XP server over any connection.

Dell® Solution Enablement Labs tested the scalability of this software on Dell PowerEdge® servers running Microsoft® Windows® 2000 Server and Advanced Server with Terminal Services. Microsoft Office 2000 applications provided a common set of tasks for the study, which can serve as a reference for most deployments.

MetaFrame XP runs on top of Windows 2000 Server with Terminal Services to provide additional functionality for deploying and managing Windows applications. Terminal Services technology enables Windows 2000 to support multiple, simultaneous client sessions and uses Remote Desktop Protocol (RDP) to provide connectivity for clients to the server. Citrix MetaFrame XP uses the Citrix Independent Computing Architecture (ICA®) protocol to provide connectivity from any client over any network access to the Windows applications running on a MetaFrame XP server.

Preparing for MetaFrame XP deployment

To ensure the best performance of the Citrix MetaFrame XP software in a large enterprise environment, administrators planning a deployment should consider several factors about the servers being deployed and the users involved. The MetaFrame XP scalability study addresses the issue of server size. Administrators also should determine the most appropriate server configuration and network environment for the deployment. In addition, they should evaluate how users will access the MetaFrame XP server and the applications on that server as well as how users will interact with those applications.

Scaling PowerEdge servers for MetaFrame XP

The following sections discuss several variables that affect Citrix MetaFrame XP server scalability. A high-performance SCSI subsystem and server-quality network interface cards (NICs) are recommended for the server configuration. The applications being hosted will determine the amount of memory required and the correct processors needed for the server.

Memory

Depending on the server software configuration, the administrator implementing the MetaFrame XP deployment should reserve about 200 MB for the operating system (OS). The memory required for user applications is linear so the administrator should configure the server with enough memory for the number of supported users. That is:

Total memory = OS memory + (number of users × memory per user)

Processors

Calculating the number of users that a single server can support is more difficult because multiple factors influence this number.

The applications being hosted and the way users access these applications will influence the numbers of users supported per processor. Simply adding more processors does not achieve linear scalability—a four-way server will not support twice as many users as a two-way server and an eight-way server will not support twice as many users as a four-way server.

Storage

Since many users access the storage subsystems, the storage system should provide sufficient throughput for the planned deployment. Creating shared directories on a SCSI file system is probably the most economical option for a small server-based computing deployment. For larger deployments, a Dell network-attached storage (NAS) system provides a more robust and scalable solution.

Network

Although server-based computing provides users with a low-bandwidth connection to applications on remote servers, administrators must plan this network carefully. They should pay careful attention to the connection from the client to the server and from the server to the storage. During the pilot phase, the administrator should test the latency of the deployment network and the responsiveness of applications to validate that the existing infrastructure will provide acceptable performance to users.

Considering user needs

The way users access a server and use applications in a server-based computing model influences the success of the deployment as well as the server and network performance requirements. Because logging into a server consumes a significant amount of server resources, the rate at which clients connect and disconnect to the server will affect the total number of users the server can support.

How users will access and interact with the applications on the MetaFrame XP server is critical. In fact, user perception of application performance significantly contributes to the deployment success. When considering application access, administrators should determine how the applications will be hosted: whether applications or the desktop will be published. CPU- or memory-intensive applications will reduce the number of supported users because of the substantial resource requirements.

Server	Physical memory	Processors	Disk	Network card
PowerEdge 1550	2 GB	Intel Pentium III 866 MHz	Two 18 GB RAID-1	100 Mbps
PowerEdge 2550	2 GB	2 Intel Pentium III 1 GHz	Two 18 GB RAID-1	100 Mbps
PowerEdge 6450	4 GB	4 Intel Pentium III Xeon 700 MHz	Two 18 GB RAID-1	100 Mbps
PowerEdge 8450	4 GB	8 Intel Pentium III Xeon 700 MHz	Two 9 GB RAID-1	Two 100 Mbps

Figure 1. Hardware configuration of Dell PowerEdge servers

Although a server-based computing model can support many types of users, the more mixed an environment, the more difficult the deployment. When considering users' interaction with the applications on the MetaFrame XP server, administrators should be aware of the different types of users within a deployment environment. This MetaFrame XP scalability study defined two types of users:

- **Standard user.** A user who accesses a single application and may open and close it only a few times during the workday
- **Advanced user.** A user who accesses multiple applications, switches between applications, and opens and closes these applications several times within an hour

The MetaFrame XP scalability study

Keeping the influencing factors in mind, administrators can use the results from the Citrix MetaFrame XP scalability study as a reference for any deployment of MetaFrame XP on Dell PowerEdge servers.

Testing methodology

Since many methodologies exist for testing MetaFrame XP software, the testing process of the Dell scalability study was documented to serve as a reference for planning a deployment and for performance tuning and troubleshooting during the deployment.

The Dell team chose common Microsoft Office 2000 applications to act as an application baseline and defined two types of users (standard and advanced) to clarify the scalability variable. The team tested the performance of the Office 2000 applications on PowerEdge servers running MetaFrame XP and then compared the numbers of users supported by each of the PowerEdge servers.

Test environment

The Dell study involved four PowerEdge servers: PowerEdge 1550, 2550, 6450, and 8450. Figure 1 details these server configurations.

The Dell team made several configuration changes to the Windows 2000 Server installation to improve performance for the scalability study. It is important for administrators implementing MetaFrame XP to use hardware on the Microsoft Hardware Compatibility List (HCL) and then make these adjustments to Windows 2000 servers running MetaFrame XP:

- Set page file size to MIN=MAX
- Set background processing
- Increase registry size to 90 MB
- Limit the number of supported protocols per server
- Lock in NIC speed

	Standard user	Advanced user
Test scenario 1*	1. Open Microsoft Word 2. Create form letter 3. Spell check the document 4. Close Word 5. Repeat scenario	1. Open Microsoft Word and Microsoft Excel 2. Create form letter in Word 3. Spell check the document 4. Create mailing list in Excel 5. Merge form letter with mailing list 6. Close Word and Excel 7. Start test scenario 2
Test scenario 2	N/A	1. Open Excel and Microsoft Access 2. Create mailing list 3. Create database 4. Create entries in database 5. Import data into Excel mailing list 6. Close Excel and Access 7. Repeat test scenario 1

**Duration of each test scenario was 18 minutes.*

Figure 2. Test scenarios for standard and advanced users

- Verify that the event log contains no errors after installation of all software
- Verify that all hardware was defined during installation
- Format system partitions with Microsoft Windows NT® file system (NTFS)
- Document the installation process
- Use hardware RAID-1 or RAID-5
- Disable services that are not required

Each PowerEdge server (except the PowerEdge 1550 and 2550, which had Windows 2000 Server with Terminal Services installed) had the following software installed:

- Microsoft Windows 2000 Advanced Server with Terminal Services
- Citrix MetaFrame XP 1.0
- Microsoft Office 2000
- Microsoft Office 2000 Resource Kit
- Citrix Server Test Kit

The client software included Windows 2000 Professional with ICA client and ICA client launcher. The network configuration for the test environment used 100 Mbps Ethernet.

Test scenarios

The Microsoft Office 2000 application programs selected for the MetaFrame XP scalability study included Microsoft Word 2000, Microsoft Excel 2000, and Microsoft Access 2000. These programs were used to test CPU and memory utilization. Standard user testing involved one scenario with Word; advanced user testing involved two scenarios with Word/Excel and Excel/Access. The clients connected to the server at 30-second intervals. See Figure 2.

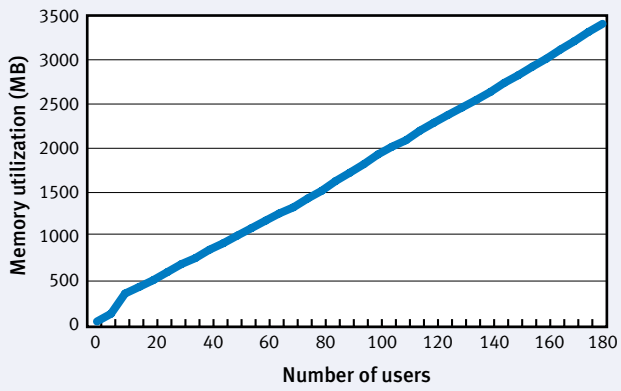

Figure 3. Memory utilization for standard users

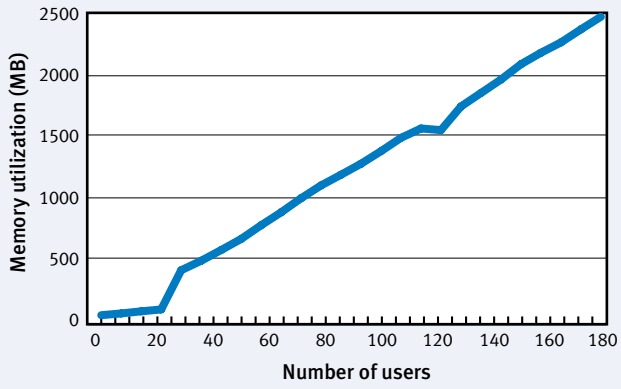

Figure 4. Memory utilization for advanced users

A standard user required 19 MB of total memory and 12 MB of physical memory (Figure 3). An advanced user required 28 MB of total memory and 19 MB of physical memory (Figure 4). Each application required the following memory:

- Memory per ICA client ~15 MB
- Microsoft Word 2000 ~4.0 MB
- Microsoft Excel 2000 ~5.5 MB
- Microsoft Access 2000 ~7.5 MB

Test results

As expected, the percentage of CPU utilization directly correlated to the Dell PowerEdge server used and the number of users involved (Figure 5). The PowerEdge 8450 showed 70 percent CPU utilization for 180 standard users whereas the PowerEdge 6450 reached that mark with 125 standard users. The PowerEdge 2550 reached 74 percent CPU utilization with

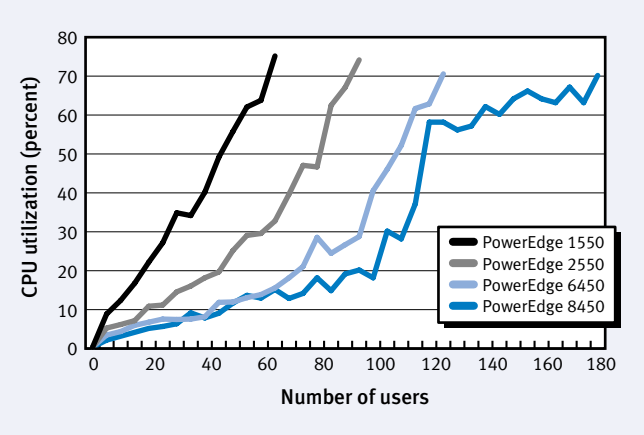

Figure 5. CPU utilization for standard users on PowerEdge servers

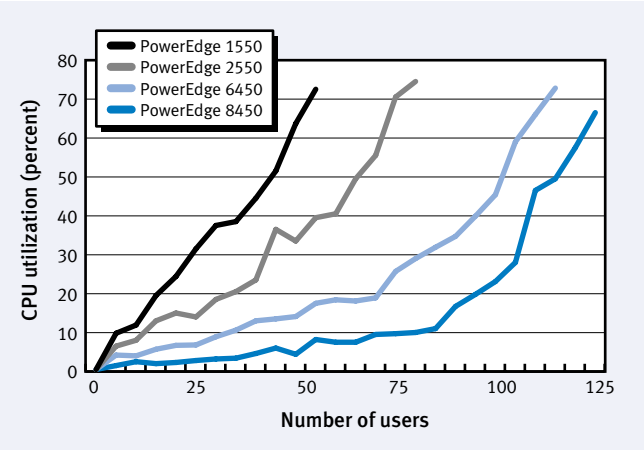

Figure 6. CPU utilization for advanced users on PowerEdge servers

95 standard users; the PowerEdge 1550 reached 75 percent with 65 standard users.

Tests with advanced users show similar differences between servers (Figure 6). The PowerEdge 8450 reached 66 percent CPU utilization with 125 advanced users, the PowerEdge 6450 reached 72 percent utilization with 115 users, the PowerEdge 2550 reached 74 percent with 80 users, and the PowerEdge 1550 reached 72 percent with 55 users.

These results show that the type and number of clients within an environment should determine the size of PowerEdge server used when deploying Citrix MetaFrame XP.

Applying study results to an actual deployment

Administrators can reference this Citrix MetaFrame XP scalability study to plan a MetaFrame XP deployment on Dell PowerEdge servers. Because many factors contribute to the performance of the MetaFrame XP software on PowerEdge servers, it is important to consider carefully all variables and nuances of a particular environment, particularly the following factors.

Scaling. For organizations that anticipate scaling to a large number of users (more than 100), it is easy to deploy PowerEdge 1550 or 2550 in a server farm and increase the number of PowerEdge servers as needed. Administrators should carefully monitor this type of deployment to determine whether and when more servers are required to meet user performance needs.

Memory. Although planning memory utilization is easy when all users accessing the MetaFrame XP server are using the same application, most environments have multiple applications and mixed users that range from standard to advanced. This mixed environment makes it important for administrators to monitor resource utilization during a pilot test and into deployment to determine the amount of memory required by the applications and users.

Network. The Citrix ICA protocol provides an effective method to connect clients and servers, even in low-bandwidth deployments. For large server-based computing deployments, administrators should determine the number of users that local area network (LAN) and/or wide area network (WAN) connectivity can support; large amounts of data may be moving between the servers and the storage, making sufficient bandwidth between servers a necessity.

Processor. If deploying processor-intensive applications in a MetaFrame environment or in an environment that requires significant memory, administrators may want to select a PowerEdge 6450 that supports four Intel® Pentium® III Xeon™ processors and up to 8 GB of memory using Windows 2000 Advanced Server.

Dell recommends that administrators perform a pilot test of MetaFrame XP before the actual deployment to determine how the software will perform in the planned environment.

Following these guidelines and applying the results of the scalability study should facilitate the deployment of Citrix MetaFrame XP on Dell PowerEdge servers.

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FOR MORE INFORMATION

Citrix MetaFrame XP on Dell PowerEdge servers: http://www.dell.com/downloads/us/pedge/citrix.doc

Citrix MetaFrame XP: http://www.citrix.com