MetaFrame Solutions Guide

Citrix® MetaFrame Application Server for Windows 2000 Servers

Version 1.8

Citrix Systems, Inc.

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Contents

Welcome

The *Citrix MetaFrame Solutions Guide* is designed to:

- Show you some of the many ways MetaFrame 1.8 for Windows 2000 Servers can be used to meet common requirements
- List some of the products that have been found to be compatible with MetaFrame
- Help you select the proper hardware and software components to build a system running MetaFrame with Windows 2000

Who Should Use this Guide

This guide is designed to help administrators and resellers with the installation, setup, and operation of MetaFrame.

How to Use this Guide

The chapters of the *MetaFrame Solutions Guide* roughly reflect the phases you go through when you deploy a MetaFrame solution:

Chapter	Contents
Chapter 1, “What Is MetaFrame?”	Introduces you to the components of Citrix’ server-based computing solution and provides ideas for planning your deployment.
Chapter 2, “Deploying the MetaFrame Servers and ICA Clients”	Provides installation tips, system configuration guidelines, and information about popular third-party hardware devices.
Chapter 3, “Installing Applications”	Describes the special requirements for multiuser applications and the installation of many popular third-party software applications.
Chapter 4, “Securing the Enterprise”	Describes techniques and third-party applications that you can use to secure your systems.
Chapter 5, “Connecting to the Web”	Introduces Citrix Web Computing and details supported Web browser and server software.
Chapter 6, “Maintaining MetaFrame”	Contains tips about fine tuning MetaFrame systems and instructions for applying service packs and hotfixes.
Chapter 7, “Troubleshooting the System”	Gives step-by-step instructions for diagnosing problems on MetaFrame servers.

Note

The products listed in this guide have been tested and found to be compatible with MetaFrame. Many other products work well with MetaFrame but Citrix cannot guarantee the compatibility of untested products.

Because MetaFrame runs on Windows 2000, most compatible applications can be expected to work. Review the application notes in Chapter 3 for detailed application integration tips and techniques.

Some application notes in this guide were supplied by third parties and are noted as such.

Disclaimer

This guide is not intended to be a comprehensive listing of all the third-party components that can be used with Citrix MetaFrame. MetaFrame supports industry-standard hardware and software; therefore, many options exist far beyond those contained in this guide.

Citrix makes no claim as to the suitability of products mentioned in this guide to fit your needs. All third-party products may be available through multiple suppliers. The products and suppliers listed are for reference purposes only and are subject to change without notice.

If you encounter a compatibility problem with any product listed in this guide, contact the product vendor for technical support.

Conventions

The following conventional terms, text formats, and symbols are used throughout the printed documentation.

Convention	Meaning
Bold	Indicates boxes and buttons, column headings, command-line commands and options, icons, dialog box titles, lists, menu names, tabs, user input, and menu commands.
Italic	Indicates a placeholder for information or parameters that you must provide. For example, if the procedure asks you to type *filename*, you must type the actual name of a file. Italic also indicates new terms and the titles of other books.
ALL UPPERCASE	Represents keyboard keys; for example, CTRL, ENTER, F2.
`Monospace`	Represents text displayed at the command prompt and text file contents.
▶	Indicates a procedure.

Convention	Meaning
▪	Indicates a list of related information, not procedural steps.
WINNT or %SystemRoot%	Refers to the Windows 2000 system tree. This can be \WTSRV, \WINNT, \WINDOWS, or whatever other directory name you specify when you install Windows 2000.
{braces}	Enclose required items in syntax statements. For example, **{ yes | no }** indicates that you must specify **yes** or **no** when using the command. Type only the information within the braces, not the braces themselves.
[brackets]	Enclose optional items in syntax statements. For example, [*password*] indicates that you can choose to type a *password* with the command. Type only the information within the brackets, not the brackets themselves.
| (vertical bar)	Stands for "or" and separates items within braces or brackets. For example, **{ /hold | /release | /delete }** indicates that you must type **/hold** or **/release** or **/delete**.
… (ellipsis)	Indicates that you can repeat the previous item(s) in syntax statements. For example, **/route:***devicename*[,…] indicates that you can specify more than one device, putting commas between the device names.

Finding More Information About MetaFrame

Your MetaFrame package includes the following printed documentation:

- The CD liner notes includes an overview of the product, Citrix support information, and instructions for activating your Citrix software licenses.
- The *MetaFrame Administrator's Guide* tells administrators how to install, configure, and maintain MetaFrame servers.
- The *Citrix ICA Client Quick Reference Cards* give users step-by-step instructions for using the Citrix ICA Clients to connect to Citrix servers and run published applications.

Your MetaFrame software includes the following online documentation in WinHelp format in the *MetaFrame Books Online*:

- The *MetaFrame Solutions Guide* gives administrators detailed information about planning, deploying, and configuring server-based computing solutions using MetaFrame, the Citrix ICA Clients, and a wide variety of third-party hardware and software.
- The *Citrix ICA Client Administrator's Guides* tell administrators how to install, configure, and deploy the various ICA Clients to end-users.
- The online version of the *MetaFrame Administrator's Guide.*

▶ **To access *MetaFrame Books Online***

Click **Start**, point to **Programs**, then **MetaFrame Tools**, and click **MetaFrame Books Online**.

All of the documentation for MetaFrame is also available in Adobe PDF format in the documentation directory of your MetaFrame CD-ROM. Using the Adobe Acrobat Reader, you can view and search the documentation electronically or print it for easy reference. To download the Adobe Acrobat Reader for free, please go to Adobe's Web site at http://www.adobe.com.

Important Please consult the Readme.txt file in the root directory of your MetaFrame CD-ROM for any last-minute updates, installation instructions, and corrections to the documentation.

Finding Information About Windows 2000

Most Windows 2000 compatibility guidelines can be applied to Citrix MetaFrame because MetaFrame is designed to run with Windows 2000. For example, MetaFrame supports the deployment of Win32, Win16, DOS, OS/2 1.x (text only), and POSIX applications. The MultiWin and ICA technologies included in MetaFrame extend the capabilities of Windows 2000 and, in some cases, require additional set up and configuration for best results with applications.

For Windows 2000 compatibility information, see the following Microsoft resources:

- The Microsoft Web site at http://www.microsoft.com
- Microsoft Technet

Citrix on the World Wide Web

Citrix offers online Technical Support Services at http://www.citrix.com that include the following:

- Downloadable Citrix ICA Clients, available at http://download.citrix.com
- A Frequently Asked Questions page with answers to the most common technical issues
- An FTP server containing the latest service packs and hotfixes for download
- An Online Knowledge Base containing an extensive collection of technical articles, troubleshooting tips, and white papers

- Interactive online support forums
- The Citrix Developer Network (CDN) available at http://www.citrix.com/cdn

  This new, open enrollment membership program provides access to developer tool kits, technical information, and test programs for software and hardware vendors, system integrators, ICA licensees, and corporate IT developers who incorporate Citrix server-based computing solutions into their products.

Citrix Technical Support Bulletin Board Service

The Citrix Technical Support Bulletin Board Service is fully integrated with Citrix Online Technical Support Services. Customers without Web or e-mail access can dial in to the Citrix BBS at (954) 267-2590. Communication parameters are: no parity, 8 data bits, 1 stop bit, up to 28,800 baud.

Year 2000 Readiness

For a detailed description of the Year 2000 Readiness of Citrix products, see our Web site at http://www.citrix.com/misc/y2000.htm.

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CHAPTER 1

What Is MetaFrame?

This chapter gives you an executive summary of MetaFrame and describes:

- The challenges of deploying applications across the enterprise
- What server-based computing is
- The components of Citrix' server-based computing solution
- MetaFrame's features and benefits
- Citrix partnerships and compatibility
- Planning considerations for a MetaFrame solution

Enterprise Application Challenges

MIS managers face the daunting task of deploying client/server Windows applications across enterprise networks that can easily grow to regional, national, or global proportions. Unfortunately, traditional client/server technologies rarely rise to the enterprise-wide challenges faced by MIS. In fact, the established approaches usually hinder strategic application deployments by inflating costs, complicating management, and performing poorly.

Traditional client/server application architectures and the accompanying deployment models established by distributed PC-based LANs, remote control, and remote node technologies all fail to deliver fast, inexpensive, efficient application deployments. The problem is inherent to traditional client/server architecture, which emphasizes client-side computational power. In today's widely distributed enterprises, the client/server model breaks down as the client moves farther away from the server, yet is required to perform the same tasks as a local machine.

Organizations seeking to broadly deploy line-of-business applications across the enterprise face a diverse set of challenges associated with cost, management, and performance:

- **LAN-Locked Applications**. Most business applications, such as two-tier client/server, are designed for the LAN and are not optimized to run over high-latency phone or WAN connections that run 100 to 1000 times slower than a local segment.
- **New Users**. Today's corporate computing infrastructure is built for employees, not a company's prospects, customers, and suppliers.
- **Heterogeneous Clients**. Not everyone uses or needs a PC on the desktop. Some use non-Windows systems such as OS/2, UNIX, or Macintosh. Some need low-cost, fixed function devices, such as terminals. Others need new devices such as wireless tablets and personal digital assistants (PDAs).
- **Management**. Managing access (security), version control (maintenance), system configuration (moves, adds, deletes), and support (help desk) are very costly, particularly for distant users.

MIS rarely has the luxury of deploying mission-critical applications in a homogeneous environment, let alone from a centralized location. Instead, the enterprise network usually includes a widely dispersed variety of servers, client workstations, and operating systems. A variety of wide area connections joins remote office LANs throughout the nation or the world. The user base can include from dozens to thousands of local, remote, mobile, and telecommuting users.

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What Is Server-Based Computing?

Server-based computing is a logical, efficient evolution of today's networking environments that gives organizations a way to extend resources, simplify application deployment and administration, and lower the total cost of application ownership.

With server-based computing, applications are deployed, managed, supported, and executed completely on a server. Client devices, whether "fat" or "thin," have instant access to business-critical applications on the server, without application rewrites or downloads. Because server-based computing works within the current computing infrastructure and standards, it is rapidly becoming the most reliable way to reduce the complexity and total cost of enterprise computing.

Server-based computing relies on three critical components:

- A **multiuser operating system** that allows multiple concurrent users to log on and run applications in separate, protected sessions on a single server.
- A **remote presentation services architecture** capable of separating the application's logic from its user interface, so that only keystrokes, mouse clicks, and screen updates travel the network.

  MetaFrame uses Citrix' ICA, which enables virtually any client device to access virtually any application over any type of network connection. Unlike the Network Computing (NC) architecture, server-based computing does not require applications to be downloaded to client devices. As a result, application performance is neither bandwidth- nor device-dependent.
- **Centralized application and client management**, which enables enterprises to overcome the critical application deployment challenges of management, access, performance, and security.

Citrix Server-Based Computing

Citrix' server-based computing solution consists of:

- MetaFrame Application Server for Windows
- The Citrix ICA Clients
- Citrix Services

MetaFrame Application Server for Windows

MetaFrame Application Server for Windows incorporates Citrix' Independent Computing Architecture (ICA) protocol and provides a high-performance, cost-effective, and secure way to deploy, manage, and access business-critical applications throughout an enterprise, regardless of client device or network connection. With this innovative software, enterprises can:

- Bring server-based computing to heterogeneous computing environments and provide access to the most powerful 32-bit Windows-based applications, regardless of client hardware, operating platform, network connection, or protocol
- Offer enterprise-caliber server and client management that allows IS professionals to scale, deploy, and support applications from a single location
- Provide a seamless user experience at the desktop, delivering a wide variety of applications with exceptional performance that is independent of bandwidth

Citrix MetaFrame brings server-based computing to the entire enterprise, including headquarters, branch offices, and remote users, and extends the capabilities of Windows 2000 Servers for departmental and workgroup environments. It offers IS professionals a cost-effective way to deploy, manage,

and support applications from a single point. It provides universal application access from virtually any type of client device. It ensures bandwidth-independent performance with any type of network protocol or connection, and offers unique features for enhanced application management and security.

MetaFrame provides:

- **Support for heterogeneous computing environments**
  While Windows 2000 supports Windows-based devices and IP-based connections, MetaFrame goes further, providing universal access to Windows-based applications regardless of client hardware, operating platform, network connection, or LAN protocol. As a result, organizations can keep their existing infrastructures while still deploying the most advanced 32-bit Windows-based applications across the enterprise.
- **Enterprise-scale management**
  Organizations building enterprise computing solutions around Windows 2000 will benefit from the robust enterprise management tools of MetaFrame, including increased system scalability and simplified support of multiple applications for thousands of users enterprise-wide. Servers can be added easily and transparently without touching user desktops. Applications can be deployed and administered across multiple servers from a single location.

  Not only does MetaFrame provide the ability to train users of heterogeneous clients on the latest Windows-based applications, it also allows administrators to control user access to client resources, thereby maintaining system integrity and network performance. To secure corporate information, MetaFrame keeps all vital data and applications on the server, allowing it to be accessed without downloading.
- **Seamless desktop integration**
  MetaFrame goes beyond Windows 2000 by offering increased functionality and enhanced user experience, including complete access to all local system resources, such as full 16-bit stereo audio, local drives, COM ports, and local printers. Applications running remotely from the server look, feel, and perform as though they are running locally. With MetaFrame, users enjoy a comfort level that eliminates the need for training and increases user productivity.

The Citrix ICA Clients

Citrix is continually expanding its offering of ICA Clients to support the growing need for access to Citrix servers from almost any type of device. Among the supported ICA Client platforms are:

32-bit Windows The Citrix ICA Client for Win32 supports Windows 95, Windows 98, Windows NT, and Windows 2000, and offers features that take advantage of the robust capabilities of the client machine. The Program Neighborhood provides users customized views of applications published throughout the enterprise that they are authorized to access.

16-bit Windows The Citrix ICA Client for Win16 supports Windows 3.1 and Windows for Workgroups 3.11, leveraging older, less powerful Windows PCs and providing their users access to 32-bit applications.

DOS The Citrix ICA Client for DOS includes versions for both 16- and 32-bit extended DOS machines. The 32-bit version provides more features than the 16-bit version, while requiring less conventional memory.

Web plug-ins The Citrix ICA Windows Web Clients are available as ActiveX and Netscape plug-ins that Web masters can incorporate into Web pages for Internet or Intranet access to applications running on Citrix servers.

Java The Citrix ICA Client for Java can run in both applet and application mode. As an applet, the Java client can be embedded in a Web page, like the Web plug-in clients. As an application the Java client supports client platforms that include a resident Java virtual machine (JVM).

Macintosh The Citrix ICA Client for Macintosh supports Macintosh PCs running System 7.1 or later and extends remote application access to Macintosh users.

UNIX The Citrix ICA Client for UNIX includes versions for Linux, SCO, Digital UNIX, HP-UX, IBM AIX, SGI IRIX, and Sun Solaris.

Windows CE The Citrix ICA Client for Windows CE is integrated into products manufactured by our OEM partners, including manufacturers of windows-based terminals, hand-held devices, and Windows CE Professional devices.

For more information on the types of products available, see our Web site at http://www.citrix.com.

For specific details about the features, installation, and administration of the clients, see the *Citrix ICA Client Administrator's Guides* for the clients you plan to deploy.

Citrix Services

Citrix offers a variety of server add-ons that enhance the scalability, manageability, and reach of MetaFrame and the Citrix ICA Clients:

- Load Balancing Services
- SecureICA Services
- DirectICA Services
- Installation Management Services
- Resource Management Services
- VideoFrame
- License Packs

Load Balancing Services

Citrix Load Balancing Services gives you the ability to scale a single MetaFrame server into a multi-server farm. With load balancing, you can publish an application to be run on any subset of servers in a Citrix server farm. When an ICA Client user starts a remote session on the Citrix server and launches a load balanced application, that user is automatically connected to the least busy server in the farm. With Load Balancing Services, you can:

- Balance application load among both MetaFrame and *WINFRAME* servers
- Adjust the criteria used to determine server load

SecureICA Services

SecureICA Services contains features to enhance the security of data communication across any type of connection supported by MetaFrame. SecureICA Services uses the RC5 encryption algorithm from RSA Data Security, Inc. The MetaFrame server and the Citrix ICA Client use the Diffie-Hellman key-agreement algorithm with a 1024-bit key to generate RC5 keys.

DirectICA Services

Citrix DirectICA for MetaFrame adds support for multi-VGA adapters to Citrix MetaFrame Application Server for Windows. A *multi-VGA adapter* (also called a *multiconsole adapter*) is a hardware device that contains several VGA video adapters with additional support hardware. Each multi-VGA adapter appears to the server as several VGA video adapters, each with an accompanying keyboard, mouse, and optional serial and parallel ports, depending on the manufacturer and

model. The only limit to the number of multi-VGA adapters that you can install is your license count.

The combination of a keyboard, mouse, and monitor attached to a port on the multi-VGA adapter is referred to as a *DirectICA station*. MetaFrame treats connections associated with DirectICA stations much like the system console; the devices (serial and parallel ports) associated with the DirectICA station are on the server computer itself. Any serial or parallel ports associated with a DirectICA station are given unique device names and are treated as ports on the server computer. Because the ports are on the server, DirectICA stations do not support drive mapping, COM port mapping, or printer mapping.

For more information about DirectICA, see the *MetaFrame Administrator's Guide*.

Installation Management Services

Citrix Installation Management Services lets you simultaneously install an out-of-the-box application on all Citrix servers in a farm from a single point without manual intervention. You can install applications on servers regardless of their physical locations, network connection type, or individual hardware setup.

Resource Management Services

Citrix Resource Management Services is the only application and systems management product designed specifically for Citrix servers. RMS provides full-feature management tools for analyzing and tuning MetaFrame, *WINFRAME*, Terminal Server, and Windows 2000 systems.

VideoFrame

VideoFrame provides on-demand streaming video support over a wide range of bandwidths to ICA Clients running on Windows platforms.

License Packs

When you first purchase MetaFrame, you get one or more base licenses for an initial user count. MetaFrame uses server-based concurrent licensing, which determines the number of users that can log onto your server at any given time.

As your user base grows, you can purchase license packs from Citrix to expand your user count.

Citrix MetaFrame License Packs come in 5-, 10-, 20-, and 50-user versions.

For more information about Citrix licensing, including how to pool user counts from multiple servers, see the *MetaFrame Administrator's Guide.*

MetaFrame's Features and Benefits

MetaFrame offers benefits to both IS management and end-users. Version 1.8 provides a range of new features to further simplify application deployment and access.

IS Management Benefits

MetaFrame provides a number of features that ease the burden on MIS:

- **Economy**. MetaFrame supports multiple concurrent users on a single processor and offers free, unlimited client software licensing, making it a cost-effective solution for enterprise-wide application delivery.
- **Enterprise Scalability**. Symmetrical multiprocessing (SMP) hardware compatibility enables MetaFrame to support hundreds of concurrent users.
- **Extensive Connectivity**. MetaFrame connects users to the network through standard telephone lines, WAN links (T1, T3, 56Kb, X.25), broadband connections (ISDN, Frame Relay, ATM), or the Internet.
- **Single-Point Application Management**. With MetaFrame, all application upgrades and additions are made only once at the server and are instantly available to all remote users.
- **End-to-End Management**. Using MetaFrame, administrators can set up applications, view active sessions, monitor system performance and events, troubleshoot problems, and create reports from the server. MetaFrame also allows administrators to use popular network management tools, such as Microsoft Systems Management Server and SNMP managers.
- **Remote Administration**. System administrators can dial-up to the Citrix server for remote administration and management.
- **Remote Support and Training**. Administrators can connect to a remote user's session to visually see what is on the screen and interact with the user, making MetaFrame a valuable remote support and training tool.
- **Seamless Network Integration**. MetaFrame integrates into NetWare, Windows NT, Novell, and other PC networks, allowing administrators to quickly set up users from existing domain or bindery information.
- **Security**. The MetaFrame security tools enhance the standard Windows 2000 security features by providing additional methods for securing file systems.

End-User Benefits

MetaFrame also improves the end-user's experience through:

- **Fast Application Access**. The Citrix ICA Clients give remote users fast access to any type of application, including DOS and 16- and 32-bit Windows programs, whether productivity applications, traditional client/server applications, or in-house mission-critical applications.
- **Local/Remote Transparency**. MetaFrame provides all the familiarity of a local LAN desktop. Remote users have complete access to all local system resources such as notebook drives, remote printers, and clipboards. Users can also cut and paste between local and remote applications and drag-and-drop to copy files in the background while they continue to work.
- **Integrated Desktops**. From a single desktop, remote users can run applications locally from the notebook PC or remotely from the Citrix server for best performance.
- **Easy Setup**. With its Windows 95-like installation and setup wizard, ICA Clients are easy to install for Windows 3.1, Windows for Workgroups, Windows 95, Windows 98, Windows NT, and Windows 2000. The wizard guides users through all the necessary installation steps and automatically detects the PC's available modem.
- **32-Bit Windows Application Availability**. Remote users gain immediate access to Windows 95 and Windows NT applications, regardless of their client hardware. MetaFrame enables even DOS-based 286 systems to run Windows 95 applications at near-LAN speeds over low-bandwidth connections.

Features Included in 1.8

- **Program Neighborhood**. Program Neighborhood introduces a new metaphor for user application access that replaces Remote Application Manager for the Citrix ICA Win32 Client and delivers access to centrally deployed applications. With the introduction of Program Neighborhood, server-based applications can be pushed to the Program Neighborhood client, integrated into the local 32-bit Windows desktop, or pushed directly to the client's Start menu.

  Similar in concept to Windows Network Neighborhood, Program Neighborhood provides total administrative control of applications by providing users with dynamic access to published applications. Not only do users have an enhanced server-based application experience, but also no client configuration is required. Program Neighborhood provides complete administrative control over application access and local desktop integration.

- **SpeedScreen**. SpeedScreen builds on the intelligent agent technology, introduced in MetaFrame 1.0, that reduces the transmission of frequently repainted screens. In comparison with MetaFrame 1.0, bandwidth consumption is reduced, on average, by 25-30% and total packets transmitted is cut by up to 60%, resulting in significant improvements in measured speed on restricted bandwidth connections.

  SpeedScreen furthers the user experience with consistent performance regardless of network connection by reducing latency and improving the feel of the server-based application.

- **Installation Management Services (IMS) Ready**. The Installation Management Services option gives Citrix administrators the ability to centrally manage software replication across Citrix server farms. You can run an application's installation routine just once per platform, then deploy the application to each server in the farm automatically.

  This innovative system services option for MetaFrame offers administrators an excellent alternative to manually installing and configuring the same application on multiple Citrix servers. Administrators can now more easily and cost-effectively deploy applications to thousands of users across the enterprise.

- **Video Ready**. VideoFrame in conjunction with MetaFrame 1.8 enables the production and deployment of custom video applications to 32-bit Windows ICA Clients using an innovative intelligent compression and a streaming extension to the ICA protocol.

  By integrating VideoFrame into a Citrix server farm, administrators can now deploy custom video applications to any 32-bit Windows desktop, on demand, while maintaining consistent performance across any network connection, regardless of available bandwidth.

- **ICA Browser Management**. With ICA Browser management, part of the enhancements to Citrix Server Administration, administrators now have the ability to control browser parameters such as backup ICA Browsers, ICA Gateways, and update and refresh intervals. Administrators can also configure which servers always attempt to become the master ICA browser.

  ICA Browser management simplifies browser administration through an intuitive user interface for better system scaling and management.

- **License Pool Recovery**. Citrix has introduced a new backup licensing feature to better manage pooled licenses across the server farm. With this feature, you can define the number of backup servers to which user licensing data is replicated.

  This addition to Citrix license pooling provides a greater level of fault tolerance across multiple Citrix servers.
- **Client Device Licensing**. This feature allows a user to establish multiple sessions to multiple servers while consuming only a single pooled license for each session.

  Client device licensing reduces IT organizations' total cost of ownership (TCO) by providing seamless access to multiple applications across multiple servers, without incurring additional licensing costs.

Partnerships and Compatibility

Citrix has an ongoing program of application compatibility testing; however, we recommend that you contact the application vendors for information about MetaFrame compatibility. The Citrix-Compatible program and the Citrix Business Alliance program supply much of the information found in this guide.

The Citrix-Compatible Program

The Citrix-Compatible program enables software and hardware manufacturers to showcase their products or services as compatible with Citrix products.

Citrix-compatible products are listed in this guide. This guide is available for download on the Citrix World Wide Web site (http://www.citrix.com). Some members of the Citrix-Compatible program also include product brochures and special offers in the Citrix Solutions Provider handbook distributed in every Citrix Solutions Network (CSN) training class.

Citrix Business Alliance Partners

Members of the Citrix Business Alliance program provide the technology building blocks for solutions that include high-performance servers, flexible communications infrastructures, robust client-server development tools, and turnkey corporate applications. This program is composed of leading industry vendors who work with Citrix to develop innovative new products and markets for server-based computing.

Planning Considerations for a MetaFrame Solution

Before you begin the rest of the book, here are some sample questions to help you analyze your system requirements, along with some possible answers:

- What business problem are you trying to solve?
  - Remote e-mail access while traveling
  - Branch office access to large client/server applications (for example, human resources)
  - Streamline order entry process
  - Improve customer service
- What computing platform and applications are you using?
  - NetWare
  - Oracle database
  - PowerBuilder application on Windows desktops
- How many users need access? How many concurrent users? How long will a typical connection last?
  - 100 users total, 25 concurrent connections, 30 minutes
- What application server(s) are you planning to use?
- How will you connect to the application server?
  - Async Dial-In
  - Remote node (Microsoft RAS or third-party remote node software)
  - LAN
  - WAN (leased line, Frame Relay, ISDN, ATM)
  - Internet
- What client hardware/software will you be using?
  - 486DX/2 Windows notebook, 12MB RAM, Shiva PPP dialer supporting IP and IPX
- What are the functional requirements for a remote user?
  - Interactively access Microsoft Office, client/server applications, 3270 connectivity to mainframe applications
  - Print e-mail, documents, reports to client printer
  - File transfer between clients and servers
  - Security issues like dial-back, firewalls, third-party security hardware, etc.
- What are the performance requirements?
  - Ten seconds to look up a record
  - Type ahead limited to 2–3 characters for 50 WPM typist

- What is the time frame for initial pilot and full deployment?
  - Thirty day pilot, full deployment in the following 60 days
- Have the resources been allocated for this project?
  - Budget approved
  - Project manager and internal resources assigned
  - Professional systems integrator/Citrix authorized reseller engaged
- Who are the decision makers?
  - Director of MIS: budget approval, overall responsibility
  - Vice President of Finance: signoff on success criteria and final OK
  - Project Manager: "owns" the project
- How will we support the system once it is in place?
  - Disaster and recovery plans
  - Maintenance plans
  - Capacity planning and evaluating future needs

CHAPTER 2

Deploying the MetaFrame Servers and ICA Clients

The first phase of putting a MetaFrame solution into production is to deploy your servers and clients. To do so, you need to go through these steps:

1. Decide on your server hardware and peripheral devices.
2. Decide how your MetaFrame servers should fit into your NT domains.
3. Install Windows 2000 with Terminal Services.
4. Install MetaFrame.
5. Create a server farm and add your MetaFrame servers to it.
6. Preconfigure modem support for your end-users.
7. Install the clients and any custom configuration files.

This chapter includes information to assist you with these steps.

For help with	See
Step 1	"Sample Server Configurations" and "Server Hardware Device Notes"
Step 2	MetaFrame Servers and NT Domains
Step 3	Installing Windows 2000 Server with Terminal Services
Step 4	Installing MetaFrame
Step 5	Creating Server Farms
Step 6	Client Modem Support

For step-by-step instructions on installing the ICA Clients, see the *Citrix ICA Client Administrator's Guides* for the clients you plan to deploy.

Sample Server Configurations

Hardware compatible with Microsoft Windows 2000 Server and MetaFrame is listed in the *Microsoft Windows 2000 Hardware Compatibility List (HCL).* The following table shows several sample hardware configurations suitable for deploying MetaFrame servers in an enterprise environment.

Note This is not a comprehensive list of compatible platforms and is presented solely to provide examples of known good configurations. No endorsement of any particular manufacturer is implied.

Server Make/Model	System BIOS	CPUs	Disk Controller	Network Adapter
Acer Altos 21000		(4) PIII-500MHz Xeon	Adaptec 7896 U2	Intel 82557-based 10/100
Amdahl Envista Series	AMI V.1.00.05.CD0	(4) PP200	Mylex DAC960PD Disk Array Controller, (2) AIC 7870 v.1.26s emb_PCI	Intel 82557-based 10/100 Ethernet PCI
Compaq Lightning MAC B2 *		(8) 500MHz PII Xeon	Compaq Integrated Smart Array/42xx	Compaq NC3131 Dual Port UTP Fast Ethernet
Compaq Proliant 800	P14 8/19/98	(2) PII-450	SimBios SCSI-3	Compaq Netelligent 10/100 TX PCI UTP Controller 2.3
Compaq Proliant 2500	E24 09/18/96	(1) PP-200	Symbios Logic 875XSID, 2280 PCI SCSI	Compaq Netelligent 10/100 TX PCI UTP Controller 2.3
Compaq Proliant 3000	P09 11/25/98	(1) PII-450	Compaq Wide-Ultra SCSI	Compaq Netelligent 10/100 TX PCI UTP Controller 2.3
Compaq Proliant 5000 Server	E16 12/30/96	(4) PP-200	Symbios Logic 875XSID PCI SCSI	Compaq Netelligent 10/100 TX PCI UTP Controller 2.3
Compaq Proliant 5500 Server	P12 11/20/98	(1) PII-400	Compaq Wide-Ultra SCSI	Compaq Netelligent 10/100 TX PCI UTP Controller 2.3
Compaq Proliant 6000 Server	E20 05/16/97	(2) PP-200	(2) Symbios Logic C810 PCI SCSI	Compaq Netelligent 10/100 TX PCI UTP Controller 2.3
Compaq Proliant 6500 Server	P11 11/13/98	(4) P6-400	Compaq Wide-Ultra SCSI	NIC 3122 PCI Dual 10/100
Dell Optiplex Gx1	Phoenix v1.49 2/17/98	(2) PII-400	Adaptec AIC-7890/7880	3COM 3C590 Extended
Dell Power Edge 4100/200 *	Phoenix 4.05 va05	(2) PP-200	Adaptec 7880, 7860, PE RAID 2	Intel EtherExpress Pro 100B

Server Make/Model	System BIOS	CPUs	Disk Controller	Network Adapter
Dell Precision 410 MT	Phoenix v1.49 2/17/98	(1) PII-400	Adaptec AIC-7880/7890	3COM 3C905B-TX 10/100
Hewlett Packard NetServer E/40	Phoenix 4.05.8	(1) PP-200	Adaptec AHA2910/AIC785x Pci SCSI v.1.24	3Com 3C595
IBM Netfinity 3000	IBM PC BIOS 3/8/98	(1) PII-350	Adaptec AHA-2940U/AHA-2940UW Pci SCSI	Intel 8255x-based PCI Ethernet card (10/100)
IBM Netfinity 3500 *	IBM PC BIOS 3/20/98	(2) PII-333	Adaptec AIC-7895 v1.31	IBM Etherjet 10/100
IBM Netfinity 5000	Surepath v1.06Rev9	(2) PII-450	IBM ServerRAID v3.10.08	AMD PC NET 10/100
IBM ServeRAID Netfinity 5500 *	Surepath 05/12/98	(2) PII-350	IBM ServerRAID v2.70.04	AMD PCNET 10/100
IBM Netfinity 7000 *	AMI BIOS 1.00.14.CDO	(4) PP-200	IBM ServeRAID Adapter (3.0.01), Adaptec AIC-78xx PCI SCSI	3COM Etherlink XL 10/100 (Not part of server package)
IBM Netfinity 7000 M10 (8680-2RU) *	IBM Netfinity BIOS 9/19/98	(4) PII-400 Xeon	IBM ServeRAID Adapter (BIOS ver. 2.23.7), (2) Adaptec AHA2240U/UW Dual (AHA-394XAU/UW/AUWD) PCI SCSI	Intel-82557 (EtherExpress Pro) Embedded
IBM PC Server 330 *	SurePath 10/22/97	(2) PP-200	IBM ServeRAID 2.23.7, Adaptec 7880 v.1.26s1	AMD PCNET
Intergraph Interserve	AMI v2.0 1996	(4) PP-100	Adaptec AIC-7860, Megaraid v1.06	Intel-82557 (EtherExpress Pro) 10/100
NCR	Phoenix 2.00.00.040	(8) PP-200	Adaptec AIC-7880 PCI SCSI	SMC9332BDT
NetPower Sparta Series	AMI 1.00.06.CD0	(2) PP-200	(2)Adaptec PCI 7880 v1.25, Adaptec AHA-2940U/2940UW PCI SCSI 2.23.7	Intel Pro 100B 82557
Sequent NTS-2000	AMI 1.00.07.CD0	(4) P6-200	Mylex DAC 960 v1.29. 4MB, (2) AIC-7880U PCI SCSI	SMC 9332/9334 BDT 10/100

* Additional information about these systems is included below.

Server Hardware Device Notes

This section contains notes for popular server hardware devices.

Compaq Lightning MAC B2

This application note describes how to install Citrix MetaFrame and Microsoft 2000 Datacenter Server on a Compaq Lightning MAC B2 server.

Software Requirements

- Microsoft Windows 2000 Datacenter Server
- MetaFrame Version 1.8 for Windows 2000
- Compaq Softpaq for Microsoft Windows 2000

Before Installation

1. Obtain the Compaq Softpaq for Microsoft Windows 2000 from the Compaq Web site at http://www.compaq.com/support/files/server/softpaqs or by contacting Compaq Support.
2. Create the four Softpaq support diskettes by following the online instructions.

Installing Windows 2000 and MetaFrame

1. Insert the Windows 2000 Datacenter Server CD-ROM, turn on the machine, and when prompted, press any key to boot from the CD.
2. Press **F6** to install third-party mass storage controllers when prompted from the Windows 2000 Setup screen.
3. Press **S** to specify additional SCSI adapters when prompted to do so.
4. When prompted for a manufacturer-supplied hardware support disk, insert Compaq Softpaq diskette #2 into drive A and press ENTER. Select Compaq Integrated Smart Array Controllers and press ENTER to continue.
5. See the *Microsoft Windows 2000 Server Installation Guide* to complete the installation.
6. Insert the MetaFrame Version 1.8 for Windows 2000 CD-ROM and choose MetaFrame Setup from the list of on-screen options.
7. See the *MetaFrame Installation Guide* to complete installation and setup.

Dell PowerEdge 4100/200

This application note describes how to install MetaFrame on a Dell PowerEdge 4100 system.

The Dell PowerEdge series systems are high-speed, upgradeable PC servers designed around the Intel Pentium Pro family of microprocessors. The PowerEdge 4100 systems provide both Extended Industry-Standard Architecture (EISA) and high-performance Peripheral Component Interconnect (PCI) expansion slots. The

PowerEdge 4100 series comes in two models: the 4100/180 equipped with one or two 180MHz Pentium Pro processors (each with 256KB of Level 1 cache) and the 4100/200 equipped with one or two 200MHz Pentium Pro processors (each with 512KB of Level 1 cache). The 4100 series has an upper limit of 1GB of RAM. Optionally, the 4100 can be equipped with the Dell PowerEdge RAID II controller.

Software Requirements

- MetaFrame Version 1.8 for Windows 2000
- Microsoft Windows 2000 with Terminal Services
- Dell Server Assistant CD-ROM Version 1.30 or later

Installing MetaFrame

1. Insert the Dell Server Assistant CD-ROM into the CD-ROM drive of the PowerEdge 4100 and power on the Dell machine. The Dell Server Assistant software boots from the CD-ROM. From the Dell Server Assistant CD-ROM menu, select **Create Diskettes**. Follow the instructions on-screen to create the Dell support diskettes.
2. Install Windows 2000 following the directions in the Microsoft documentation. When Setup displays all recognized SCSI controllers, if the PowerEdge RAID II Controller is installed in the PowerEdge 4100, press **S** to install the Dell PowerEdge RAID II Controller drive
3. Insert the Dell PowerEdge Drivers diskette that was created in Step 1 and click **OK**.
4. Complete Windows 2000 installation.
5. After the system reboots, log on to the Windows 2000 console as an administrator.
6. Insert the MetaFrame compact disk into the CD-ROM drive and begin installing MetaFrame following the instructions in the Citrix MetaFrame documentation.

Installing the Dell PowerEdge RAID II Controller Console

1. Install the PowerEdge RAID II Console after Windows 2000 installation is complete.
2. From the console, log on as an administrator.
3. Insert the Dell PowerEdge RAID II Controller Driver diskette into drive A.
4. Type **a:\setup** in the text box of the **Run** menu and press ENTER to begin installation. Follow the displayed instructions.
5. When installation is complete, the PowerEdge RAID II Console is added to the Programs folder in the administrator's **Start** menu.

IBM Netfinity 3500

This application note describes how to install MetaFrame on an IBM Netfinity 3500 system. IBM Netfinity 3500 servers are the new generation foundations for your networked computing and e-business needs today and into the future.

Software Requirements

- MetaFrame Version 1.8 for Windows 2000
- Microsoft Windows 2000 with Terminal Services installed
- SCSI-7800 Device Drivers, Version 2.11 or later

Installing MetaFrame

1. Obtain the SCSI-7800 Device Driver and Utilities Version 2.11 by contacting IBM Support or visiting the IBM Web site at http://www.pc.ibm.com/servers
2. Install Windows 2000 following the directions in the Microsoft documentation.
3. When prompted to autodetect mass storage controllers, press ENTER to detect the Atapi Version 1.2 IDE CD-ROM controller.
4. Press **S** to configure additional SCSI controllers.
5. Expand the list of SCSI controllers, select **Other** (located at the end of the list), and press ENTER.
6. Insert the SCSI-7800 Device Driver/Utilities Diskette and click **OK**. The device drivers on the diskette are displayed. Select the Adaptec AIC-78xx driver for Microsoft Windows NT 4.0 and press ENTER to continue.
7. Complete Windows 2000 installation.
8. After the system reboots, log on to the Windows 2000 console as an administrator.
9. Insert the MetaFrame compact disk in the CD-ROM drive and choose **MetaFrame Setup** from the list of on-screen options.
10. Install MetaFrame following the instructions in the Citrix MetaFrame documentation.

IBM ServeRAID Netfinity 5500

This application note describes how to install MetaFrame on an IBM ServeRAID Netfinity 5500 system. The IBM Netfinity 5500 server has the power, scalability, and manageability for today's complex network systems demands. There is support for two-way SMP integral tape drives and the ultra-fast 10,000-rpm hard disk drives. Fully in step with Intel's processor technology, Netfinity 5500 is the powerful and reliable foundation upon which you can run your business-critical applications.

Software Requirements

- MetaFrame Version 1.8 for Windows 2000
- Microsoft Windows 2000 with Terminal Services installed
- IBM PC ServeRAID Device Driver and Utilities (Version 2.0 or later)

Installing MetaFrame

1. Obtain the IBM PC ServeRAID Device Driver and Utilities Version 2.00 by contacting IBM Support.
2. Install Windows 2000 following the directions in the Microsoft documentation.
3. When prompted to autodetect mass storage controllers, press **S** to detect the Atapi Version 1.2 IDE CD-ROM controller.
4. Press **S** to configure additional SCSI controllers.
5. Expand the list of additional SCSI controllers, select **Other** (located at the end of the list), and press ENTER.
6. When prompted for a driver diskette, insert the IBM PC ServeRAID Adapter Device Driver/Utilities Diskette and press ENTER. The device drivers on the diskette are displayed. Select the IBM PC ServeRAID Adapter driver and press ENTER to continue.

   The ServeRAID Adapter **must** be installed first or the installation process will hang.
7. Complete Windows 2000 installation.
8. After the system reboots, log on to the Windows 2000 console as an administrator.
9. Insert the MetaFrame compact disk in the CD-ROM drive and choose **MetaFrame Setup** from the list of on-screen options.
10. Install MetaFrame following the instructions in the Citrix MetaFrame documentation.

IBM Netfinity 7000

This application note describes how to install Windows 2000 and MetaFrame on an IBM Netfinity 7000 system.

The IBM Netfinity 7000 is a high-performance, symmetric multiprocessing (SMP) server that is ideally suited for networking environments requiring superior microprocessor performance, efficient memory management, flexibility, and large amounts of data storage, utilizing hot-swap drive bays for added reliability. The IBM Netfinity 7000 provides both Extended Industry-Standard Architecture (EISA) and high-performance Peripheral Component Interconnect (PCI) expansion slots.

Software Requirements

- MetaFrame Version 1.8 for Windows 2000
- Microsoft Windows 2000 with Terminal Services installed
- IBM PC ServeRAID Device Driver and Utilities (Version 2.82 or later)

Installing MetaFrame

1. Obtain the IBM PC ServeRAID Device Driver and Utilities Version 2.82 by contacting IBM Support or visiting the IBM Web site at http://www.pc.ibm.com/servers
2. Install Windows 2000 following the directions in the Microsoft documentation.
3. During Setup, press **S** to manually configure SCSI controllers.
4. Expand the list of SCSI controllers, select **Other** (located at the end of the list), and press ENTER.
5. When prompted for a driver diskette, insert the IBM PC ServeRAID Adapter Device Driver /Utilities Diskette and press ENTER. The device drivers on the diskette are displayed. Select the IBM PC ServeRAID Adapter driver and press ENTER to continue.

   The ServeRAID Adapter **must** be installed first or the installation process will hang.
6. Press **S** to configure additional SCSI controllers. Select Adaptec AHA294x/AIC78xx and IDE CD-ROM (ATAPI v1.2 PCI).
7. Complete Windows 2000 installation.
8. After the system reboots, log on to the Windows 2000 console as an administrator.
9. Insert the MetaFrame compact disk in the CD-ROM drive and choose **MetaFrame Setup** from the list of on-screen options.
10. Install MetaFrame following the directions in the Citrix MetaFrame documentation.

IBM Netfinity 7000 M10 (86802RU)

This application note describes how to install Citrix MetaFrame and Microsoft Windows 2000 on an IBM Netfinity 7000 M10 system.

The IBM Netfinity 7000 M10 is a high-performance, symmetric multiprocessing (SMP) server that is ideally suited for networking environments requiring superior microprocessor performance, efficient memory management, flexibility, and large amounts of data storage, utilizing hot-swap drive bays for added reliability. The IBM Netfinity 7000 M10 provides both Extended Industry-Standard Architecture (EISA) and high-performance Peripheral Component Interconnect (PCI)

expansion slots. The M10 adds the processing power of up to four Intel Pentium II Xeons.

Requirements

Software Requirements

- MetaFrame Version 1.8 for Windows 2000
- Microsoft Windows 2000 with Terminal Services installed
- Adaptec 7800 Family Manager Set for Windows NT 4.0, Version 3.01 or higher
- IBM ServeRaid Adapter Device Drivers, Version 3.00.18 or higher
- IBM 100/10 EtherJet PCI Adapter Device Drivers, Version 2.5 or higher
- S3 Incorporated Video Adapter Device Drivers, Version 3.24.10 or higher

Hardware Requirements

- External SCSI cable (IBM Part No. 76H3589)
- External half-high SCSI storage enclosure (IBM Part No. 3510020)
- Netfinity 4.51G 10K Wide Ultra SCSI hard disk drive (IBM Part No. 01K8009)

Before Installation

1. Obtain the required device drivers by contacting IBM Support or visiting the IBM Web site at http://www.pc.ibm.com/servers.
2. Create boot diskettes. At a DOS prompt, type **winnt32 /ox** from the \I386 directory on the Windows 2000 CD-ROM and follow the on-screen instructions.
3. Install the Netfinity hard disk drive in the external SCSI enclosure and connect it to the Adaptec SCSI controller card's external port using the SCSI cable.

Installing Windows 2000 and MetaFrame

1. Insert boot disk #1, turn on the machine, and follow the on-screen instructions.
2. When prompted to autodetect mass storage controllers, press **S** to skip mass storage detection.
3. Press **S** to configure additional SCSI adapters.
4. Expand the list of additional SCSI adapters, select **Other** (located at the end of the list), and press ENTER.
5. When prompted for a driver diskette, insert the IBM ServeRaid Device Drivers diskette and press ENTER. Select the IBM ServeRaid Adapter and press ENTER to continue.

6. Press **S** to configure additional SCSI adapters, select **Other**, and press ENTER.
7. When prompted for a driver diskette, insert the Adaptec 7800 Family Manager Device Drivers diskette and press ENTER. Select the Adaptec AIC-78XX PCI SCSI controller (NT 4.0) and press ENTER to continue.
8. Press **S** to configure additional SCSI adapters. Expand the list of additional SCSI adapters, select the IDE CD-ROM (ATAPI 1.2)/PCI IDE controller, and press ENTER to continue.
9. When prompted to choose where to install Windows 2000, select the external (non-RAID) hard disk drive and press **C** to create a partition.

Note It is recommended that you create a 1000MB partition for the installation of Windows 2000, leaving the bulk of the hard disk to be used for the page file.

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10. Refer to the Microsoft documentation to continue the installation.
11. From the **Network Adapters** dialog box, click **Select from list…** to display the **Select Network Adapter** dialog box.
12. Click **Have Disk…** and insert the IBM 100/10 EtherJet PCI adapter diskette. Click **OK** to continue.
13. Select the IBM 100/10 EtherJet PCI adapter and click **OK** to continue.
14. Refer to the Microsoft documentation to complete the installation.
15. Insert the MetaFrame Version 1.0 CD-ROM and choose **MetaFrame Setup** from the list of on-screen options.
16. See the MetaFrame *Administrator's Guide* to complete installation and set up.

Video Card Adapter Installation

During system installation, the standard video driver supplied with Windows 2000 is automatically installed. To obtain larger screen sizes and video color depth, you must install the manufacturer's supplied video driver. The following procedure describes how to install the correct video driver.

1. Click Start, select **Settings**, then click Control Panel.
2. In Control Panel, double click **Display**.
3. Select the **Settings** tab and then click the **Display Type...** button.
4. In the **Adapter Type** field, click the **Change...** button. The **Change Display** dialog box appears.
5. Click the **Have Disk...** button.
6. Insert the new display driver diskette into drive A, then click **OK**.
7. From the list of displayed S3 devices, select your S3 device.

8. From **Third-party Drivers**, click **Yes** to proceed. If you receive the message "The driver is already installed on the system" and are asked to use the current or new drivers, click **New**.
9. If prompted for the driver diskette a second time, click **Continue**.
10. When you receive the message "The drivers were successfully installed," remove the display driver diskette, then click **OK**.
11. Click **Close** twice.
12. Click **Yes** to reboot the server.

IBM PC Server 330

This application note describes how to install MetaFrame on an IBM PC Server 330 system.

The IBM PC Server 330 is a high-speed, upgradeable PC server-class system with large data storage capacity and improved system expandability. The PC Server 330 provides both Extended Industry-Standard Architecture (EISA) and high-performance Peripheral Component Interconnect (PCI) expansion slots.

Software Requirements

- MetaFrame Version 1.8 for Windows 2000
- Microsoft Windows 2000 with Terminal Services installed
- IBM PC ServeRAID Device Driver and Utilities Version 1.40

Installing MetaFrame

1. Install Windows 2000 following the directions in the Microsoft documentation.
2. When prompted whether to autodetect mass storage controllers , press **S** to skip mass storage detection and **S** again to specify additional SCSI adapters.
3. Insert the IBM ServeRAID Device Driver and utility diskette, press ENTER until the IBM PC ServeRAID Adaptor is displayed. Press ENTER to accept the driver and then press ENTER to continue.
4. Complete Windows 2000 installation.
5. After the system reboots, log on to the Windows 2000 console as an administrator.
6. Insert the MetaFrame compact disk into the CD-ROM drive and begin installing MetaFrame following the instructions in the Citrix MetaFrame documentation.

MetaFrame Servers and NT Domains

Citrix strongly recommends against installing MetaFrame 1.8 for Windows 2000 Servers on a network domain controller. Also, it is strongly recommended that you do not promote a MetaFrame 1.8 server to a domain controller. Therefore, it is recommended that the network have other redundant servers— without MetaFrame 1.8 for Windows 2000 Servers installed— that can be promoted to domain controllers if necessary.

Significant restrictions and limitations will result from installation of MetaFrame 1.8 on a Windows 2000 Server that is configured as a domain controller or promoted to a domain controller. The restrictions and limitations include the following:

- Anonymous groups and user accounts are deleted from a server that is promoted to a domain controller
- All non-administrator users are locked out and cannot access the server
- Demoting a server from a domain controller does not guarantee that access will be restored to non-administrator users and groups
- Demoting a domain controller places the server in a workgroups setting

Installing Windows 2000

You must install and configure Windows 2000 before you install MetaFrame. Before you install Windows 2000, make sure the following information is available:

- The types of SCSI adapters and devices on your servers
- The types of network adapters you plan to use and any disks that were provided by the vendors

Note Windows 2000 cannot be installed on drives altered with a compression utility.

You can install Windows 2000:

- Using the Windows 2000 boot diskettes
- Over an existing Windows NT or a Terminal Server/MetaFrame installation using the Winnt32.exe program
- From a DOS prompt using the Winnt.exe program

Tip Citrix recommends using the boot diskettes provided with Windows 2000 to perform the installation because you can then partition and format the target hard disk drives as necessary. The other two methods do not support reformatting of the drive containing the installation files.

Use one of the other methods only if you do not have a CD-ROM drive on the server and want to perform the installation across the network. In that case, boot the server in DOS, format the system partition, and then install Windows 2000 across the network, converting the drive to NTFS from FAT in the process.

If the installation disks, also called boot diskettes, that are supplied with Windows 2000 are misplaced or lost, you can create them on an existing Windows NT, Windows 2000, *WINFRAME,* or MetaFrame server using either the Makeboot.exe or MakeBT32.exe executable from the Windows 2000 CD, as follows:

1. Have four blank, formatted, high-density 3.5-inch floppy disks ready. Label the formatted disks “Setup Boot Disk,” “Setup Disk#2,” “Setup Disk#3,” and “Setup Disk#4.”
2. Insert the Windows 2000 CD in the CD drive.
3. At a command prompt, change to the \Bootdisk directory on the CD-ROM.
4. Once in this directory, type either **Makeboot** or **MakeBT32** and press ENTER.
5. When prompted, insert the Setup Boot Disk in drive A. After some files are copied, you are prompted to insert Setup Disk #2, Disk #3, and then Disk #4.

To install a fresh copy of Windows 2000 using the boot diskettes, perform the following steps:

1. Insert the Windows 2000 Setup Boot Disk into the server’s drive A and start the server.

   An installation screen appears.
2. Setup gives you a choice of autodetecting the mass storage devices or selecting them manually. In the latter case, Setup allows you to manually select SCSI adapters, CD-ROM drives, and special disk controllers by pressing **F6** for installation. Citrix recommends that you allow Setup to autodetect the devices.
3. Insert disks #2 through #4 in drive A. Setup loads the drivers for Windows 2000 installation to boot Windows NT.

4. From the **Setup Notification** dialog box, press ENTER to continue the installation.
5. Press ENTER to continue the installation, **R** to repair an installation, or **F3** to quit the entire process.
6. Press ENTER to continue the installation.

   The End User License Agreement (EULA) is displayed. Read the EULA and press **F8** if you accept the terms and conditions in the agreement.
7. Setup performs a search to detect any previous installations of Windows NT, Windows 2000, or Terminal Server. If you are installing a fresh copy of Windows 2000, press **N** for new installation.
8. You are asked for a traget location to install Windows 2000. You can create or delete partitions at this point.
9. Select the newly created partition or an existing partition as the target and press ENTER.
10. You can choose to format this partition as either FAT or NTFS. To restrict and audit user access, Citrix recommends formatting the partition as NTFS.
11. When format is complete, files are copied to the server. Setup has completed the text-based portion of the installation. Remove any disks and CDs from their drives and press ENTER to restart the computer.
12. The server restarts with the GUI setup. Follow the on-screen prompts to install and configure Windows 2000, keeping the following in mind:
    - Install all the protocols for which you will be creating ICA connections. To minimize resource allocations, install only the protocols required.
    - Install the Terminal Server service.
    - Setting up Windows 2000 as a domain controller causes greater load on the server because it must authenticate domain logons and maintain the directory database for a domain.
    - Do not install screen savers because they create unnecessary load.
    - Install only the Windows 2000 services that you need.
    - Create an Emergency Repair Disk for your system. Do not forget to update this disk after making changes to your system configuration; for example, after renaming drives when installing MetaFrame.

Installing MetaFrame

If you are deploying only one or two MetaFrame servers, a typical interactive installation, running Setup.exe on each server, is fine. However, if you have a large number of servers to deploy, you may prefer to use unattended setup.

You can run an unattended setup to perform a new installation or an upgrade of a MetaFrame server without being present. Unattended setup mode uses an optional answer file to provide answers to the questions asked during Setup. If you do not use an answer file, or if you use an answer file but do not specify answers to some questions, default answers are used for those questions.

You can accommodate a variety of server configurations by creating multiple answer files and tailoring them to the specifics of each type of server you are deploying. Similar server configurations require only minor changes in the answer files.

For step-by-step instructions about installing MetaFrame and additional information about unattended installation, see the *MetaFrame Administrator's Guide*.

Creating Server Farms

Published applications:

- Give ICA Client users easy access to applications running on Citrix servers
- Increase your control over application deployment
- Shield users from the mechanics of the Windows NT server environment hosting the ICA session

The Citrix utility Published Application Manager, with its support for server farms and Program Neighborhood, is the main tool for publishing applications.

When you publish applications, user access to those applications is greatly simplified in three areas:

- **Addressing**. Instead of connecting to a Citrix server by its IP address or server name, ICA Client users can connect to a specific application by whatever name you give it. Connecting to applications by name eliminates the need for users to remember which servers contain which applications.
- **Navigation of the server desktop**. Instead of requiring client users to have knowledge of the Windows NT 4.0 and/or 3.51 desktop (Windows NT Explorer or Program Manager) to find and start applications after connecting to Citrix servers, published applications present the ICA Client user with only the desired application in an ICA session.
- **User authentication**. Instead of logging on and logging off multiple Citrix servers to access applications, Program Neighborhood users can authenticate themselves a single time to all servers and obtain immediate access to all applications configured for their user group or specific user name. Also, publishing applications for the special Citrix *anonymous* user group lets you

completely eliminate the need for user authentication for those applications you want to provide to all users on your network.

Citrix server farms provide you with a flexible and robust way of deploying applications to ICA Client users. Server farms let you centralize your control over the application deployment process by grouping Citrix servers into a single administrative unit. Citrix servers in a farm function together to make applications easily available to your ICA Client users.

A *server farm* is a group of Citrix servers managed as a single entity and that share some form of physical connection and a common base of user accounts. After you place your servers in a server farm, you can publish applications on servers in the farm for users in the common base of accounts. After starting Program Neighborhood, a user logs in once, then sees an application set containing each application configured for his or her specific user account or user group.

For more information about server farms and how to create them, see the *MetaFrame Administrator's Guide* and the online help for Published Application Manager.

Client Modem Support

Although Citrix and Microsoft make every effort to provide support for the latest modems, new modems are released almost daily. This section describes how to add support for a new modem to the MetaFrame server and client systems.

The first step in adding support for new modem types is to obtain the modem Inf file from the manufacturer's Web site, bulletin board system (BBS), or FTP site. Once you have the Inf file, follow the procedures in this section to install the Inf file on a client PC for use by the Citrix ICA Client. Follow the procedures in the Windows 2000 Administrator's Guide to install the Inf file for use by Windows 2000 Configuration and Microsoft RAS.

▶ **To install a new modem for use by the Citrix ICA Client (DOS, Win16, Win32)**

1. The modem scripts for the ICA Clients are contained in the Modem.ini file. This file is located in the following directory (by client type):
   - DOS client: \WFClient\Modem.ini
   - Win16 client: \ICA16\Modem.ini
   - Win32 client: \Program Files\Citrix\ICA Client\Modem.ini
2. Use a text editor to add the name of the new modem to the [Modems] list at the beginning of the Modem.ini file. Insert the name in the proper position by alphabetical order.

3. Add the initialization strings for the modem that you downloaded from the manufacturer to the file. These strings are located in alphabetical order by manufacturer and modem type at the end of the Modems list. Save the file and exit the editor.
4. Verify that the modem added now appears in the ICA Client modem list.

CHAPTER 3

Installing Applications

The second phase of putting a MetaFrame solution into production is to install the applications on your servers and make them available to your end-users. To do so, you must:

1. Understand the special demands a multiuser operating system places on applications
2. Install the applications you plan to publish on your MetaFrame servers

This chapter includes information to assist you with these steps.

For help with	See
Step 1	Application Integration
Step 2	Software Application Notes

Application Integration

When integrating an application into a MetaFrame environment, the main areas of consideration are:

- Application installation and configuration
- Application compatibility
- Application video performance

Some applications have characteristics that, although relatively benign in a single-user environment, can lead to decreased performance or application incompatibilities in a MetaFrame multiuser distributed presentation environment. Understanding and avoiding these characteristics (if possible) helps ensure the smooth integration of an application into a MetaFrame environment.

As a general rule, follow the application guidelines below when selecting or developing applications:

- Win32 (32-bit) applications are preferred over Win16 (16-bit) applications. Windows 2000 with Terminal Services runs Win16 applications through a process called Win16 on Win32 (WOW), which causes Win16 applications to have higher processor requirements than comparable Win32 applications.
- The Windows Ini files must be accessed using the proper Windows NT APIs. This is needed so the Ini file synchronization features of Windows 2000 will work properly.
- Applications (mostly DOS applications) that poll a hardware device or the keyboard rather than waiting for an event can have an adverse effect on system performance. The DOSKBD command can be used to tune DOS applications that perform excessive keyboard polling.
- Use the Windows NT APIs instead of custom coding whenever possible. Many Windows NT APIs have Citrix MultiWin enhancements to seamlessly support a multiuser environment.
- Avoid hard coding of paths and network identifiers.
- NetWare applications must be able to run in bindery mode.
- DOS graphics are not supported on ICA connections.
- Avoid using bitmaps in graphics; use vector-based graphics instead. Use the raster operator to “brush” graphics on the screen for best performance on an ICA device.
- VxDs are not supported in a Windows NT environment.
- When developing Win32 applications, make sure that the Dlls do not have to be moved in memory; instead, use fixed Dll addresses. The Windows NT SDK includes tools to help with this.

The following sections discuss some of these guidelines in greater detail.

Application Installation and Configuration

In a multiuser environment such as MetaFrame, it is essential that all users be able to make use of the same applications concurrently without interfering with each other’s preference settings or data.

The first and most important step is to assign each user a unique home directory; for example, C:\Users\%Username%. If no home directory is assigned, the system assigns the default local home directory to the user account (the root directory) on the server’s local drive where Windows 2000 is installed as an upgrade or the \Documents and Settings\%Username% directory where Windows 2000 is installed as the initial version). Windows 2000 is also equipped with a desktop folder called My Documents, which offers an alternative to home directories but

does not replace them. All users have this folder in their user profile. For applications to work properly, utilize Active Directory Users and Computers for domain user accounts and Computer Management (local) for local user accounts to assign a separate home directory to each user.

To configure existing users to use separate home directories

1. If you want to change the path to a domain user's home directory, log on as a domain administrator. If you want to change the path to a local user's home directory, log on as a local administrator.
2. For a domain user account, open Active Directory Users and Computers. Expand the domain node of the console tree, expand the organizational unit where the user is located, and click **Users**.

   For a local user account, open Computer Management (local). In the console tree, click **Computer Management**, **System Tools**, **Local Users and Groups**, and then **Users**.
3. Double-click the user whose home directory you want to change.
4. Click the **Terminal Services Profile** tab.
5. Click the radio button next to **Local Path** and enter ***x*:\users\%username%**, where *x* is the drive where MetaFrame is installed (usually drive C).

   If the home directory is on a network share, click **Connect**, select a drive to connect, and then type the network path.
6. Click **Apply** and then **Close**.

DOS and OS/2 text applications can generally be installed and used as-is. DOS applications that perform keyboard polling may need tuning with the DOSKBD command to avoid excessive resource consumption.

Windows applications often use Windows features such as the system Registry and Ini files. Some of the information in these files is common to all users and some information is user-specific. This may require some application customization, as discussed in this section.

There are two ways to install 16- or 32-bit Windows applications in a MetaFrame environment: user-global and user-specific.

User-Specific

User-specific means that the application is installed by a specific user only for his or her own use. The default installation is user-specific. Any Ini or other files the application tries to place in the default Windows directory are installed to that user's home Windows directory. Even if the application is installed to a network or shared directory, other users do not have access to all the Dll and Ini files needed to run the application and must do a user-specific install for themselves. In

short, a separate install must be done for each user who wants to use the application.

If an application is installed with the user-specific method, no special considerations regarding the storage and retrieval of data are needed. However, because the application must be completely installed once for each user, this method can consume a large amount of disk space and adds to administrative overhead in larger environments.

Some applications offer the option of doing a *network* installation. This process copies the installation diskettes or CD-ROM files to a common directory on the network from which individual users can then run a SETUP or INSTALL utility, which copies the required Ini files to their home Windows directory. While it does use less space on the MetaFrame server than multiple user-specific installations, it still requires that a separate process be run for each user.

User-Global

Citrix recommends using the *user-global* method of installing Windows applications. With this method, an application is installed once by an administrator and can be run by anyone who logs on to that MetaFrame server.

To perform a user-global install, use either of the following methods:

- Use the Add/Remove Programs utility in Control Panel to initiate the installation
- Use the **change user /install** command at the command prompt before installing the application and **change user /execute** after installing the application

The Add/Remove Programs utility and the **change user /install** command place the session into *install mode*. This ensures that Ini files are installed to the Windows 2000 system directory instead of the user's home Windows directory. When the installation is complete, the Add/Remove Programs utility and **change user /execute** command place the session back into *execute mode*. When a user starts the application for the first time, the required user-specific files are automatically copied to the user's home directory.

Most Win32 applications install in a pseudo user-global fashion by default, even when the session is not in install mode, because they make use of the Windows 2000 registry, where each user can have a unique set of registry settings. Win16 applications use Ini files for configuration settings so they **must** be installed using install mode in order for multiple users to get separate copies of these files. It is recommended that you always install any Windows application, whether 16- or 32-bit, using install mode. For security reasons, it is also recommended that you install applications on Windows NT file system (NTFS)-formatted drives rather than on FAT-formatted drives.

To perform a user-global install using Add/Remove Programs (recommended)

1. Log on to the MetaFrame server as an administrator.
2. Close all applications and ensure no users are connected to the server. Disable further logons by typing **change logon /disable** at a command prompt.
3. Open Control Panel.
4. Double-click **Add/Remove Programs**.
5. In the **Add/Remove Programs** dialog box, click **Add New Programs**.
6. Select the method to install the program and follow the instructions in the wizard.
7. In the **Change User Option** dialog box, click **All users begin with common application settings** and then click **Next**.
8. Install the application on a local NTFS drive as directed by the installation program.
9. The **After Installation** dialog box appears. Click **Next** when installation is complete.
10. In the **Finish Admin Install** dialog box, click **Finish**.
11. Enable user logons by typing **change logon /enable** at a command prompt.

To perform a user-global install using the change user command

1. Log on to the MetaFrame server as an administrator.
2. Close all applications and ensure no users are connected to the server. Disable further logons by typing **change logon /disable** at a command prompt.
3. At a command prompt, type **change user /install**.

   This command places the system in *install* mode and allows Windows 2000 to keep track of the user-specific application registry entries, initialization (Ini) files, and Dynamic Linked Library (Dll) files the application adds to the Windows 2000 system during installation.
4. Install the application following instructions in the documentation.

   If you are asked to enter your name during the installation process, use a generic name because the name is the default for all users. Configure any default program settings you want **all** users to have.
5. When installation is complete, at a command prompt, type **change user /execute**.

   This command returns the system to *execute* mode.

6. Enable user logons by typing **change logon /enable** at a command prompt. Make sure that any shared resources (such as network drives or printers) are set up for each user before running the application. Check the software documentation for any notes that apply to the installation or use of the application.
7. It is generally a good idea to write-protect the application's directory (and \Winnt if you have not already done so) from all non-administrator users. This allows users to read the program files but protects the files from inadvertent changes or deletions.

Note If you installed to an NTFS partition, the security options in Windows NT Explorer allow you to set the security to a wide array of options and restrict access only to specific user groups. If the application is installed on a FAT partition, you can use the ATTRIB command to mark the files and directories as read-only but cannot use the advanced security features of NTFS. For this reason, Citrix recommends that Windows 2000, MetaFrame, and applications be installed on NTFS partitions. While using NTFS is not a must, it does provide a wider range of security options. If the applications reside on a NetWare file server, use the FILER program to set the security options.

If you need to determine if the system is in execute or install mode, type**change user /query** at the command prompt.

The exact actions performed when a user-global application is started can be tuned and optimized by creating and setting compatibility bits in registry variables associated with the application.

Application Compatibility

Many older applications are not compatible with MetaFrame's multiuser environment. Several Application Compatible Scripts (ACS) are available to help ensure that the applications run in such an environment. The ACS are in the %SystemRoot%\Application Compatibility Scripts folder on the MetaFrame server.

Application Video Performance

The Citrix Independent Computing Architecture (ICA) protocol provides high-performance Windows presentation services over low-bandwidth connections. ICA is a robust and extensible protocol that includes definitions for the following capabilities:

- Full-screen text presentation
- Graphical Windows application screen presentation

- Keyboard and mouse input
- Session control
- Framing for asynchronous connections
- Error detection and recovery
- Encryption
- Data compression
- File system redirection
- Print redirection
- COM port redirection
- Multiple generic virtual channels
- Cut and paste across clients and servers
- General purpose Citrix server browsing

The Thinwire Virtual Channel

The thinwire protocol is an ICA virtual channel protocol used to transmit presentation commands from Windows applications running on the application server to the client. The thinwire protocol is highly tuned for transmission of Windows object display over low-bandwidth connections. This is accomplished through:

- Command- and object-specific intelligent compression with state persistence; that is, run-length encoding for bitmaps
- Outboard complex clipping and complex curve drawing
- Intelligent caching of Windows objects such as bitmaps, brushes, glyphs, and pointers
- Remote SaveScreenBitmaps
- Cross-session persistent caching

To enable thinwire to most efficiently distribute the Windows image to the ICA client, use the following guidelines:

- Use vector graphics instead of bit-mapped images for graphics
- Use the raster operator to “brush” graphics to the screen

Bitmaps require more bandwidth than vector graphics because all of the image data for each unique bitmap must be transmitted from the server at least once. ICA compensates for this by caching each unique bitmap on the client system. When a bitmap is to be displayed, it is compared with the client’s locally cached bitmaps. If the displayed bitmap matches one that is already cached at the client, ICA sends

a command telling the client to redisplay the local copy instead of sending the image over the wire.

Blinking cursors cause unnecessary bandwidth utilization because every blink requires data packets to be transmitted. Applications that do not use a blinking cursor or that allow the blinking cursor to be disabled are preferred.

Software Application Notes

The products listed in this section have been tested and found to be compatible with MetaFrame. Other products work well with MetaFrame but Citrix cannot guarantee the compatibility of untested products.

Because MetaFrame is an add-on to Microsoft Windows 2000, most Windows NT-compatible applications can be expected to work. Review the following application notes for detailed application integration tips and techniques.

Accounting Software

Great Plains Dynamics C/S+ and Dynamics

Overview

Great Plains Software develops, markets, and supports accounting and financial management software worldwide, offering solutions ranging from midrange client/server systems to small business integrated accounting software.

Great Plains Dynamics C/S+ is a client/server financial management suite for Microsoft BackOffice. Dynamics C/S+ offers a complete suite of Internet-ready financial applications and tools in a flexible three-tier client/server architecture. Dynamics C/S+ for SQL Server is exclusively optimized for Microsoft SQL Server. ISAM database options are also available for Dynamics C/S+.

Great Plains Dynamics is an accounting solution for growing companies with $1 to $50 million in revenues seeking financial information access throughout the deployment of strategic technologies and the Internet. Dynamics is a complete financial management solution with more than 20 financial modules and tools, and hundreds of Dynamics companion products.

Citrix MetaFrame extends Dynamics C/S+ and Dynamics into WAN and dial-in environments without sacrificing performance. By running the client portion of Great Plains Dynamics or Dynamics C/S+ on a MetaFrame server, you can use Citrix's advanced ICA protocol to provide local LAN performance to client PCs on the local LAN, over a WAN, or even to dial-in users in the field. Using ICA, only the keyboard, mouse, and video information are transferred between the

MetaFrame server and the ICA Client; all the interaction between the Great Plains server and client machines takes place over the high-speed LAN.

The two companies' combined products provide customers with a state-of-the-art client/server financial management solution that can be economically deployed enterprise-wide across a wide area network, while delivering a high level of performance to all users, no matter where they are.

Requirements

Hardware Requirements

- Server PC with Pentium processor or greater for Dynamics Server; dual-processor SMP system recommended for Dynamics C/S+ Server. See the *Great Plains Installation: Procedures* manual for detailed system requirements.
- MetaFrame server with Pentium processor or greater for Dynamics Client; a dual-processor SMP system is recommended for Dynamics C/S+ Client. The system should contain 32MB RAM plus 8-10MB per remote client, and at least 400MB available disk space.
- ICA Client PCs. See the *Citrix ICA Client Administrator's Guides.*

Software Requirements

- MetaFrame Version 1.8 for Windows 2000
- ICA Client (DOS, Win16, or Win32)
- Great Plains Dynamics or Dynamics C/S+

Supported Databases and Operating Environments

Dynamics C/S+ Client/Server Systems

Note For best performance, implement the MetaFrame server on a physical server different from the database engine.

Database software	Dynamics C/S+ clients	Database server	Application server	Networking software
MS SQL Server 6.5	Citrix MetaFrame 1.8 for Windows 2000 or higher	Windows NT Server 3.51 or higher (Intel or Alpha)	Windows NT Server 3.51 or higher (Intel or Alpha) Windows NT Workstation 3.51 or higher (Intel or Alpha)	Windows NT Server 3.51 or higher (Intel or Alpha)

Database software	Dynamics C/S+ clients	Database server	Application server	Networking software
Btrieve Server for NT	Citrix MetaFrame 1.8 for Windows 2000 or higher	Windows NT Server 3.51 or higher (Intel only)	Windows NT Server 3.51 or higher (Intel only) Windows NT Workstation 3.51 or higher (Intel only)	Windows NT Server 3.51 or higher (Intel only)
Faircom Server	Citrix MetaFrame 1.8 for Windows 2000 or higher	Windows NT Server 3.51 or higher (Intel or Alpha)	Windows NT Server 3.51 or higher (Intel or Alpha) Windows NT Workstation 3.51 or higher (Intel or Alpha)	Windows NT Server 3.51 or higher (Intel or Alpha)

Dynamics Client/Server Systems

Note For best performance, implement the MetaFrame server on a physical server different from the database engine. By keeping the servers separate, performance on both can be optimized and maintained.

Database software	Dynamics clients	Servers	Networking software
Btrieve Server for NT	Citrix MetaFrame 1.8 FOR WINDOWS 2000 or higher	Windows NT Server 3.51 or higher (Intel) Citrix MetaFrame 1.8 for Windows 2000 or higher	Windows NT Server 3.51 or higher (Intel)
Btrieve Server for NetWare	Citrix MetaFrame 1.8 for Windows 2000 or higher	NetWare 3.12, 4.10, or 4.11	NetWare 3.12, 4.10, or 4.11
c-tree Plus	Citrix MetaFrame 1.8 for Windows 2000 or higher	Windows NT Server 3.51 or higher (Intel) NetWare 3.12, 4.10, or 4.11 Citrix MetaFrame 1.8 for Windows 2000 or higher	Windows NT Server 3.51 or higher (Intel) NetWare 3.12, 4.10, or 4.11

Dynamics Stand-alone Systems

Database	Operating environments
Btrieve Workstation	Citrix MetaFrame 1.8 for Windows 2000
c-tree Plus	Citrix MetaFrame 1.8 for Windows 2000

Installation

To install Great Plains Dynamics C/S+ or Dynamics

1. Verify system requirements. Make sure your system meets the recommended minimum requirements for a Dynamics or Dynamics C/S+ system and that your system is prepared for installation. See the instructions in the Dynamics or Dynamics C/S+ *Installation: Procedures Manual* and the MetaFrame documentation.
2. Install MetaFrame. See the MetaFrame documentation for detailed installation procedures.
3. Review database server information, if necessary. Depending on your database server choice, review the Dynamics or Dynamics C/S+ *Installation: Procedures Manual* to properly configure your database.
4. Install Dynamics or Dynamics C/S+ on one client and on a server. It is recommended that you install the Dynamics or Dynamics C/S+ database on a server different from your MetaFrame server. Also, install a client on a machine other than the MetaFrame server. This allows you to verify the correct installation of Dynamics or Dynamics C/S+ before you set up your MetaFrame server. The MetaFrame server can then be set up as another client. Once this is accomplished, all client machines on your network can be configured to access your Dynamics or Dynamics C/S+ database.
5. Check the mapped drives or UNC (universal naming convention) pathnames that each client uses to identify the server. Be sure that each client identifies the Dynamics or Dynamics C/S+ folder on the server the same way; for instance, all clients should identify the C:\Dynamics folder on the server using the same ID, such as F:\Dynamics or F:\.
6. Install Dynamics or Dynamics C/S+ applications on a client computer and install data on the server computer, following the instructions in the Dynamics or Dynamics C/S+ *Installation: Procedures Manual.*

Note When installing Dynamics, do not use your server to install data; it will prevent your clients from locating the data and you will need to enter a location translation.

7. Use Dynamics or Dynamics C/S+ Utilities. See the Dynamics or Dynamics C/S+ *Installation: Procedures Manual* for information about how to define your account framework and synchronize it with your dictionary, and to register Dynamics or Dynamics C/S+.
8. Perform initial setup procedures. Follow the instructions in the Dynamics or Dynamics C/S+ *Installation: Procedures Manual* to start the program for the first time and perform initial setup procedures such as creating a company, adding users, and setting user access. You must complete these procedures before you begin using Dynamics or Dynamics C/S+.
9. Install and set up Dynamics or Dynamics C/S+ on all additional client computers, including the MetaFrame server and the remote ICA client sessions.

Client Platforms

IBM OS/2 Warp Version 4.0

Overview

The ICA Win16, DOS, and Win16 Web Clients are supported on OS/2 Warp Version 4.0.

Note Cut, Copy, and Paste operations only work when cutting or copying data from the ICA Client and pasting it to the WIN-OS2 or OS/2 session. Data cut or copied from the OS/2 or separate WIN-OS2 session (not the one running the ICA Client) cannot be pasted to the ICA Client.

The following connectivity methods are supported for the ICA Win16 and DOS Clients:

Client	TCP/IP	IPX	SPX	NetBIOS	Async (direct)	Async (modem)
DOS	No	Yes	No	Yes	Yes	Yes
Win16	Yes	No	No	Yes	Yes	Yes

In addition to using the Win16 and DOS Clients, you can configure the ICA Web Client (Win16 version) for use with the IBM OS/2 Web Explorer.

Software Requirements

- IBM OS/2 Warp 4.0
  - File and Print Client Services
  - TCP/IP Services
  - NetWare Client Services
- Citrix MetaFrame Version 1.8 for Windows 2000
  - ICA DOS Client
  - ICA Win16 Client
  - ICA Win16 Web Client (ALE 16-bit Plugin), available on the Citrix Web site at http://download.citrix.com

Installation

OS/2 Installation

Install OS/2 Warp Version 4.0 following the standard installation procedure. Use the default settings. Install networking support for File and Print Client Services, Novell NetWare, TCP/IP Client Services, and the NetWare client. Verify that the network adapter settings are correct. Select the workstation name, description (if desired), and domain name. Choose the protocol you want to use. For TCP/IP, specify the hostname (usually the same as the workstation name), the IP address, the subnet mask, the router address, and the domain name as required by your configuration, or use DHCP if a DHCP server is present on the LAN.

IBM OS/2 Warp Version 4.0 includes network and TCP/IP protocols and software as part of the operating system. Follow the instructions for installing the additional network and TCP/IP software as part of the installation of the system. Network and TCP/IP software for WINOS2 and virtual DOS are installed as defaults during the installation.

WINOS2 Setup

Before installing the ICA Client, you must set the WINOS2 settings to allow the ICA Client to operate properly with DDE and Clipboard. Establish the settings as follows:

Note You can elect not to make these settings if you do not intend to use the DDE or Clipboard functions.

---

1. Under OS/2 System Folder, click **System Setup** and then **WIN-OS/2 Setup**.
2. Under **WIN-OS/2 Setup Properties**, click the **Data Exchange** tab.
3. In the **Data Exchange Settings** dialog box, choose **Public** for both selections. This is required for DDE and Clipboard operation.

4. Close all the previous selections; this portion of the settings is complete.
5. Under OS/2 System Folder, select **Command Prompts**.
6. Select **WIN-OS/2 Window**. The right mouse button brings up a menu; click **Properties**.
7. Select the **Session** tab, then select **WIN-OS/2 Properties**. Make sure the **All DOS and WIN-OS/2 Settings** radio button is highlighted and click **OK**.
8. Set WIN_RUN_MODE to 3.1 Enhanced Compatibility.
9. Set WIN_DDE to On.
10. Set WIN_CLIPBOARD to On.
11. Click **Save** and close the notebook.
12. Close all the previous selections; this portion of the settings is complete.
13. When using IBM LAN and NetBIOS, add the following line to the Autoexec.bat:

    ```
    x:\ibmcom\ltsvcfg n1=1
    ```

    where *x* is the OS/2 system drive. This command enables the NAME_NUMBER_1 support required for NetBIOS connections.

Client Installation on OS/2

Before installing the client, decide what protocols you will use. Client installation is simple; insert the ICA Client diskette in drive A and run **setup** in a WINOS2 session.

Client Protocol

TCP/IP
: If you choose TCP/IP, make sure you have the server hostname handy and that OS/2 TCP/IP and DOS TCP/IP are installed.

IBM LAN
: All IBM LAN software must be installed prior to installing the client. You must know the server name, the client name, and the password. The following line must be in Autoexec.bat to allow NetBIOS to work:

  ```
  c:\ibmcom\lstvcfg n1=1
  ```

Dial-In
: When installation starts, you are asked if you want to select the Dial-In option. **Do not** select this option at this time. Once installation is complete and you are setting up the local user, you can use the Dial-In option to allow a modem connection.

ICA Win16 Client

Before installing the ICA Win16 Client, decide what network protocols and hardware you will use.

IPX and SPX connections are not supported at this time because OS/2 does not support VxDs. TCP/IP connections are supported without any changes. Serial Dial-In and direct connect connections are supported without any changes. NetBIOS connections are supported if you load NAME_NUMBER_1 support.

NetBIOS connections require you to load NAME_NUMBER_1 support before running the client. This support is not enabled by default. Include the following line in the Autoexec.bat or in a .Bat file that starts the ICA Client:

```
x:\ibmcom\ltsvcfg n1=1
```

where *x* is the OS/2 system drive.

ICA DOS Client

Change the ICA DOS Client session by following the procedure below:

1. Right click the **DOS Full Screen** icon.
2. Select **Properties**.
3. Select the **Sessions** tab.
4. Select **DOS Properties**.
5. Select **All DOS Settings** and click **OK**.
6. From the **DOS Settings-All DOS Settings** dialog box, change the **DOS_FILES** setting to **40**.

   The default value of 20 causes the ICA DOS Client to exit with an "insufficient files" error message.

DOS sessions under OS/2 Warp load NetWare support (TBMI2 and NETX) by default; IPX connections are supported without any changes. SPX is not supported.

For the DOS 16-bit Client for 286 processors: TCP/IP support is loaded. When creating a TCP/IP remote application entry, specify TCP/IP–VSL as the connection type. Include the following line in the Autoexec.bat or in a .Bat file that starts the DOS Client:

```
x:\wfclient\mibmtcp.exe
(c\wfclient- is the default directory for the DOS Client, change
accordingly)
```

NetBIOS connections require you to load NAME_NUMBER_1 support before running the client. This support is not enabled by default. Include the following line in the Autoexec.bat or in a .Bat file that starts the DOS Client:

```
x:\ibmcom\ltsvcfg n1=1
```

where *x* is the OS/2 system drive.

DOS async connections require changes to the default DOS settings for the session. The following changes support direct connect and modem connections at up to 57.6Kbps:

COM_DIRECT_ACCESS	On
COM_HOLD	On
COM_RECEIVE_BUFFER_FLUSH	None
COM_SELECT	All
DOS_DEVICE	*x*:/OS2/MDOS/COMDD.SYS (see note below)
DOS_FILES	40
HW_ROM_TO_RAM	On
HW_TIMER	On
IDLE_SECONDS	60
IDLE_SENSITIVITY	100

Note *x* is the OS/2 system drive. Add this device driver statement to the list of device drivers.

ICA Win16 Web Client and Web Explorer

The IBM OS/2 Web Explorer is an OS/2-based Web browser. The procedure below describes how to configure the IBM OS/2 Web Explorer for use with the Citrix ICA Web Client.

1. Download the ICA Win16 Web Client (ALE 16-bit Plugin) from the Citrix Demo Web page at http://download.citrix.com. Follow the directions on the page to install the 16-bit Web client – Wfplug16.exe.
2. Edit the file C:\Mptn\Etc\Explore.ini. In the [advanced] section, specify a Mailcap file if one does not exist by adding C:\Mptn\Etc\Mailcap to the end of the mailcap= statement. In the [advanced] section, specify an Extmap file if one does not exist by adding C:\Mptn\Etc\Extmap to the end of the Extmap= statement. Save the file and exit the editor.
3. Edit or create the file C:\Mptn\Etc\Mailcap. Add the line:

   ```
   application/x-ica; c:\OS2\MDOS\WINOS2\System\WFICA16.EXE %s
   ```

   Save the file and exit the editor.
4. Edit or create the file C:\Mptn\Etc\Extmap. Add the line:

   ```
   application/x-ica ica
   ```

   Save the file and exit the editor.
5. Restart the Web Explorer.

Printer Setup

Local Printing

1. Verify that the WIN-OS/2 printer drivers are installed on a local machine.
2. To access your local printer, connect to the MetaFrame server. Click **Start**, select **Settings**, and then **Printers**.

   Note You must have administrator privileges on the server to add or remove a printer.

3. Double-click **Add Printer**.

   The **Add Printer Wizard** dialog box appears.
4. Select **Network Printer Server** and click **Next**.
5. Double-click **Client Network** and then **Client**.
6. Select the printer and manufacturer, and follow the on-screen instructions. When a printer is connected, a printer description appears in the **Printers** dialog box.

Printing Using a Network Printer

1. Make sure the printer is physically attached to the network server. The network server must have the printer driver installed.
2. The printer must be shared and all members must have full access to it and its settings.
3. Click **Start**, select **Settings**, **Printers**.
4. Double-click **Add Printer**.

   The **Add Printer Wizard** dialog box appears.
5. Select **Network Printer Server** and click **Next**.
6. Locate the network printer and follow the on-screen instructions to continue with installation.
7. When the printer object is created, the printer is accessible by the clients. MetaFrame server applications can now print.
8. A print object is created automatically in the Client Print Manager. The client user has to select the print object as the default to configure the server printer as the default printer.

Printing from the MetaFrame Server

The printer object for a MetaFrame printer is created using the MetaFrame Print Manager.

1. Create the printer object as a shared object.
2. Once the printer object is created, the printer is accessible by the clients. Applications running on the MetaFrame server can now print on the server printer. A print object is created automatically in the Client Print Manager. The client user has the option of selecting the print object as the default if the user needs the server printer to be the default printer.

DDE and OLE

DDE and OLE are supported within the Citrix ICA Clients. There is no interoperability between the ICA Clients and WIN-OS2 or OS/2 sessions.

Network and CD-ROM Drives

All non-local drives are supported by executing the following command at a command prompt:

net use *x*: \\client*y:*

where *x*: is the drive to be mapped to and *y*: is the non-local drive supported by OS/2.

E-Mail Software

Microsoft Exchange Server (Enterprise Edition) Version 5.0 and Microsoft Exchange Client Version 5.0

Overview

Microsoft Exchange Server is a client/server corporate messaging system that incorporates e-mail, scheduling, electronic forms, document sharing, and custom applications in a single product. Microsoft Exchange consists of two parts: Exchange Server and Exchange Client. This section describes a tested method for installing and configuring Microsoft Exchange Server 5.0 and Microsoft Exchange Client 5.0 using a MetaFrame server.

In a standard configuration, Microsoft Exchange Server is installed and run as a service on the primary domain controller (PDC), which can be a MetaFrame server or a Microsoft Windows 2000 server. The Exchange Client is installed on all other MetaFrame servers. Users connect to the MetaFrame servers and run the Microsoft Exchange Client, which then accesses the Microsoft Exchange Server.

Software Requirements

- MetaFrame Version 1.8 for Windows 2000
- Microsoft Windows 2000 with Terminal Services installed
- Microsoft Exchange Server Version 5.0 and Microsoft Exchange Client Version 5.0

Installing and Configuring Microsoft Exchange Server 5.0

Installing Microsoft Exchange Server 5.0

1. Install and configure MetaFrame as a primary domain controller (PDC). Make sure that the page file size is equal to at least 1.5 times the amount of physical RAM and that there is at least 250MB of free hard drive space.
2. Log on to the console of the MetaFrame server as an administrator.
3. At the command prompt, type **change user /install** and press ENTER. This places the user session in install mode.
4. Insert the Microsoft Exchange Server 5.0 CD-ROM into the CD-ROM drive.
5. Run Server\Setup\i386\Setup.exe from the Exchange Server 5.0 CD-ROM.
6. Click **OK** in the Microsoft Exchange Server Setup window.
7. Microsoft Exchange Setup offers three choices:
   - Typical Installation
   - Complete/Custom Installation
   - Minimum Installation

   If you are installing Exchange 5.0 for the first time, select Typical Installation. Typical Installation was chosen for this test.
8. Enter the CD Key and click **OK**.
9. Click **OK** in the MetaFrame Server **Licensing Mode** dialog box.
10. Enter the required information in the **Choose Licensing Mode** dialog box.
11. Check **I Agree** in the **Per Server Licensing** dialog box and then click **OK**.
12. Add the number of licenses purchased or required for this Exchange Server and click **Continue**.
13. If Microsoft Exchange 5.0 was previously installed on your system, at this point you can make changes to an existing site that you have already created. For new installs, select **Create a New Site**. Enter your organization name and a user-defined site name. Record this data for future use.

    Setup confirms the creation of a new site.

    Setup asks for an account name that will be used to log on to the system to start Exchange services when the system boots. Although this can be any user account, it is recommended that the administrator account be used.

14. Source files are now copied to your system.
15. When installation is completed, you can run the Optimizer immediately or run it later at your convenience.
16. At the command prompt, type **change user /execute** and press ENTER.

Installation of Microsoft Exchange Server 5.0 is now complete.

Verifying Installation of Microsoft Exchange Server 5.0

Follow the procedure below to verify that Microsoft Exchange Server 5.0 is correctly installed and configured.

1. Click **Start,** select **Administrative Tools**, then **Computer Management**. Expand **System Tools** and select **Services**. Scroll down the Services list and verify that the following services are listed and are automatically started:
   - Microsoft Exchange Directory
   - Microsoft Exchange Information Store
   - Microsoft Exchange Message Transfer Agent
   - Microsoft Exchange System Attendant
2. Click the **Server Start** button and select **Programs**, then **Microsoft Exchange**. Verify that the following are listed:
   - Microsoft Exchange Administrator
   - Microsoft Exchange Migration Wizard
   - Microsoft Exchange Optimizer
   - Microsoft Exchange Server Health
   - Microsoft Exchange Server History
   - Microsoft Exchange Server IMS Queues
   - Microsoft Exchange Server IMS Statistics
   - Microsoft Exchange Server IMS Traffic
   - Microsoft Exchange Server Load
   - Microsoft Exchange Server Queues
   - Microsoft Exchange Server Users

Configuring Microsoft Exchange Server 5.0

After installing Microsoft Exchange Server 5.0, the server needs to be configured for users to log on and retrieve mail. Because Microsoft Exchange Server resides on a MetaFrame server, all users with mailboxes on this Microsoft Exchange Server are also MetaFrame users. However, MetaFrame users do not automatically have Exchange mailboxes. Use the following procedure to configure Exchange users.

1. Open Microsoft Exchange Administrator.
2. Type the server name to which you want to connect or click **Browse**. The server is typically the MetaFrameserver on which Microsoft Exchange is installed.
3. In the left side of the **Administrator** dialog box, expand the site name icon and click **Recipients**.
4. From the **File** menu, select **New Mailbox** to create mailboxes. Click **Primary Windows NT Account** to associate this new mailbox with an existing account on the domain. If an account does not exist, the form allows creation of new accounts.

Installing and Configuring Microsoft Exchange Client 5.0

Special Considerations

If Microsoft Exchange Client 5.0 is being installed on the MetaFrame server containing the Microsoft Exchange 5.0 Server, perform the following steps to ensure a successful Exchange Client installation. If Microsoft Exchange Client 5.0 is being installed on any other MetaFrame server, go to "Installing Microsoft Exchange Client 5.0" later in this chapter.

1. Log on to the MetaFrame server as an administrator.
2. Click **Start**, select **Administrative Tools**, then **Computer Management**. Expand **System Tools** and select **Services**. Stop the following services:
   - Messenger
   - Microsoft Exchange Directory
   - Microsoft Exchange Information Store
   - Microsoft Exchange Message Transfer Agent
   - Microsoft Exchange System Attendant
3. Close the **Computer Management** dialog box.
4. Install Microsoft Exchange Client 5.0 as described below, skipping Steps 1 and 2.

Installing Microsoft Exchange Client 5.0

Note Windows Messaging forms do not work for multiple users.

After installing Microsoft Exchange Client, run the script %SystemRoot%\Application Compatibilty Scripts\Install\Winmsg.Cmd. This script adds %SystemRoot%\Application Compatibility\Scripts\Logon \WmsgUsr.Cmd to UsrLogon.Cmd.

When a user logs on, the %SystemRoot%\Forms subdirectory is copied to the user's home directory.

Running this script is not required if you run the Office 97 installation script instead.

1. Install and configure MetaFrame.
2. Log on to the console of the MetaFrame server as an administrator.
3. At a command prompt, type **change user /install** and press ENTER.
4. From the Microsoft Exchange Client CD, run *x*:\Eng\Winnt\i386\Setup.exe, where *x* is the CD-ROM drive.
5. After accepting the copyright policies, type your name and company information.
6. Change the default installation path if desired.
7. Microsoft Exchange Setup offers three choices:
   - Typical Installation
   - Complete/Custom Installation
   - Minimum Installation

   If you are installing Exchange Client 5.0 for the first time, select Typical Installation.
8. Click **OK** when setup is complete.
9. At a command prompt, type **change user /execute** and press ENTER.

Note If Microsoft Exchange Server 5.0 is installed on the same system where the Exchange Client is installed, make sure that the Exchange Server services you stopped during installation are started again before proceeding to the next section.

10. Check that the permissions for Everyone in the %SystemRoot%\Forms folder are Change.
11. Check that the permissions for Everyone in the %SystemRoot%\System32 \Oleaut32.dll are Read.

Configuring Microsoft Exchange Client 5.0

Once Microsoft Exchange Server and Client are installed and configured, users can log on to a MetaFrame server on the network and access their mailboxes on the Microsoft Exchange Server 5.0 using the Microsoft Exchange Client 5.0.

Before you can access e-mail, you must perform the following steps to configure Microsoft Exchange 5.0 Client.

1. Log on to a MetaFrame server that has Exchange Client 5.0 installed.
2. Double-click **Inbox Desktop** or select **Start**, **Programs**, and then **Microsoft Exchange**.
3. When the Setup wizard appears, verify that Microsoft Exchange Server is checked and that Microsoft Mail and Internet Mail are not checked; click **Next**.
4. Enter the name of the Microsoft Exchange Server. This is typically the name of the server on which Microsoft Exchange Server 5.0 is installed. Also enter the mailbox name; this is typically the username.
5. Select if you travel with the computer and click **Next**.
6. In the **Personal Address Book** dialog box, save Mailbox.pab in the user's home directory.
7. After completing the Setup wizard, the Exchange Inbox appears.

Setup of Microsoft Exchange Client 5.0 is now complete.

Microsoft Exchange Server (Enterprise Edition) Version 5.5 and Microsoft Exchange Client Version 5.0

Overview

Microsoft Exchange Server is a client/server corporate messaging system that incorporates e-mail, scheduling, electronic forms, document sharing, and custom applications in a single product. Microsoft Exchange consists of two parts: Exchange Server and Exchange Client. This section describes a tested method for configuring Microsoft Exchange Server 5.5 and Microsoft Exchange Client 5.0 using a MetaFrame server.

For this application note, two configurations were tested. In the first configuration, Microsoft Exchange Server 5.5 and Microsoft Exchange Client 5.0 were both installed on a MetaFrame server. For the second configuration, Microsoft Exchange Server 5.5 was installed on a dedicated Windows 2000 server and Microsoft Exchange Client 5.0 was installed on a MetaFrame server. With both configurations, multiple users can simultaneously run the client software by creating ICA sessions on the MetaFrame server. This note does not describe the installation of Microsoft Exchange Server on Windows 2000. For installation on Windows 2000, see the Microsoft documentation.

Software Requirements

- MetaFrame Version 1.8 for Windows 2000
- Microsoft Windows 2000 with Terminal Services installed
- Microsoft Exchange Server 5.5 and Microsoft Exchange Client 5.0

Installing and Configuring Microsoft Exchange Server 5.5

Installing Microsoft Exchange Server 5.5

1. Install and configure the MetaFrame server.
2. Log on to the console of the server as a domain administrator.
3. At a command prompt, type **change user /install** and press ENTER. This places the user session in install mode.
4. Run Server\Setup\i386\Setup.exe on the Microsoft Exchange Server 5.5 CD-ROM.
5. Click **Accept** in the Microsoft **Exchange Server Setup** dialog box.
6. Microsoft Exchange Setup offers three choices:
   - Typical Installation
   - Complete/Custom Installation
   - Minimum Installation

   Typical Installation was chosen for this test.
7. Enter the CD Key and click **OK**.
8. Check the **I agree** box in the Microsoft Licensing window and then click **OK**.
9. If Microsoft Exchange 5.5 was previously installed on your system, at this point you can make changes to an existing site that you have already created. For new installs, select **Create a New Site**. Enter your organization name and a user-defined site name.

   Setup confirms the creation of a new site.

   Setup asks for an account name and password to be used to log on to the system to start Exchange services when the system boots. Although this can be any user account, it is recommended that the administrator account be used.
10. Source files are now copied to your system.
11. When installation is completed, you can run the Optimizer immediately orrun it later at your convenience.
12. At a command prompt, type **change user /execute** and press ENTER.

Installation of Microsoft Exchange Server 5.5 is now complete.

Verifying Installation of Microsoft Exchange Server 5.5

Follow the procedure below to verify that Microsoft Exchange Server 5.5 is correctly installed.

1. Click **Start**, select **Administrative Tools**, then **Computer Management**. Expand **System Tools** and select **Services**. Scroll down the Services list and verify that the following services are listed and are automatically started:
   - Microsoft Exchange Directory
   - Microsoft Exchange Event Service
   - Microsoft Exchange Information Store
   - Microsoft Exchange Message Transfer Agent
   - Microsoft Exchange System Attendant
2. Click the **Server Start** button and select **Programs**, then **Microsoft Exchange**. Verify that the following are listed:
   - Microsoft Exchange Administrator
   - Microsoft Exchange Migration Wizard
   - Microsoft Exchange Optimizer
   - Microsoft Exchange Server Health
   - Microsoft Exchange Server History
   - Microsoft Exchange Server IMS Queues
   - Microsoft Exchange Server IMS Statistics
   - Microsoft Exchange Server IMS Traffic
   - Microsoft Exchange Server Load
   - Microsoft Exchange Server Queues
   - Microsoft Exchange Server Users

Configuring Microsoft Exchange Server 5.5

After installing Microsoft Exchange Server 5.5, configure the server for users to log on and retrieve mail. Because Microsoft Exchange Server resides on a MetaFrame server, all users with mailboxes on this Microsoft Exchange Server are also MetaFrame users. However, MetaFrame users do not automatically have Exchange mailboxes.

▶ To configure Exchange users

1. Open Microsoft Exchange Administrator.
2. Type the server name to which you want to connect or click **Browse**. The server is typically the MetaFrame server on which Microsoft Exchange is installed.

3. In the left side of the **Administrator** dialog box, expand the site name icon and click **Recipients**.
4. From the **File** menu, select **New Mailbox** to create mailboxes. Click **Primary Windows NT Account** to associate this new mailbox with an existing account on the domain. If an account does not exist, the form allows creation of new accounts.

Installing and Configuring Microsoft Exchange Client 5.0

Installing Microsoft Exchange Client 5.0

Perform the following steps to ensure a successful Exchange Client installation:

1. Log on to the MetaFrame server as an administrator.

   If Microsoft Exchange Client is not being installed on the same server as Microsoft Exchange Server, skip Steps 2 and 3.
2. Click **Start**, select **Administrative Tools**, then **Computer Management**. Expand **System Tools** and select **Services**. Stop the following services:
   - Messenger
   - Microsoft Exchange Directory
   - Microsoft Exchange Event Service
   - Microsoft Exchange Information Store
   - Microsoft Exchange Message Transfer Agent
   - Microsoft Exchange System Attendant
3. Close the **Computer Management** dialog box.
4. At a command prompt, type **change user /install** and press ENTER.
5. From the Microsoft Exchange Client CD, run *x*:\Eng\Winnt\i386\Setup.exe, where *x* is the CD-ROM drive.
6. After accepting the copyright policies, enter your name and company information.
7. Change the default installation path if desired.
8. Microsoft Exchange Setup offers three choices:
   - Typical Installation
   - Complete Installation
   - Custom Installation
9. Click **OK** when setup is complete.
10. At a command prompt, type **change user /execute** and press ENTER.

Note If Microsoft Exchange Server 5.5 is installed on the same system where the Exchange Client is installed, make sure that the Exchange Server services you stopped during installation are started again before proceeding to the next section.

11. Run %SystemRoot%\Application Compatibility Scripts\Install\Winmsg.cmd. When application tuning is complete, have all users log off and then log back on for the changes to take effect.
12. Check that the permissions for Everyone in the %SystemRoot%\Forms folder are Modify.
13. Check that the permissions for Everyone in the %SystemRoot%\System32 \Oleaut32.dll are Read.

Configuring Microsoft Exchange Client 5.0

Once Microsoft Exchange Server and Client are installed and configured, users can log on to a MetaFrame server on the network and access their mailboxes on Microsoft Exchange Server 5.5 using Microsoft Exchange Client 5.0.

Before you can access e-mail, you must perform the following steps to configure Microsoft Exchange Client 5.0.

1. Log on to a MetaFrame server that has Exchange Client 5.0 installed.
2. Double-click **Inbox Desktop** or select **Start**, **Programs**, and then **Microsoft Exchange**.
3. When the Setup wizard appears, verify that Microsoft Exchange Server is checked and that Microsoft Mail and Internet Mail are not checked; click **Next**.
4. Type the name of the Microsoft Exchange Server. This is typically the name of the server on which Microsoft Exchange Server 5.5 is installed. Also enter the mailbox name; this is typically the username.
5. Select if you travel with the computer and click **Next**.
6. In the **Personal Address Book** dialog box, save Mailbox.pab in the user's home directory.
7. After completing the Setup wizard, the Exchange Inbox appears.

Setup of Microsoft Exchange 5.0 Client is now complete.

Microsoft Outlook 98

Overview

Outlook is the latest client messaging software from Microsoft. It combines e-mail and scheduling functions seamlessly into one interface.

Requirements

Hardware Requirements

- Server capable of running Microsoft Windows 2000 and MetaFrame

Software Requirements

- MetaFrame Version 1.8 for Windows 2000
- Microsoft Windows 2000 with Terminal Services installed
- Outlook 98

Installation

To install Outlook 98 on a Windows 2000 server with MetaFrame installed

Note If Outlook 98 and Exchange Server 5.0 will be installed on the same MetaFrame/ Windows 2000 server, Outlook 98 must be installed first.

1. Log on as an administrator and insert the Outlook 98 CD-ROM into the CD drive.
2. When the **Microsoft Outlook** dialog box appears, exit the dialog box.
3. At a command prompt, type **change user /install**. Then run Setup.exe on the root of the Outlook 98 CD.
4. Click **Install Outlook 98** when the **Setup** dialog box appears.
5. Click **Standard Installation**.
6. Click **Corporate email**.
7. If prompted, click **Upgrade Only Newer Items**.
8. Allow installation to complete.
9. At a command prompt, type **change user /execute**.
10. Click **OK** to restart the server.
11. When Outlook installation is complete, run Outlk98.cmd from the %SystemRoot\Application Compatibility Scripts\Install folder.
12. Follow the directions on the screen. When application tuning is complete, log off and then back on for the settings to take effect.

Configuration

1. From each Citrix ICA Client, log on to the MetaFrame/Windows 2000 server.
2. Select **Start**, **Programs**, and then **Outlook 98** to launch Outlook.
3. In the Outlook Setup wizard, select **MS Exchange Server** and click **Next**.

4. Specify the location of the Exchange Server and the owner of the mail account, then click **Next**.
5. Click **No** when asked if you travel with this computer, then click **Next**.
6. Place the Personal Address Book on the user's home drive or a local client drive, then click **Next**.
7. Specify whether or not to add Outlook to the Startup folder and click **Next**.
8. Click **Finish** to complete the configuration.
9. Click **Yes** to make Outlook your default manager for mail, news, and contacts.

Financial Software

PeopleSoft 6.x

Note This application note was provided by PeopleSoft. All trade names referred to are the Servicemark, Trademark, or Registered Trademark of the respective manufacturers.

The information contained in this note is subject to change without notice.

This note provides guidelines for configuring and installing Microsoft Windows 2000, with or without Citrix MetaFrame, for use with PeopleSoft applications.

Supported Configurations

Be sure to check with your administrator to get the latest information about supported configurations, including PeopleSoft versions, Windows 2000 versions, and Citrix MetaFrame versions.

CPU and Memory Recommendations

The recommended minimum client hardware configuration is a Pentium 133 CPU with at least 32MB of RAM. Based on these figures, the following table represents the recommended CPU and memory for a typical Windows 2000 server running PeopleSoft clients.

Note Sizing is a relative process and, depending on your specific requirements, these numbers can skew either way; this information is only meant as a starting point. Your environment (hardware, applications, user activity level, and so on) dictates your actual needs.

Concurrent users	Processor required	RAM
10–12	One P6 200 or above	256MB+
20–24	Two P6 200 or above	512MB+
30–36	Three PII 233 or above	768MB+
40–48	Four PII 233 or above	1GB+
48+	Add servers based on above model	

Usage Restrictions

Windows 2000 will be servicing many clients, in essence acting as the operating system for all users connected to it. With this in mind, keep the Windows 2000 server free of PeopleSoft processes that can be handled by other servers. Here are some recommendations for process distribution:

- Never run the database server on the Windows 2000 server. Run it on a separate machine.
- Never run the PeopleSoft application server on the Windows 2000 server. Run it on a separate machine.
- Never run Process Scheduler on the Windows 2000 server. Run it on your database server or on a separate server.
- If possible, use a separate file server to act as the repository for non-shared user files, including PeopleSoft cache files. This puts the burden of read/write file I/O on a separate server, reducing the overhead for the Windows 2000 server and allowing more of its resources to be devoted to processing user applications.
- Use a high-speed network connection between the Windows 2000 server and any auxiliary servers, including, but not limited to, database servers, application servers, Process Scheduler servers, and file servers.

User Home Directories

Because multiple clients run on a single server, it is important that each user have his or her own dedicated file area (commonly referred to as a home directory) for non-shared files such as temp and cache files.

PeopleSoft Cache Files

In a client/server environment, each PeopleSoft user has a set of cache files stored on his or her client machine. In the Windows 2000 environment, each user must also have a unique set of cache files. You can achieve this by assigning each Windows 2000 user a home directory, preferably on a separate server, and using Configuration Manager to point the cache files directory to a subdirectory of that home directory.

Specifying a User's Cache Files Directory under a Dedicated Home Directory

Only one Windows 2000 user should be able to read and write data to each PeopleSoft cache directory.

It is equally important that only one PeopleTools instance has access to each set of cache files. If multiple PeopleTools instances access the same set of cache data, you could experience application exception errors. This can happen if a user ends a Windows 2000 session improperly, then starts another session. To avoid this, see "Ending a Windows 2000 Session" later in this chapter.

Anonymous Users

If your Windows 2000 environment uses anonymous log on IDs, make sure that each anonymous ID has its own home directory area and that only one instance of each anonymous user can be logged on at the same time.

Installing Applications

When installing applications on the Windows 2000 server, such as Microsoft Office or PeopleSoft, if you want all users to be able to access these applications, use the Add/Remove Programs Administrative wizard and make sure all users begin with common application settings.

Ending a Windows 2000 Session

▶ **To end a Windows 2000 session**

Click **Start** and then **Logoff** in the session taskbar.

- Or -

Click **Start** and then **Disconnect** in the session taskbar.

- Or -

Click the **Close Window** button at the upper right corner of the title bar.

The recommended way to end a Windows 2000 session is option 1. This ends the user session and closes down all running programs, including PeopleTools. This ensures that no PeopleTools programs are left running. The next time a PeopleTools program is launched, it will not conflict with any other PeopleTools program run in the previous session. This ensures a clean set of cache files for each user's PeopleTools program.

If you choose options 2 or 3, it is possible for "phantom" programs to be running when users reconnect. This means that multiple instances of PeopleTools are running without the user knowing it. These multiple instances of PeopleTools can corrupt the cache files, causing a system access violation and shutting down PeopleTools.

To further ensure that users are safely closing programs when they leave a session, administrators can set an option in each user's profile. This can be done in two places.

Option 1

Console Setup for User Manager

You must utilize User Manager in order to change a user's profile. Setting up the Management Console allows easier access to more commonly used utilities, such as User Manager.

1. Click **Start**, select **Run**, and type **mmc** to run User Manager.
2. In the **Console** dialog box, click **Console**, then select **Add/Remove Snap-in**.
3. Click **Add**. The **Add Standalone Snap-in** dialog box appears. This dialog box allows you to customize the console settings and allows quicker access to commonly used MetaFrame utilities.

User Manager

1. In **Local Users and Groups**, double-click the Users folder, then double-click the user whose profile you want to change.
2. In the **User Properties** dialog box, click the **Sessions** tab.
3. Under the **Sessions** tab, change **When a session limit is reached or connection is broken** to **End session**.
4. Click **OK** and exit User Manager.

Option 2

1. Click **Start**, select **MetaFrame Tools (Common)**, and click **Citrix Connection Configuration**.
2. In the **Citrix Connection Configuration** dialog box, double-click a connection.
3. In the **Edit Connection** dialog box, click **Advanced**.
4. In the **Advanced Connection Settings** dialog box, change **On a broken or timed-out connection** to **reset** and click **OK**.
5. Click **OK** again and exit Citrix Connection Configuration.

Performance Tuning Considerations

This section offers suggestions about how to improve the performance of PeopleSoft applications on a MetaFrame server.

Background Wallpaper

ICA sessions carry display characteristics over the network to the end user. The fewer graphics that need to travel the network, the better the performance for the end user. For this reason, the administrator can disable background desktop wallpaper.

PeopleSoft Splash Screen

If you are concerned about the network traffic generated by the PeopleSoft splash screen when signing on from an ICA Client, you can disable it.

To disable the splash screen at startup, add the following command line parameter to the Pstools.exe command used to start PeopleTools:

```
-ss NO
```

The entire command line would look like this:

```
N:\PT750\BIN\CLIENT\WINX86\PSTOOLS.EXE –ss NO
```

Troubleshooting

If you are experiencing problems running PeopleSoft applications in your MetaFrame server environment, read this section for tips and answers to known issues.

Application Errors

Sometimes when certain users access applications such as Crystal Reports, they get an error message stating dlls or system files are missing. Why does it happen?

Windows 2000 is a multiuser operating system. When an application gets installed, it can be installed in one of two ways, either as an application for the specific user installing the application or as an application for all users of the system.

When installing an application, if all users are to have access to it, make sure it gets installed for all users. See “Installing Applications” earlier in this chapter.

File ID Limits

With more concurrent users on Windows 2000, the server frequently gets Event ID 2009 errors in the Event Log. What is this and why does it happen?

Windows 2000 has a limitation of open file handles (FIDs). For each SMB virtual circuit, there is a limit of 2048 FIDs. If client sessions are accessing the same file server, all clients share the SMB virtual circuit; therefore, all clients contribute to the 2048 FID limitation.

This is also true for mappings to the local Windows 2000 server. Because most home directory mappings are done by connecting to a shared resource, even if client sessions access a local Windows 2000 drive, if a drive mapping is used (for example, virtual drive is mapped with the net use command), all clients have the 2048 FID limitation.

PeopleSoft uses numerous files when running. It is recommended that you use a separate file server to limit resource contention. When using a separate file server, all clients are subject to the combined 2048 FID limit. A solution is to spread users across multiple file servers. The actual limit of users per server is based on actual usage. For example, users who use third-party applications on top of PeopleSoft would use more FIDs.

Host Connectivity Software

Hummingbird eXceed 5 for Windows 2000

Overview

Hummingbird eXceed 5 for Windows 2000 is a comprehensive X Window server application for Windows NT and MetaFrame servers. eXceed works with your TCP/IP network to access X applications (also known as X clients) on host computers running X Windows. The eXceed software turns your system into a PC X server. In the X Windows environment, a PC X server is also referred to as an X Windows terminal or server. The X Windows desktop runs as an application on the MetaFrame server. An ICA Client session connected to the MetaFrame server can use eXceed to run X Windows-based applications on a host computer running the X Window environment. The benefits of using Hummingbird eXceed for Windows 2000 on a MetaFrame server include:

- The ability to deliver an X Windows desktop over a low bandwidth connection with excellent performance
- The MetaFrame server and ICA Client sessions can replace expensive X Terminals

Software Requirements

- Hummingbird eXceed 5 for Windows 2000
- Microsoft Windows 2000 with Terminal Services installed
- MetaFrame Version 1.8 for Windows 2000

Installation

There are three steps to installation and configuration.

- Installing the Hummingbird application software on the MetaFrame server
- Installing the ICA Client software for each user
- Configuring the ICA Client software for each user

Installing Hummingbird Application Software

The first step in installing eXceed 5 is to install the shared server portion of the Hummingbird Application Software on the MetaFrame server.

1. Log on to the MetaFrame server as an administrator.
2. At a command prompt, type **change user /install** and press ENTER.
3. Insert the Hummingbird eXceed 5 CD-ROM into a CD-ROM drive on the MetaFrame server.
4. At a command prompt, change the working directory to the \Exceed directory on the eXceed 5 CD-ROM.
5. Type **expand msvcrt20.dl_ %systemroot%\system32\msvcrt20.dll** and press ENTER.
6. Type **expand ctl3d32.dl_ %systemroot%\system32\ctl3d32.dll** and press ENTER.
7. Type **expand mfc30.dl_ %systemroot%\system32\mfc30.dll** and press ENTER.
8. Run Setup from the \Exceed directory on the CD-ROM.
9. When Setup starts, select **Shared User Installation** and then **Express**. Specify a local directory on the MetaFrame server (for example, C:\Win32app\Exceed).
10. When installation is complete, type **change user /execute** and press ENTER.

The eXceed 5 shared server is now installed. Each user who will use eXceed must perform an installation from the C:\Exceed\Userins directory. This process is detailed below. If the administrator has already installed the client software, go directly to “Client Configuration” later in this chapter. All other users must perform a client software installation from the shared directory.

Installing Hummingbird Client Software

This section describes the client-side installation of the Hummingbird Application Software. This must be done by each MetaFrame user who will run the Hummingbird eXceed application.

1. Log on to the MetaFrame server as a user.
2. At a command prompt, type **change user /install** and press ENTER.
3. Run Setup from the \Exceed\Userins directory created in Step 7 above.
4. The first Setup popup asks you to specify the eXceed home directory. Specify the directory created in Step 9 above.
5. The next popup asks you to specify the user's home directory. Specify the user's home directory; for example, %SystemRoot%\Profiles\HermS\Exceed.
6. For users without rights to \%SystemRoot%\System32, three errors will appear during the file copy, each saying "MoveFileEx: Error#{5}. The requested access was denied." Click **OK** each time. This indicates the administrator copied the files to the proper directory in Steps 5, 6, and 7 above.
7. Each user must select a password to configure the X configuration setup.
8. You are asked if you want to tune the video display. Click **Yes** if Msvcrt20.dll was copied into the %SystemRoot%\System32 directory. If it was not, click **No**.
9. At a command prompt, type **change user /execute** and press ENTER.

Client Configuration

This section describes the client-side configuration of the Hummingbird Application Software. This configuration must be done by each MetaFrame user who will run eXceed.

1. After the eXceed client software is installed, double-click the Xconfig icon in the eXceed program group.
2. Double-click the Communication icon. Set the mode to XDMCP-indirect and select a unique display number for each user.

Note Each user must have a unique display number. If two users have the same user number, incorrect program operation can occur.

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3. Select **Configure** and enter the IP address of the X server running XDM.
4. Click **OK** twice.
5. Select the Windows Mode icon and set the Windows mode to **Single**.
6. Click **OK**.
7. Select the Transports icon, enter the broadcast address, and click **OK**.

8. Close the Xconfig window and run the eXceed icon in the eXceed program group to run an X Windows session from the selected XDM server.

Note At this time eXceed does not support multiuser 3270 connectivity under MetaFrame.

Internet Service Provider (ISP) Connectivity Software

ExtendNet VPN Remote Access Server

Overview

Note The information in this application note was provided by Mike Stone, Systems Engineer, Extended Systems Inc., 5777 North Meeker Ave., Boise, ID 83713.

This application note describes how to install and use the ExtendNet VPN to manage PC-to-LAN Virtual Private Network connections. By simply dialing a local Internet Service Provider (ISP) and using the industry-standard Point-to-Point Tunneling Protocol (PPTP), remote users can access their LAN (and, consequently, Citrix MetaFrame server) as if physically connected. All authentication from the Internet, encryption of packets, decryption of packets, and management of users is processed by the ExtendNet VPN server.

The primary benefits of utilizing the ExtendNet VPN for managing PC-to-LAN (MetaFrame server) connections are:

Security. ExtendNet VPN shields your mission-critical MetaFrame server from direct Internet access. Anyone desiring access to the MetaFrame server MUST authenticate to the ExtendNet VPN first. This keeps the Windows/MetaFrame server safely behind the ExtendNet VPN, further reducing the risk of attack from the Internet. PPTP provides 40-bit (the maximum allowed internationally) or 128-bit (domestic maximum) encryption keys. The ExtendNet VPN is also a dedicated hardware platform with a proprietary “hardened” operating system with a reduced code set versus a commercially available operating system, such as Windows 2000.

Performance. The ExtendNet VPN offloads the tasks of encryption and decryption from the MetaFrame server. The ExtendNet VPN is hardware optimized to maximize throughput and decrease the utilization levels of the MetaFrame server.

Ease of use. By utilizing a standards-based solution dedicated to remote access, the ExtendNet VPN is easy to set up and configure. Interoperability is achieved using standard PPTP and Simple Network Management Protocol (SNMP) communication specifications.

Requirements

Hardware

- File server
- An available 10Base-T, 10Base-2, or 100Base-TX network connection for the VPN server
- Dedicated Internet connection at the MetaFrame site
- Management console in the form of a PC running Windows 95 or Windows NT 4.0 to run the management software (InterprEYES Manager and Monitor)
- Remote clients with dial out capability (modem, etc.) and access to the Internet through an account with an ISP

Software

- MetaFrame Version 1.8 for Windows 2000
- Microsoft Windows 2000 with Terminal Services installed
- Remote clients running Windows 95, Windows 98, or Windows NT
- Remote Windows 95 or Windows 98 must have Dial-Up Networking (DUN) Version 1.3 with the Microsoft VPN option enabled
- Remote Windows NT clients must have Service Pack 4 installed
- Network Operating System (NOS) protocol supporting TCP/IP

System Integration

Note Before you proceed, make sure that Microsoft Windows 2000 and Citrix MetaFrame are already installed on the server and that the server is configured to accept TCP ICA connections.

- ExtendNet VPN serves as a gateway between the Citrix network and the Internet. Because the ExtendNet VPN functions on the TCP/IP layer (the network and transport layers of the OSI model), remote users can authenticate to the ExtendNet VPN, receive an IP address that is valid for the local subnet, and then authenticate to the Citrix MetaFrame server as if physically connected to the MetaFrame server's network.
- Firewall and/or router configuration. The ExtendNet VPN utilizes Microsoft's PPTP for encapsulating and encrypting the packets during transmission over the Internet. PPTP requires that two packet types are passed to the PPTP server (in this case, the ExtendNet VPN). Data packets are PPP packets encapsulated

using an enhanced Internet Generic Routing Encapsulation Protocol Version 2 (GRE V2). GRE is protocol type 47. Control packets (for status inquiry and signaling information) are transmitted and received over a TCP connection. The TCP port used is 1723. Both of these packet types must be able to reach the ExtendNet VPN and may require some configuration of a router and/or firewall (if present and filtering) at the ExtendNet VPN site.

- Client configuration. Because the ExtendNet VPN uses PPTP to enable remote access to a LAN over the Internet, each client must be configured to utilize PPTP. Installing the Microsoft software varies by operating system (either Windows 95, Windows 98, or Windows NT) but is detailed in the *Extended Systems VPN User's Guide-Remote Setup*.

Installation

To install and configure the ExtendNet VPN server

1. Connect the ExtendNet VPN to the LAN with 10Base-T, 10Base-2, or 100Base-TX.
2. Install the InterprEYES discovery and management software on a Windows server.

   InterprEYES discovers and allows configuration of the ExtendNet VPN. It automatically discovers an ExtendNet VPN on the same local subnet but requires multicast support to discover an unconfigured device that is on a remote network.
3. Configure a remote client to access the ExtendNet VPN.

   Note The Citrix ICA Client must already be installed on the remote client machine in order to log on to the Citrix server.
4. Test the configuration by attempting to connect the remote client to the ExtendNet VPN.
5. After authenticating to the local network successfully, the remote client can log on to the Citrix server by a TCP ICA connection. This type of connection is enabled by default on a MetaFrame 1.8 for Windows 2000 server.

Usage

When utilizing the ExtendNet VPN, a client performs the following steps to initiate a Citrix MetaFrame session.

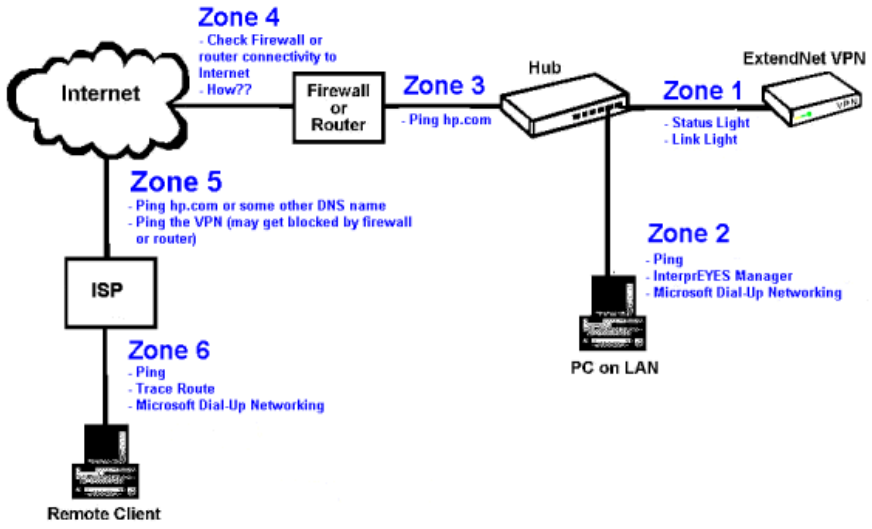
1. Connect to the Internet. This is typically achieved through a DUN connection but can also be through a LAN connection to the Internet.
2. Double-click the DUN icon representing the VPN connection to the ExtendNet VPN.

3. Log on to the Citrix MetaFrame server through the ICA client.

You can now access any resources on the MetaFrame server as if you were physically connected.

Troubleshooting

To start troubleshooting a VPN connection, break the issue into zones. Start with the physical connection (Zone 1). Verify that you have a green status and link light. Build up to Zone 2. Verify that local communication exists to the ExtendNet VPN by pinging from a local workstation, such as **ping <local IP address>**.



Ensure that a workstation can communicate with the ExtendNet VPN using the InterprEYES utility to check the ExtendNet VPN's current IP address, subnet mask, and default gateway. Another good test is to see if a client workstation can initiate a VPN session locally utilizing Microsoft's VPN adapter (DUN on Windows 95 or 98 and a RAS connection in Windows NT). In Zone 3, verify that communication exists with the Internet. Ping a domain name by entering the following (or some other domain name) at a command line: **ping www.extendedsystems.com**.

Zone 4 is the most common cause of issues. By default, a router or firewall is configured to deny all traffic from the Internet. This means a remote user trying to connect to the ExtendNet VPN will never reach the ExtendNet VPN server (in Zone 1) because the packets will be refused by the firewall/router at Zone 4. Check your forwarding rules for the firewall/router to make sure these packet types are allowed through. If remote clients are getting errors connecting to the ExtendNet VPN (specifically error 650 or 629) but clients in Zone 2 can reach the VPN, it is most likely due to the firewall. In Zone 5, verify the client DUN is

configured to the IP address of the ExtendNet VPN server. Also, try to ping hp.com and then try to ping the IP address of the ExtendNet VPN.

For more advanced troubleshooting tips, query Extended Systems' knowledge base at **http://www.extendedsystems.com** or contact Extended Systems' technical support directly.

Modem Connectivity Software

Comtrol RocketModem

Overview

The Comtrol RocketModem is a multiport, PCI bus expansion card with multiple modem capabilities. This section describes a tested configuration of Comtrol RocketModem with Citrix MetaFrame.

Requirements

Hardware Requirements

- Dell OptiPlex GXi with one Pentium processor
- Comtrol RocketModem card with four modems

Software Requirements

- MetaFrame Version 1.8 for Windows 2000
- Comtrol RocketModem Device Driver Version 3.14

Installing Comtrol RocketModem Card

1. Turn the computer off, remove the computer cover, and select a slot to install the controller.
2. Remove the expansion slot cover and insert the RocketModem card.
3. Replace the covers and restart the system.

Installing Comtrol RocketModem Device Driver

1. On the desktop, right click **My Computer** and click **Properties**.
2. Click the **Hardware** tab and then click **Hardware Wizard**.

   Windows 2000 will find your new device if it has been properly installed.
3. Let the Hardware wizard search for a suitable driver for your device.
4. When your driver is found, click **Next**.
5. Click **Finish** to complete Comtrol RocketModem installation.

6. Insert the driver installation diskette that accompanied your new hardware in drive A (or other appropriate drive). From the \Winnt subdirectory, extract the self-extracting zipped file (6540v4_19_2.exe) to an empty directory on your computer.
7. At a command prompt, type **change user /install**.
8. Run Setup.exe. In **RocketPort/RocketModem NT Setup**, select an I/O address range (180-1c3 hex default was chosen for this installation). Running Setup creates an entry for the Comtrol RocketModem in the **Start** menu.

Note Make sure that these selections do not conflict with an existing I/O address range or with COM ports already in use.

9. In the remaining **RocketPort/RocketModem Setup** dialog boxes, click **OK**.
10. Reboot the system in order for the changes to take effect.

Setting up Comtrol RocketModem

1. In Control Panel, double-click **Phone and Modem Options**. Click the **Modems** tab.
2. Click **Add**. Check **Don't detect my modem; I will select it from a list**.
3. Choose **Comtrol** as the manufacturer and select **RocketModem VS2000 v.34**.
4. Select all ports in the range assigned to the RocketModem board and click **Next**.
5. Click **Yes** for all the subsequent dialog boxes to continue the installation.
6. Click **Finish** to complete the setup.
7. Click **OK**.

Terminal Connection Configuration Using Comtrol RocketModem

1. Click **Start**, select **Programs**, then **Administrative Tools**, and then **Terminal Services Configuration**.
2. In the **Terminal Services Configuration** dialog box, click **Action** and select **Create New Connection**.
3. Under **Connection type**, select **Citrix ICA 3.0**, choose **Basic** encryption level, and select **Use remote control with default user settings**.
4. Enter a connection name and select **Async** for transport. Click **Next**. Select one of the RocketModem COM ports for **device**, click **Next**, and then click **Finish**.
5. Repeat Steps 1–4 for additional terminal connections.
6. Reboot the server.

Configuring ICA Clients to use Comtrol RocketModem

1. Using a text editor, open \System32\RAS\Modem.inf.
2. Using a text editor, open \Program Files\Citrix\ICA Client\Modem.ini.
3. Maintaining alphabetical order, add the name of the modem connected to the RocketModem that is listed in the Modem.inf file to the top portion of the Modem.ini file and add an equal sign at the end of the modem name; for example, US Robotics=.
4. Copy the initialization strings from the Modem.inf file and paste them at the end of the Modem.ini file.
5. Close the Modem.inf file and save and close the Modem.ini file.
6. With the text editor, open \Program Files\Citrix\ICA Client\Wfclient.ini.
7. Below the last COM port listed in the Windows COM Port Name section of the Wfclient.ini file, add the COM port followed by an equal sign for each port to be used by the RocketModems; for example, COM5=.
8. Save the Wfclient.ini file and close the text editor.

Citrix ICA Clients can now access the RocketModems.

Verifying the Installation of Comtrol RocketModem

Follow the procedure below to verify that the Comtrol RocketModem is correctly installed and configured:

1. Connect the modem ports to phone ports.
2. Click **Start**. Select **Programs**, **Accessories**, then **Hyperterminal**, and click **HyperTerminal**.

Note If this is the first time you are using HyperTerminal, enter an area code and click **Close**. When prompted, type a modem name.

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3. Type a name in **Connection Description** and click **OK**.
4. In the **Connect To** field, enter an area code and a phone number that can be used for testing.
5. In the **Connect Using** list at the bottom of the **Connect To** dialog box, select the first of the RocketModems.
6. In the **Connect** field, click **Dial**.
7. Verify the connection is made.
8. Repeat Steps 1–7 for each RocketModem.

Networking Software

Microsoft Windows 2000 Multi-Protocol Routing Service

Overview

This section describes how to install and integrate the Microsoft Windows 2000 Multi-Protocol Routing Service on a Microsoft Windows 2000 server. Multi-Protocol Routing enables small- to medium-sized organizations to deploy a Windows 2000 server as a low cost LAN-to-LAN routing solution for TCP/IP and IPX networks, eliminating the need for a dedicated router. The Multi-Protocol Routing Service can also be used to link LANs that have different network topologies (such as Ethernet and Token Ring). Each packet sent over a LAN has a packet header that contains source and destination address fields. Using the packet header information, the routing service receives network packets from a source and routes them to their destination using the shortest path available. This reduces network traffic on other LAN segments, optimizing network performance.

The Multi-Protocol Routing Service allows a Windows 2000 server to act as a router for the network. Any ICA Client on any attached network loop can establish a remote session from a MetaFrame server on any other network loop using the TCP/IP and IPX protocols.

Requirements

Hardware Requirements

- Microsoft Windows 2000 server with two or more network cards for full Multi-Protocol Routing functionality

Software Requirements

- MetaFrame Version 1.8 for Windows 2000
- Microsoft Windows 2000 with Terminal Services installed

Installation

1. Click **Start**, select **Programs**, **Administrative Tools**, and then click **Routing and Remote Access**.
2. In the left window pane, highlight the local server, click the **Action** menu option, and select **Configure and Enable Routing and Remote Access**.

   The **Network** dialog box appears.
3. When the Routing and Remote Access Configuration wizard appears, click **Next**.

4. On the **Routing and Remote Access** dialog box, uncheck the **Enable remote access** control box and check the **Enable server as a router** control box. Select a routing type and click **Next**.
5. When prompted, click **Finish** to complete the routing service installation and start the service.

Configuration and Troubleshooting

IP

After the routing service is configured and started, you need to add static IP addresses for each of the network cards.

1. In the **Routing and Remote Access** utility, double-click **IP Routing**.
2. Double-click the General icon. A list of all the network cards installed on your machine appears.
3. Double-click **Local Area Connection** and select the **Configuration** tab.
4. Click **Use the following IP address**.
5. Specify an IP address and subnet mask for the Local Area Connection.
6. In the **Router (Default Gateway)** field, enter the IP address of the network to which you want to route the packets.
7. Repeat IP configuration for all other Local Area Connections.

Note At a command prompt, type **route print** to see what routes your machine has. You can also use the **ping** and **tracert** commands to troubleshoot or verify that the Multi-Protocol Routing service is working for TCP/IP.

After configuring IP for each network card on your machine, the Windows 2000 server starts exchanging routing information with other Windows 2000 and RIP routers. For more information about TCP/IP, see the appropriate Windows 2000 documentation.

IPX

If no network number is defined for the segment to which Windows 2000 server is connected, you must define a unique network number for that segment. For example, if you have a Windows 2000 server with two network interface cards and the first network card is connected to an existing Novell network, you can leave the network number blank because Windows 2000 auto-detects the network number for that segment. If the second network card is connected to the Microsoft network; no IPX network number is defined for this segment. You must type in a unique network number for this segment. Use Ipxroute.exe to determine the network number of your network adapter. Ensure that the same frame types are selected for both network adapters.

Productivity Software

Symantec ACT! Version 3

Overview

Symantec's ACT! 3.0 is a business contact management program. MetaFrame extends ACT!'s capabilities by allowing multiple users to simultaneously use ACT! with shared or unshared contact databases. This note describes a tested method of configuring ACT! 3.0 using MetaFrame.

Requirements

Hardware Requirements

- MetaFrame server

Software Requirements

- MetaFrame Version 1.8 for Windows 2000
- ACT! Version 3

Installing ACT!

1. At a command prompt, type **change user /install**.
2. Run Setup.exe from the ACT! CD-ROM.
3. Fill in the user information.
4. Select the installation location.
5. Select the type of installation (Typical was chosen for this test configuration).
6. Complete registration information.
7. At a command prompt, type **change user /execute**.

Configuring ACT!

On MetaFrame, ACT! can be set up to allow a shared database to be used simultaneously by multiple users and for unshared databases to be used by individuals. In either case, permissions must be set to allow proper access.

All users who share a common database must have access to both the database file (that is, Contacts.dbf) and the directory that contains the database file (for example, C:\Act\Database). If a user does not have the correct permissions when he or she starts ACT! for the first time, the Database Setup wizard does not accept any database filenames. When this happens, the user must exit the Setup wizard and choose **New** from the **File** pull-down menu to create a database and save it in a location where he or she has sufficient rights.

Verifying Installation of ACT!

Follow the procedure below to verify that ACT! is correctly installed and configured:

1. Click **Start**, select **Programs**, **ACT! 3.0 for Windows,** and then **ACT! 3.0**.
2. Follow the Setup wizard (default values were used in the test configuration).
3. Enter **My Record** information.
4. Click **Contact** and then **New Contact** from the menu bar to add a new contact.
5. From the menu bar, select **Lookup**, then **Company,** and enter the name of a current contact with the company name you selected.

Note ACT! does not allow any two users of a shared database to make concurrent changes to the same contact record. Once a user starts to change a record, that user must save the changes or switch to a different record before others can make changes to the record. ACT! allows users of a shared database to make concurrent changes to different contact records.

Additionally, if an alarm is set for a scheduled activity, all users concurrently running ACT! and using the same database receive the alarm.

Corel WordPerfect Suite 8

Overview

Corel WordPerfect Suite 8 is an office application suite that includes WordPerfect, Quattro Pro, and Presentations. MetaFrame extends WordPerfect Suite 8 capabilities by allowing multiple users to concurrently use any of the suite's programs. This note describes a tested method for configuring WordPerfect Suite 8 using MetaFrame.

Requirements

Hardware Requirements

- MetaFrame server

Software Requirements

- MetaFrame Version 1.8 for Windows 2000
- Corel WordPerfect Suite 8

Installing Corel WordPerfect Suite 8

1. Install and configure MetaFrame as a standalone server or a domain controller.
2. Log on to the console of the MetaFrame server as an administrator.

3. At a command prompt, type **change user /install** and press ENTER. This places the user session in install mode.
4. Insert the Corel WordPerfect Suite 8 CD in the CD-ROM drive.
5. When AutoRun displays the Corel WordPerfect Suite 8 Applications Disk window, click **Corel WordPerfect Suite Setup**.
6. Click **Next** in the **Welcome** dialog box and **Yes** in the **License Agreement** dialog box.
7. Enter the appropriate information in the **Registration Information** dialog box.
8. Select the type of installation: **Typical**, **Compact**, **Custom**, or **Run From CD-ROM**. (For this installation, Typical was chosen.)
9. Enter the installation location.
10. Select the components to be installed. (All components were selected during this installation.)
11. Click **Install** in the **Ready to Install** dialog box.
12. When installation is complete, click **OK** to exit setup.
13. At a command prompt, type **change user /execute** and press ENTER.

Verifying Installation of Corel WordPerfect Suite 8

Follow the procedure below to verify that WordPerfect Suite 8 is correctly installed and configured:

1. Select **Corel Desktop Application Director 8** from the Accessories program group.
2. Double-click the WordPerfect icon and verify that WordPerfect starts correctly.
3. Repeat Step 2 for Quattro Pro and Presentations.

Lotus Notes 4.5 for Windows NT

Overview

This application note describes how to integrate Lotus Notes 4.5 Server and Workstation software with MetaFrame. Lotus Notes is a workgroup environment for developing applications that enables groups of people to share information and work together. Lotus Notes enables you to communicate with colleagues, collaborate in teams, and coordinate strategic business processes.

There are two parts to the Notes installation.

- Installing Lotus Notes Server for Windows NT on a Windows 2000/MetaFrame server

- Installing Lotus Notes Workstation for Windows NT that can also run on a MetaFrame server

If a Lotus Notes Server is already running in your network and you are not installing Notes on a MetaFrame server, proceed to the Installing Lotus Notes Workstation Program section later in this chapter. If you plan on running both Lotus Notes Server and Lotus Notes Workstation on a MetaFrame server, follow the directions in both the server and workstation installation sections.

Installation Note

Although both the Lotus Notes Server and many copies of Lotus Notes Workstation for Windows can run on a single MetaFrame server, this is not always the best solution. If the system running MetaFrame is a high end, multiprocessor machine with a large amount of RAM and a very fast hard disk subsystem, this configuration works fine. However, if the MetaFrame servers are configured to meet only MetaFrame needs, you need to add more computing resources to those machines or consider running Lotus Notes Server on a separate machine. It is recommended that you have a standalone Windows NT Server to run Lotus Notes Server and run the Lotus Notes Workstation client on the MetaFrame servers. This allows Lotus Notes Server to use all of the system resources of a separate machine. The MetaFrame server(s) with the Lotus clients can then support multiple remote or network users who want to access the Lotus Notes Server.

Lotus Notes Workstation for Windows NT allows you to do a public install. It is suggested that you do a single public install to the MetaFrame server or to any available network server. Users who want to set themselves up for Lotus Notes access can then run the standard Lotus Notes Workstation installation from the public install by changing into that directory and running Setup.

Requirements

Hardware Requirements (choose one of the following)

- One MetaFrame server
- One MetaFrame server and one Windows NT 4.0 or Windows 2000 server

Software Requirements

- MetaFrame Version 1.8 for Windows 2000
- Citrix ICA Client
- Lotus Notes Release 4.5

Installation

To install Lotus Notes Server for Windows NT on a MetaFrame Server

1. It is recommended that you create an administrative user specifically for Lotus Notes on the MetaFrame server that will run the Lotus Notes Server. Log on to the MetaFrame server as this administrative user.
2. Before proceeding with the Notes Server installation, you must run **change user /install** from the command prompt if you want to run Notes Server as an automatic service. However, this does not allow you to run the Administrators Personal Workstation at the same time that the Notes Server is running. Therefore, it is recommended that you run the Administrators Personal Workstation from a workstation rather than the Notes Server.
3. Proceed with installing Lotus Notes Server. Run install from the Win32\Install directory on the Lotus Notes 4.5 CD-ROM or from the floppy diskettes made from the Win32\Disk_Kit directory. Register the software.
4. In the **Install Options** dialog box, select directories and the group under which you want to install. If you want to install Notes as a service, choose **Customize Features-Manual Install**. If you do not want to install Notes as a service, choose **Server Install** and skip to Step 6.
5. In the **Customize** dialog box, verify that **Notes Service Install** is selected.
6. After installation of the Notes Server is complete, Notes places the Lotus Notes Server and Workstation icons in a Common program group on your desktop. Move these icons to a Personal Program Group. This situation arises only if you are using a single MetaFrame server for the Notes server and client workstation installs (see the Installation Note above).
7. The first time you double-click the Notes Workstation icon, Notes Setup starts automatically. You must complete server setup before working in Notes. If you try to start Notes server without first completing Notes setup, the server exits with the message: "You must first run the workstation server setup program to set up your system. To restart the setup process, double-click the Notes workstation icon."
8. Proceed with Lotus Notes installation. See the Lotus Notes documentation for specifics about the Lotus Notes Server setup.
9. When server setup is complete, you need to name the port (that is, SPX; LAN0) under **Tools**, **Server Administration**, **Servers**, **Servers View**. Double-click the appropriate server and edit Network Configuration.
10. Running Notes as an automatic service is useful if you need to start the server from a remote location or to restart automatically after a system failure. If you choose to install Notes as a service during installation, follow these instructions to make the service automatic.

    A. Click **Start**, select **Programs**, then **Administrative Tools**, and click **Computer Management**.

B. Expand **System Tools**, then click **Services**.

C. Double-click **Lotus Domino Server**.

D. Select **Automatic** as the startup type.

11. Reboot the MetaFrame server to start the Lotus Notes server, or run **change user /execute** from the command prompt and double-click the Notes Server icon to start the Notes Server manually.

▶ **To install the Lotus Notes Workstation Program for Windows on a MetaFrame server**

1. Log on to the MetaFrame server on which you are going to install the Notes client using the desired Citrix ICA Client (DOS, Win16, or Win32.) Log on as the user for whom you want to set up the Lotus Notes Workstation for Windows program.
2. If you did a file server or network distribution install of the Lotus Notes Workstation for Windows program, **net use** the directory on the network, change to the Notes public directory, and run the install program. If you did not do a public install, load the CD-ROM or floppy diskettes and do a normal install of the workstation program. From a command prompt, run install from the Win32\Install directory or from the floppy diskettes created from the Win32\Disk_Kit directory.
3. When the install program is launched, you may receive a message telling you there are multiple copies of Notes for Windows on the hard disk. This is to be expected because many clients may be using this particular MetaFrame server as a Notes workstation.
4. At the **Install Options** panel, choose **Standard Install** and point your Program and Data drive paths to the user's Windows directory; for example, \Wtsrv\Profiles\Daniela\Notes and \Wtsrv\Profiles\Daniela\Notes\Data. Select **Program Group** and proceed with workstation installation. If the selected user profile path is not the default, you must provide the profile path name.
5. Repeat Steps 1- 4 for each user who wants to set up the Lotus Notes Workstation program for Windows.

Lotus SmartSuite 97

Overview

This application note describes how to install Lotus SmartSuite 97 on a MetaFrame server.

Lotus SmartSuite 97 is a package of 32-bit software applications that operate together to make work easier and communication more effective. The package includes Lotus SmartCenter 97 and SuiteStart 97 (command centers that access desktop applications and application files), Lotus 1-2-3 97 (a spreadsheet

program), Lotus Word Pro 97 (a word processor), Lotus Approach 97 (a database), Lotus Freelance Graphics 97 (a presentation graphics package), Lotus Organizer 97 (a personal information management tool), and Lotus ScreenCam 97 (a show-and-tell communication tool).

Organizer 97 and ScreenCam 97 are not supported under MetaFrame Version 1.8 for Windows 2000. During installation, you are asked if you want to install the ScreenCam files. Errors in installation **will occur** if these files are installed.

Software Requirements

- Microsoft Windows 2000 with Terminal Services installed
- MetaFrame Version 1.8 for Windows 2000
- Lotus SmartSuite 97

Installation

There are three ways to install Lotus SmartSuite 97:

- Standard
- File Server
- Network Distribution.

A standard installation places the product on the MetaFrame server's hard disk. This allows ICA clients to access the applications from the MetaFrame server desktop.

A file server installation allows Lotus applications to be shared by multiple "node" users on networks such as Windows NT or Novell NetWare. The main portion of the applications resides in one location, or sharepoint, and all node users are configured to use the applications from that location. All users must have access to this shared location through a network or on a local machine. This type of installation is recommended only when using Microsoft Windows 2000 with Terminal Services.

A distribution installation copies the contents of the Lotus diskettes or CD-ROM to the MetaFrame server. You can then use the copy on the MetaFrame server to perform subsequent standard, file server, or network distribution installs. This installation is useful if you will be running several standard installs to other machines. You can run Install from the distribution location on the MetaFrame server or network sharepoint rather than installing from disk or CD-ROM on each machine.

▶ **To perform a standard installation of Lotus SmartSuite 97 on a MetaFrame server**

1. Log on to the MetaFrame server as a local administrator.

2. At a command prompt, type **change user /install**.
3. Run Install.exe from the SmartSuite 97 CD-ROM.
4. Continue the installation following the directions in the SmartSuite 97 manual, with the following exception:

   Organizer 97 and ScreenCam 97 are not supported under MetaFrame Version 1.8 for Windows 2000. If the files are installed, errors in installation **will occur**.
5. After installation, if you are prompted to restart the computer, click **Restart.** After the computer reboots, log on to the console as a local administrator.
6. Run Ssuite97.cmd in the %SystemRoot%\Application Compabitility Scripts\Install folder. Follow the directions on the screen.
7. When application tuning is complete, log off and then log back on for the settings to take effect.

▶ **To perform a network distribution installation of Lotus SmartSuite 97 on a MetaFrame server**

1. Log on to the MetaFrame server as a local administrator.
2. Run Install.exe from the SmartSuite 97 CD-ROM.
3. Check the **File Server or Multiple User Install** check box at the bottom of the initial **Welcome** dialog box.
4. Click the **Network Distribution Install** radio button when prompted for the type of network installation.
5. Continue the installation following the directions in the *SmartSuite 97 Network Administrator Manual* or the SmartSuite 97 Readnet.txt file.
6. The client can now install SmartSuite 97 by accessing Install.exe using the sharepoint on the network or by logging onto the MetaFrame server where the installation was executed and running Install.exe from there.

Microsoft Office 97

Overview

This application note describes how to install Microsoft Office 97 on a MetaFrame server.

Software Requirements

- MetaFrame Version 1.8 for Windows 2000
- Microsoft Office 97

Installation

To install Microsoft Office 97 on a MetaFrame server

1. Log on to the console as a local administrator.
2. At a command prompt, type **change user /install**.
3. Run Setup.exe from the Office 97 CD-ROM.
4. Continue the installation following the directions in the Office 97 manual.

Note If the server drives were remapped during MetaFrame installation, the following error messages appear when 84% of Microsoft Office 97 is installed:

"Setup tried to create an invalid path using C:\MSoffice\Winword and Bookshelf.dll."

"Setup tried to create an invalid path using C:\MSoffice\Winword and Bshelf94.dot."

"Setup tried to create an invalid path using C:\MSoffice\Winword and Bsword.hlp."

If these error messages appear, click **OK**. They do not affect installation.

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5. After setup, if you are prompted to restart the computer, click **Restart Windows**. After the computer reboots, log on to the console as a local administrator.
6. Run Office97.cmd from the %SystemRoot%\Application Compatibility Scripts\Install folder.
7. Follow the directions on the screen. When application tuning is complete, log off and then log back on for the settings to take effect.

Microsoft Office 2000

Overview

This application note describes how to install Microsoft Office 2000 on a MetaFrame server.

There are three outstanding issues with Office 2000 at the present time:

- Do not set any features to **Run from Network**, **Run from CD**, or **Installed on First Use**. These settings do not work in a Windows 2000 server environment
- Set the Outlook features that you want to install to **Run from My Computer**. Set all other features to **Not Available**
- Some features of Outlook 2000 do not work properly in the Windows 2000 server environment. See the *Microsoft Office Resource Kit Journal* on the

Microsoft Web site at (http://www.microsoft.com/office/ork/2000 /journ/OutlTermSrvr.htm)

Software Requirements

- Microsoft Windows 2000 with Terminal Services installed
- MetaFrame Version 1.8 for Windows 2000
- Microsoft Office 2000

Installation

▶ **To install Microsoft Office 2000 on a MetaFrame server**

1. Log on to the MetaFrame server as an administrator.
2. Copy the Termsrvr.mst transform file from the Office 2000 Resource Kit or from the Microsoft Web site to a location on the MetaFrame server.
3. Close all applications and ensure no users are connected to the server. Disable further logons by typing **change logon /disable** at a command prompt.
4. Open Control Panel.
5. Double-click **Add/Remove Programs**.
6. In the **Add/Remove Programs** dialog box, click **Add New Programs**.
7. Select **CD or Floppy** to install the program.

   The **Install Program From Floppy Disk or CD-ROM** dialog box appears. Click **Next**.
8. Setup automatically detects the location of Setup.exe if installation is from the CD-ROM. If Setup.exe is located elsewhere; that is, on a network sharepoint, use the **Browse** button to point to that location.
9. On the command line, add the following command (separated by spaces) after Setup.exe:

   TRANSFORMS="path\TermSrvr.mst"

   This command identifies the Terminal Server transform for Setup to use during installation. Specify the correct path to the Mst file downloaded in Step 2 above.

   Click **Next**.
10. Proceed with installation until you reach the license agreement. Click **Next** to accept the terms of this agreement.
11. If you want to perform a Normal or Default installation, click **Install Now**. Allow the Installer to complete the installation and then skip to Step 16.
12. If you want to perform a Custom installation, click **Custom Install**.
13. Select the location where you want to install Office 2000.

Note You need at least 259MB on the destination drive to install Office 2000.

14. Select the applications you want to install. The recommended applications are selected by default. Unselected applications or applications that are marked unavailable are marked as such because of incompatibility or performance issues.
15. After you choose which applications to install, click **Next** and allow the Microsoft Office 2000 Installer to continue with the installation.
16. When Setup is complete, click **Next** on the **After Installation** dialog box.
17. In the **Finish Admin Install** dialog box, click **Finish**.
18. Enable user logons by typing **change logon /enable** at a command prompt.

System Integration

See the *Microsoft Office 2000 Resource Kit Journal* for additional information about system integration issues and recommendations. This document is located on the Microsoft Web site at http://www.microsoft.com.

Novell GroupWise 5.5

Groupwise 5.5 is Novell's latest version of their groupware software. It is closely linked with NDS and now supports multiple clients and multiple protocol access, including SMTP and POP services, and a Web-based GUI client. There are several installation options for GroupWise, including running a post office on a Windows NT server. For simplicity, this application note discusses installing GroupWise Domain and Post Office services on a Novell NetWare server, although the directions also apply to post offices running on a Windows NT server. This note is limited to discussing only the Windows 32-bit version of Novell's client software.

Test Configuration

- One NetWare 5.0 server
- One MetaFrame 1.8 for Windows 2000 server

Software Requirements

- At least one NetWare 4.1x or higher server with GroupWise 5.5 Domain and Post Office services installed
- Windows 2000 Server CD (if Windows Messaging is not installed on the MetaFrame server)
- Novell GroupWise 5.5

Installation

▶ **To install the GroupWise 5.5 client on a MetaFrame server**

1. At a command prompt, type **change user /install**.
2. Insert the GroupWise 5.5 CD into the appropriate drive and run Setup.exe from the \Clients\Win32 directory.
3. If the Windows Messaging System files are not installed on your MetaFrame server, you receive the following message:

   "Windows Messaging System is required to run GroupWise 5.5 but is not found on your computer."

   Click **Next** to install the Messaging System (requires Windows 2000 Server CD). The system reboots.

   Important After the system reboots, at a command prompt, type **change user /install**.

4. Select the **Standard** installation.
5. Select the location where you want to install GroupWise.
6. Select the components of GroupWise you want to install.
7. Select the group name for the GroupWise application icons.
8. Select the components you want to install into the startup folder. These components are launched at startup for all users.
9. Select the **Language** to install.
10. Click **Next** to begin the file copy process.
11. When the files are copied, exit the installation application without launching it.
12. At a command prompt, type **change user /execute** to change the mode back to execute.

Usage

Follow the usage directions in the *GroupWise 5.5 User's Guide*.

Troubleshooting

See "Troubleshooting" in the *GroupWise 5.5 User's Guide*.

Novell ManageWise Version 2.6

Novell's ManageWise Version 2.6 was not designed to be a multiuser product. As a result, there are few options for how to install it on MetaFrame except as it is installed for Windows NT. It can be made multiuser by manually pointing the location of the databases that the application uses for storing and retrieving data to

a virtual location (like a user's home directory) so that it is different for each user. If you do decide to do this, you also need to manually copy the database files to that directory for each user, change each user's Nms.ini file, and then point the two database entries to the virtual directory. This means that more disk space is needed to store each set of databases for each user. Forcing ManageWise to be multiuser is not recommended.

Test Configuration

- MetaFrame Version 1.0 server with Novell's 32-bit client for Windows NT
- NetWare Version 5 server
- ManageWise Version 2.6

Software Requirements

- NetWare Version 4.1x or higher
- MetaFrame Version 1.0

Installation

To install ManageWise Version 2.6 on a MetaFrame server

1. Log on to the MetaFrame server and into the NDS tree as an administrator.
2. On the MetaFrame server, at a command prompt, type **change user /install**.
3. Run Setup.exe from the ManageWise CD-ROM.
4. After navigating through the introductory screens, select the drive letter that is mapped to the SYS: volume of your NetWare server.
5. Add a license and choose the type of installation you want (Custom or Typical).
6. Continue through the summary screen. There is a significant delay in the installation program after the summary screen. Do not reset the computer; installation will continue.
7. Have the installation program update the Autoexec.ncf and Net$log.dat files.
8. Complete the installation and exit Setup.exe.
9. At a command prompt, type **change user /execute**.

Usage

Follow the usage directions in the *ManageWise Version 2.6 User's Guide.*

Troubleshooting

See the Troubleshooting section in the *ManageWise Version 2.6 User's Guide.*

Programming Software

Microsoft Visual Basic Version 5.0 Enterprise Edition

Overview

Microsoft Visual Basic Version 5.0 allows users to create applications for Microsoft Windows. MetaFrame extends Visual Basic's capabilities by allowing multiple users to concurrently create, modify, and run Visual Basic applications. This application note describes a tested method for installing and using Microsoft Visual Basic Version 5.0 Enterprise Edition with MetaFrame.

Software Requirements

- MetaFrame Version 1.8 for Windows 2000
- Microsoft Visual Basic Version 5.0 Enterprise Edition

Installing Microsoft Visual Basic

1. Log on to the console of the MetaFrame server as an administrator.
2. At a command prompt, type **change user /install** and press ENTER. This places the user session in install mode.
3. Run Setup.exe.
4. In **Name and Organization Information**, enter the appropriate information.
5. Enter the installation location.
6. Select the type of installation: **Typical**, **Compact**, or **Custom**. (For this installation, Typical was chosen.)
7. When installation is complete, click **OK** to exit Setup.
8. At a command prompt, type **change user /execute** and press ENTER.
9. Reboot the computer.

Verifying Installation of Microsoft Visual Basic Version 5.0

To verify that Visual Basic 5.0 is correctly installed and configured:

1. In Windows NT, click **Start**, select **Programs**, and click **Visual Basic**.
2. In **New Project**, click **Existing**.
3. In **Directories**, select *x*/Vb/Samples/Pguide/Biblio, where *x* is the directory in which Visual Basic was installed.
4. In **File Name**, double-click **Biblio.vbp**.
5. After the file loads, expand the Forms directory in the upper right side window.
6. Double-click **Form1**.

7. When the form loads, verify that the form can be changed and saved.
8. From a MetaFrame session, verify that a user without administrative rights can repeat Steps 1–7.

Note Visual Basic 5.0 must be installed in a directory where users without administrative rights have Change or Full Control permissions. Without these permissions, users cannot create applications that contain databases.

CHAPTER 4

Securing the Enterprise

The third phase of putting a MetaFrame solution into production is to secure your data, applications, and systems from unauthorized use and attack. This chapter provides the following sections to assist you:

- Defining User Rights
- Protecting Against Viruses and Trojan Horses
- Auditing System Activity
- Securing Data and Applications

Defining User Rights

In MetaFrame and Windows 2000, there are several ways to define and enhance users' workstation environments. You can define network connections, available applications, Windows program groups, and Windows desktop appearance. If you want, you can prevent users from changing the desktop environment you create.

If you need to set up a large number of users who have similar characteristics on a MetaFrame server, it is convenient to create a *user template*. This template can be configured with the desktop configuration, applications, and network drives that the user needs and can then be used as a pattern to create new users when needed.

User Profiles

The most powerful method you have of managing user environments is through *user profiles*. A profile is a file that serves as a snapshot of a user's desktop environment. With profiles, you can also restrict users' ability to change these settings. You can create profiles for users who have domain accounts and store these profiles on servers. Each user can have a single profile with one configuration that is loaded when the user logs on.

You can control what users can and cannot do on their workstations and on the rest of the network in several ways. The most important method, and the one most often utilized, is to use the predefined local groups. Adding a user to one of these groups gives the user a large set of predefined rights and abilities.

Another way to restrict users' abilities is by limiting their logon hours and the network computers they are allowed to use.

Permissions on each file, directory, or printer shared on the network define who can and cannot access those resources. You can assign permissions to local groups, global groups, and directly to individual users. It is not recommended that you assign permissions to individual users, however, because these are hard to maintain for large numbers of users.

You can monitor what users do by *auditing* actions and resources. Auditing an action or resource causes an entry to be written to the Event Log whenever that action is performed or that resource is accessed.

Although not recommended, you can directly manipulate *user rights* (also called *rights*) that specify what actions local groups, global groups, and users can perform. Using the predefined local groups and their predetermined sets of rights serves most needs. If you need to grant rights to other groups or users, or fine-tune what rights the predetermined groups have, you have the ability to do so.

Finally, you can also control a user's desktop environment by assigning the user a *profile*.

Granting Access to Anonymous Users

If you are going to configure your MetaFrame server for High security and you want to allow anonymous users access to your system, you must allow Read and Execute permissions to the following list of files for the Anonymous group. You also must specifically allow access to any applications you want to be available for anonymous users. These changes are necessary because anonymous users are not members of the Users group.

- %SystemRoot%\System32\Userinit.exe
- %SystemRoot %\ System32\Winlogon.exe
- %SystemRoot %\ System32\Winsta.dll
- %SystemRoot %\ System32\Clib.dll
- %SystemRoot %\ System32\Regapi.dll
- %SystemRoot %\ System32\Ulmreg.dll
- %SystemRoot %\ System32\Ctxsku.dll
- %SystemRoot %\ System32\Samlib.dll

- %SystemRoot %\ System32\Winspool.drv
- %SystemRoot %\ System32\Mpr.dll

Protecting Against Viruses and Trojan Horses

It is extremely important to prevent intentional intrusions into your computer network that take the form of viruses and Trojan horses. *Viruses* are programs that attempt to spread from computer to computer and either cause damage (by erasing or corrupting data) or annoy users (by printing messages or altering what is displayed on the screen) on every computer they infect. *Trojan horses* are programs that masquerade as other common programs while they attempt to capture information.

An example of a Trojan horse is a program that masquerades as a system logon screen in an attempt to capture user names and password information, which the writers of the Trojan horse can later use to access the system.

How to Prevent Trojan Horse Attacks

Windows 2000 provides an important safeguard against Trojan horse programs. Before you can log onto a Windows 2000 computer, you must press the *secure attention sequence*, CTRL+ALT+DEL. This series of keystrokes always directly invokes the Windows 2000 operating system logon screen; Trojan horse programs are never activated this way. Users provide only their username and password to the operating system itself. To ensure the effectiveness of this procedure, make sure your users always press CTRL +ALT+DEL or CTRL +F1 in a MetaFrame session before logging on at a computer, even if the logon window is already on the screen.

The secure attention sequence is also required before a user can unlock a locked workstation or change his or her password.

Another way to guard against Trojan horses is to make your applications Read and Execute only so that they cannot be replaced with programs that masquerade as the original program to illegally obtain information.

How to Prevent Virus Outbreaks

Viruses are usually not intentionally introduced to your system. In most cases, users unknowingly introduce a virus into your network when they obtain what they believe to be a useful, safe program from another source, such as an online bulletin board. Many network users are unaware that they can bring viruses into the network this way. Therefore, one of the best ways to keep your network virus-free is by educating your users.

Have at least one commercial virus-detection program in use and regularly check your file servers for viruses. If possible, make virus-detection software available to your users.

Other ways to protect against computer viruses include the following:

- Set file permissions to make all applications available on network servers and workstations Read and Execute only, preventing them from being replaced by viruses.
- Before putting a new application or file on the network, put it on a computer not attached to the network and check it with your virus detection software. Log on to this computer using a Guest account so that the program being examined cannot modify any important files.
- Regularly use a Windows NT-compatible virus scanner. Consider using the **at** command to periodically run the virus scanning program; for example, late at night when no users are logged on.
- **NEVER LEAVE A DISKETTE IN THE DISKETTE DRIVE OF YOUR SERVER**. If the system is rebooted (for example, because of a power failure), the system will attempt to boot from diskette and become infected.
- Regularly back up the files on your file servers (and workstations, if possible) so that damage is minimized if a virus attack does occur.

Auditing System Activity

You can specify that an audit entry be written to the Event Log whenever certain actions are performed or files are accessed. The audit entry shows the action performed, the user who performed it, and the date and time of the action. You can audit both successful and failed attempts at actions, so the audit trail can show both who actually performed actions on the network and who tried to perform actions that are not permitted.

Note Event Viewer log entries for logon events now include the computer name where the logon attempt originated.

The following table lists the categories of events you can choose to audit and what events are covered by each category. For each of the categories listed below, you can choose whether to audit only successful actions in that category, failed attempts to perform actions in that category, both, or neither.

Category	Events
Logon and Logoff	Logon attempts, logoff attempts, and the creating and breaking of network connections to servers.
File and Object Access	Accesses a directory or a file set for auditing in Windows Explorer; uses of a printer managed by the computer.
Use Of User Rights	Successful uses of user rights and failed attempts to use rights not assigned to users.
User and Group Management	Creation, deletion, and modification of user and group accounts.
Security Policy Changes	Granting or revoking user rights to users and groups, and establishing and breaking trust relationships with other domains.
Restart, Shutdown, and System	Shutting down and restarting the computer, filling up the audit log, and discarding audit entries if the audit log is already full.
Process Tracking	Starting and stopping processes on the computer.

You specify what types of system events are audited through the Group Policy Snap-In. The following table shows the types of folder and file accesses you can audit.

Folder access	File access
Displaying names of files in the folder	Displaying the file's data
Displaying folder attributes	Displaying file attributes
Changing folder attributes	Displaying the file's owner and permissions
Creating subfolders and files	Changing the file
Going to the folder's subfolders	Changing file attributes
Displaying the folder's owner and permissions	Running the file
Deleting the folder	Deleting the file
Changing folder permissions	Changing the file's permissions
Changing folder ownership	Changing the file's ownership

The Auditlog Utility

The Auditlog utility is used to generate reports of logon/logoff activity for a MetaFrame server based on the Windows 2000 security Event Log. To use Auditlog, logon/logoff accounting must be enabled.

Syntax

Auditlog [*username*|*session*] [/before:*mm/dd/yy*] [/after:*mm/dd/yy*] [/write:*filename* | [/time | /fail /all | /detail]] [/eventlog:*filename*]

Auditlog [/clear[:backup_log_file_name]]

Auditlog [/?]

Parameters

username
Generates a report of logon/logoff activity for the specified *username*.

Session
Generates a report of logon/logoff activity for the specified *session*.

/before:*mm/dd/yy*
Reports only on logon/logoff activity before *mm/dd/yy*.

/after:mm/dd/yy
Reports only on logon/logoff activity after *mm/dd/yy*.

/write:*filename*
Specifies the name of an output file. Creates a comma-delimited file that can be imported into an application such as a spreadsheet to produce custom reports or statistics.

/time
Generates a report of logon/logoff activity for each user, displaying logon/logoff times and total time logged on. Useful for gathering usage statistics by user. (Not used for with /fail or /detail.)

/fail
Generates a report of failed logon/logoff attempts. (Not used with /time or /all.)

/all
Generates a report of all logon/logoff activity. (Not used with /fail.)

/detail
Generates a detailed report of logon/logoff activity. (Not used with /time.)

/eventlog:*filename*
Specifies the name of a backup security event log to use as input to Auditlog. Create a backup security log from the Event Log Viewer or with the Auditlog/Clear:*filename* utility, which saves the current event log in *filename* and clears the event log.

/clear[:backup_log_file_name]
Closes the current logon/logoff log file, optionally saves it as *filename* (for back up purposes), and opens a new log file.

/? (help)
Displays the syntax for the utility and information about the utility's options.

Remarks

Auditlog gives the administrator a powerful tool to verify and maintain system security and correct usage. The information can be extracted as reports or as comma-delimited files that can be used as input to other programs.

You must enable logon/logoff accounting in order to collect the information used by Auditlog. To enable logon/logoff accounting:

1. Click **Start**, **Programs**, and then **Administrative Tools** to open Local Security Policy.
2. On the **Tree** tab (left pane), select **Local Policies** and then **Audit Policy**.
3. Right click **Audit Logon Events** and **Audit Account Logon Events**, then select **Security**.
4. Select **Success** and **Failure** under **Local Policy**. Click **OK** to save your changes.

Securing Data and Applications

SecureICA Services

Citrix SecureICA Services enhances the security of ICA connections by allowing users to access Citrix MetaFrame servers over secure communications channels. This section provides details about the SecureICA encryption software.

SecureICA Features

Citrix SecureICA contains features to enhance the security of data communication across any type of connection supported by ICA. SecureICA Services uses the RC5 encryption algorithm from RSA Data Security, Inc. The Citrix server and ICA Client use the Diffie-Hellman key agreement algorithm with a 1024-bit key to generate RC5 keys.

SecureICA Services offers the following features:

- 128-bit encryption during user authentication

  To ensure account security, SecureICA uses 128-bit encryption during the authentication phase.
- Strong session encryption and flexible encryption support

  The 128-bit encryption level is considered virtually impossible to break with current technology. The 40-bit and 56-bit encryption levels require a significant investment in time and money to break with a brute force attack. The availability of 56-bit encryption for global use provides an international data encryption solution.
- Per-connection encryption support

  Different encryption levels can be used for each connection. For example, a dial-up connection with 40-bit encryption and a LAN connection with 128-bit encryption can be used simultaneously.
- Cross client compatibility

  SecureICA Clients are available for DOS, Win16, Win32, and the ICA Web Client Netscape Plug-in and Internet Explorer ActiveX control.
- Enforceable encryption levels

  The Citrix server administrator can enforce minimum encryption levels on a per-connection and per-user (*WINFRAME* only) basis. ICA Client connections are allowed only if the ICA Client is using at least the minimum level.
- Dynamic key generation

  The SecureICA server and client generate unique RC5 keys for each connection. A system service periodically generates new Diffie-Hellman parameters in the background, providing an enhanced level of security.

Understanding Encryption

Encryption is the process of obscuring the true meaning of a message so that only the intended recipient can understand it.

The encryption process transforms data into a form that is unreadable to anyone without a special piece of information. This information allows the recipient to unscramble or decrypt the message. This piece of information is called a *key*.

The process used to create the scrambled message is called an *encryption algorithm*.

There are two general types of encryption algorithms. A *symmetric key* algorithm uses the same key to encrypt and decrypt the scrambled data. This means the secret key must never be revealed to anyone but the intended recipient of the data. The advantage of a symmetric key algorithm is its speed.

The disadvantage of a symmetric key algorithm is that the secret key used to encrypt the data must be sent to whoever needs to decrypt the data. If there was a secure channel to transmit the key, the data could be sent the same way and encryption would be unnecessary.

The second type of algorithm is a *public-private key* algorithm. It relies on certain mathematical properties to create a set of keys, such that one key can only encrypt data and the other key can only decrypt the data. The encrypt-only key is called a *public key*. The decrypt-only key is called a *private key*. A message encrypted with the public key can only be decrypted by the private key.

The public key can be openly transmitted without compromising the security of the encrypted data. Knowing the public key does not allow anyone to decrypt the encrypted data.

Many modern encryption programs combine the two types of algorithms. A symmetric key algorithm encrypts the data. The secret key is exchanged using a public-private key algorithm. This provides the speed of a symmetric key algorithm with the security of a public-private key algorithm.

RC5 is a symmetric key algorithm. The Diffie-Hellman key agreement algorithm is a public-private key algorithm.

Understanding Government Export Restrictions

The United States government restricts the export of strong cryptography. Encryption strength is usually defined by the size of the keys used to encrypt and decrypt data.

Encryption products using keys greater than 56 bits are usually restricted from export. However, larger keys can be exported for use in authentication products.

SecureICA Services comes in two versions: North American and Global. The North American version of SecureICA Services uses a 128-bit key during user logon. A selectable 40-, 56-, or 128-bit key is used to encrypt the remainder of the session. The Global version uses a 128-bit key during user logon. A 56-bit key is used to encrypt the remainder of the session.

United States export policy regarding encryption has been known to allow for export of stronger data keys to subsidiaries of North American based financial institutions. The export of these stronger keys must be applied for and is controlled on a per-application basis.

Third-Party Security Products

This section contains detailed installation and integration information for the following third-party security devices:

- Security Dynamics ACE/Server Software
- VTCP/SECURE Software

These security devices control remote access to the MetaFrame server through proprietary access control software. The remote user dials in or connects over the network to obtain access to the MetaFrame server by successfully completing an authentication dialog with the security device. Once the user is authenticated, the security device is transparent to the user.

Several general configuration issues are encountered when using third-party security devices:

- For the MetaFrame server to properly detect when a connection is made or broken, the security device must supply modem signals that can be used by the MetaFrame server to detect when a connection is made or terminated. This varies depending on the security device.
- If needed, configure the client PC and the client software to operate properly with the security device. Some security systems require software or hardware on the client PC.
- The MetaFrame server and the security device itself must be secured from unauthorized tampering. It is recommended that you place all hardware in a secured room to prevent unauthorized personnel from acquiring access to the equipment.
- Most third-party security devices secure remote Dial-In users (or local, directly connected asynchronous users) only. You need to consider how to secure your system from improper access by LAN- or WAN-connected users.

The third-party security devices discussed in this section control remote access to the MetaFrame server through proprietary access control software. Details about access control hardware are available through the individual hardware manufacturers. The software access control devices most often used are based on one of two premisses.

The first method is based on secondary user authentication. In addition to the Primary Windows Authentication, the access control software adds another layer of authentication based on separate user databases. This software control method decreases the likelihood of compromised passwords.

The next method of software access control is based on encrypting data transmissions. In this case, the access control software provides a layer of authentication and then encypts all data packets between the client and server.

This software control method prevents eavesdropping on unsecure phone lines or networks.

The access control software listed in this chapter implements one of these two methods to provide security and access control.

Security Dynamics ACE/Server

The Security Dynamics ACE/Server security software provides SecurID identification and authentication of users on TCP/IP networks. There are two pieces to the ACE/Server security software program: the ACE/Server Host and the ACE/Agent for Windows 2000.

Note The term ACE/Agent has replaced ACE/Client in most of Security Dynamics products and literature.

The ACE/Server host software operates on Windows Terminal Server and on a wide variety of UNIX-based platforms, while the ACE/Agent for Windows 2000 runs on a MetaFrame server. When used in conjunction with a SecurID token, ACE/Server centrally authenticates a user's identity, allowing only authorized users access to protected network resources.

Note The Security Dynamics ACE/Server uses the Progress database. This database does not function on multiprocessor machines.

The ACE/Server is a secondary security solution that supplements Terminal Server's own base security. This additional security can be configured for remote control logons (sessions) and remote access logons (RAS). The ACE/Server acts as a database storing PIN tokens for authenticating users logging onto a MetaFrame server. The ACE/Agent is installed on the MetaFrame server and is integrated into the session and RAS logons. Upon logon to the MetaFrame server, the user is challenged by both MetaFrame security and SecurID passcode security.

Requirements

The ACE/Server host software operates on Terminal Server and a wide variety of UNIX platforms. This note describes only the configuration tested in the Citrix labs.

Note ACE/Server Version 3.3 is not supported on Windows 2000. Therefore, only the ACE/Server host software installation on UNIX Solaris is discussed here.

Security Dynamics SecurID

ACE/Server UNIX Solaris Version

Hardware Requirements

- Sun SPARCstation with CD-ROM drive and 4mm DAT tape

Software Requirements

- Solaris Version 2.5 (UNIX operating system)
- Progress Software Database
- Security Dynamics ACE/Server Version 3.3
- Security Dynamics ACE/Agent for Windows NT Version 4.1 or higher

Citrix MetaFrame and ACE/Agent for Windows 2000

Hardware Requirements

- MetaFrame 1.8 for Windows 2000 server

Software Requirements

- MetaFrame Version 1.8 for Windows 2000 (see "MetaFrame Server Configuration" later in this section)
- Security Dynamics ACE/Agent for Windows 2000

Integration Overview

Follow the steps below to install ACE/Server on a Solaris UNIX platform.

1. Install the Solaris UNIX operating system.
2. Install the Progress Database.
3. Install and configure the ACE/Server.
4. Configure a Windows 2000/MetaFrame server (detailed below).
5. Install and configure the ACE/Agent for Windows 2000 on the MetaFrame server (detailed below).

Windows 2000/MetaFrame Server Configuration

For detailed information about MetaFrame server equipment selection and software installation, see the Citrix MetaFrame documentation.

1. Install MetaFrame following the instructions in the Citrix documentation.

Notes The TCP/IP protocol must be installed on the MetaFrame server in order to communicate with the ACE/Server installed on the Sun SPARCstation.

For asynchronous modem connections, the MetaFrame server must have an intelligent multiport board, such as a Digi International, installed and configured.

For remote node connections, RAS must be installed on the server. (Remote MetaFrame ICA Dial-In connections do not use RAS.)

2. Reboot the server.

Installing ACE/Agent for Windows 2000 on a Windows 2000/MetaFrame Server

1. Obtain a copy of the Sdconf.rec file and place it in the %SystemRoot% \System32 directory on the Windows 2000/MetaFrame server. This allows you to set security options and test the installation without having to reboot beforehand.
2. Make sure that the MetaFrame server is configured as a client machine in the ACE/Server database. If this is the first authentication for this MetaFrame server, verify that the **Sent Node Secret** checkbox is unchecked.
3. If the ACE/Agent for Windows 2000 was installed on the MetaFrame server but was reconfigured; that is, the IP address has changed, be sure to delete the Node Secret file. This file, Secureid, is stored in the %SystemRoot%\System32 directory.
4. Insert the Windows 2000 CD in the CD-ROM drive of the MetaFrame server. The ACE/Agent for Windows 2000 Setup is located in the Valuadd\3rdparty \Security\Sdti directory. Proceed with the installation as described in the ACE/Agent documentation. Run Setup using the **Add/Remove Programs** applet in the Control Panel. The ACE/Agent can be configured to support remote control connections, remote node connections, or both.
5. When prompted to set security options, do so. For remote control users, select **Enable Local Access Security** on the **Local** tab. To verify that a user can authenticate, select **Test Authentication with ACE/Server** on the **Main** tab. Authentication problems occur here if the MetaFrame server is not configured as a client in the ACE/Server database, if the Sdconf.rec file is outdated, or if the Securid (Node Secret) file is outdated.
6. If you intend to use RAS as a connectivity option on the MetaFrame server, select **Enable Remote Access Security**. This option is disabled if the RAS server is not installed.

Note To have the ACE/Server authenticate everyone who connects through RAS, select **Challenge All Users** on the **Remote** tab.

7. After configuring security options, the installation asks whether you want to add users to the Security Dynamics user groups that have been created (see "Usage" later in this section for more details about these groups). Click **Yes** to start the ACE/Agent for Windows 2000 Snap-In and create users to add to these groups or to add existing users. Users configured as such are required to provide SecurID authentication.

Note If the ACE/Agent is already installed, the above configuration is accomplished with the ACE/Agent for Windows 2000 Snap-In by clicking **Start**, **Programs**, and then **Administrative Tools**. Select **System Tools**, followed by the SecurID icon on the menu bar.

Connectivity Matrix

The connectivity matrix below identifies currently supported configurations for using the SecurID product and ICA Client programs for various operating systems and protocols.

Client operating system	ICA Client	Protocol	Session*	RAS**
DOS	DOS	IPX	X	X
		NetBIOS	X	
		TCP/IP	X	X
		Async null modem	X	
		Async Dial-In	X	
Windows 3.x	Win16	IPX	X	X
		NetBIOS	X	
		TCP/IP	X	X
		Async null modem	X	
		Async Dial-In	X	
Windows 95/NT	Win32	IPX	X	X
		NetBIOS	X	X
		TCP/IP	X	X
		Async null modem	X	
		Async Dial-In	X	

* Session connections are remote control connections made using the Citrix ICA Client Independent Computing Architecture (ICA) protocol.

**RAS connections are remote node connections made using the Citrix MetaFrame Dialup Manager for DOS, MetaFrame Dialup Manager for Windows, Windows 95 Dialup Networking, or Remote Access Dialout for Windows NT in conjunction with RAS configured on the MetaFrame server.

Usage

Remote Control Connections

1. Select a configuration from the connectivity matrix above and set up a supported client configuration. (For instructions about installing and configuring a connection with an ICA Client, see the Citrix MetaFrame documentation.
2. Initiate a connection to the MetaFrame server using one of the supported protocols. The standard MetaFrame logon screen appears.
3. Log on to the MetaFrame server. If the user specified belongs to the local user group Sdlocal or domain Sdlocal (see "Domain Controller Installations" below), you must provide a SecurID authentication passcode.
4. Respond to the SecurID challenge with a passcode from a SecurID token card.

Bypassing Authentication on a Per-Session Basis

Windows 2000 contains a fix that allows you to configure sessions to bypass SecurID logon authentication (not RAS authentication) on a per-session basis. If the user is a member of the Sdlocal group or the server is configured to challenge all users, the user is not challenged. To bypass SecurID authentication for a session:

1. Start Citrix Connection Configuration.
2. Select a session.
3. Select **Advanced Session**.
4. Check the **Use Default Authentication** box and click **OK** to save the changes.

Remote Node Connections

1. Configure a machine as specified in the above configuration matrix. Dial into a RAS port. Be sure that the client software is configured to display terminal mode after dialup. This step is essential or you cannot log on. Each user configured in the Sdremote or domain Sdremote user groups is prompted for the *domain*, *username*, and *password*.
2. Upon successful authentication, your *username* and *password* are taken from the RAS client's configuration and verified by the network as with a normal RAS logon.

Note Your RAS logon *username* and your ACE/Server name must be identical.

Domain Controller Installations

If the ACE/Agent software is installed on a MetaFrame server that is also a domain controller, two additional groups are created during the installation: domain Sdremote and domain Sdlocal. These two groups allow users on any

machine that uses the domain controller to be authenticated using the SecurID solution.

Note Any machine, whether local or domain, on which you want to use SecurID authentication must have the ACE/Agent installed.

Two example configurations are shown below:

Example 1

An ICA Client, using RAS, connects to the MetaFrame server Server_1 in the domain DC_EX and the user specified is a member of DC_EX's domain Sdremote user group. The user is challenged with the SecurID authentication.

Note In this example, both Server_1 and DC_EX must have the ACE/Agent installed.

Example 2

An ICA Client, using ICA remote control, connects to the MetaFrame server named Server_2 and logs into domain DC_EX2. The user is a member of DC_EX2's domain Sdlocal group. The user is challenged with the secondary authentication.

Note Both Server_2 and DC_EX2 must have the ACE/Agent installed.

Troubleshooting

When I try to connect to the MetaFrame server using RAS, it drops the connection whenever it tries to verify the username and password on the network.

Do not forget to turn on the terminal mode after dialin option on the RAS client side. This option is essential or you will not be prompted by the SecurID authentication.

When I try to log on to the MetaFrame server using a RAS or session connection, I get a "User access denied" message. The ACE/Server log shows the message "Node verification failed."

There are two possible causes. First, check to see if the client configuration on the ACE/Server has the **Sent Node Secret** box checked. If it does, uncheck it. Next, on the MetaFrame server, look in the %SystemRoot%\System32 directory. If the file Securid exists, delete it. Try to log on again. If you still get the failure, delete the Sdconf.rec file from the %SystemRoot%\System32 directory and obtain a current copy from Security Dynamics.

When I try to start Sdadmin on the ACE/Server, I get a "user root not found" message even though I have a root user on the server.

This happens only on the first logon after installation, if ever, and it means that the database is not yet ready to be administered. Run Sdcreadm on the ACE/Server and then try again.

I am trying to get a user to authenticate but the token is not being accepted. I tried to resynchronize the card in the database but that gives an Invalid tokencode error message.

The database is not receiving a value in the range of values that it will accept. Typically, this means that the time zone or the date and time configured on the ACE/Server are not correct. Check the date and time that the ACE/Server reports in the **System, Edit System Parameters** menu. If the time shown there is not correct, make the appropriate adjustments to either the Timezone variable (Start\Control Panel\Date+Time icon) or to the date and time (using the **Date** command).

I have dialup or network users who do not have SecurID cards. How can they connect without being challenged by the ACE/Server?

As an administrator, run Citrix Connection Configuration and edit a session. Click **Advanced Session**. Check the **Use Default Authentication** box and click **OK** to save the change.

During installation, I get an "Operating system not supported" error when I run Sdsetup and Sdnewdb.

The documentation provided with the ACE/Server includes a Readme stating that certain operating systems (including newer versions of Solaris) are not included in the installation scripts. It also includes directions for editing those scripts (Sdsetup and Sdnewdb) to make them support those operating systems. Follow the instructions in the ACE/Server documentation.

Solaris Installation

Installation of the Solaris operating system is detailed in the documentation provided by Sun Microsystems; however, some general steps are listed below.

1. Place the Solaris installation CD in the CD-ROM drive and turn on the computer. If a previous installation of Solaris or SunOS exists on the machine, interrupt the boot process (with STOP+A), specify **N** for new command mode, and type **boot cdrom**.
2. From this point on, you are in the Solaris installation procedure. The three parts of the installation procedure are:
   - Machine Identification
   - Software Installation

- Post Installation.

The following questions and answers are important to ensure that both Progress and ACE/Server function correctly:

Machine Identification

Question	Answer
Networked	Yes
Specify Time Zone By	Offset from GMT

Install Software

Question	Answer
Software Group	<-Entire Distribution

Be sure to specify a valid root password.

3. When the installation is complete, make the following modification:

   cd /etc
   vi system (or use whatever editor you like) and add the following lines to the end of the file:

```
Set SEMSYS:SEMINFO_SEMMNI = 64
Set SEMSYS:SEMINFO_SEMMNS = 200
Set SEMSYS:SEMINFO_SEMMNU = 100
Set SEMSYS:SEMINFO_SEMMSL = 50
Set SHMSYS:SHMINFO_SHMMAX = 16777216
Set SHMSYS:SHMINFO_SHMMNI = 100
Set SHMSYS:SHMINFO_SHMSEG = 16
```

4. The Timezone, as set up by the default installation, will not work correctly with the ACE/Server's reliance on GMT (UTC) time. Change the /Etc/Default/Init file to match your particular time zone configuration. In the Eastern US, change the TZ field in that file to EST5EDT4; this indicates Eastern Standard Time, with an offset from UTC of five hours, and Eastern Daylight Time with an offset from UTC of four hours.
5. Modify the /Etc/Services file to include the two lines for the ACE services. They are as follows:

```
securid         5500/udp        # ACE/Server
securidprop     5510/tcp        # ACE/Server Slave
```

Progress Database Installation

Installation of the Progress Database is detailed in the documentation provided by Security Dynamics; however, some general steps are listed below.

1. Log on as root user to the Solaris machine. Insert the Progress Database 4mm DAT tape into the tape reader. From the console, execute these commands:

   cd /mnt
   cpio -iudcvBm < /dev/rmt/0m
   /proinst

2. Enter the product license Serial Numbers, Reference Numbers, and Control Numbers from the product license addendum sheet that comes with the database package. When done, press Ctrl+E.
3. Specify the installation directory and let the installation continue. When asked if you want to copy scripts, answer **N** or **No**.
4. Install the patch for the Progress Database. Insert the Progress Patch DAT tape and execute these commands:

   md temp
   cd temp
   tar -xv

   Note The process takes several minutes.

5. Follow directions in the Readme.pro file created by the previous command. Use this file to create a shell script (batch file) that updates everything in one command.

Solaris ACE/Server Installation

Installation of the ACE/Server is detailed in the documentation provided by Security Dynamics; however, some general steps are listed below.

1. Place the ACE/Server tape in the DAT drive. On the drive where you intend to install the ACE/Server, execute these commands:

   mkdir sds
   cd sds
   tar -xv

2. Edit the Sdsetup and Sdnewdb files to modify the versions of Solaris that are supported.
3. Execute Sdsetup and follow the installation instructions, answering the questions as they apply to your system and configuration.

Solaris ACE/Server Configuration

Configuration of the ACE/Server is detailed in the documentation provided by Security Dynamics; however, some key details are listed below.

1. From the ACE/Server console, start the Sdadmin program.

2. From the **Tokens** menu, select **Import** and import the token file(s) you intend to use for this integration.
3. Select **Site** and then **Add**. This is a container for machines you intend to use from this location. It is a client machine management tool, not a physical separation.
4. Add a group. A group is a way to easily associate a selection of client machines with a selection of users. Any user who is designated as a member of a group can log on and get authenticated by any machine also contained in that group.
5. Add one client entry for each machine that will use the SecurID secondary authentication. Each machine's IP address must be resolvable by the server, whether by DNS, NIS, or simply the /Etc/Hosts file. The machine's type is dependent on the operating system. For Windows 2000 and MetaFrame machines, it is NetOS. Be sure to add the clients to the group created above.
6. Add a user entry for each user who will use SecurID authentication. The default shell variable is not relevant for users who will log on from Windows 2000 and MetaFrame hosts but is required for users who will log on from a UNIX client. Be sure to add the users to the group configured in Step 4 above; all can log on from any client configured in that group.

VTCP/SECURE Software

Overview

VTCP/SECURE is a security software package that allows remote users to connect to a MetaFrame server over untrusted networks for a secure remote MetaFrame session. This is done by creating a virtual private network that transparently encrypts and validates all data between the Citrix ICA Client and the MetaFrame server.

VTCP/SECURE provides encryption, authentication, and authorization to protect TCP networked computers and incorporates a number of security management features. The encryption, authentication, and key exchange algorithms include DES 40, Triple DES, and Diffie-Hellman. Authentication, authorization, and accounting services are provided through TACACS+ or the internal one-time password authentication service.

Software Requirements

- MetaFrame Version 1.8 for Windows 2000
- VSGATE Server Software Version 2.1a or higher
- VSCLIENT Client Software Version 2.1a or higher
- TCP Client WinSock Version 1.1 or higher

Note Client systems require a minimum of 8MB of RAM for VTCP/SECURE and the ICA Client software.

Installation Overview

VTCP/SECURE is composed of two parts: the VSCLIENT software that is installed on the client machine and the VSGATE software that is installed on a MetaFrame server or a gateway server to the corporate Intranet. VTCP/SECURE gateways can reside on the UNIX, Windows NT, or Windows 95 operating systems. These gateways allow network connectivity to a MetaFrame server residing on the corporate Intranet. The gateways decrypt data from the remote client for communication on the local Intranet. The VSCLIENT software can reside on Windows operating systems compliant with WinSock 1.1 or higher.

The procedures below describe how to install the VTCP/SECURE gateway software on MetaFrame and how to install and use the VSCLIENT software with Windows 95. In this example, the MetaFrame server itself is directly connected to the Internet without an intervening gateway server. For ICA Client configurations, see the connectivity matrix below. For more detailed information about VTCP/SECURE, see the VTCP/SECURE *Administrators Guide*, the Vamin2.hlp file included with the VTCP/SECURE software, or contact Infoexpress, Inc.

Note When connecting any MetaFrame server to an untrusted network, secure your MetaFrame server using the procedures outlined in the MetaFrame documentation.

Quick Start Installation

1. Install the VSGATE software on a MetaFrame server with TCP/IP sessions and Internet networking access.
2. Configure the VSGATE software.
3. Install the VSCLIENT software on a Windows 95 system.
4. Create a VSCLIENT connection entry to the MetaFrame server.
5. Install the ICA Win32 Client.
6. Use Program Neighborhood Custom Connection to create a remote TCP/IP network connection entry.

Quick Start Usage

1. Use Dial-up networking from the Windows 95 client machine to dial into an Internet Service Provider (ISP) for TCP connectivity or use your existing TCP/IP network connection.
2. Run the VTCP/SECURE client software from Windows 95, creating a secure communications channel to the MetaFrame server.

3. Run the ICA Win32 Client and connect to the MetaFrame server.

The following matrix lists the possible client operating systems and the recommended ICA Clients to use. The VSCLIENT software for Windows works on all of the listed operating systems over TCP/IP remote node dial up or network TCP/IP client connections only. Direct ICA dialin and other network protocols are not supported by VTCP/SECURE software.

Client operating system	ICA Client
Windows 3.1 (with WinSock 1.1 or higher)	ICA 16-bit Client for Windows
Windows for Workgroups (with WinSock 1.1 or higher)	ICA 16-bit Client for Windows
Windows 95	ICA 32-bit Client for Windows
Windows NT 3.51 or 4.0	ICA 32-bit Client for Windows

Installation

VSGATE Software

1. Log on to the MetaFrame server as an administrator.
2. At a command prompt, type **change user /install**.
3. Install the VSGATE software.
4. During the VSGATE software installation, select to install the software as a service and enter the TCP/IP subnet mask of the MetaFrame server.
5. Following installation, at a command prompt, type **change user /execute**.
6. Reboot the MetaFrame server and log on to the server as an administrator.
7. Run Vsadmin from the VSGATE program group.
8. From the Vsadmin program, select **5** to manage local passwords.
9. Select **1** to add a user.
10. Enter the new username.
11. Select the default settings except for the Access Filter settings.
12. Select **1** for Netops for Access Filter settings.
13. Save the configuration.

VSCLIENT Software

1. On a Windows 95 client, install the VTCP/SECURE software.
2. During VSCLIENT installation, select **System Wide**.
3. Reboot the Windows 95 client.

Usage

1. From the Windows 95 client machine, dial into the ISP for Internet access using Windows 95 Dial-up Networking or, if available, use an existing TCP/IP network connection.
2. Select the VSCLIENT application from the VSCLIENT program group.
3. Click **Connect**.
4. Enter the name or IP address of the MetaFrame server and click **OK**. (Leave the port address empty.)
5. Once communication to the VSGATE server is established, you are prompted for the VTCP/SECURE *username* and *password* you created in Vsadmin. With proper authentication, a "Smart Tunnel" or virtual private network is created between the remote client and the MetaFrame server.
6. Run the ICA 32bit Client and create an entry to connect over TCP/IP to the MetaFrame server.
7. Double-click the new entry to establish a secure TCP/IP network connection to the MetaFrame server.

CHAPTER 5

Connecting to the Web

If you are publishing applications for end-users who connect to your Citrix servers over the Internet or your organization's Intranet, the next phase of deploying your solution is to set up Citrix Web Computing. This chapter provides the following information to assist you:

- An introduction to Citrix Web Computing
- Requirements for supported Web browsers for Citrix Web Computing
- Requirements for supported Web servers for Citrix Web Computing
- A sample procedure for setting up Citrix Web Computing

An Introduction to Citrix Web Computing

Citrix Web Computing consists of four components:

- **Web server**. The Web server software can run on the Citrix server or on a separate computer. The only step needed to enable the Web server for Citrix Web Computing is to register ICA as an application MIME type. Any Web server that supports application MIME types can be used.

  One important distinction that sets Citrix Web Computing apart from the CGI and Microsoft Active Server Pages models is that the Web server does not execute any additional software to support Citrix Web Computing. The Web server contains ICA files that are downloaded to the Web browser for processing by the Citrix ICA Web Client.
- **Citrix server**. To the Citrix server, an ICA connection from a Web client is no different than a connection from any other ICA Client. The same security and user configuration guidelines used for published applications apply to Web Computing.

  By default, the ICA connections created during Setup support an unlimited number of connections. See your Windows 2000 documentation for instructions about how to limit the number of concurrent users.

Fifteen anonymous user accounts are created automatically during installation. If more than 15 anonymous users are logged in, each additional anonymous user account is dynamically created. By default, the anonymous user limit is 99. See the MetaFrame release notes for instructions about how to change this limit.

- **Citrix ICA Web Clients**. The ICA Web Clients work with any Web browser that supports configurable MIME types. The Citrix ActiveX control for Internet Explorer and Plug-in for Netscape Navigator and Netscape Communicator allow these Web browsers to display ICA sessions embedded in Web pages.

  When a user clicks a hyperlink to an ICA file or loads an HTML page containing an embedded ICA session, the Web browser passes the ICA file to the ICA Web Client, which then initiates a session on the Citrix server using the information contained in the ICA file and the application definition. Video, keyboard, and mouse data are passed between the session on the Citrix server and the ICA Web Client using the Citrix ICA protocol.
- **ICA file**. ICA files are text files containing a series of command tags. These tags define the attributes of the session to be launched on a Citrix server. The Web browser downloads the ICA file and passes it to the ICA Web Client, which then initiates the ICA session on the Citrix server.

  You can use either Published Application Manager or the ICA File Editor to create ICA files.

For more information about Citrix Web Computing and the ICA Web Clients, see the *Citrix ICA Client Administrator's Guide* for the Windows Web Clients.

Web Browsers for Citrix Web Computing

Microsoft Internet Explorer Version 4.0 for Windows NT

Microsoft Internet Explorer Version 4.0 is a World Wide Web browser with an integrated set of tools for every type of user, from basic services like e-mail to conferencing, broadcasting, and Web-authoring capabilities.

Requirements

Hardware Requirements

- Internet connection (modem, Ethernet card, ISDN, etc.)

Software Requirements

- Microsoft Internet Explorer Version 4.0 for Windows NT

Note Active Desktop is currently not supported.

Configuration

If the Citrix ICA Web Client is not installed, Internet Explorer automatically downloads and installs the client from the Web server. Copy the Citrix ICA Web Client files to the local Web server. By default, the HTML files generated by Citrix's Published Application Manager wizard point to www.citrix.com. Change this link to point to the location where the Citrix ICA Web Client was copied on the local Web server.

1. The first time Internet Explorer downloads the Citrix ICA Web Client, a window labeled "Security Warning" appears.
2. You are asked if you want to install and run the Citrix ICA Web Client.
3. Click **Yes**. The Citrix ICA Web Client is installed and the session launches.

Microsoft Internet Explorer Version 5.0 for Windows NT

Microsoft Internet Explorer Version 5.0 is a World Wide Web browser with an integrated set of tools for every type of user, from basic services like e-mail to conferencing, broadcasting, and Web-authoring capabilities. Internet Explorer Version 5.0 is installed by default when you install a Windows 2000 server.

Requirements

Hardware Requirements

- Internet connection (modem, Ethernet card, ISDN, etc.)

Software Requirements

- Microsoft Internet Explorer Version 5.0 for Windows NT

Internet Explorer 5.0 does not need any configuration for ActiveX support of the Citrix ICA Web Client. HTML files with embedded or launched ICA connections can be opened without additional configuration.

Netscape Navigator Version 3.04, 32-bit Version

Netscape Navigator Version 3.04 is a multimedia World Wide Web browser for HTML documents on the Internet and on Intranets. Navigator integrates Web exploration, e-mail, news groups, chat, and FTP capabilities. There is platform support for live on-line applications. Navigator supports Live Objects, frames, Java applets, and Netscape inline plug-ins.

Requirements

Hardware Requirements

- Internet connection (modem, Ethernet card, ISDN)

Software Requirements

- Netscape Navigator Version 3.04, 32-bit Version

Configuration

If the Citrix ICA Web Client is not installed, Netscape Navigator automatically downloads and installs the client from the Web server. Copy the Citrix ICA Web Client files to the local Web server. By default, the HTML files generated by the Citrix Published Application Manager wizard points to www.citrix.com. Change this link to point to the local Web server where the ICA Web Client is installed.

1. The first time Netscape Navigator downloads the Citrix ICA Web Client, a window appears stating that a plug-in is required.
2. You are asked if you want to download the Citrix ICA Web Client plug-in.
3. Click **Yes** to download the ICA Web Client to the destination directory.
4. Close the browser and run the plug-in (Wfplug32.exe) from the directory where it is installed.
5. When the ICA Web Client plug-in is successfully installed, the browser can open and launch ICA connections from the HTML files.

Netscape Communicator Version 4.61, 32-bit Version

Netscape Communicator Version 4.61 is a World Wide Web browser designed for corporate users with support for calendars, mainframe access, and centralized management of Communicator. It combines Netscape Navigator with a suite of Internet tools for mail, news and discussion group access, online conferencing, Web page creation, and instant messaging.

Requirements

Hardware Requirements

- Internet connection (modem, Ethernet card, ISDN)

Software Requirements

- Netscape Communicator Version 4.61, 32-bit Version

Configuration

If the Citrix ICA Web Client is not installed, Netscape Communicator automatically downloads and installs the client from the Web server. Copy the ICA Web Client files to the local Web server. By default, the HTML files generated by the Citrix Published Application Manager wizard points to www.citrix.com. Change this link to point to the local Web server where the ICA Web Client is installed.

1. The first time Netscape Communicator downloads the Citrix ICA Web Client, a window appears stating that a plug-in is required.
2. You are asked if you want to download the Citrix ICA Web Client plug-in.
3. Click **Yes** to download the ICA Web Client to the destination directory.
4. Close the browser and run the plug-in (Wfplug32.exe) from the directory where it is installed.
5. When the Web Client plug-in is successfully installed, the browser can open and launch ICA connections from the HTML files.

Web Servers for Citrix Web Computing

MetaFrame supports any Web server that supports application MIME types. Procedures for doing this vary by Web server. The Web server software can run on the same computer as MetaFrame or on a separate server. The following Web servers are several of those supported by MetaFrame.

Microsoft Internet Information Server Version 5.0

Microsoft Internet Information Server (IIS) Version 5.0 is an integrated Web server that installs by default with Windows 2000. It is a complete solution for creating and managing Web sites on the Internet or an Intranet. IIS uses the same directory, security model, and file permissions as all other Windows NT server network services.

Software Requirements

- Microsoft Internet Information Server Version 5.0
- MetaFrame Version 1.8 for Windows 2000

Registering the ICA MIME Type

The ICA MIME type is automatically registered with IIS 5.0. No configuration is necessary.

Netscape FastTrack Server Version 3.01 for Windows NT

Netscape FastTrack Server Version 3.01 is an entry level Web server that lets users create and manage a Web site. It is a complete solution for creating and managing Web sites on the Internet or an Intranet. The FastTrack Server includes the Netscape Communicator client software for creating, editing, and publishing documents.

To install the Netscape FastTrack Server on a MetaFrame server

1. Log on to the MetaFrame server as an administrator.
2. At a command prompt, type **change user /install**. This places the user session in install mode.
3. Install Netscape FastTrack Server following the directions in the readme file.
4. When installation is complete, at a command prompt, type **change user /execute**. This changes the user session back to execute mode.

Registering the ICA MIME Type

1. Edit the following four files:
   - *path*\bin\admserve\cfgstuff\MIME.types
   - *path*\bin\httpd\install\misc\MIME.types
   - *path*\admserve\httpd-*servername*\MIME.types
   - *path*\httpd-*servername*\MIME.types

   where *path* is the directory containing the Netscape FastTrack Server and *servername* is the name of the FastTrack Server.
2. Add the following line to the end of each file:

   ```
   type=application/x-ica exts=ica
   ```

Sample Procedure for Setting Up Web Computing

Here is a sample procedure for setting up a seamless connection to a MetaFrame server using:

- MetaFrame Version 1.8 for Windows 2000
- Microsoft's Internet Explorer 4.x or 5.x Web Browser
- Microsoft's Internet Information Server 5.0

For more detailed instructions about setting up Citrix Web Computing, see the *Citrix ICA Client Administrator's Guide* for the ICA Windows Web Clients.

To publish an application

The first step in this procedure is to publish an application. Publishing an application allows you to start an application without knowing any details of the application's location, executable name, or server name.

1. Open Published Application Manager.
2. From the **Application** menu, click **New**.
3. Enter the application name and a detailed description; click **Next**.
4. Select whether the application will be started explicitly or anonymously and then click **Next**.
5. Click **Browse** to locate the executable file for the application and click **Next**.
6. Specify the Window properties for the application and click **Next**.
7. Specify the default settings for Program Neighborhood clients when users connect to this application. Click **Next**.
8. Select how the application will appear on Citrix clients that have Program Neighborhood user interface and click **Next**.
9. Highlight the groups and users that are allowed to run the application and click **Add**. When the groups and users are selected, click **Next**.
10. Highlight the server(s) that will be configured to run the application and click **Add**. When finished, click **Next**.
11. Click **Finish**.

To create ICA and HTML files

The next step in this procedure is to create both an ICA file and an HTML file. An ICA file is a plain text file that contains the parameters necessary to define an ICA session.

1. Open Published Application Manager.
2. Highlight the published application you just created and from the **Application** menu, click **Write HTML File**.
3. Select the level of assistance you require and click **Next**.
4. Select **Create a New ICA File**. Click **Next**.
5. Select the size and color attributes you want displayed when connecting to the application by the ICA file. For the **ICA File Name** field, click **Browse** to specify the Web server's root path (typically \Inetpub\wwwroot) and a name for the ICA file. Click **Save**. The file name and path are automatically entered into the **File Name** dialog box. Click **Next**.
6. Select the type of application session you want to create: **Embedded** or **Launched**.

7. Select the details associated with the session type. For the HTML file name, click **Browse** to specify the Web server's root path and a name for the HTML file. Click **Save**. The file name and path are automatically entered into the **File Name** dialog box. Click **Next**.
8. Click **Finish**.

The following sample ICA file is created from the process:

```
[WFClient]
Version=2
TcpBrowserAddress=10.4.10.191
TcpBrowserAddress2=10.4.10.95
IpxBrowserAddress=CC:00C04F98D76F
IpxBrowserAddress2=CC:00C04F98D81C
NetBiosBrowserAddress=MARLINS
NetBiosBrowserAddress2=DOLPHINS

[ApplicationServers]
BLPNC=

[BLPNC]
Address=BLPNC
InitialProgram=#BLPNC
DesiredHRES=640
DesiredVRES=480
DesiredColor=2
TransportDriver=TCP/IP
WinStationDriver=ICA 3.0
```

The TcpBrowserAddress is the IP address of a server on the network where access to the application is available. This could also include an IPX address or NetBIOS address if those protocols are used instead of IP.

The second section is the Application Servers section.

```
[ApplicationServers]
BLPNC=
```

The Application Servers section indicates the published application to which you will be connected.

The section that describes the application appears as follows. The address is the published application name or the specific address of the server. If a specific address is used, load balancing is not employed. The initial program name is the published application to which you will be connecting; if this is left blank, a desktop is defaulted. The transport driver indicates the transport protocol you will be using. The desired resolution is indicated; if a screen percent is present, it overrides the resolution indicated. The desired color refers to the number of colors; 16 colors=1, 256 colors=2.

```
[BLPNC]
Address=BLPNC
InitialProgram=#BLPNC
DesiredHRES=640
DesiredVRES=480
DesiredColor=2
TransportDriver=TCP/IP
WinStationDriver=ICA 3.0
```

The following sample HTML file is created from the process:

```
<!DOCTYPE HTML PUBLIC "-//IETF//DTD HTML//EN">
<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-1">
<meta name="METAMARKER" content="null">
<title>Demo Application Page</title>

<script language="VBScript">
<!--
option explicit
dim majorver
dim ua
dim ie3
dim ie4
dim aol
dim minorver4
dim update
dim winplat
dim nav
dim intButton
set nav = navigator
ua = "Mozilla/2.0 (compatible; MSIE 3.02; Windows NT)"
minorver4 = ""

if len(ua) >=1 then 'nav object is supported
     winplat = mid(ua,instr(ua,"Windows") + 8, 2)
     majorver = mid(ua,instr(ua,"MSIE") + 5, 1)
     ie3 = majorver = 3 and (winplat = "NT" or winplat = "95" or winplat
= "32")
     ie4 = majorver = 4 and (winplat = "NT" or winplat = "95" or winplat
= "32")
     update = instr(ua,"Update a")
     aol = instr(ua,"AOL")

     if ie4 then minorver4 = mid(ua,instr(ua,"MSIE") + 7, 3)
end if
-->
</script>
```

```
</head>

<body bgcolor=#FFFFFF link=#CC0000 vlink=#660099
topmargin=0 leftmargin=0>
<table border=0 cellpadding=4 cellspacing=0>
    <tr>
        <td bgcolor="#FF9900" width=110> </td>  <!-- Delete this
line to remove the orange band!! -->
        <td valign=top bgcolor=#FFFFFF>
You can easily use this template for other
applications.  The source for this page is well documented and easily
customizable.
Please take a look at it.<p>
<FONT color=#ffffff>

<!-- DIRECT.EXE EMBED -->

<script language="JavaScript">
<!--
// YOU SHOULD ONLY NEED TO CHANGE THE VARIABLES BELOW.
//
// icaFile: location of the .ICA file for both the OBJECT and EMBED.
   var icaFile = "bl.ica";
// width and height: pixel-size of the embedded application.
   var width = 640;
   var height = 480;
// start attribute: if Auto, application fires up upon pageload. If
Manual, application waits to be clicked by user.
   var start = "Auto";
// border attribute: On/Off, to specify border around application
window.
   var border = "On";
// Want vertical/horizontal space around the app? Set these just like
for the <IMG> tag.
   var hspace = 2;
   var vspace = 2;
// Where is the ActiveX CAB file located? It's probably best to leave
this set to Citrix:
   var cabLoc =
"http://www.citrix.com/bin/cab/wfica.cab#Version=4,2,274,317";
// Where is the Plugins Reference page located? It's probably best to
leave this set to Citrix:
   var plugRefLoc = "http://www.citrix.com/demoroom/plugin.htm";
// END OF CHANGES. DO NOT CHANGE THE VARIABLES BELOW.
//
```

```
// The following is the ActiveX tag:
   var activeXHTML = '<CENTER><OBJECT classid="clsid:238f6f83-b8b4-11cf-
8771-00a024541ee3" data="' + icaFile + '" CODEBASE="' + cabLoc + '"
width=' + width + ' height=' + height + ' hspace=' + hspace + ' vspace='
+ vspace + '> <param name="Start" value="' + start + '"><param
name="Border" value="' + border + '"></OBJECT></CENTER>';

// And the Plugin tag:
   var plugInHTML = '<CENTER><EMBED SRC="' + icaFile + '" pluginspage="'
+ plugRefLoc + '" width=' + width + ' height=' + height + ' start=' +
start + ' border=' + border + ' hspace=' + hspace + ' vspace=' + vspace
+ '></CENTER>';

var userAgent = navigator.userAgent;
if (userAgent.indexOf("Mozilla") != -1) {
if (userAgent.indexOf("MSIE") != -1) {
if (userAgent.indexOf("Windows 3") > 0)
{ document.write(plugInHTML); }
else
{ document.write(activeXHTML); }
}
else
{ if (userAgent.indexOf("Win16") > 0) { document.write(plugInHTML); }
else { document.write(plugInHTML); }
}
}
//-->
</script>
<noscript>
<a href="bl.ica">
Your browser does not support JavaScript! You'll have to click here to
launch the application.
</a>
</noscript>
</FONT>
                <br>
                <font size=2 face="Arial,Helvetica,sans-serif"><br>
                The client works with web sites that
                have a link to a Citrix multi-user application
                server. Users must have an active TCP/IP
                connection to an Internet or Intranet Web server
                to use the Citrix ICA Web Client. <br>
                <br>
                <strong>How do I get the client? </strong><br>
                If you're using a browser that supports ActiveX,
                such as Internet Explorer 3.0/4.0, the ICA Web ActiveX
                Control download will initialize<br>
                after loading this page. <br>
                <br>
```

```
                If you're using Netscape
Navigator&#174;/Communicator&#174;, you'll have
                to download the ICA Web Plug-in -- we have a
                16-bit (Windows 3.x, Windows for<br>
                Workgroups) version, and a 32-bit (Windows 95,
                Windows NT&#174;) version. <br>
                </font><a
                href="http://www.citrix.com/demoroom/plugin.htm"><font
                size=2 face="Arial,Helvetica,sans-serif">Click
                here to get the Netscape Plug-ins.</font></a> <br>
                           <font size=2 face="Arial,Helvetica,sans-
serif">
                             <br>
<br>
                Be sure to check out our ICA Java Applet client. Just
click on
                            the 'Java Embed' entries in the left-hand
sidebar under Excel, Powerpoint or Taxi. The ICA Java Applet will load
automatically to your system.
                </font><a href="/java/default.asp">
         <font size="2" face="Arial,Helvetica,sans-serif"><br>Click
                here to get the full-featured Java ICA
Client.</font></a>

<br>                <strong>Handling Different
Browsers</strong><br></font>
                <font
                size=2 face="Arial,Helvetica,sans-serif">
                These embedded applications are now presented in
                the preferred manner to your Web browser through
                the use of JavaScript.<br>
                             <a
href="http://www.citrix.com/demoroom/switchscript.htm">
                Go here to see how it's done.</font></a>
                                <br><br>
                <strong>Problems?</strong><br></font>
                <font
                size=2 face="Arial,Helvetica,sans-serif">
                Contact our Demo Room Support at <a
href="mailto:demo@citrix.com">
                demo@citrix.com</a> for assistance with demonstration
problems.
                            </font>
                               <hr size=1 noshade>
                <p><br>
                </p>
                </td>
            </tr>
        </table>
        </td>
```

```
    </tr>
</table>
</body>
</html>
```

To test the connection

To test your connection, open Internet Explorer. In the **Location** field, enter the URL and HTML file name; for example, http://dolphins/bl.htm. The Web page loads with the Citrix ICA session inside the browser window and your published application starts.

CHAPTER 6

Maintaining MetaFrame

Once you have deployed and configured your MetaFrame servers and ICA Clients, you have to maintain your systems. This chapter includes information to assist you with:

- Monitoring network activity and performance
- Applying service packs and hotfixes

Monitoring Network Activity and Performance

This section discusses tools that track network activity and performance. These tools, Event Viewer, Network Monitor, and Performance Monitor, display three types of information, respectively:

- Event logs that record errors, security audits, and other significant events for problem diagnosis
- Network traffic statistics that indicate such things as network utilization, total frames received per second, and broadcast frames received per second
- Performance statistics that indicate such things as queue activity, processor utilization, memory usage, and server throughput

Event Viewer

Windows 2000 with Terminal Services installed keeps a record of errors, logon activities, and other significant events that happen on computers. These records are stored in event logs that can be examined with the Event Viewer. Typical log entries include such items as the failure of a device driver, a data error from a network card, or an unsuccessful logon.

Every Windows 2000 computer has several logs in which events are recorded. The following table describes the event logs relevant to MetaFrame.

Event log	Description	Event selection process
System	Errors, warnings, or information generated by the MetaFrame server.	Selection of events is preset by the operating system.
Security	Valid and invalid logon attempts and events related to resource use such as creating, opening, or deleting files or other objects.	Control of security event auditing is set in the Local Policies folder in the Local Security Policy MMC. Control of file and directory access audits is set through Windows NT Explorer.
Application	Errors, warnings, or information generated by application software, such as an electronic mail or database program.	Application developers decide which events to monitor.

System and application logs are available to be viewed by all users, while security logs are accessible only to system administrators. With appropriate administrative rights, you can also view logs on other computers.

Using Event Logs to Troubleshoot

Each entry in an event log can include the following information:

- Date
- Time
- Source
- Type
- Category
- Event ID
- User
- Computer Name

In addition, most events generate a text description and sometimes binary data, which are available by double-clicking a single entry. The binary data is generated by the application that was the source of the event record. Because the data appears in hexadecimal format, interpreting it may require consulting someone who is familiar with the source application. Binary data is displayed in words or in bytes.

Careful monitoring of event logs can help you predict and identify the sources of system problems. For example, if log warnings show that a disk driver can only read or write to a sector after several retries, it indicates that the sector will eventually become corrupt. Log files can also confirm problems with application

software. If an application crashes, an application event log provides a record of activity leading up to the event for support personnel to analyze.

Here are some suggestions to help you diagnose problems using event logs:

- Archive logs in log format. The binary data associated with an event is discarded if you archive data in text or comma-delimited format.
- If you suspect a hardware component is the origin of system problems, filter the system log to show events generated only by that component.
- If a particular event seems related to system problems, try searching the event log for other instances of the same event or to judge the frequency of an error.
- Note Event IDs. These are unique numbers that match a text description in a source message file. This number is used by product support representatives to understand what occurred in the system.

Using Event Logs to Analyze Activity

Using spreadsheet or word-processing programs, you can manipulate event log data saved as text to produce graphs, charts, and reports. Graphs generated from event logs are used to show the times when logon activity is highest, the average time between network failures, and so on.

Reading event logs into other applications requires saving them in text or comma-delimited text format. This type of archive discards binary data associated with an event but saves all other log details.

Network Monitor

Network Monitor can be used to capture and display frames (also called *packets*) to detect and troubleshoot problems on the network. The Network Monitor is not installed by default when Windows 2000 is installed.

▶ **To install Network Monitor and the Network Monitor Agent**

1. In Control Panel, double-click **Add/Remove Programs**.
2. Select **Add/Remove Windows Components**.
3. In the Windows Components wizard, double-click **Management and Monitoring Tools**.
4. Select **Network Monitor Tools**, then complete the Installation wizard.

You can now start Network Monitor from Administrative Tools or from a command prompt.

ICA packets use TCP port 0x5D6 or 1494 using decimal notation. It is recognized in Network Monitor by looking for the 5D6 in either the Source Port or Destination Port address. A display filter can be set on the Source and Destination port to show only 0x5D6 packets in Network Monitor.

Note Network Monitor is not the only place to get information about ICA traffic. If you have connection problems, use MetaFrame Administration to monitor the ICA connection status while a user attempts to log on.

ICA packets are encrypted. If an analysis of a trace is necessary to troubleshoot a problem between the MetaFrame server and an ICA Client, save the capture data to a file. Send this capture data to support personnel if the problem cannot be resolved.

Performance Monitor

The hardware and software configuration used with a MetaFrame server has a large effect on system performance as measured by user response time. The most useful tool in tuning a MetaFrame server is Performance Monitor. Performance Monitor is a graphical tool that collects and examines data concerned with system activity. The overall performance of a MetaFrame server can be examined by monitoring the following areas:

- Processor(s)
- Memory
- Hard Disk(s)
- Network

System throughput problems usually occur when demand for one of these resources exceeds the supply. The available resources in this case are the microprocessor(s), memory, hard disk(s), and networking hardware and software. Finding out how user applications interact with each of these resources is a logical first step when you start monitoring.

When monitoring a system, you are really monitoring the behavior of its objects. In MetaFrame, an object is a standard mechanism for identifying and using a system resource. Objects are created to represent individual processes, sections of shared memory, and physical devices. Performance Monitor groups counters by object type. A unique set of counters exists for the processor, memory, cache, hard disk, users, processes, and other object types that produce statistical information. Certain object types and their respective counters are present on all systems. However, other counters, such as transport-protocol counters, appear only if the computer is running the associated software.

Each object type can have several instances. For example, the Processor object type will have multiple instances if a system has multiple processors. The PhysicalDisk object type has two instances if a system has two disks. Some object types, such as Memory and Server, do not have instances. If an object type has multiple instances, each instance produces the same set of statistics (counter information).

Solving Performance Problems

The following sections describe potential bottlenecks that can affect system performance and discuss how to use Performance Monitor to determine if any of these areas are adversely affecting system performance.

Processor(s)

The processor-related factors that can affect performance on a MetaFrame server include:

- Processor utilization
- Interrupts
- Context switches
- Screen savers

Processor Utilization

If processor utilization is over 90% on a regular basis, consider upgrading the processors in the MetaFrame server. Install a faster processor if this is a single-processor system, or install additional processors or faster processors in a multiprocessor system. Many server-class systems are designed to allow the inclusion of additional processors or processor boards. MetaFrame scales linearly as processors are added, subject to performance constraints from other system resources such as memory. To determine CPU utilization, monitor the %Processor Time counter under the Processor object. The %Processor Time shows the percentage of elapsed time that a processor is busy executing non-idle threads. If the %Processor Time counter consistently registers at or near 100%, the processors might be slowing down the system response time. If 100% processor utilization is consistent, check the processor queue length for excessiveness.

Interrupts

A defective device adapter can cause an excessive number of interrupts. This severely degrades the performance of the system because most of the processor time is spent handling interrupts. A moderately busy server (32-bit hard disk adapter, network card, and about 12 users) will experience an average of about 100 interrupts per second. If the number of interrupts per second increases dramatically without a corresponding increase in system activity, it could indicate a hardware problem. To determine if there is excessive interrupt activity, monitor the Interrupts/sec counter under the Processor object.

Context Switches

Device drivers perform context switches to switch between user and system level processing. A poorly-written device driver can cause the system to make a large amount of context switches. A typical value for context switches is 500 per second or fewer. If the number of context switches per second is greater than 500, a device driver may have built-in critical sections that are too long. To check the server for poorly written device drivers, monitor the Context Switches/Second counter under the System object.

Screen Savers

Screen savers, especially “busy” ones, can use a large amount of processor resources and, in the case of an ICA connection, network bandwidth. If you plan to use a screen saver, use a generic one and test it on the system before you implement it.

To determine if a screen saver is using too much processing time, run the screen saver on the console. Log on to an ICA Client and run Performance Monitor. Monitor the %Processor Time counter under the Processor object. Note the demand that the screen saver puts on the processor.

Memory

The factors related to system memory that can affect performance on a MetaFrame server include:

- Memory load
- The system page file, Pagefile.sys
- Memory paging

Memory Load

To determine how much memory is present on the MetaFrame server, use the Computer Management MMC as follows:

1. In the Administrative Tools group, click the **Computer Management** icon. The **Computer Management MMC** appears.
2. Expand **System Information** and click **System Summary**. Memory statistics appear in the right panel.

Pagefile.sys

Windows 2000 preallocates hard disk space for virtual memory. This area is marked as a file called Pagefile.sys. In Windows 2000, the default pagefile size is 1.5 times the amount of physical memory. This value is determined during system installation. The MetaFrame server can exceed the default size space if it is determined that more memory is needed. However, this is time consuming and can slow down the system.

Use Performance Monitor to monitor the demands on the pagefile. Check the Commit Limit and the Committed Bytes counters under the Memory object to determine how the pagefile is performing. When the Committed Bytes counter exceeds the Commit Limit, increase the size of the pagefile as follows:

1. In Control Panel, double-click **System**.
2. Click the **Advanced** tab, then the **Performance Options** button.
3. Click the **Change** button in the **Virtual Memory** section, then enter new Initial and Maximum sizes. Click **Set** and then click **OK**.
4. Click **OK** to exit.

Determine the optimum pagefile size by logging Committed Bytes over a period of two weeks with Performance Monitor. Record the maximum value over the two week period. Increase this number by 10% to 20% to determine the system's minimum pagefile size.

Memory Paging

Windows 2000 keeps the most used data in physical memory and pages the least accessed data out to the pagefile. When a system is heavily loaded, memory is paged in and out at a rapid rate. This affects system performance if the hardware is unable to keep up with the server. The number of pages per second being paged in and out of memory is a valuable indicator of hardware performance. The pages per second should consistently average five or less per hard drive. If the pages per second is constantly above five, the system is paging in and out of virtual memory too much. Either use faster hard disks so the system can access virtual memory quicker or add more RAM to the machine.

Note All configured connections, whether active or inactive, consume system memory. To avoid allocating memory for connections that will never be used, be sure to configure only the type and number of connections required for your configuration.

Hard Disks

Citrix does not recommend installing MetaFrame on a RAID drive or using a RAID drive for the MetaFrame swap file. RAID drives have additional overhead that enhances data reliability but can adversely affect operating system performance.

The factors related to hard disks that can affect performance on a MetaFrame server include:

- Percentage of disk time
- Disk queue length

Percentage of Disk Time

The %Disk Time counter measures the percentage of time that a hard drive is active. If the %Disk Time counter value is high, the hard disk is not adequate for the system. Take one or more of the following steps:

1. Use a 32-bit PCI bus mastering SCSI controller or a higher-performance (for example, Wide SCSI or Fast Wide SCSI) subsystem in the MetaFrame server. This speeds up data transfer to and from the drive.
2. Spread the pagefile across multiple drives.
3. Install a separate hard drive and assign only the pagefile to the drive.
4. Install a separate SCSI controller and hard drive and assign only the pagefile to that drive and controller.
5. Offload some of the more frequently accessed data to a less utilized server.
6. Install another server to help handle the user load.

Disk Queue Length

Another item to monitor is the Disk Queue Length counter. This measures the number of I/O requests outstanding for the hard drive. If data has to wait in a long queue before it is written or read from the disk, it can affect the MetaFrame server performance. The Disk Queue Length values should be sustained at no more than 1.5 to 2 times the number of spindles making up the physical disk. Most disks have only one spindle. RAID disks usually have more but appear as only one physical disk to Performance Monitor.

Network

When monitoring network performance, examine the total bytes per second passing to and from the server. Compare this with the speed of the network being used to transfer the data; for example, 10Mbps or 100Mbps Ethernet, or 4Mbps or 16Mbps Token Ring. (Because these values are in bits per second, divide by 8 to get the number of bytes per second; for example 10Mbps Ethernet is actually 1.25MBps.) If the server's total network throughput is close to the network's transfer speed, the network is saturated. Possible solutions are listed below.

Upgrading the Network

- Add a faster network backbone
- Add a router between network segments
- Connect the servers directly to the backbone

Upgrading the Server

- Add a faster network adapter
- Use the latest drivers for the network adapter
- Assign a lower interrupt for the network adapter to give it higher system priority

Monitoring Users and ICA Sessions

MetaFrame supports multiple simultaneous users logged on to the MetaFrame server from a variety of connections. You can use the Event Viewer to examine events such as user logon and logoff and connection activity. You can use Performance Monitor to track resource consumption by user or connection, or diagnose connection problems by examining statistics gathered on a per-user or per-connection basis.

For example, you can monitor the amount of processor time being used to identify potential performance problems. Statistics can be used to find and diagnose connection problems, such as a defective modem or WAN link, by finding connections with excessive error counts.

Virtual Memory

In a multiuser environment like MetaFrame, the demand for memory is higher than in single-user environments. It is, therefore, recommended that the system's pagefile size be increased.

1. In Control Panel, double-click **System**.

   The **System Properties** dialog box appears.
2. Select the **Advanced** tab.

3. Click the **Performance Options** button, then the **Change** button in the **Virtual Memory** section..

   This opens the **Virtual Memory** dialog box.

4. Set the **Initial Size** and the **Maximum Size** to correspond to the calculated value, which is 2.5 times the size of the system RAM. For example, if you have 256MB of RAM, set the Initial and Maximum sizes to 640MB.

Note Setting both the Initial Size and the Maximum Size to the same size provides the best performance because the MetaFrame server does not take extra time increasing the paging file.

Spreading the pagefile across all available drives improves the performance of your MetaFrame server because the MetaFrame server can perform Read and Write operations to more than one disk simultaneously.

Third-Party Technologies for Prioritizing ICA Traffic

Here are two solutions for ensuring that ICA packets are prioritized and routed properly in busy network environments:

- Cisco Queuing Technologies
- Packeteer (PacketShaper)

Cisco Queuing Technologies in a Citrix Environment

For organizations using Cisco routers, a method exists for prioritizing the ICA protocol when routing over low bandwidth links such as a serial connection. Cisco offers two methodologies for prioritizing the ICA protocol. These methodologies, Priority Queuing and Custom Queuing, relate to ICA traffic prioritization over ports 1494 and 1604.

Note Routing is critical for large enterprise networks to function properly. Only qualified personnel who are well versed with Cisco technologies should perform router configuration.

Requirements

Hardware Requirements

- MetaFrame and/or *WINFRAME* servers
- Cisco Router

Software Requirements

- MetaFrame Version 1.8 for Windows 2000

  - Or -

- MetaFrame Version 1.0 or later on Windows Terminal Server

  - Or -

- *WINFRAME* Version 1.7 with Service Pack 5B or later

Usage

Using Cisco routers, ICA traffic can be prioritized by two distinct methods: Priority Queuing and Custom Queuing. The following sections define and describe these methods in detail. They also provide the necessary commands required as input at the router command interpreter. These sections assume that the user is knowledgeable in using Cisco routers and has the proper authorization to make such changes. All commands in these sections are given to the router from the privileged level of the EXEC command interpreter.

Priority Queuing

Priority Queuing allows you to set up a priority on a particular protocol or port number. Anytime a buffer of that protocol or port number is transmitted, it is given high, medium, or low priority.

By using this method, however, other protocols can be limited if there is significant priority traffic running through the router. For example, during periods of intense prioritized ICA traffic, there would not be sufficient network bandwidth for an FTP session or non-ICA print job.

The steps required to set up a priority queue are listed below:

1. At the Router # command prompt, type **config terminal**. This places the system in configuration mode.
2. Configure a priority list (1-16) and name the IP protocol as the one to prioritize. Specify the transport layer protocol and port number (TCP 1494) to be prioritized. At the Router#(config) prompt, type:

   priority-list 1 protocol ip high tcp 1494
3. Assign a default level of prioritization. At the Router#(config) prompt, type:

   priority-list 1 default low

   In this case, protocols that do not fall into category 1 default to low priority.
4. Specify the queue sizes. This step is optional. See the Cisco documentation for additional information.

5. Assign the priority list to an interface. This step applies to serial ports, so the command refers to the serial interface (s0). To assign priority 1 to the interface s0, from the Router#(config) prompt, type:

   int s0
   priority-group 1

   To determine if the changes have taken effect, use the show interface (s0) or the show queuing command.

Custom Queuing

Custom Queuing provides the ability to set up 16 different queues that act in a round robin format. This is similar to division multiplexing. The router scans process packets through all of the sequences in a round robin format. You set the byte length for a specific queue so that multiple packets from the same protocol are transmitted as opposed to one packet of another protocol. This is considered a better alternative than Priority Queuing. Similar to token ring, everyone gets a chance to transmit data. Only some protocols can transmit more data than the rest.

The steps required to set up Custom Queuing are as follows:

1. At the Router # command prompt, type **config terminal**. This places the system in configuration mode.
2. Set custom queuing filters for protocols or interfaces. At the Router#(config) prompt, type:

   queue-list 1 protocol ip high tcp 1494

   This configures queue list 1 for the IP protocol and the TCP port 1494, which is what ICA uses to initiate a session.
3. Assign a default queue. This specifies the default queue for all unnamed protocols and ports that are not explicitly defined. At the Router#(config) prompt, type:

   queue-list 1 default 2
4. Change queue capacity. This step is optional. See the Cisco documentation for additional information.
5. Configure the transfer rate per queue. This sets the byte count for a particular queue. This allows multiple packets to be sent for one queue while sending one packet for another queue. At the Router#(config) prompt type:

   queue-list 1 queue 1 byte-count 4500

   Queue 1 in queue-list 1 has a byte-count of 4500, which is three times that of a regular Ethernet packet, thereby sending three packets of this queue-list member as opposed to one packet of the default queue.

6. Assign the custom queue list to an interface. This step applies to serial ports so the command refers to the serial interface (s0). The first entry designates the serial interface while the second assigns custom queue 1 to the interface (s0). From the Router#(config) prompt, type:

   int s0
   custom-queue-list 1

   To determine if the changes have taken effect, use the show interface (s0) or the show queuing command.

Troubleshooting

If a priority or custom queue is not working properly, follow these directions:

Unassign the queue from the ports for which it is configured. In interface setup configuration, type the following:

1. If a priority is set up, from Router(config-if)#, type:

   no priority-group 1

2. If a custom queue is set up, from Router(config-if)#, type:

   no custom-queue-list 1

This immediately removes the policy from that interface until a problem is determined. Repeat the procedure from the (config) mode to actually remove the queues, inserting the word “no” in front of the commands to reverse them. Run show running-config to verify that changes were made. Make sure you copy to startup-config using copy running-config startup-config when changes are acceptable.

Packeteer (PacketShaper)

PacketShaper comes in three configurations.

- The PacketShaper 1000 manages WAN connections at speeds up to 384Kbps
- The PacketShaper 2000 handles WAN and Internet connections at speeds up to 10Mbps
- The PacketShaper 4000 supports WAN and Internet connections at speeds up to 100Mbps

Typically a PacketShaper is located at the remote side just outside of the CSU/DSU to manage the data flowing in and out of the remote location. You can access PacketShaper through a Web interface, a Telnet command line interface, or a console session. PacketShaper identifies traffic, in this case port 1494, traveling in both directions and prioritizes that traffic in a way that allows ICA traffic to get through on the busiest of WANs. PacketShaper can be easily set up.

Packeteer requires some knowledge to get the full benefit from the device. Packeteer allows you to monitor the traffic traveling across the link and then apply policies to that traffic depending upon mission criticality of the protocols or traffic classes. Included in this note are the directions to set up Packeteer to recognize the ICA protocol and start tracking it. You can toggle packet shaping on and off to see the effect that it has on network traffic.

Requirements

Hardware Requirements

- *WINFRAME* or MetaFrame server
- WAN Setup

Software Requirements

- *WINFRAME* Version 1.7 or later
- MetaFrame Version 1.0 or later
- PacketShaper Version 3.0 or later

Installation

Below are the instructions to set up a PacketShaper running Version 3.0 to recognize and prioritize ICA traffic. For Version 3.1, Packeteer has built-in recognition for Citrix *WINFRAME*/MetaFrame, so when traffic autodiscovery is on, PacketShaper detects *WINFRAME*/MetaFrame ICA and server balancing traffic and automatically creates classes for both. To determine what version you are running, log on to PacketShaper using the Web interface. Version information is in the top right corner of the PacketShaper Policy Console home page.

1. Make sure your PacketShaper is correctly configured and is functioning on your network. In your configuration (the Setup option of the PolicyConsole navigation bar), make sure that Traffic Discovery is turned on. If you have any questions about this, please contact Packeteer technical support at support@packeteer.com or (408) 873-4550.
2. Create a class for Inbound Citrix *WINFRAME*/MetaFrame traffic:
   A. Click the **Manage** option of the PolicyConsole navigation bar.
   B. Click **Inbound** in the Traffic Tree in the left side of the **Manage** dialog box.
   C. Click **Class...** in the **New** area in the right hand side of the **Manage Traffic Tree** dialog box. This creates a child class on the inbound branch of the traffic tree.

D. In the **New Class** dialog box, complete the following areas:

Class name	outside_WinFrame/MetaFrame_inbound
Protocol family	IP
Service	TCP
Server location	any
Outside port	1494

E. Click the **Add Class** button.

3. Create a class for Outbound Citrix *WINFRAME*/MetaFrame traffic:

A. Click **Outbound** in the Traffic Tree in the left side of the **Manage** dialog box.

B. Click **Class...** in the **New** area in the right hand side of the **Manage Traffic Tree** dialog box.

C. In the **New Class** dialog box, complete the following areas:

Class name	inside_WinFrame/MetaFrame_outbound
Protocol family	IP
Service	TCP
Server location	any
Outside port	1494

D. Click the **Add Class** button.

4. Set up PacketShaper so you can monitor *WINFRAME*/MetaFrame traffic:

A. Click the **Monitor** option of the PolicyConsole navigation bar.

B. Click the **Clear All Statistics...** button so that you can see the *WINFRAME*/MetaFrame traffic more clearly.

5. Create Citrix *WINFRAME*/MetaFrame traffic so that PacketShaper can detect it.

A. Open the *WINFRAME*/MetaFrame Client Remote Application Manager.

B. From Remote Application Manager, open the applications to which you have access.

C. Return to PacketShaper's **PolicyConsole Monitor** dialog box.

D. Click **Update**.

6. Set Policy to give *WINFRAME*/MetaFrame traffic priority over all other traffic.

A. Click the **Manage** option of the PolicyConsole navigation bar.

B. Click class outside_WinFrame/MetaFrame_inbound.

C. In the **New** column, select **Policy**.

D. From the **Policy** dialog box, click **Priority**.

E. When the screen refreshes, set priority to **7** and click **Add Policy**.

7. Repeat these steps for the inside WinFrame/MetaFrame outbound class.

You have now configured PacketShaper to manage network traffic so that ICA traffic has priority over all other network traffic.

Applying Server Hotfixes and Service Packs

What are Hotfixes and Service Packs?

Hotfixes are interim *WINFRAME* or MetaFrame system patches available for download from the Citrix Web site (http://citrix.com/support), the Citrix FTP site (ftp.citrix.com), and the Citrix BBS (954-267-2590). Apply hotfixes only on the advice of Citrix Technical Support. Hotfixes are tested and verified to fix specific problems.

Service packs are collections of patches that are released between major revisions of Windows NT. Service packs are cumulative; that is, they contain the patches included in all prior service packs.

Hotfix Naming Convention

Hotfixes are posted as self-extracting executables and follow a specific naming convention. MetaFrame and *WINFRAME* server hotfixes have a slightly different naming convention than client hotfixes. Hotfix ME100010.EXE is used as a server hotfix in the example for the table.

M	Digit 1 specifies whether the hotfix is applicable to a MetaFrame or *WINFRAME* server. This digit can be one of two values: S = *WINFRAME* server hotfix, M = MetaFrame server hotfix.
E	Digit 2 reflects the applicable language, English in this case. Other values include F = French, G = German, S = Spanish, J = Japanese.
10	Digits 3 and 4 reflect the version of the software for which this hotfix is applicable, MetaFrame Version 1.0 in this case.
0	Digit 5 indicates which service pack should be installed before the hotfix is installed. If this digit is "0," it indicates that the hotfix can be installed without first installing a service pack.
010	Digits 6 through 8: this value is sequential and indicates the hotfix number. This example shows it is the tenth hotfix since the last service pack was released. International hotfix numbers match the domestic version of the hotfix

The table below illustrates the naming convention used for client hotfixes. Hotfix NE200581 is used as the example for this table.

N	Digit 1 specifies to what client the hotfix is applicable. This digit can be one of four values: N = ICA 32-bit Client hotfix, W = ICA 16-bit Client hotfix, D = DOS Client hotfix, B = Web Client hotfix.
E	Digit 2 reflects the applicable language, English in this case. Other values include F = French, G = German, S = Spanish, J = Japanese.
2	Digit 3 reflects the security level of the client. This digit can be one of four values: 0 = No encryption, 1 = 40-bit encryption support, 2 = 56-bit encryption support, 3 = 128-bit encryption support.
00	Not used at this time
581	Digits 6 through 8 reflect the client build number, client build number 581 in this case.

Extracting, Installing, and Removing Hotfixes

Create a directory called \Hotfix to store the self-extracting files that you download. Create subdirectories for each hotfix. Use these subdirectories to store the files that are archived within each self-extracting file. Each hotfix contains an executable file, Hotfix.exe. Because each hotfix executable file has the same name (Hotfix.exe), it is **very important** to store each hotfix in a separate subdirectory. Install hotfixes from the directory where you store the extracted files.

▶ To install a hotfix

Note Change drive letters and/or directories to match your system configuration.

1. Download the hotfix to the \Hotfix directory.
2. At a command prompt, change to the system directory; for example **C:**
3. Type **cd \hotfix** to change to the \Hotfix directory.
4. Create a subdirectory for the new hotfix; for example, **md me100010**. Change to this directory.
5. Type **..\me100010** to execute the self-extracting file in the parent directory. The files are extracted to the current directory.
6. Review the Readme.txt file for information about the hotfix, such as special installation instructions.
7. Type **hotfix /i** to install the hotfix.
8. Type **hotfix /v** to verify that the files are correctly installed.
9. Type **shutdown 0 /reboot** to reboot the server.

To remove a hotfix

1. At a command prompt, type **C:** to switch to the current directory.
2. Change to the directory containing the hotfix; for example, **cd me100010**.
3. Type **hotfix mf:me100010 /r** to remove the hotfix.
4. Type **shutdown 0 /reboot** to reboot the server.

The Hotfix Utility

Hotfix is a utility that makes installing, tracking, and maintaining hotfixes easier.

Command Syntax

HOTFIX [/H /R /V] [*hotfixname*]
HOTFIX /I [*sourcedir*]
HOTFIX [*computername*] [/L /F] [*hotfixname*]

Parameters

computername
The name of a remote computer that is the target of the command. This can be used only with the /LIST option.

hotfixname
The name of the hotfix.

sourcedir
Source directory containing the corrected files and the Hotfix.ini file for the hotfix.

Options

/FULL or /F
Specifies a detailed listing of a specific hotfix. If /F is not specified, the default is a brief description of the hotfix.

/HELP /H or /?
Displays the syntax for the utility and information about the utility's options.

/INSTALL or /I
Installs the hotfix identified by the Hotfix.ini file in the source directory or the current directory in the source directory was not specified. The fix is installed on the local machine.

/LIST or /L
Displays a list of all installed hotfixes. If a hotfixname is specified, a detailed listing of the specific hotfix is displayed.

/REMOVE or /R
Removes the specified hotfix from the local machine.

/VERIFY or /V
Verifies that the specified hotfix is correctly installed on the local machine. If no hotfixname is specified, all installed hotfixes are checked.

CHAPTER 7

Troubleshooting the System

This chapter contains information to help you diagnose and solve problems with your MetaFrame systems:

- Troubleshooting user accounts
- Finding memory leaks
- Resolving driver conflicts
- Setting up a MetaFrame server kernel debug session

Troubleshooting User Accounts

Periodically when using an application, I get an error from the application that the hard disk or some group of files is corrupted or missing. Why is this happening?

Many applications create temporary files as they run. They use these files to store information about the document you are working on or information about your particular settings. Any application temporary files are saved in the users' home directories. If users' home directories exist on a network and your network is unstable, these errors can occur. This can also happen when a network server goes down, cannot be reached, or if the network becomes overloaded. If you are having these problems, work with your network administrator to locate the network problem and stabilize the network. You can also move the home directories to the local MetaFrame hard drive to prevent saving temporary files over the network.

Do not keep users' temporary files on a client drive.

Make sure the paths for the TEMP and TMP environment variables do not point to a user's client computer hard drives. If these variables point to a client drive, applications that store temporary files in the directories specified by the TMP or TEMP environment variables can run very slowly and can experience other problems. The best place for temporary files is on the MetaFrame server itself.

Finding Memory Leaks

When multiple users are running a number of applications on a MetaFrame server, it is not unusual for some of these applications to have some form of memory leak that slowly consumes the available memory of the server. A *memory leak* occurs when a memory pool allocates some of its memory to a process and the process does not return the memory. When this happens repeatedly, the memory pool is depleted. If you monitor paged pool bytes and page file usage in Performance Monitor, you will see that they increase over time.

The most common signs that a system is experiencing a memory leak include but are not limited to:

- Virtual memory errors (displayed at the console only)
- Excessive paging of the system pagefile(s)
- Sluggish performance
- System appears to hang
- Client connection/disconnection problems
- Processes and applications become unresponsive

Identifying Memory Leaks Using Performance Monitor

A memory leak can be caused by a process created by a service, a program, a device driver, etc. The most common way to find a memory leak is to use Performance Monitor to chart the following:

- Object: Process
- Instance: Process Name
- Counter: Private Bytes

For example, on a system with 128MB RAM, a 384MB Pagefile, and two users, the Spoolsv.exe shows 250,000,000 private bytes.

Always select the Memory, Objects, and Processes objects when you are looking for a pool leak. Select all counters under each object. You can also select other object counters to help you identify a specific problem. You then simply view all charted objects until one or more objects show a trend that could be a pool leak.

1. By charting the memory resources, it becomes clear that one or more memory pools are allocating memory and the available memory in one or more memory pools is being continuously depleted. When charted, a memory pool can display a continuously climbing stair-step effect while the process leaking memory is running. However, during times of inactivity, it is common to see the charted line remain flat. The charted line continues the stair-step pattern the next time the process leaking memory is started and run.

2. By charting the object counter Threads, it is evident that the thread count grows in a manner similar to the tagged pool memory allocations and bytes listed in Step 1. Depending on the amount of threads that are created, the object counter Threads can jump to a high value immediately.
3. The object Process helps determine which process is causing the leak. Select object counters Pool Nonpaged Bytes, Pool Paged Bytes, and Thread Count. Chart all instances of these counters. The process leaking memory charts in a manner similar to the pool memory charted in Step 1.

Identifying Memory Leaks in NT Services

Although Performance Monitor usually provides the necessary information to determine which process is creating a pool leak, it does not always provide the information necessary to determine the exact cause of a memory leak. A trend that shows a memory leak can often be identified but an exact process is not always identifiable as the cause of the memory leak.

If the process leaking memory is a service, you can identify which service it is by stopping different services while using Performance Monitor to monitor the number of threads running. The number of threads running depends on many factors, but the number grows larger as the process leaking memory continues to run.

▶ **To determine which service is leaking memory**

1. Run Performance Monitor and add the **Threads** counter for the object type **Object** to the chart.
2. From Control Panel, double-click **Services**.
3. Tile the windows so you can see both Performance Monitor and the **Services** dialog box.
4. Stop and start the active services one at a time.

   If the service that is leaking memory has been running long enough, there will be a drastic reduction in threads when the service is stopped.

Note If no services are leaking memory, the leak could be caused by a regular program. Repeat the above procedure, but instead of stopping services, close and open all active programs one at a time.

Limiting the Impact of Memory Leaks

While there is no way to prevent memory leaks, rebooting the MetaFrame server whenever possible can prevent memory leaks from compounding. Rebooting the server has the added advantage of preventing system degradation caused by disconnected user sessions, crashed applications, and runaway processes. A regular reboot can be scheduled using the **Tsshutdn** command at the command prompt. For more information about the **Tsshutdn** command, type **tsshutdn /?** at a command prompt.

Resolving Driver Conflicts

I just installed the Canon GP200F printer/fax drivers on my MetaFrame server. Now, every time I run Word 97 and select the Canon GP200F to print to from an ICA Client, I get an error on the MetaFrame server.

The driver Dlls are disrupting the load process by, perhaps, having conflicting base addresses that cannot be rebased. It could also be that the Dll initializations fail because too many implicitly loaded Dlls need thread local storage.

One way to find out is to get the Listdlls executable from www.sysinternals.com and run it in a command window as follows: Listdlls. You can also run Listdlls /help for additional command line options. This lists all the Dlls in the address space and where they are loaded.

Setting up a MetaFrame Server Kernel Debug Session

Kernel debugging is a process that uses the built-in debugging features of Windows 2000 with Terminal Services installed to gather information for detecting, isolating, and resolving system problems.

Kernel debugging involves two computers:

- The computer being debugged, referred to as the *target computer*
- A second computer that controls the execution of the target computer, called the *host computer*

The host computer runs an application called the *kernel debugger* that is used to examine memory and processor status, single-step through programs, and perform other operations useful in problem determination. The target computer can be allowed to run until an error condition occurs or it can be stopped at any time. For Intel-based systems, the kernel debugger application is I386kd.exe.

To allow symbolic debugging (that is, debugging using descriptive names instead of numbers), *symbols* are loaded onto both target and host computers. These symbols contain information used to present data to technical personnel in a more

readable manner; for example, displaying regions of memory in terms of their actual usage instead of as lists of hexadecimal numbers. For the information presented to be meaningful, it is important that the symbols present on the target and host computers be identical.

The host computer controls the target computer through a serial communications port. The host can be connected to a local target computer by a serial communications null-modem cable (*local debugging*), or the host can be at a remote location (such as Citrix headquarters) and connected to the target computer by modem (*remote debugging*). The modem used can be any standard Hayes-compatible PC modem; however, Citrix recommends using a U.S. Robotics Sportster series 56Kbps modem for best results.

This section describes how to configure a target computer and a host computer for local or remote debugging.

The Kernel Debugger (I386kd.exe)

Using the kernel debugger program, I386kd.exe, a support engineer can use the host computer to control program execution on the target computer. The target computer can be allowed to run until an error condition occurs or it can be manually stopped at any time. The action of stopping the target computer is called *breaking in*. The support engineer breaks into the target computer by pressing CTRL+C in the kernel debugger session on the host computer. If a trap or fault occurs on the target computer, the target machine halts and displays system information. At this point, the operator on the host computer can interactively examine the status of the target computer or allow execution to resume. Press **G** in the kernel debugger session on the host computer to allow execution on the target computer to resume.

The kernel debugger can be used to set execution and memory access breakpoints, examine and modify memory contents, check the state of CPU registers, disassemble code, and other operations.

Symbols and Symbol Trees

To allow symbolic debugging (that is, debugging using descriptive text instead of hex numbers), *symbols* are loaded onto both the target and host computers. These symbols contain information used to present data to technical personnel in a more readable manner; for example, displaying regions of memory in terms of their actual usage instead of as lists of hexadecimal numbers.

For the information presented to be meaningful, it is important that the symbols installed on the target and host computers be identical and that they match the executable files on the target computer. The symbol files for the base MetaFrame system are located on the MetaFrame CD-ROM in the \Support\Debug\I386 \Symbols directory. The Symbols directory contains directories corresponding to

each type of file. You must use **xcopy** to copy the Symbols directory and all its subdirectories to the %SystemRoot% directory on the target computer. These symbols are also copied to a directory on the host computer; this can be any directory and does not have to be the %SystemRoot% directory. These directory structures are referred to as the *symbol tree*.

If hotfixes are installed on the MetaFrame server, the symbol files must be installed in the proper order: first the base MetaFrame symbols, then the hotfix symbols. This ensures that the symbols match the executable code.

Kernel Debug Configurations

There are two basic kernel debug configurations: local debug and remote debug. A third type of debug configuration, the ICA debug, is a variation of local debug. Each configuration is discussed below.

In a *local debug* configuration, the host and target computers are in close proximity and are connected by a null-modem cable. While this is the simplest debug configuration, it can only be used for on-site debugging.

In a *remote debugging* configuration, the host and target computers are connected through dial-up modems. This configuration allows a support representative to dial into the target computer located at a remote customer site from a host computer located at Citrix headquarters.

In some cases, the support representative is not able to directly access the target computer. If two MetaFrame servers are at the remote site, the support representative can perform an *ICA debug* configuration.

Much like the local debug, the host and target computers are in the same location connected by a null-modem cable. In addition, the host computer is configured to accept an ICA dial-in connection. The remote support representative dials in to the host computer and runs the kernel debugger in a remote session. This method combines the simplicity and reliability of a local debug with the ability to remotely debug a customer's target computer.

Requirements for Debugging

To perform kernel debugging, you need the following equipment:

- Target system: MetaFrame server with any hotfixes installed
- Host system (local and ICA debug sessions): MetaFrame server with any hotfixes installed

Note The symbols for the MetaFrame server and hotfixes must be installed in the proper order so that the symbols match the executable files. The host system must have the same MetaFrame server and hotfix symbols installed, but it does not require the same software configuration.

Hardware Requirements

Local Debug Session

- Null-modem cable between host and target computers

Remote Debug Session

- Modems and modem cables for host and target computers. The host computer is usually preconfigured and is at the support provider's site. The target computer requires a modem configured to allow dial-in access to the target system. Citrix recommends using the U.S. Robotics Sportster series 56Kbps modem.

ICA Debug Session

- Null-modem cable between host and target computers
- Modems and modem cables for host and remote client computers. The host computer must have a connection configured in Citrix Connection Configuration

Configuring the Target Computer for Debugging

The procedure for configuring the target computer is similar for both local and remote debugging. The only difference is that remote debugging requires you to place the modem attached to the debugging port into auto-answer mode.

There are four steps to the setup process:

- Installing hotfixes
- Installing symbols
- Preparing the modem and/or COM port
- Modifying the Boot.ini to enable kernel debugging

Installing Hotfixes on the Target Computer

See "Applying Server Hotfixes and Service Packs" in Chapter 6, "Maintaining MetaFrame."

Installing Symbols on the Target Computer

The correct symbols must be installed on the target computer before kernel debugging can occur.

▶ **To install the debugging symbols on the target computer**

1. Create a Symbols directory in the %SystemRoot% directory; for example,**md %systemroot%\symbols**.
2. Insert the MetaFrame CD-ROM into a CD-ROM drive that can be accessed by the target computer. Use **xcopy** to copy the \Support\Debug\I386\Symbols directory and its subdirectories from the MetaFrame CD-ROM to the Symbols directory; for example: **xcopy /v /s *x*:\support\debug\i386\symbols %systemroot%\symbols**, where *x* is the CD-ROM drive.
3. If you are installing hotfixes, copy the symbol files corresponding to the new binaries in the hotfix to the %SystemRoot%\Symbols directory on the target computer.
4. When you are done installing the symbols, configure the target system modem and COM port.

Preparing the Target Computer Modem and COM Port

The next step is to configure the COM port and the optional modem (remote debug only) on the target computer. Local and ICA debug configurations use a null-modem connection between the target and host computers and do not need modem configuration. Remote debug configurations require modem configuration.

▶ **To configure the target system COM port for debugging**

For both local and remote debugging, you must select the serial port that will be used by the host system. This must be the highest numbered planar COM port; for example, if your motherboard contains COM1 and COM2 ports, the debugger defaults to COM2. Select the highest-numbered planar COM port in Device Manager.

Note **Do not** configure the COM port used for debugging as a connection. Use Citrix Connection Configuration to make sure no connection is configured for that port.

Modifying the Boot.ini File to Enable Kernel Debugging

Boot.ini is a system text file that lists the operating systems that can be started, the default operating system to start, and a timeout value specifying how long to wait before automatically starting the default operating system.

When you first start a MetaFrame server, the system loader (NTLDR) reads the Boot.ini file in the system partition. Boot.ini defines what items will be listed in the boot menu and how NTLDR will start each item. Here is a sample Boot.ini file:

```
[boot loader]
timeout=30
default=multi(0)disk(0)rdisk(0)partition(1)\Winnt
[operating systems]
multi(0)disk(0)rdisk(0)partition(1)\Winnt="Microsoft Windows 2000
Advanced Server" /fastdetect
```

The line immediately following the [operating systems] section describes the path NTLDR uses to boot this particular installation of Windows 2000. For the purpose of this document, this line is referred to as the *boot line*. The boot line in this example shows that the Windows 2000 server is installed in the \Winnt directory on the first partition (partition 1) of the first disk (disk 0).

The target computer is placed in debug mode by setting one or more of the following switches in the boot line in Boot.ini.

Boot.ini Debugger Switches

The following Boot.ini switches are used to enable the kernel debugger on the target computer:

/Debug	Causes the kernel debugger to be loaded during boot and kept in memory at all times. This allows a support engineer to break into the target computer at any time, even if the system is not suspended at a kernel STOP (blue) screen.
/Crashdebug	Causes the kernel debugger to be loaded during boot but swapped out to the pagefile after boot. In this mode, a support engineer can break into the debugger only if the target computer is suspended at a kernel STOP (blue) screen.
/Baudrate=*value*	Determines the speed at which the target computer communicates with the host computer. The default value is 19200 bps. For a remote debug configuration, set the value for 9600 bps. This switch also forces /Debug mode.
/Debugport=COM*x*	Specifies the serial port used for the kernel debugger on the target computer, where *x* is the communications port to use. If no serial port is specified, the kernel debugger defaults to COM2. Like /Baudrate, this switch also forces /Debug mode.

Boot.ini Changes

Because the Boot.ini file usually has the Hidden, System, and Read-only file attributes set, these attributes must be manually unset and then reset after editing.

To modify Boot.ini

1. Right click Boot.ini and select **Properties**. Uncheck the Read-only check box in the **Properties** dialog box. Boot.ini can now be edited using Notepad. A sample Boot.ini follows:

```
[boot loader]
timeout=30
default=multi(0)disk(0)rdisk(0)partition(1)\Winnt
[operating systems]
multi(0)disk(0)rdisk(0)partition(1)\Winnt="Microsoft Windows 2000
Advanced Server" /fastdetect
```

2. The best way to modify Boot.ini is to create a new boot entry for debugging. This gives you the ability to boot your MetaFrame server for normal use or for debug use. Copy the desired boot line and append the /Debug switch to the end of the boot line. This switch is sufficient for local and ICA debug configurations. For remote debug configurations, you must also append the /Baudrate=9600 switch to the end of the boot line. If the debug modem or null-modem cable is connected to a communications port other than COM2, make sure you append the /Debugport=COM*x* switch. A sample modified Boot.ini follows:

```
[boot loader]
timeout=30
default=multi(0)disk(0)rdisk(0)partition(1)\Winnt
[operating systems]
multi(0)disk(0)rdisk(0)partition(1)\Winnt="Microsoft Windows 2000
Advanced Server" /fastdetect
multi(0)disk(0)rdisk(0)partition(1)\Winnt="Microsoft Windows 2000
Advanced Server" /fastdetect /debug /baudrate=9600 debugport=com1
```

Note **Do not** configure the COM port used for debugging as a connection. Use Citrix Connection Configuration to make sure no connection is configured for that COM port.

After making the required changes, choose **Save** from the **File** pull-down menu to save the changes.

3. Exit Notepad.
4. Right click Boot.ini and select **Properties** to restore the Read-only attribute of Boot.ini.
5. Reboot the system.

The MetaFrame server is now ready for debugging by a remote host.

Configuring the Host Computer for Debugging

The host computer set up is similar whether the host computer is used in a local, remote, or ICA debug configuration. There are four steps to the set up process:

- Installing symbols
- Preparing the COM port and optional modem
- Installing and configuring the kernel debugger
- Running the kernel debugger

Installing Symbols on the Host Computer

To effectively debug the target computer, the host computer must have access to a set of symbol files that exactly correspond to the files installed on the target computer. Because the system files installed on the host may not match the system files installed on the target (and are not required to), the symbol tree on the host must be in a directory other than the host's %SystemRoot% directory. Citrix recommends creating a \Debug directory on the host computer with subdirectories for each version of the symbol tree; for example the tree containing the symbols for MetaFrame Version 1.8 for Windows 2000 might be named \Debug\MF18 \Symbols. Follow the same procedures used to install the symbol files on the target computer to install symbols on the host computer, except that where the procedure refers to the %SystemRoot% directory on the target computer, use the \Debug directory on the host computer instead.

To install the debugging symbols on the host computer

1. Create a \Debug directory on the host computer. Create a subdirectory for each version of the symbol tree; for example \Debug\MF18\Symbols.
2. Insert the MetaFrame CD-ROM into a CD-ROM drive that can be accessed by the target computer. Use **xcopy** to copy the \Support\Debug\I386\Symbols directory and its subdirectories from the MetaFrame CD-ROM to the directory created in Step 1; for example: **xcopy /v /s *x*:\support \debug\i386\symbols d:\debug\mf18\symbols**, where *x* is the CD-ROM drive.
3. If you are installing hotfixes, copy the symbol files corresponding to the new binaries in the hotfix to the \Symbols directory of the target computer.
4. When you are done installing the symbols, configure the target system for debugging.

Preparing the Host Computer Modem and COM Port

As with the target computer, the next step is to configure the COM port and the optional modem (remote debug only) on the host computer. Local and ICA debug configurations use a null-modem connection between the target and host computers and do not need modem configuration. Remote debug configurations require modem configuration.

Local Debug

For local debugging, very little configuration is required. Connect a null-modem cable between the serial ports of the host and target computers.

Remote Debug

In a remote debug configuration, a modem is connected to the host computer. This modem must be set to communicate at 9600 bps. It may also be necessary to disable flow control, error correction, and compression. See "Running the Kernel Debugger" later in this chapter for directions about resetting the modem.

ICA Debug

Like local debug configurations, ICA debug configurations require a null-modem connection between the host and target computers. In addition, an async dial-in connection must be configured on the host computer and a modem connected to the dial-in connection port. Use Citrix Connection Configuration or the Dial-In Setup wizard to create the dial-in connection.

Installing and Configuring the Kernel Debugger Application

To install the kernel debugger application, insert the Windows 2000 CD-ROM in the host computer. Run the Dbg.exe image in \Support\Debug and specify that it installs to the \Debug directory on the host that was created to hold the symbol files.

The following environment variables control the behavior of the kernel debug application, I386kd.exe.

Variable	Purpose
_NT_DEBUG_PORT	COM port used by the host computer for debugging. Default = COM1.
_NT_DEBUG_BAUD_RATE	The maximum baud rate for the debug port. Use 9600 or 19200 for modem connections, 19200 for null-modem serial connections. Default = 19200.
_NT_SYMBOL_PATH	The path to the symbols directory.
_NT_DEBUG_LOG_FILE_APPEND	The name of the log file to which debugger appends output.
_NT_LOG_FILE_OPEN	Optional; the name of the file to which to write a log of the debug session.

I386kd.exe supports the following command-line switches:

-b Causes the debugger to stop execution on the target computer as soon as possible by causing a debug breakpoint (INT 3).

-m Causes the debugger to monitor modem control lines. The debugger is only active when the data carrier detect (DCD) modem signal is asserted; otherwise, the debugger is in terminal mode and all commands are sent to the modem. This option can be used only with a remote debug configuration.

-r Toggle output register flag.

-v Verbose mode; displays more information about such things as when symbols are loaded.

-x Causes the debugger to stop execution on the target computer and break to a command prompt when an exception first occurs rather than letting the application or module that caused the exception handle it.

Citrix recommends that a batch file be used to configure the environment prior to executing I386kd.exe. For example, assume the following host configuration:

- Remote debug configuration
- Host modem is connected to COM2
- The baud rate is 9600
- The host's symbol tree is located in C:\Debug\MF18\Symbols
- A log file is created in C:\Debug\MF18\Symbols

Here is a sample batch file using the assumptions listed above:

```
REM Sample Debug Batch File: SETDEBUG.BAT
REM Set Remote Debug Configuration: COM2, 9600 baud
set _NT_DEBUG_PORT=com2
set _NT_DEBUG_BAUD_RATE=9600
REM Set path to debug symbols
set _NT_SYMBOL_PATH=c:\debug\mf18\symbols
REM Enable logging and set log path
set _NT_LOG_FILE_OPEN=c:\debug\mf18\symbols\debug.log
REM Start kernel debugger: Verbose mode, Monitor DCD
i386kd -v -m
```

Running the Kernel Debugger

The actual debugging process is outside the scope of this document. This section describes only how to verify that the debugger is installed and configured properly. Once this is verified, the system is ready for a support engineer to debug the system.

Local and ICA Debugs

When I386kd is executed on the host computer, the following text is displayed:

```
Microsoft(R) Windows 2000 Kernel Debugger
Version 5.00.2066.1
Copyright (C) Microsoft Corp. 1981-1999
Symbol search path is:
i386kd: waiting to reconnect...
```

At this point, the kernel debugger is waiting for user input. You can press CTRL+C to break into the target computer if it is still running. If the target is currently stopped at a blue screen, break in occurs automatically. If you have any problems at this point, press CTRL+R to force a resynchronization between the host and target computers.

Remote Debug

If you are using a remote debug configuration, I386kd must be executed with the **-m** option. The following text is displayed:

```
Microsoft(R) Windows 2000 Kernel Debugger
Version 5.00.2066.1
Copyright (C) Microsoft Corp. 1981-1999
Symbol search path is: e:\;e:\mfsymbols
i386kd: waiting to connect...
i386kd: No carrier detect - in terminal mode
```

In this case, the debugger is in terminal mode, so you can directly send standard **at** commands to the host modem. Begin by sending commands to disable hardware compression, flow control, and error correction. These commands vary from modem to modem, so consult your modem documentation. The following modem initialization string is recommended for U.S. Robotics modems:

```
AT&H0&I0&K0&M0&N6
```

Once the modem is initialized properly, it must be instructed to dial the phone number of the target modem. This is accomplished by sending the **ATD** command to the modem. For tone dialing phone systems, type **ATDT*phonenumber***, where *phonenumber* is the telephone number of the modem connected to the target system.

Some telephone systems use pulse dialing systems. For pulse dialing systems, type **ATDP*phonenumber***, where *phonenumber* is the telephone number of the target modem.

Assuming the modem connected to the target system is properly configured, the host modem and target modem establish a connection and assert the data carrier detect (DCD) signal. Once DCD is detected, terminal mode is disabled and you are connected to the debugger on the remote target computer.

At this point, the kernel debugger is waiting for user input. You can press CTRL+C to break into the target computer, if it is still running. If the target is

currently stopped at a blue screen, break in occurs automatically. If you have any problems at this point, press CTRL+R to force a resynchronization between the host and target computers.

With some remote debug configurations, it can be difficult to break into the debugger. See "Troubleshooting" below for additional tips.

Troubleshooting a Debug Session

Typically, few problems are encountered with local and ICA debugs. Most problems occur when doing a remote debug and they are generally modem related. The most common problems encountered are:

- Inability to break into the debugger
- Failure of the target modem to auto-answer
- [Parity Error] message

Each problem is discussed separately below.

Inability to Break into the Debugger

This is the most common problem experienced. The symptom is that the target computer fails to respond to the CTRL+C and CTRL+R commands from the host computer. The target and host modems appear to be connected and functioning normally but the host operator is unable to stop the target computer.

It is not clear why this condition occurs. Because this problem can be difficult to resolve, Citrix recommends using an ICA debug instead of a remote debug if the problem occurs. If an ICA debug configuration is not possible, follow the steps below to resolve this problem:

1. Make sure the target computer is started in debug mode. When the target computer is rebooted in debug mode, the initial blue startup screen displays text showing the kernel debugger enabled on a particular COM port. If this text is not displayed, the debug options were not added correctly to the Boot.ini file. Make sure the COM port displayed is the one to which the modem is connected.
2. Change the modem make and model on the target computer. If possible, use the same make and model modem as the Citrix representative. Similar modems appear to have a higher remote debug success rate compared with modems from different manufacturers. Citrix recommends using the U.S. Robotics Sportster 56Kbps modem.
3. Force the baud rate of both modems to 9600 bps. Consult your modem documentation for the initialization strings that set the DTE and DCE rates to 9600 bps. For U.S. Robotics modems, this command is AT&N6.

4. Add the /baudrate=9600 option to Boot.ini. This forces the baud rate on the debug COM port to 9600 bps. Always set remote debug configurations for this option.
5. Press the PrintScreen key on the target computer console. While in debug mode, the PrintScreen key causes the host computer to break in.
6. Make sure both modems are set to transmit break signals. For some modems, a break signal (CTRL+C) received from the computer may cause the modem to perform a specific task without actually transmitting the break to the remote system. For instance, the default behavior of U.S. Robotics modems is to flush the data buffer before sending the break signal to the remote modem. Make sure both modems are set to pass the CTRL+C character. Consult your modem documentation for the necessary commands. For example, to disable destructive breaks on U.S. Robotics modems, the command is AT&Y2.
7. With the modems connected and data carrier detect present, reboot the target computer. If the target modem is set to ignore the state of DTR, the modems will stay connected even if the target computer is rebooted. When the kernel loads on the target computer, it outputs information to the debug port. If the host computer is connected at that time, this can cause the systems to synchronize.

Failure of the Target Modem to Auto-Answer

For all Hayes-compatible modems, ATS0=1 is the command that instructs the modem to auto-answer on one ring. The target modem must be configured with this setting. If the target modem does not auto-answer, follow the procedure below:

1. Move the target modem to a COM port other than the port currently being used by the kernel debugger. If only one COM port is available on the target computer, connect the modem to a different computer or reboot the target with the debugger disabled.
2. Use the Terminal application (or another communications program such as Hyperterminal) to send the ATS0=1 command to the modem. Make sure you receive an OK response from the modem.
3. If possible, dial the number for the modem from a telephone handset to check that it now auto-answers.
4. Save the current modem configuration in non-volatile RAM so the modem is in auto-answer mode when it is powered up. For example, the command AT&W saves the current modem configuration to non-volatile RAM (NVRAM) for U.S. Robotics modems. When the debug process is finished, restore the factory defaults by sending the AT&F command (or equivalent) to the modem. Use the AT&W command (or equivalent) to save the factory defaults to NVRAM.

5. Reconnect the target modem to the debug port on the target computer (or restart the target computer in debug mode).
6. Use the host computer to dial into the target modem.

[Parity Error] Message

This message is displayed on the host computer if the baud rates are too high to sustain a reliable connection. The following steps resolve this problem:

1. Force the baud rate of both modems to 9600 bps. Consult your modem documentation for the initialization string(s) that sets the DTE and DCE rates to 9600 bps. For U.S. Robotics modems, this command is AT&N6.
2. Add the /baudrate=9600 option to Boot.ini. This sets the baud rate on the debug COM port to 9600 bps. Always set remote debug configurations for this option.
3. Change the modem make and model on the target computer. If possible, use the same make and model modem as the Citrix representative. Identical modems appear to have a higher remote debug success rate versus modems from different manufacturers.
5. Conduct a loopback test to isolate the network. Install the ICA Win32 Client on the MetaFrame server and make an IPX connection back to the MetaFrame server. If the loopback test passes, verify that ICA connections on the same network segment as the MetaFrame server can connect. If clients on the same network segment can connect but clients on other segments cannot connect, there is a problem with the router configuration or cabling.
6. Install the most current ICA Client.
7. Install the most current network interface card (NIC) drivers on the client and server machines.
8. Remove and reinstall the NWlink IPX service.
9. Use Event Viewer to check for connection-related error messages.
10. If the problem persists, create a debug trace for the ICA Client connection.

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