IBM

WorkSpace On-Demand Customer Scenarios

Ron Aguirre, Dr. Peter Boy, Kyrie Lin
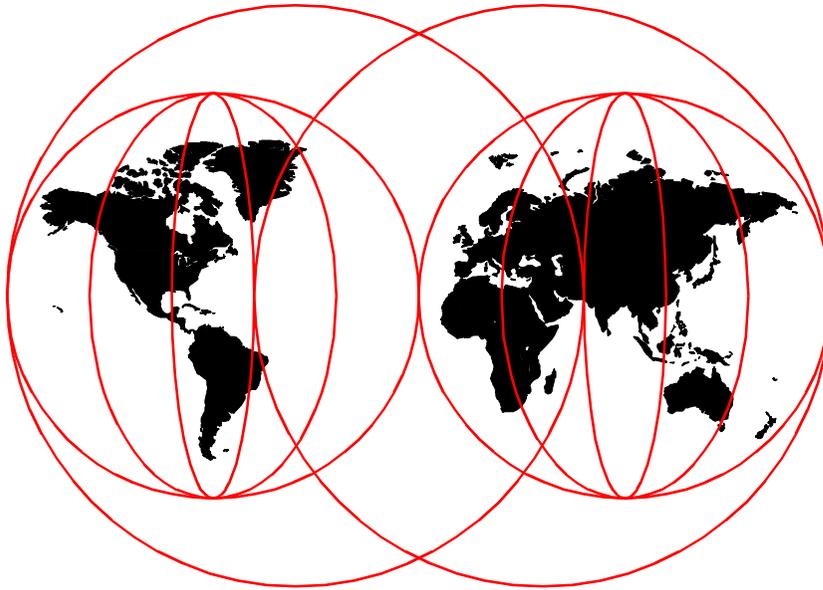
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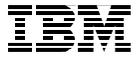
International Technical Support Organization

WorkSpace On-Demand Customer Scenarios

February 2000

┌─ **Take Note!** ──┐

Before using this information and the product it supports, be sure to read the general information in
Appendix D, "Special notices" on page 145.

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Second Edition (February 2000)

This edition applies to IBM WorkSpace On-Demand 1.0, 2.0 and IBM WorkSpace On-Demand 2.0
Feature for Windows Clients for use with IBM OS/2 Warp Serve 4.0 and IBM OS/2 Warp Server for
e-business.

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Contents

Preface

This redbook describes the early implementation of IBMs WorkSpace On-Demand family of network computing products in several customer enterprises. These enterprises are:

- The TELiS Project (Germany)
- Asian Financial Service (alias)
- Bank of America (formally NationsBank) (USA)
- Sparkasse Freiburg - Noerdlicher Breisgau (Germany)
- Standard Bank of South Africa Ltd.

This redbook examines each customer's reasons for choosing WorkSpace On-Demand, their expected use of the products, and their experiences during the proof-of-concept and initial production deployment phases of their implementations.

This redbook describes the applications and "middleware" that customers need to integrate into the WorkSpace On-Demand client environment and, where applicable, describes the additional machine classes necessary to support the customer's existing hardware. There is also discussions on hints and techniques that can expedite the planning and deployment of a WorkSpace On-Demand installation.

The team that wrote this redbook

This redbook was produced by a team of specialists from around the world working at the International Technical Support Organization, Austin Center.

Ron Aguirre is an Advisory Software Engineer at the International Technical Support Organization, Austin Center. He writes extensively and teaches IBM classes worldwide on all areas of OS/2 and WorkSpace On-Demand. Before joining the ITSO two years ago, Ron worked for IBM in various technical roles, including service research, satellite imaging, and artificial intelligence.

Dr. Peter Boy is a research specialist in Germany. He has many years of experience in the field of Sociology. He holds a degree in Sociology from University of Bremen, C.f. Soc.Pol.Resea. His areas of expertise include research in re-socialization by education. He has written extensively in this area.

Kyrie Lin is a contract Software Engineer working for IBM at the Software Integration Testing Center of GCG in Taiwan. He has four years of product experience in OS/2 and WorkSpace On-Demand product testing. He has been a contractor with IBM for the past four years. His areas of expertise include systems integration and systems automation.

Thanks to the following people for their invaluable contributions to this project:

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Part 1. The who and the why

This part describes each customer enterprise and discusses their reasons for choosing WorkSpace On-Demand.

Chapter 1, "Customer Environments," describes each customer enterprise, the industry in which they operate, and the business and network environment within their organization.

Chapter 2, "Reasons for Choosing WorkSpace On-Demand," examines each customer's expectations of WorkSpace On-Demand and describes the value that they ascribe to the product as a result of their experiences during proof-of-concept projects.

Chapter 1. Customer Environments

This chapter describes the customers who provided information for this redbook and discusses the network configuration in which each customer deployed WorkSpace On-Demand.

1.1 The TELiS Project

TELiS is a federal project under participation of the provinces Brandenburg, Bremen, and Niedersachsen (Lower Saxony), which is sponsored by the European joint initiative (Employment) action committee (Integra), which aim to exploit the possibilities and limitations of IT technology to support vocational and social training in penal institutions.

TELiS is an abbreviation for the German term "Telelernen im Strafvollzug" (distant learning in a penal institution), which is an initiative to improve, by means of IT technology, the education and vocational skills of imprisoned persons.

The first phase started on January, 1 1998 and will end on December, 31 2000. During this first phase, there are three different centers. Each explores different aspects of our telematic learning software.

- *Bremen* concentrates on short-term qualifications, generally appropriate of the state of education of most inmates, and employs the software primarily within the framework of work practice. There are three different penal institutions where the program will be implemented.

- The penal institution *Hannover* (Lower Saxony) develops training modules for qualification measures in the occupation of working with metal. The main emphasis is on CAD-application software.

- In *Brandenburg,* the project partner carries out the development of measures for key qualifications that will be used to foster the integration of prisoners into society and the working world.

These three locations represent different specializations in different focuses in vocational training.

The course of the project is layered into several steps.

In the *first step,* each site set up a computer-based learning environment. This step alone imposed quite a challenge. Quite a few people, which considered the project as "revolutionary" in that environment, had to be convinced, and numerous security issues had to be solved. In this first step,

each site used a LAN infrastructure based on the technology and technical skills that were at hand. The main focus was to establish a working learning environment and to prove its usefulness. Therefore, the individual implementations are quite heterogeneous.

In the *parallel (second) step,* one of the penal institutions of Bremen (the prison for juveniles) was elected as a test case for setting up a secure and easy to administrate IT structure in a general way, which is an affordable basis for a later deployment. The juvenile prison shows improved facilities in vocational training by tradition, therefore, we focused on technical issues here as well.

In the *third step,* a communication network between these three geographical locations by means of a WAN (Wide Area Network) had to be established using standard TCP/IP. This network had to be linked to the Internet in a secure and controlled way. This area is exposed to security concerns, and the installation in Bremen proves as a test case for security.
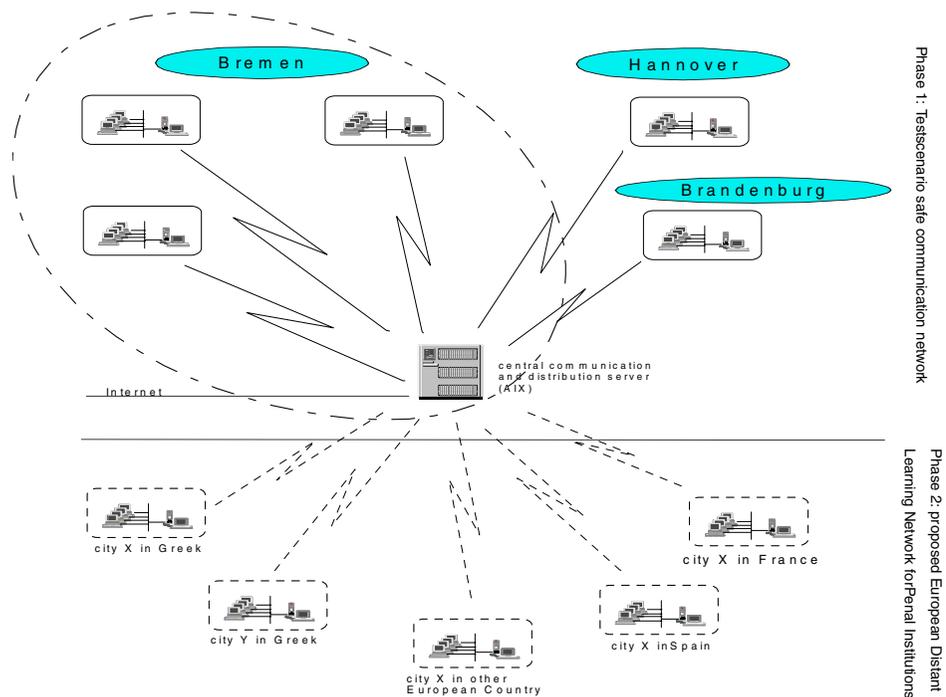
Figure 1. The TELiS Project: A structural overview

For mainly security reasons, all the traffic between the sites will be routed to a central server, which acts as an additional security gate. In order to be

affordable, the bandwidth of the WAN will be quite limited. It is for casual information only and is not meant as a backup file or software server. It is to work as the central mail router and carry a Web server for information delivery. It will be used as a software distribution server as far as this task is reasonable given the limited bandwidth. Its main task is the central gateway and firewall to the Internet.

The basic idea is simple: Qualified (suitable) learning software (CBTs) is loaded on a central server and can be read back from the participating partners as required. Within the participating penal institutions, the prisoners can then work with these programs in context to their learning situation. At the same time, a controlled exchange of material for professional qualification is possible by means of this cooperation net. The future Internet technology will present further improvement also in this domain so that virtual classrooms will move into jails, which up to now, were "closed" institutions.

Two examples may illustrate this basic idea:

The participating partners can act as a network of business shops, as in the real world. JVA Blockland may receive a (fictitious) order for the manufacture of a tool as per sample. The order processing department in Blockland sends the sample to the JVA Hannover with the request to provide a technical drawing. After receipt of this technical drawing, the JVA Blockland prepares the tool as per the resent documents.

The penal institution in Bremen may need a special CBT software for an inmate. The teacher may look up the central server and find a suitable one either on the server itself or as a reference to a participating penal institution. They can then download the software directly or request it per e-mail and file transfer.

In further steps, it is planned to join other penal institutions of the European community into this project and to establish a learning network for penal institution inmates. For the further deployment, there should be a proven concept for the local installations, a task which is investigated into the software implementation in Bremen. It has to establish the basic concepts and the basic technical implementation as a proposal to other penal institutions in other European countries. These institutions are independent from each other and self-determined. So, it is up to them to decide about the local implementation. There are some special quirks to deal with, which the project differs from usual business applications and which have some influences on the design in implementation of the local parts of the network.

1.2 Asian Financial Services environments

Customers in Taiwan and China are using different operating systems on their servers. These systems have been in place for many years. The customers have special built software to be used in their day-to-day operations. They tend not to modify this software frequently.

In the previous environment, servers handled between 10 ~ 500 clients. These servers are spread across different locations. Also, the network can be complicated.

1.2.1 Asian Financial Services LAN infrastructure

The Asian Financial Services has 45 branches. The branch network infrastructure is comprised of a single 10 BastT Ethernet segment in each location. The exact configuration varies between branches, and some have passive devices, while other branches have intelligent, controlled access units.

At present, a single 10 BastT Ethernet LAN segment is sufficient to handle the requirements of Asian Financial Services. Asian Financial Services plans to expand to the use of WorkSpace On-Demand 2.0 and WorkSpace On-Demand 2.0 Feature for Windows Clients in all branches.

For application traffic, Asian Financial Services primarily makes use of TCP/IP protocols with static IP addresses in their network. NetBIOS is used for the WorkSpace On-Demand 2.0 Remote IPL traffic.

Windows NT Server
4.0
UDB Server V5.2
Comm Server 5.0
Lotus Notes Server

Ethernet 10 Bast-T

Warp Server 4.0 SMP
Comm. Server V5
UDB Server V5.2
LANDP V4

Token Ring
16 Mbps

Network
Printer in NT
Domain

Windows 98 Client
Personal Communication V 4.2
M S Office 97 SP2
Lotus Notes V 5.0
Universal Database V 5.2
Connection

OS/2 Warp 4.0
PComm 4.2
LANDP 4.0
CT/2 V3.0

OS/2 Warp 4.0
CT/2 V3.0
UDB 5.2 client
LANDP 4.0

OS/2 Warp 4.0
CT/2 V3.0
UDB 5.2 client
LANDP 4.0

Figure 2. Environment in Asian Financial Services branch network

1.2.2 WorkSpace On-Demand servers

The current network is controlled by two to three different manufactures
servers. The networks use IBM PC Servers and Compaq Servers as central
site servers. Other locations use OEM brand machines as servers. Each
server has two network adapters for connecting to other servers. These
servers handle routine File and Print services, financial reporting, and
database operations.

The Asian Financial Services may use workstation-class machines as servers
running OS/2 Warp Server 4.0. An example of such a machine is the IBM PC
300 GL.

Each server typically has an Intel Pentium 200 MHz SMP processor installed,
although some servers may have smaller processors installed. The server are
fitted with 128 MB of RAM and approximately 6.3 GB of hard disk space.
Each server has a single Token-Ring or Ethernet network adapter installed.
The Servers are running the OS/2 Warp Server 4.0 Advanced SMP version.

Each OS/2 Warp Server 4.0 supports up to 20 clients for DBCS countries. These countries are using the Chinese version of the operating system. At the present time, this is sufficient to handle the requirements of the Asian Financial Services. Some branch offices are currently examining the possibility of installing WorkSpace On-Demand 2.0 for clients to use.

1.2.3 Clients

The past clients used were i386 or i486 machines. These machines are limited to running PC-DOS 6.3 or OS/2 1.2 or 2.1 operating systems. Every application used was based on DOS or OS/2. At present, Asian Financial Services has a number of different types of clients in their environment.

Current clients are:

- IBM PC 350 PCI /ISA bus
- IBM PC 300 GL
- OEM Brand machines

Processors vary from i486 66 MHz processors to Pentium-based PII 400 MHz processors. The clients' memory configuration also varies. Typically, clients have 32 MB of RAM, but some low-end machines have 24 MB of RAM, and high-end machines with 64 MB.

The clients' machines may have different network adapters installed in the machines. This depends on which network they are attached to.

1.2.4 Concept of Asian Financial Services

When we started to investigate the current LAN environment, Asian Financial Services used our concept to assist them in designing the entire environment. The concept was to use existing equipment whenever possible.


```
WorkSpace On Demand for Windows
client feature
Personal Communication 4.2
Lotus Notes Client 5.0
MS-Office 97 SP2
LANDP 4.0
```

```
Network Printer
```

```
WorkSpace On Demand
Server

Communication Server
V5.0
Universal Database V5.2
Server
Lotus Notes Server V5.0
```

```
Ethernet 10 BaseT Network
```

```
WorkSpace On Demand OS/2 Client
CT/2
Universal DataBase 5.2 Client
LANDP 4.0
```
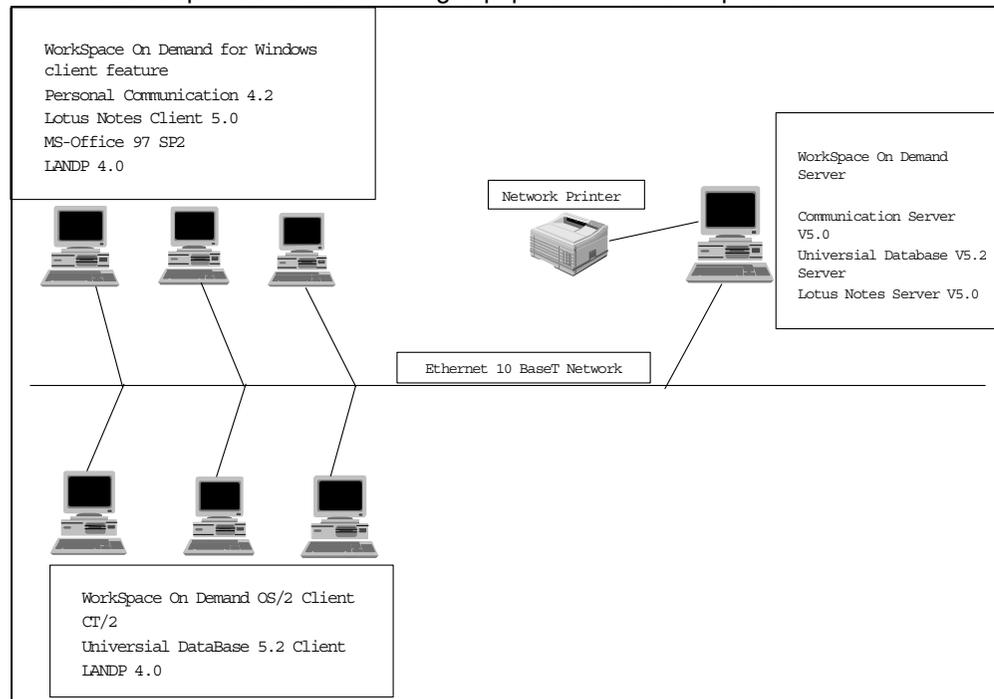
Figure 3. New design for Asian Financial Services branch network layout

In our concept, we gave Asian Financial Services three schemes for creating the new LAN environment. Asian Financial Services approved the above (Figure 2) to design the LAN environment. This environment can be flexible for the different systems of Asian Financial Services.

As a result of our concept, we can help with Asian Financial Services' growth.

1.3 Bank of America (formally NationsBank)

Bank of America is one of the largest banks in the United States. Bank of America has experienced rapid growth through acquisition. Due to the nature of their business, Bank of America spends a lot of time and money integrating newly acquired banks into the Bank of America network. WorkSpace On-Demand is a fast and cost effective method for reaching this goal.

Bank of America currently has a branch network of approximately 3,500 servers and 35,000 clients. These systems are located in Bank of America's 3,575 banking centers throughout the mid-west and south-eastern United States. Bank of America plans to fully convert this entire infrastructure to WorkSpace On-Demand.

1.3.1 Branch LAN Infrastructure

Bank of America's branch network infrastructure is comprised of a single 16 Mbps Token-Ring LAN segment in each location. The exact configuration varies between branches, and some have passive devices, while other branches have intelligent, controlled access units.

At present, a single 16 Mbps Token-Ring LAN segment is sufficient to handle the requirements of Bank of America's retail banking network. However, Bank of America has plans to expand the use of WorkSpace On-Demand into other, larger centers, and the network traffic generated by these centers may exceed the capabilities of the existing 16 Mbps Token-Ring LAN infrastructure. Bank of America is currently examining a number of possibilities to increase network bandwidth within the LAN, including:

- Multiple switched LAN segments to spread network traffic more evenly.

- Newer technologies, such as switched 100 Mbps Ethernet networks.

At the time of writing, these investigations were still at an early stage, and no decision has yet been made regarding which solution, or combination of solutions, Bank of America may adopt.

OS/2 Warp Server
Workspace On Demand
Communications Server 4.1
Personal Communications 4.1
Netfinity Manager 5.1
TCP/IP 3.1
IBM Antivirus 2.5
Network Printer Utility 5.12
Line of Business Application Servers

Frame Relay
Network

MVS/VM Host

Pentium II - P233 MHz
128 MB RAM
6.4 GB Hard Drive
VGA
PCI Token Ring

Server

Router

Network Printer

Token Ring
16 Mbps

Pentium - P166 MHz/
Pentium II - 233 MHz
48 MB RAM
2.5 GB Hard Drive
SVGA
PCI Token Ring

Platform/Teller
Workstation

Platform/Teller
Workstation

Workspace Client
Personal Communications 4.1
Netfinity Services 5.1
IBM Antivirus 3.0
Microsoft Excel 5.0
Microsoft Word 6.0
Line of Business Applications

Figure 4. Bank of America - Typical branch layout

Each branch's LAN is connected to Bank of America's central SNA network and, as such, to multiple mainframe systems. The connectivity is achieved by means of routers connected to Bank of America's Frame-Relay network.

For application traffic, Bank of America primarily makes use of TCP/IP protocols with static IP addresses in their network. NetBIOS protocols are used, of course, for the WorkSpace On-Demand remote IPL traffic.

1.3.2 WorkSpace On-Demand servers

Bank of America uses workstation-class machines as WorkSpace On-Demand Servers. An example of such a machine is the IBM PC 300XL.

Each server typically has a Pentium PII 233 MHz processor installed, although some servers have smaller processors. The servers are fitted with 128 MB of RAM and approximately 6 GB of hard disk space. Each server has a single Token-Ring network adapter installed. All servers are running OS/2 Warp Server Advanced.

Each WorkSpace On-Demand server supports up to 48 clients. At the present time, this is sufficient to handle the requirements of Bank of America's largest centers with a single server. However, Bank of America is currently examining the possibility of installing WorkSpace On-Demand in other locations, which may require more clients, and multiple servers are under consideration.

1.3.3 Clients

Bank of America has a number of different types of clients in their environment.

- IBM PC 300GL
- IBM PC 300XL
- IBM PC 350 PCI / ISA bus
- IBM 9576 Micro Channel
- IBM 9577 Micro Channel
- IBM PC 330 PCI /ISA bus

Processors vary from 486 33 MHz processors to Pentium-based P233 MHz processors. The clients' memory configuration also varies. Typically, clients have 48 MB of RAM installed, but Bank of America does have some entry-level machines at 16 MB of RAM and some high-end machines with 64 MB.

The clients all have a single Token-Ring adapter, which varies from the traditional IBM 16/4 Token-Ring Adapter/A to the newer PCI Token-Ring cards. Bank of America also makes use of Micro Channel adapters in the older systems.

For performance reasons, Bank of America has chosen to use local swapping on all clients.

1.4 Sparkasse Freiburg - Noerdlicher Breisgau

Sparkasse Freiburg - Noerdlicher Breisgau is a retail and commercial bank with 76 branch offices located throughout southern Germany.

Sparkasse Freiburg - Noerdlicher Breisgau has implemented WorkSpace On-Demand in both its head-office and branch networks. The bank intends to replace its existing OS/2 Warp 3 clients with WorkSpace On-Demand clients.

Sparkasse Freiburg - Noerdlicher Breisgau's corporate network is effectively divided into two distinct sections with separate wide area networks centered in the bank's two head offices in Freiburg and Emmendingen. Each of these locations controls its own mainframe and branch office network.

1.4.1 LAN infrastructure

Each section of the corporate network, centered on the two head offices in Freiburg and Emmendingen, has its own LAN infrastructure. Each section of the network is configured as a single, large OS/2 Warp Server domain, comprised of multiple Token-Ring network segments running at 16 Mbps and connected by switches. The Freiburg domain is the larger of the two, with approximately 300 clients located in the head office and branches, while the smaller Emmendingen domain has approximately 150 clients.

Figure 5 shows the network layout of the two head offices.
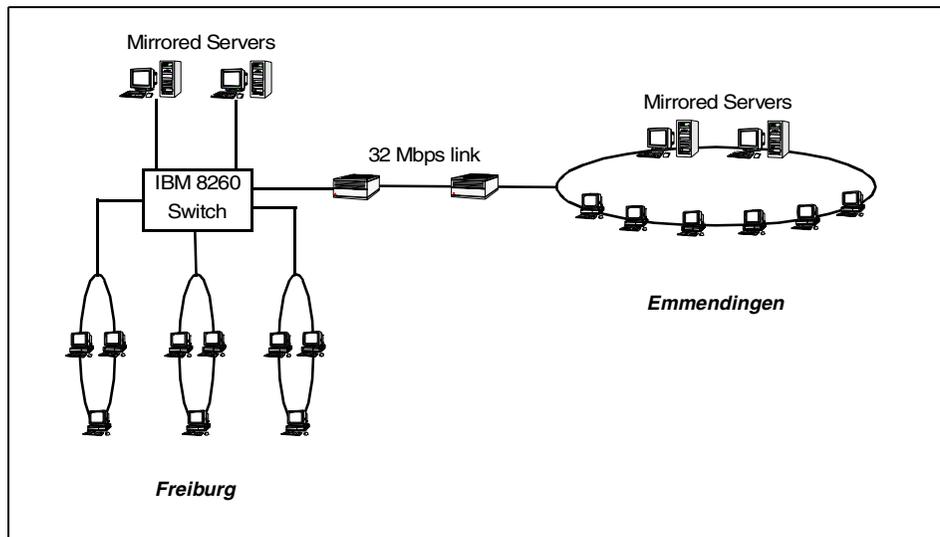
Figure 5. Sparkasse Freiburg Noerdlicher Breisgau - Head office network layout

The LAN within the Freiburg office is divided into three segments with Fibronics 9230 and 9234, IBM 8260 switches, and a Fibronics GigaHub. Each segment is connected to its own port on the switch, and the servers are

connected directly through their own full-duplex ports for maximum performance. All components are manageable using SNMP tools.

The Emmendingen office LAN is composed of a single LAN segment with IBM 8230 and Madge SmartRAM Token-Ring access units. The bank plans to divide this LAN into multiple segments in the near future. At that time, all network components will be upgraded so that they are manageable using SNMP tools in the same way as the Freiburg office.

The network in each branch office is composed of a 16 Mbps Token-Ring LAN segment. Each branch office has its own backup domain controller to provide logon verification and resource authentication in case of communication failure between the branch office and the head office. This backup domain controller is located on the backbone segment along with the branch's WorkSpace On-Demand server.

Sub-branches are connected to the head office through a branch office's network. Each sub-branch office also has its own backup domain controller. These backup domain controllers can be used to provide logon verification and resource authentication in the event of a communication failure. In addition, the backup domain controllers also act as WorkSpace On-Demand servers in small locations where the bank cannot justify the cost of a separate machine.

1.4.2 WorkSpace On-Demand servers

Under the current implementation using WorkSpace On-Demand 1.0, each branch office has its own boot server. This decision was taken due to the impracticality of remote-booting across the wide area network using the NetBIOS protocol. When WorkSpace On-Demand 2.0 becomes available with TCPBEUI support, the bank plans to assess the viability of storing client operating system images at a central site and booting the clients remotely across the routed wide area network. Alternatively, they may boot clients from a local server but store data at a central site.

Currently, Sparkasse Freiburg - Noerdlicher Breisgau has one WorkSpace On-Demand server installed for approximately 45 client workstations. In order to enhance performance and provide a greater level of redundancy at the server, the bank plans to move to a ratio of 20 clients per WorkSpace On-Demand server. The branch offices are already at the desired ratio of servers to clients, and the bank is deploying additional WorkSpace On-Demand servers to its head offices to achieve the same ratio.

In larger locations, each WorkSpace On-Demand server resides on its own machine, separate from the existing OS/2 Warp Server servers. Each WorkSpace On-Demand server is configured as an additional server within the OS/2 Warp Server domain. This allows the bank to introduce WorkSpace On-Demand into an existing network with minimal disruption since no modification is required to the existing servers.

In small branch offices, however, the cost of an additional server machine could not be justified. In this case, the WorkSpace On-Demand server code resides on the branch's backup domain controller, and steps were taken in the pre-installation phase of the deployment to ensure only minimal disruption to the branch network's operation. This integrated server approach was adopted for all branch locations with less than 15 client workstations.

When the roll out is complete, Sparkasse Freiburg - Noerdlicher Breisgau plans to deploy 16 dedicated WorkSpace On-Demand servers and 61 integrated servers.

1.4.2.1 Servers in head offices
All WorkSpace On-Demand servers in the two head offices are IBM PC Server 325 machines. Each server has 256 MB of RAM installed, and two hard disks each of 4.5 GB capacity, running as a RAID 1 array.

1.4.2.2 Servers in branch offices
In branch offices with more than 15 client workstations, the bank has approximately 20 client workstations per WorkSpace On-Demand server. These WorkSpace On-Demand servers are separate machines running as dedicated boot servers. All these servers have the same hardware configuration; each is an IBM PC Server 325 system with 256 MB RAM and two hard disks each of 4.5 GB capacity running as a RAID1 array. These servers are, therefore, identical to those used in the head offices.

1.4.2.3 Servers in small branch offices
In small branch offices (that is, those with less then 15 client workstations), the WorkSpace On-Demand Server is installed on the backup domain controller installed in the branch. This server is an IBM PC 325 with 128 MB of RAM installed and one 9.1 GB hard disk.

1.4.3 Application and data servers
Sparkasse Freiburg - Noerdlicher Breisgau has a single primary data server, mirrored with Vinca Standby Server products and an application server in each head office. Each branch office has its own multi-function server, which

contains the client operating system images and application code but no data.

1.4.4 Print servers

The Emmendingen office has two print servers with 26 network HP LaserJet printers installed. In the Emmendingen branch office, print services are installed on the application servers.

The Freiburg office has only a few network printers, which are connected directly to the primary domain controller.

1.5 Standard Bank of South Africa Ltd

Standard Bank is one of the largest financial institutions in southern Africa. It has a turnover of approximately $650 million (U.S.) per year and over 1,000 points of representation. Standard Bank is exploiting direct delivery channels through services, such as Internet banking, banking by fax, and banking by phone.

WorkSpace On-Demand is part of Standard Bank's initiative to exploit network computing in retail banking (focused in urban and metropolitan areas). The bank's retail banking organization has some 400 points of representation currently running OS/2 Servers. WorkSpace On-Demand will enable Standard Bank to maximize its return on investment in respect to the OS/2 platform (particularly hardware) and will provide significant integration benefits with respect to its office automation platform and marketing requirements.

For the initial deployment, Standard Bank has chosen to implement WorkSpace On-Demand in its retail branch and agency network, thus replacing its current OS/2 Warp Version 3 clients. Should the expected cost of ownership benefits be realized, WorkSpace On-Demand will be considered for deployment in other business units.

Standard Bank's retail branch network environment is comprised of three different branch/LAN configurations:

- Small configuration - Up to 40 workstations.
- Medium configuration - 41 to 80 workstations
- Large configuration - 81 to 150 workstations

Each branch in Standard Bank's retail network is classified into one of the above three categories. This classification allows the creation of a "standard"

deployment package for each category, which can then be applied to all the branches within that category by selecting the necessary hardware and software components from a set of pre-configured items. This approach greatly simplifies the roll out process for the bank's many branches and agencies.

1.5.1 Branch LAN infrastructure

Each branch local area network is comprised of a 16 Mbps Token-Ring network using Type 1 cabling. Each LAN is segmented and supports up to 40 client workstations per segment. The segments are connected via a Madge 8-port switch, allowing up to eight LAN segments to be connected as shown in Figure 6.
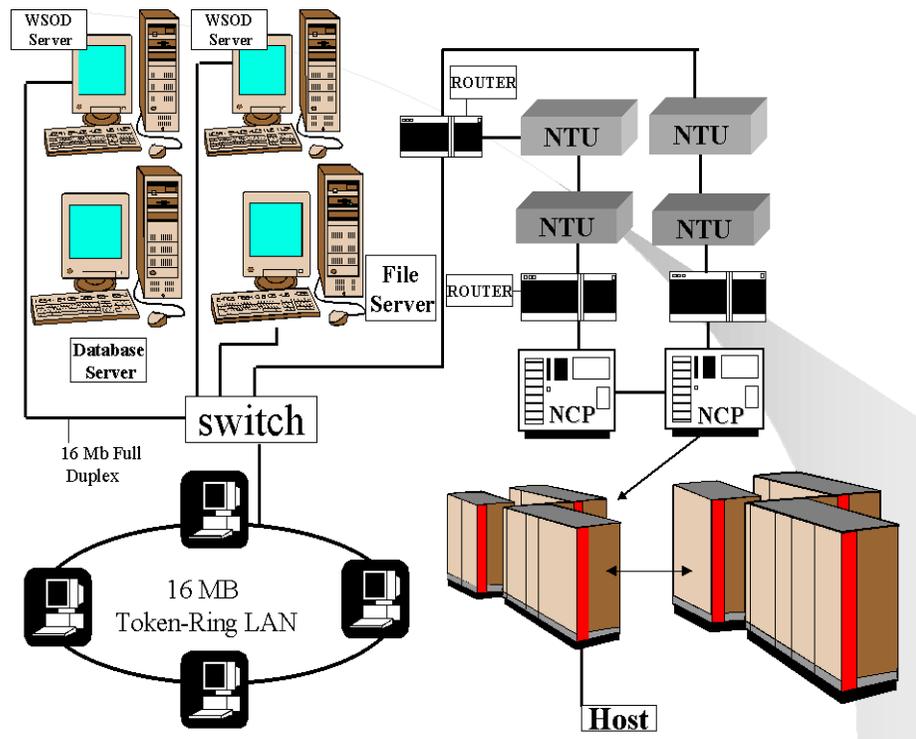
Figure 6. Standard Bank - Typical WorkSpace On-Demand installation

Depending on the branch configuration being supported, up to three of the segments are used for client workstations. Each WorkSpace On-Demand

server uses a separate segment with its own 16 Mbps full-duplex port on the switch. The branch file/print and database servers reside on their own segment, and the remaining port is used by the router.

Each branch is connected to Standard Bank's head office and IBM MVS mainframe computer systems via a wide-area network using 64 KB Diginet lines and Cisco routers.

1.5.2 WorkSpace On-Demand servers

Each WorkSpace On-Demand server is an IBM PC 300GL desktop 200 MHz machine, with 96 MB of RAM and 2.5 GB of hard disk space. All WorkSpace On-Demand servers have a single IBM PCI Token-Ring adapter, and all are running OS/2 Warp Server Advanced.

The WorkSpace On-Demand servers are used to boot the client workstations and to load the primary Branch Delivery System (BDS) applications. End users log on to the branch's OS/2 Warp Server domain (see 1.5.3, "File and database servers") in order to run business applications.

In normal operation, each WorkSpace On-Demand server supports up to 30 clients. In those branches with multiple servers, however, the servers are configured to provide mutual failover support in case one server becomes inoperative. For this reason, OS/2 Warp Server's tuning parameters are configured to support up to 65 clients.

The HPFS386 cache size on the WorkSpace On-Demand servers is set to 49 MB to allow the operating system image to be held in cache. Lazywrite is turned off since Standard Bank experienced problems during testing when lazywrite was enabled.

1.5.3 File and database servers

Each branch has one or more file and database servers, which were present in the branches prior to the deployment of WorkSpace On-Demand. The hardware configurations of the file and database servers differ from branch to branch, depending on the requirements of the individual location.

A typical branch server is a 90 MHz Pentium machine with 196 MB of RAM and 2 GB of hard disk space. Each server has 1, 2, or 3 PCI Token-Ring adapters, depending on whether the branch is a small, medium, or large configuration.

The branch file server acts as the primary domain controller and also provides a communications gateway to the wide-area network. The database

server acts as a backup domain controller in addition to its regular database serving duties.

1.5.4 Printing

Standard Bank does not use print servers in its branches. Instead, peer services is used to attach printers connected directly to client workstations.

Each user is given "guest" access to predefined printer resources. The required access control profiles are generated when the client is created as part of Standard Bank's customized client creation process. This causes printer icons to be generated on the client's desktop and the correct printer drivers to be loaded.

Since all printing takes place from within the bank's Branch Delivery System application, a file named BDCSB.CFG is created when the client itself is created and is stored in the IBMLAN\RPL\MACHINES*machine_id* directory on the server. The BDS application then reads this file dynamically and determines the correct printer destination, depending on the type of print job. Figure 7 shows a sample BDCSSB.CFG file with printer routings.

```
 #Terminal, Destination  BDS
bd_terminalid    : xxxx1EF1
bd_fileserver    : xxxxACAE
bd_destination1  : xxxxCICS
centre_id        : xxxx
#
# host timeout 30 seconds
host_timeout     : 30000
#
#Network assignments used in printing
#
LPT9  : \\xxxxACCF\LAN
LPT2  : \\xxxxACA4\LAN
LPT7  : \\xxxxACAF\LAN

disk_s  : \\xxxxACAE\SB
disk_w  : \\xxxxACAE\APPS
disk_n  : \\xxxxACAE\NETSCAPE
disk_r  : \\xxxxACAE\SB
```

Figure 7. Sample printer routing file BDCSB.CFG

During client startup, the STARTUP.CMD file spawns a process that determines the contents of the NET SHARE command and shares the printer. The printing routines within the BDS application then send the printout to LPT1, LPT9, or LPT2, depending on the type of print job. Standard Bank has standardized its printers and only makes use of Canon printers within the retail network.

1.5.5 Clients

Standard Bank has approximately 7500 client workstations in the current retail banking networking. These clients display a mixture of hardware configurations. Most clients are 90 MHz Pentium PCI/ISA desktop machines, with a small number of 66 MHz 486-based Micro Channel desktop machines. Each client has 32 MB of RAM installed.

An important note is that the 486 performs almost as well as the Pentium in a WorkSpace On-Demand environment. See Chapter 5, "Optimizing performance" on page 57 for further details on client workstation performance during the boot cycle.

The software configuration is standard for all clients (see Figure 6 on page 17). This standard software configuration simplifies the roll out process since the client image for this configuration can be inserted into the standard server configuration. Standard Bank uses an in-house CID build mechanism to generate client definitions during server installation. This mechanism is intelligent enough to cater for MCA and ISA/PCI configurations (for more information, see Chapter 8, "Supporting Additional Hardware" on page 87), and puts all the necessary configuration files in place at build time.

Note that all clients use local swapping since all client machines possess a hard drive. Testing showed that local swapping reduces network and server traffic considerably.

Chapter 2. Reasons for choosing WorkSpace On-Demand

This chapter examines each customer's reasons for choosing WorkSpace On-Demand and discusses the customer's expectations of the product. The chapter provides an insight into why WorkSpace On-Demand may be suitable for a particular customer environmentand the benefits that the customer may derive from using WorkSpace On-Demand .

2.1 The TELiS Project:

We have chosen WorkSpace On-Demand as the implementation solution for the local part. It has been developed with specific focus on high security, high availability and limited total cost of ownership demands. Its special features makes it a proper solution for the needs of the installation environment compared to other available systems.

To explain the requirements and their solution, we focus on two views of the system:

1. *Presentation to the user*, which keeps things simple for the user and prevents the user from making mistakes and affecting the system, either by chance or by intention.

2. *Management features*, which are based on a centralized secure approach, which helps reduce the follow up costs of maintaining and keeping the system running

2.1.1 The end user environment

Getting access
When a user wants to use PC-based training program or another available program, the user turns on the PC. Next, the user faces a logon dialog, which gives the user the opportunity to log on the OS/2 Warp Server (or to shutdown the workstation). There is *no option* to locally boot an operating system without verification of access rights on the server. There is no way to escape the logon dialog. The screen is greatly simplified, showing a dialog box only, but nothing else.

The working environment
After verification on the server, the desktop for the user gets populated with different sets of icons showing individual program files. The user can start the programs by simply double-clicking on one of the icons.

At this time, there is no possibility to change anything on the PC's desktop. There is no drag and drop available. Icons or folders cannot be deleted by an user. Since context menus cannot be accessed either there is no way to alter any system related settings (for example, background colors). The desktop differs from the standard OS/2 older desktop. This *reduction in complexity* is a standard feature of WorkSpace On-Demand, which is maintained and controlled by server based (and server protected) configuration files.

After finishing the session, the user can log off or shut down the workstation. The next user can then access the system.

Different IDS and personalities

Currently, we use a standard user ID for all the users because we have implemented one general set of programs. This makes access to the PCs easier for the users.

When we engage more training programs, and the classes size grows, there will be a need to differentiate between users and courses. When we start using different user IDs with different access rights, this implementation gives additional flexibility. Since the desktop gets populated with application icons after the user logs on to the server, they can use any of the available PCs in the classroom. Several users can use a PC, each with their individual settings, which may be different according to their classes and their individual training program. This solution is called *roaming user access* and brings the users' individual desktop as well as personal settings, to a specific user ID independent of the workstation they log on to. All these settings are securely stored in special user profiles on the central server. This feature is especially valuable for the project, as the users don't have a fixed workstation. Several users must share the pool of workstations.

Benefits for the TELiS project

This architecture creates for the client a perfect secure desktop workstation for purpose of the TELiS project.

It serves as a very *first security barrier*. In any case, the user has no tool to do any modification (or at least no persistent modification). Access to that workstation can only be granted after verifying proper access rights on a defined server. Users can not change the environment accidentally or on purpose.

The highly *simplified user interface* makes the system usable in a proper way to people at the given educational level and the given skills. And, the *roaming user access* makes one environment smoothly usable by different users in different classes with different needs.

2.1.2 Secure management environment

As mentioned previously, we don't have qualified IT personnel available in every prison location. Therefore, we need an approach to completely manage this environment remotely. The WorkSpace On-Demand solution uses an OS/2 Warp Server as the central server site. This gives the flexibility needed to fulfil our requirements.

2.1.2.1 Centrally remotely managed clients

Workspace on-Demand is as well a technical solution as a description of the system's ability to deliver a working environment to the user. It comes in two flavors:

- *WorkSpace On-Demand* is an OS/2 based operating system that can reside completely on the server. Workstations without harddisks in this implementation. All files are protected by security procedures on the server. The user has no access in which to modify them.

- *WorkSpace On-Demand 2.0 Feature for Windows Clients* gives the ability to use a Windows 9x (or NT) based operating system to run on the workstations and to achieve most of the facilities of the original WorkSpace On-Demand system but, unfortunately, not all.The most important difference in our concern is that the operating system needs to be stored on the local workstation and could, therefore, be modified by the user (intended or unintended).

In any case, the configuration information for each workstation is stored on the server.

Regarding *technically bound* administration needs, there is always a well defined status the workstations will boot to after being turned on. In case of hardware failure, a technician, who might not be familiar with the installation details, can exchange equipment, even the harddisk. All the adjustments are made on the server residing configuration files and are conducted remotely by an administrator who is familiar with the implementation details. No re-installation from scratch is necessary, which may introduce unrecognized security holes. There is no need to perform backups on the workstation, which is a tedious and error-prone task in that environment.

Regarding *user invoked* administration needs, these are reduced by the fact that the configuration is stored on the server and protected against user intervention by the server's security mechanisms. In case of WorkSpace On-Demand, this is done perfectly. There is no longer any locally stored configuration information or data. All configuration files, and the operating system itself, are directly stored on the server. In the case of WorkSpace

On-Demand Feature for Windows Clients, the complete OS and its configuration files must be stored locally on the workstations harddisk but are shadowed and controllable by the server. At the beginning of the boot process, the server can decide to install the complete operating system again, therefore, override any changes the user might have created (including reformatting the hard disk).

A third type of administration need concerns the normal *system adaptation* to the changing needs of everyday work, most noticeable, the installation of new software or the update of existing ones. All this work is done by modifying the server-residing configuration files. No installation efforts on the local workstations are necessary. By modifying configuration files on the server an administrator can change the workstation's operation. They can even select the operating system in which to boot by defining the workstation properties on the server. They can install additional software packages, which are usable by workstation users after a reboot.

After this first bootphase, the user is presented the LOGON panel, which is, in either case, as restricted as described above. The desktop is populated with a predefined, limited set of program icons only.

Compared to other available systems these features of WorkSpace On-Demand greatly minimize the administration workload of the learning network. Most work is induced by workstation deficiencies or adaptation needs. Most of this kind of work is transferred to, and centralized on, the server. Most important, the security policy is granted on the server and can be efficiently controlled by an administrator who is well informed about the detail, very efficiently. Time consuming work (such as exchanging a harddisk) can be delegated to other people. They can perform this work but cannot introduce security leaks by chance. It is even possible to let the inmates physically add workstations, which they refurbished as part of their work, into the network. It is the administrator who controls these newly added machines and guaranties their proper working. WorkSpace On-Demand, on the basis of an OS/2 operating system, fulfils the requirements more properly by its advanced technical features but, unfortunately, lacks sufficient support by currently needed application software. Therefore, we have to use the "second best" way, too, in order to achieve the goals.

2.1.2.2 Centralized Secure approach
As a strategic decision a centralized security approach had been chosen where servers have to mostly provide for security.

- Server has to control the flow of data over the network.

- All data, application programs, configuration files, and system files are stored on a server and have to go through its security policy.

The advantage of this approach is that there is only one location that must be cared about, and it is simple so that an error might occur.

On the other hand, it is a central aim for an attack, too. So, you have to protect it very carefully. Of course, all the standard procedures are applied. The server machines are stored in a separate, locked room, and the MAC addresses of the client machines are excluded for logon with administrator privileges. The central AIX server works as a second defense wall in case one server is cracked. The ISDN network, which is used to connect the different sites in Bremen, is configured to allow only specified connections between the involved extensions.

Nonetheless, there is the level of internal security of the server itself. Every system has security leaks that may be found by potential intruders. But the chance of an unfixed security leak is a function of the maturity of the system itself. OS/2 Warp Server is a mature system that has undergone several refinement cycles. A high degree of security is a very high priority item in most of the environments where it is used. Additionally, it is, fortunately, not in the focus of the public interest (but, unfortunately, in other aspects). So, it happens to not be the preferred aim of hackers.

In a centralized environment, the performance of the central components is a critical issue. You need as much performance as possible, which can be spelled down to: For a given hardware, you need an as efficient usage of its resources as possible. OS/2 Warp Server is known as a very performant system. In the world of PC servers, it is outperformed by the Novell server Version 3 (but it lacks all the other important features). By using an OS/2 server, the limited budget for hardware can be turned into a reasonable performance of the network.

2.1.2.3 Browser based (Thin) clients
WorkSpace On-Demand had been developed with the Thin client approach in mind. According to this design philosophy, workstations are equipped with limited hardware resources and a small but effective operating system. Even if hardware, such as a harddisk, is an inexpensive item today, it causes a lot of trouble to maintain it, is always too small, and has other performance issues. In its ideal incarnation, only an Internet browser is running on a Thin client. It is the working environment for all software that is running as a Java applet (downloaded from the server). In the perspective of maintenance, the administration workload by software configuration and installation is dropped drastically. There is no need for any installation work at all.

The Thin client approach is the best way to make the learning system run in the long term despite its rather limited budget. There is a chance for a less powerful workstation (which means a PC, which may be outdated in terms of a classic Windows machine) to perform in an adequate manner.

Benefits for the TELiS Project

This architecture is the basis for a network infrastructure that fulfils the requirements for security and low total cost of ownership in terms of the TELiS project.

2.2 Asian Financial Service

The Asian Financial Service has chosen WorkSpace On-Demand 2.0 and WorkSpace On-Demand 2.0 Feature for Windows Clients for the following reasons:

1. **Reduced Hardware and Software Costs**

Transferring all clients to single operating system is complicated. Using a simple system that is easy to integrate with existing applications is the best way. WorkSpace On-Demand 2.0 and WorkSpace On-Demand 2.0 Feature for Windows Clients fits this requirement.

Asian Financial Services were using i486 and a few Pentium systems. The systems had 32 MB RAM and had servers loaded to capacity. Requirements to change or upgrade server hardware was still under consideration.

Asian Financial Services did not want to spend any more money from their capital budget to upgrade software and hardware expenses. They wished to be able to use their existing hardware and software.

We believed that WorkSpace On-Demand 2.0 and WorkSpace On-Demand 2.0 Feature for Windows Clients would reduce the budget required to upgrade hardware and software. Also, with this they can keep their existing environment.

In past environments, use of dissimilar operating systems for different business requirements was normal operating procedure. Administrators had to prepare classes to train users or request external education centers to help provide this training. However, when a user transferred to another assignment, the user was then required to be retrained.

If the user has the same environment, the administrator only has to prepare a single education training class for users. There was no need to obtain external training facilities to train the user, thus reducing costs.

2. **Easy management on clients**

Most clients use different end-user environments. Administrators can't fully control all clients. However, for example, to prevent viruses from invading clients, it is important to know how to prevent this, but most users do not know or understand how to do this. The user doesn't know how to prevent it or even have a backup client environment. To prevent this from happening again, there needs to be improvements in the clients environment.

However, controlling all client environments is what Asian Financial Service wants. Also, maintaining and supporting applications needs to be simplified since all software is located centrally on application servers as opposed to being loaded on each client. Some remote tools can also allow an administrator to fix user problems.

3. **Greater flexibility**

In past environments, installing an operating system or application has not been easy. Once an operating system is installed in a client, changing to another is not easy. They have to be reinstalled again.

In this situation, WorkSpace On-Demand 2.0 and WorkSpace On-Demand 2.0 Feature for Windows Clients can support Asian Financial Services.

4. **Improved data security**

WorkSpace On-Demand 2.0 and WorkSpace On-Demand 2.0 Feature for Windows Clients requires users to store their data into a server. This makes it easy to back up to storage systems anywhere.

Past environments cannot control where the user stores data. Lost data cannot be recovered. WorkSpace On-Demand 2.0 can help prevent this situation.

2.3 Bank of America

Bank of America chose to implement WorkSpace On-Demand for the following reasons:

1. **Reduced management on clients**
   Bank of America decided that this was the single most important reason to choose WorkSpace On-Demand. The improved control over client

software by storing all files on protected servers, and the cost savings incurred through consequent reductions in management and end-user support, provided an excellent reason to implement WorkSpace On-Demand.

2. **Greater flexibility**
   Improved standardization through loading a single client image across Bank of America's entire branch network, along with user mobility through WorkSpace On-Demand's user roaming capabilities, provides greater flexibility to the retail banking environment.

3. **Capacity for growth and rapid change**
   With 35,000 clients and significant anticipated growth, WorkSpace On-Demand provides an easy means for Bank of America to integrate new client workstations into the standard banking environment. The Year 2000 problem is an example of a situation where the need to rapidly deploy change is critical.

4. **Simplified training**
   WorkSpace On-Demand reduces the complexity of the normal Workplace Shell interface by restricting the options available to the end user. In this way, it greatly reduces the amount of training required for an end user to competently operate the client workstation.

   Bank of America also has both a training desktop and a production desktop installed on each server so that a client workstation can easily be switched into "training mode" to train new users of the system.

5. **Simplified software updates**
   Software distribution and software updates are simplified by storing all system, application, and data files on the server. This means that updates need to reach far less targets than in a traditional client server environment. For example, a change to a client's CONFIG.SYS file in the existing client-server environment would need to be distributed to all 35,000 workstations and would be time-consuming, complex, and costly. With WorkSpace On-Demand, distributing the same change to the client image requires that the change be made to only 3,500 servers. This reduces the complexity of the update by a factor of ten, with consequent time and cost savings.

2.4 Sparkasse Freiburg - Noerdlicher Breisgau

Sparkasse Freiburg - Noerdlicher Breisgau chose to use WorkSpace On-Demand because it provided support for all of the bank's application software while also providing the following benefits:

1. **Easier software distribution**

2. **Enhanced client workstation security**
   The default GUI provided by WorkSpace On-Demand, in conjunction with the file system security provided by OS/2 Warp Server, restricts the end user's ability to access areas of the system that he or she may not be authorized to access. This reduces the likelihood of users damaging their own operating system, applications, or data files.

3. **Improved business data security**
   WorkSpace On-Demand forces end users to store their data on a server where it can be easily backed up. This greatly reduces the complexity of backing up each user's important data files.

4. **Reduced training costs**

5. **Enhanced virus protection**
   Since all software is stored on the server in protected directories, files and programs can only be loaded by administrators and not by end users. This greatly reduces the threat of a virus being inadvertently or maliciously introduced into the network via an unauthorized file.

6. **Reduced support costs**
   Support costs are reduced due to the fact that every client is in a 'known' state. Problems affecting a single client of a particular hardware type can usually be isolated to a hardware fault.

7. **Improved end-user mobility**
   The roaming features of WorkSpace On-Demand allow a user to log on to different clients, yet still access his/her applications, provided the hardware configuration of the different client machines supports the required applications.

8. **Protection of investment in client workstations**
   The "thin client" approach implemented by WorkSpace On-Demand allows smaller, less powerful machines to be used as clients. This can help reduce hardware costs compared to more traditional "fat client" environments.

9. **Year 2000 support**
   WorkSpace On-Demand Server is Year 2000 compliant, as is the client. By applying FixPack 32 and LAN fix IPX8266 to OS/2 Warp Server and Warp

Server Advanced when installing WorkSpace On-Demand, Year 2000
compliance is achieved for the entire system with only minimal effort.

2.5 Standard Bank of South Africa Ltd

Standard Bank chose to migrate to WorkSpace On-Demand from their
existing "fat client" environment for the following reasons:

1. **Migration path to network computing**
   WorkSpace On-Demand provides an excellent migration path to network
   computing since it supports existing native OS/2-based applications, yet
   offers the network functionality of a network operating system and
   supports Java virtual machines, allowing future applications written in Java
   to be carried forward without changes to the environment. WorkSpace
   On-Demand also provides a means to migrate clients from OS/2 Warp 3 to
   OS/2 Warp 4 functionality, thereby, gaining Java support without the need
   to rebuild and redistribute "fat client" workstations.

2. **Reduced support costs**
   WorkSpace On-Demand helps reduce the cost of supporting users in a
   distributed environment since all client software and data, including the
   client operating system, is stored on the server. If a problem arises with a
   client workstation, it can usually be fixed by simply rebooting the client
   workstation or, if not, by deleting and re-creating the client workstation
   definition on the server. A user's applications and data files will be
   retained.

   Maintaining and supporting applications is also simplified since all
   software is located centrally on a server as opposed to being loaded on
   each client's hard drive. Remote tools can allow an administrator to fix a
   user's problem even if the client workstation's hard drive has failed.
   WorkSpace On-Demand allows a client to swap remotely while the hard
   drive is being replaced.

3. **Easier software and application distribution**

4. **Easier operating system maintenance**
   Updating an operating system image on a WorkSpace On-Demand server
   is less complex and requires far less time than updating each individual
   client throughout the enterprise. Fixes and upgrades to the client
   operating system image can, therefore, be applied more easily under
   WorkSpace On-Demand.

5. **Enhanced client security**

6. **Containment of hardware costs**

   With Standard Bank's prior policy of maintaining all applications and data on the individual client, it was very expensive to introduce newer, larger versions of software since large numbers of hard drives typically needed to be upgraded. Since WorkSpace On-Demand stores all software on the server and only uses the client's local hard drive for swapping, the need to upgrade the client's hard drive is largely eliminated, and the consequent cost is contained.

Chapter 3. Proving the concept

This chapter describes a number of "proof-of-concept" projects undertaken by the different customers and discusses the criteria by which the customers judged the suitability of WorkSpace On-Demand for their business and network environments.

3.1 The TELiS project

The TELiS project started to install a local area network in a Bremer penal institution for juveniles. This installation should serve as a learning domain for the inmates, of course, but especially as a reference installation of a highly secure, low administration network that may be transferred to other institutions, which may join the initiative.
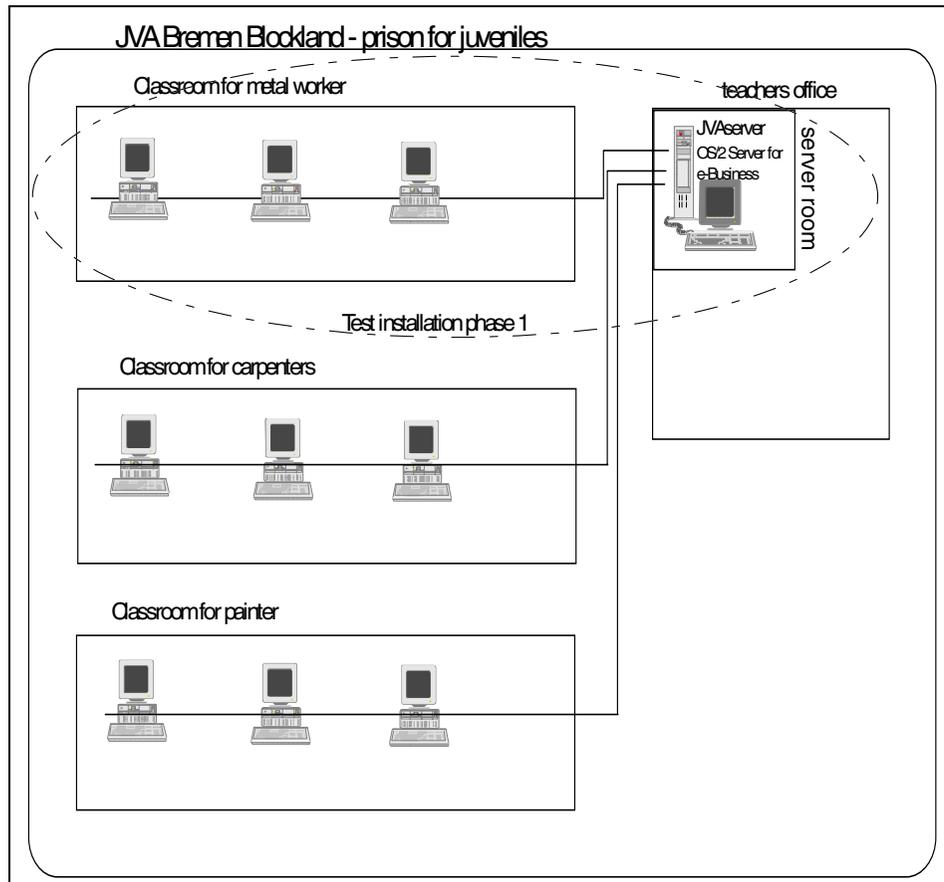
Figure 8. The test installation in Bremen

The initial test installation itself is rather small. There is one server and a set of three clients in one of the training areas (metal work) of the juvenile penal institution. After testing the setup for a while, and checking the security mechanisms, additional classrooms for other working areas are to be added in the last year of the first phase of the project.

As a server, the project decided to buy an IBM Infinity 1500, the smallest model available, for each of the Bremer penal institutions. This machine is equipped with two SCSI channels, and a second CPU can be added. The main load of a server is file IO. So, a double channel SCSI is quite fine. The power of the machine can be easily increased by additional components (RAM, CPU, Harddisks) when it is needed.

The client machines in the metal work area are new IBM PC 300 workstations. This hardware is well supported by WorkSpace On-Demand. The initial setup and installation had not been complicated by hardware issues. For the expansion to additional work areas, the project can not afford new machines, but refurbished used PCs will likely to be used.

The network is an inexpensive 10mbit Ethernet. The cabling system is twisted pair. Its power is sufficient for the small network. Even a "boot storm", that is, when all machines start up, server based WorkSpace On-Demand will not break down the performance. Other work areas will be added as separate segments. They are all located inside the same building as the next one. The distances are all shorter, as the restrictions for ethernet prescribe.

For security reasons, the workstations of the different classrooms should not have a direct communication path, as mentioned earlier. NetBIOS is a non-routable protocol. For TCPIP, some filtering has to be done. The segments are simply added by additional network adapters in the server as long as the amount of installable adapter cards is sufficient.

3.1.1 Installation of the server

When the project started, WorkSpace on-Demand 1.0 had been rolled out. The first installation was based upon this version.

Currently, the project is migrating to WorkSpace On-Demand 2.0, including the Feature for Windows Clients and OS/2 Warp Server for e-Business. The first trial using OS/2 Warp Server 4.0 could not be completed because of a bug in the ethernet adapter driver. The MAC address frame was not resolved properly; so, the client never found its server during the initial boot.

3.1.1.1 Some general principles

Instead of an upgrade of the installation in use, one of the machines was used to perform a completely new installation. This gave the project the opportunity to apply some improvements based upon previous experiences. Some general principles are explained in the following:

Separating system, configuration, application, and user data
To avoid future problems, we wished to separate system specific files from site specific configuration files, and these together from application software and user data. The boot disk should only contain operating system specific files. We would divide the hard disk space into four volumes:

- Boot disk and operating system
- Client machine specific files and configuration (RPL) files

- Application software and its configuration
- User home directories

A disadvantage of such a differentiation is that we may end with a fragmented disk space that is large enough in total, but where the individual drives can not accommodate the needed files. Here, the new Journal File System of the OS/2 Warp Server for e-Business comes in handy. We can start with small drives for each and adopt the size dynamically as needed. You can even spread a drive across several hard disks.

By this strategy, we gain some improvements in maintenance. Unfortunately, the installation process of OS/2 Warp Server and WorkSpace On-Demand installs the client machine specific files into the boot disk and buries them deep in the file directory structure by default. There are some naming conventions, which may be cryptic to the novice user (for example, naming the client machines as BB20, where BB stands for bluebird, the initial development code name). Client specific configuration files and directories you have to maintain reside side-by-side with standard system files you will never care about, thus resulting in overcrowded directories. Combined with a deep structured directory tree, this makes the maintenance of the system more complicated. It is often quite difficult to find the right file. You will get used to this after some time, but the system is meant to minimize administration work. After the initial installation, no one should need to carry out administration work on a regularly bases, and you will eventually forget the names and locations of all the configuration files.

Having a boot disk for operating system only makes it easier to apply system specific tasks, such as FixPaks. Sometimes such an operation ends up in reformatting the boot drive. It is advised to have all of the client configuration stored separately.

Remote Server maintenance
Another requirement is the facility for the remote server maintenance. OS/2 Warp Server for e-Business has a lot of options here.

The standard tools for server maintenance can be invoked on a remote client machine and will work over a TCP/IP connection.

IBMs DCAF gives access to the server monitor and keyboard to work on tasks that can not be done by the server maintenance tools. There are other tools available as well (for example, RSM).

Most important is a fail safe solution for the worst case. In OS/2, a small service partition on an alternate bootable partition can be set up, including

the client operating system, network support and DCAF. In a worst case situation, you need a person locally who can operate the on/off switch and can make a selection on the boot manager menu. This can be made by telephone contact. In normal cases, the boot manager automatically starts the server system.

3.1.1.2 4.5.2 Installation of the client machines
The client machines should be able to boot to different operating systems, WorkSpace On-Demand on the basis of OS/2 and Windows, using the WorkSpace On-Demand 2.0 Feature for Windows Client.

Windows in either of its flavors must be locally installed on a primary partition of the first hard disk of a system. Unfortunately, there is currently no way to boot and run the system completely from the server.

OS/2 can boot and run from the server. A local hard drive can be used as a swapping partition and will increase system performance. You can restrict local disk access for swapping by means of the system kernel so that the user has no way to it use in any other way. Because a local harddisk is needed for the windows system anyway, we can use it for the OS/2 client as well. OS/2 can share the partition for this purpose with the Windows operating system. Using a second HPFS partition would increase performance further, but make system administration more complicated. Multiple partitions are poorly supported by the partition program of the WorkSpace On-Demand 2.0 Feature for Windows Clients.

The installation process itself used the standard procedures. As we used well supported hardware for the initial configuration, we could use preconfigured configuration and installation files. The only work was to define the workstation using the standard tools of WorkSpace On-Demands. These are well documented in the online documentation.

The decision on which operating system to boot is made by a configuration file on the server. It maintains a file named *rpl.map* in the \ibmlan\rpl directory, which contains information about the MAC address of the clients and the appropriate configuration. Because of our installation decision, the directory is located on a separate drive, which is dedicated the rpl boot configuration files. During the installation of the client machines, the installation program adds a line for each client we installed.

For the test installation, the RPL.MAP file is as follows:

```
; server record fields:
;  1     = yyyyyyyyyyyy
;  2     = boot block configuration file (.cnf)
;  3     = number of retries before default boot
;  4     = time window for retries (in seconds)
;  5     = acknowledge (A,N)
;  6     = loader parameters (~ for os2, image share name for dos)
;  7     = descriptive comment
;  8,9, = ~
;  A     = ,,,
;  B     = ~
;  C     = workstation type; first letter is always R
;  D,E = ~

; server records
;yyyyyyyyyyyy dosnfe.cnf 3 10 N IBMLAN$ DOS~IBM~ETHERJET~10/100~ETHERNET ~ ~ ,,, Z R_DETFE ~ ~
yyyyyyyyyyyy dosnlsf.cnf 3 10 N IBMLAN$ DOS~IBM~LANSTREAMER~FAMILY~PCI~TOKEN~RING ~ ~ ,,, Z R_DTKLSFMPC ~ ~
yyyyyyyyyyyy dosnmdg.cnf 3 10 N IBMLAN$ DOS~MADGE~TOKEN~RING~SMART~16/4~AT~PLUS~RINGNODE ~ ~ ,,, Z
R_DTKMDGSMT ~ ~
..

..
..
..

; workstation record fields:
;  1     = adapter id (12 hex digits)
;  2     = workstation name
;  3     = ~
;  4     = image file for dos (.img), fit file for os2 (.fit)
;  5     = name of rpl server
;  6     = boot drive for OS2, domain name for DOS
;  7,8,9 = parameters for device drivers 1,2,3
;  A     = additional memory for device drivers 1,2,3. Default: ,,,
;  B     = ~ for os2, Z for dos
;  C     = workstation type; first letter is R -> enabled, D -> disabled
;  D     = ~
;  E     = volumeid string for dos, IML image file for os2
;  F     = P for OS/2 PCNet clients only

; workstation records
100FFFFFFFFF DEFAULT ~ imagefile SVT38 SVT38DM ~ ~ ~ ,,, Z R_DTK_NDIS ~ ~
1000FFFFFFFF DFBB20US ~ FITS\DFBB20US SVT38 Z ~ ~ ~ ,,, Z R_BB20_US_OTKNTR ~ ~
000629688B2E WS01 ~ W32DOSSB SVT38 SVT38DM ~ ~ ~ ,,, Z R_D_REBOOT ~ ~ ~

100FFFFFFFFF DEFAULT ~ imagefile TELISSRV ITSO ~ ~ ~ ,,, Z R_DTK_NDIS ~ ~
1000FFFFFFFF DFBB20US ~ FITS\DFBB20US TELISSRV Z ~ ~ ~ ,,, ~ R_BB20_US_OTKNTR ~ ~
0020351503DD CLT01OS2 ~ FITS\TEST01 TELISSRV Z ~ ~ ~ ,,, ~ R_BB20_US_OTKNTR ~ ~ ~
;0020351503DD CLT01W95 ~ W32DOSSB TELISSRV ITSO ~ ~ ~ ,,, Z R_D_REBOOT ~ ~ ~
000629688B2E CLT02OS2 ~ FITS\TEST01 TELISSRV Z ~ ~ ~ ,,, ~ R_BB20_US_OTKNTR ~ ~ ~
;000629688B2E CLT02W95 ~ W32DOSSB TELISSRV ITSO ~ ~ ~ ,,, Z R_D_REBOOT ~ ~ ~
000629678C2E CLT03OS2 ~ FITS\TEST01 TELISSRV Z ~ ~ ~ ,,, ~ R_BB20_US_OTKNTR ~ ~ ~
;000629678C2E CLT03W95 ~ W32DOSSB TELISSRV ITSO ~ ~ ~ ,,, Z R_D_REBOOT ~ ~ ~
```

Figure 9. RPL.MAP file

At the beginning of the file, the server is defined. At the end, you will find definitions for the clients. You can easily identify three clients, which follow a naming convention. The first column contains the MAC address.

In our installation, you will find each client (with the same MAC address) defined twice, one time with the boot information for the windows operating system, the other for the WorkSpace On-Demand client. One of the alternatives is deactivated by the comment sign (";") at the beginning of the line. To choose an operating system to boot, this file must be manipulated.

The definition line for the operating system not used must be commented out. Currently, the WorkSpace On-Demand client is active.

Switching the operating system must be accomplished by a non-export person. The file, rpl.map, is a critical file; therefore, nobody should edit this file directly. For the first project phase we simply used two different versions of the file, rpl.map.os2 and rpl.map.win, which could be copied to rpl.map via a affiliated cmd-file accessed by an icon on the desktop. At a later time, when many machines must be used in different ways, a simple REXX script can be used to scan the file for a defined client and its active operating system. It can list these clients in a simple GUI window and allow selection of which operating system to boot. The comment sign will be added by the script accordingly.

In terms of the project, there are two kinds of support tasks that must be provided:

- *Daily administration*. Mainly software installation and distribution, but user administration and general system maintenance ("keep in running"), too
- *Deploying*. Set up a complete new installation on a site that joins the network and chooses the reference installation

OS/2 Warp Server assists both kind of tasks through the use of several tools.

3.1.2 The support infrastructure

As mentioned earlier, there are three different prisons in the test scenario, which are build at different locations. It is time consuming to reach them. Skilled IT personal is not available onsite. The main focus of the support concept is to do as much work as possible *remotely*, assisted by people with limited IT skills.

The State of Bremen maintains a separate metropolitan network for internal communication (voice and data), which is separated from any public network. It connects all the governmental and public buildings, including the prisons and the university. Currently, it is based on ISDN technology. The project can use this network without cost, but bandwidth is limited to multi-line PPP at the best.

A central management desk is currently maintained at the University of Bremen where the central communication server is located as well. Both will be transferred to a specialized department of the government's penal institutions support organization, which will be established when the first, experimental phase of the project is finished.
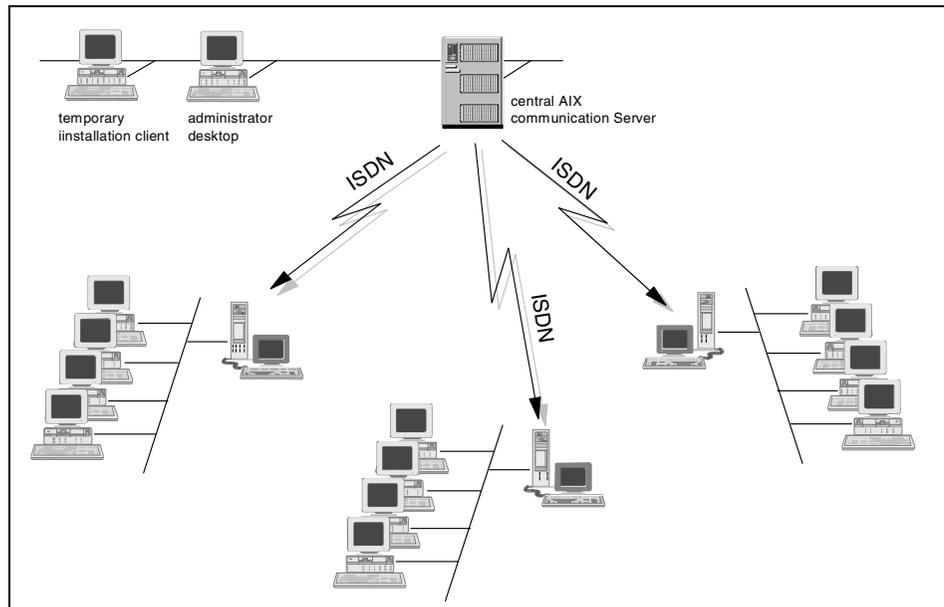
Figure 10. Structure of support

According to security rules, the administration desktop is connected to the server by the university cabling system but uses a separate token ring segment. The ISDN connectivity to the RS6000 is actually done by a ISDN-Ethernet router, which is cheaper as an internal ISDN adapter card. The OS/2 Warp Server has an internal active ISDN adapter installed, which is currently controlled by a shareware product (isdnPM).

The ISDN-based metropolitan network is sufficient for administrative task that require limited data transfer, such as remote console operations or user and resource administration using LAN Server tools. It is quite insufficient for heavy data transfer, for example, installing Windows software over the network.

3.1.3 How support and maintenance tasks are performed

There are several kinds of administration tasks. Those which require limited data transfer can be completely done by remote procedures. Others, which exhaust the available data transfer capabilities or depend on local intervention, need a combination of several methods.

3.1.4 User and system resource maintenance

This kind of administration involve adding or deleting users, modifying access rights to user resources, clearing the printer queue, and compatible tasks. This administration can be performed using remote procedures. The administrator's desktop is a OS/2 Warp 4 workstation with the LAN Server Administration tools installed. An alternative is a remote console session. We use RSM (formerly PolyPM) for this purpose. Because the remote console uses a graphical user interface, the amount of data transfer is quite reasonable, and the delay in response is noticeable.

But both alternatives work properly without any restriction.

3.1.5 Server maintenance

This kind of administration involves tasks, such as configuring the operating system and recovering from system melt down of hardware failures. In case a system crash prevents a normal reboot, we depend on local intervention. As mentioned earlier, a service partition is installed, which can be accessed via OS/2 boot manager. The boot manager will pause after the initial POST of the system. When no intervention occurs, the server for e-business is started as default. In case of emergency, a telephone contact is made to one of the teachers who is instructed to choose the service partition for booting. This service partition is a Warp 4 system including network and ISDN connectivity. Using a remote console, we can work on the server's system partition, including replay of a backup.

In case of hardware failure a technican must exchange parts. If the system's hard disk remains bootable, the technican can be assisted by a remote console session.

Until now, we could only proof the concept through an exercise.

3.1.6 Installation of additional workstations

A new workstation is defined using a script that is run remotely on the appropriate server. The new workstation has to be locally attached to the ethernet LAN and must be switched on. Because the server knows about the new client it sends all necessary information to the PC. In case of an OS/2 based WorkSpace On/Demand 2.0 client, the user can start almost immediately. In case of a Windows client, the installation process needs some time but will be done automatically without user intervention.

Physically attaching a new workstation can be done by the prison's personnel. No advanced skills are required. The same is true if a part of the workstation has to be exchanged.

3.1.7 Software installation

This is the most likely kind of administrative task. In Workspace on-Demand, installing new software is a three-step procedure. In the first step, the software is installed on a standard client using WorkSpace On/Demand 2.0 utilities to determine all the modifications the installation process may introduce. In a second step, an application package is build. It contains all the necessary files and scripts for implementing these modification into the WorkSpace On/Demand 2.0 client configuration files. In a third step, these files are transferred to the server and installed by another script.

In the TELiS Project, the administrator's workstation can serve as a temporary server, and another workstation serves as the test client. After having tested a new application, the necessary files are distributed to all other servers. Because of the limited bandwidth, this is done by CD. By running a script on those servers, the application is made available to the users.

Installation of software is a frequent task. It can be done without onsite intervention. This is a great advantage for the project.

3.1.8 Backup of the server

Part of the OS/2 Warp Server for e-Business distribution is backup software (PSNS), but it was impossible to use it in a reliable way. Often the software could not recognize the inserted tape and ended with an error. This error happens to crashed the server completely. Backups are made onto an additional hard disk as a workaround. The AT command starts a REXX script, which stops the server, performs a backup using the standard backup program and a zip tool, and restarts the server afterwards. We don't expect all drives to break at the same time.

3.2 Asian Financial Services

The Asian Financial Service immediately recognized the benefits of WorkSpace On-Demand when they did a proof-of-concept. Their primary concern was proving that all of their current business applications ran in a WorkSpace On-Demand 2.0 environment. These applications were:

WorkSpace On-Demand 2.0 client environment

- Universal DataBase connection V 5.2
- Communication Terminal /2 V 3.1
- LANDP V 4.0

WorkSpace On-Demand 2.0 Feature Windows clients environment

- MS-Office 97 SP2
- Lotus Notes V 5.0
- Personal Communication V 4.2
- LANDP V 4.0

The customer completed its proof-of-concept project using one server and six client workstations. The project was successfully completed one week in the Asian Financial Service testing center.

Asian Financial Service established a number of critical success factors to determine if WorkSpace On-Demand 2.0 was viable. The complete list of critical success factors is given as follows:

1.Complexity - In Asia, different operating systems in the same network are common. Technical knowledge is changing faster today. Integration of different clients/operating system is not a simple process. Administrators have needed to use 3rd party software to help with this integration.

Using a single operating system can reduce complexity in an environment. We will use the WorkSpace On-Demand 2.0 client to conform to Asian Financial Services' request. This will give an environment that is simple, easy to maintain, of high quality, and a stable system for users.

2.Performance - In current client environments, the boot time required is three to eight minutes for each client. It is dependent on hardware equipment. Performance should be equivalent, and better than the exiting clients.

Asian Financial Services determined that upgrading hardware is necessary to ensure adequate performance.

In their past environment, every user was assigned a client. If they were absent, no one else could use that client. Asian Financial Services decided it needed to allow different users to use different clients. This would reduce the need for additional machines, which would, in turn, reduce the increase of network loading. The end result is less network traffic, and performance can be improved.

3. Service availability - In their past environment, the end-users controlled the desktops. This presented the Help Center with many challenging issues.

Asian Financial Services decided to change the client's environment to WorkSpace On-Demand 2.0. This would give the user the same desktop environment but did not give the user access to change that environment. This reduced the education requirements for the end-users. In the past, the users were taught how to install the workstation software, now the education focuses on the applications not the installation. This reduces the Help Center workload.

4.Maintenance - WorkSpace On-Demand 2.0 and WorkSpace On-Demand 2.0 Feature for Windows Clients is simple to maintain. All code resides in the server.

5.Distribution - Before, to update each application, weeks of preparation was required. This consumed the administrator's time. WorkSpace On-Demand 2.0 and WorkSpace On-Demand 2.0 Feature for Windows Clients can decrease the time needed for software updates, and electronic distribution can be used. Also, Asian Financial Service's design is an easy way to distribute applications.

3.3 Bank of America

The proof of concept project at Bank of America was structured somewhat differently than that undertaken by the other customers described in this book. Bank of America had already studied the potential cost savings from WorkSpace On-Demand and decided to implement the product. The proof-of-concept project was intended mainly to prototype the WorkSpace On-Demand branch implementation, to determine the optimal configuration, and to identify the work necessary to integrate applications, provide the required hardware support, and so on. The proof-of-concept at Bank of America, therefore, dealt heavily with analysis and design of the production system itself, which was not a part of the proof-of-concept project for other customers.

Since much of the proof-of-concept work was done prior to WorkSpace On-Demand becoming generally available, the Bank of America team was assisted in the proof-of-concept by IBMs Rapid Deployment Team, who provided a liaison to IBMs product development labs.

The primary criteria for acceptance of WorkSpace On-Demand at Bank of America was to ensure that the bank's current production environment could be successfully migrated to WorkSpace On-Demand with little or no changes to applications or existing infrastructure.

The most critical point in the proof-of-concept project was the alterations made to the standard WorkSpace On-Demand product in order to customize the PMLOGON shell, thereby, catering for Bank of America's logon and Workplace Shell requirements. See Section 7.2, "Enhancing the PMLOGON shell" on page 104 for more detailed information on the changes and enhancements made to PMLOGON.

The Bank of America team and the IBM Rapid Deployment Team concentrated heavily on the read-only aspects of the WorkSpace On-Demand client image and optimized the number of files that can be shared in WorkSpace On-Demand, therefore, reducing the size of the machine-specific and user-specific file areas. This reduces the amount of space required on the server and also reduces the number of file handles in use at any one time.

Bank of America concentrated on machine classes to support a resolution of 1024 x 768 on the different hardware platforms. Bank of America currently has seven machine classes and is developing an eighth.

3.4 Sparkasse Freiburg - Noerdlicher Breisgau

The proof-of-concept at Sparkasse Freiburg - Noerdlicher Breisgau started on January 7th, 1998 at Emmendingen, with an introductory presentation of WorkSpace on-Demand and the RIPL concept.

The customer immediately recognized the benefits that would accrue from deploying WorkSpace On-Demand, but their primary concern was that all of their current business applications must run correctly in a WorkSpace On-Demand environment. These applications were:

- Communications Manager/2 Version 1.11
- APBI (a LANDP application)
- Current (an OfficeVision/VM front-end for PC that runs under WIN-OS/2)
- Lotus Smartsuite (AmiPro was selected as a test application)
- Lotus Notes client
- Citrix Winframe client for Windows 3.1

The bank carried out its proof-of-concept project using one server, two client workstations, and one Citrix Winframe server. The project was successfully completed over a six day period. For more information on how the bank integrated each application into the WorkSpace On-Demand environment, see Chapter 6, "Integrating Applications" on page 41.

3.5 Standard Bank of South Africa Ltd

Standard Bank of South Africa was primarily concerned with the likely performance of WorkSpace On-Demand in the branch network and its effect on the server and network bandwidth utilization. The proof-of-concept exercise undertaken at Standard Bank, therefore, focused on client performance, particularly the time required to boot multiple clients from a single server, as well as the potential for scalability and growth within the branch network.

3.5.1 Critical success factors

Standard Bank established a number of critical success factors for proving that WorkSpace On-Demand was viable in the bank's environment. The complete list of critical success factors is given as follows:

1. **Required resources** - In order to successfully implement WorkSpace On-Demand in a production environment, the bank required access to sufficient resources, that is, people with the appropriate skills.

2. **Complexity** - The bank needed to conduct sufficient planning so that the complexity of the project became apparent before a full implementation commitment was made. In this way, the bank could adequately assess the risk associated with a full implementation.

3. **Performance** - Performance needed to be equivalent to, or better than, the existing retail banking platform. One of the primary objectives of the proof of concept project was to determine what hardware and network infrastructure was necessary to ensure adequate performance and to make appropriate recommendations.

4. **Service availability** - The level of service availability needed to be equivalent to, or better than, that of the existing production environment. Another objective of the proof of concept exercise was to determine ways to ensure sufficient service levels and to provide recommendations in terms of redundancy.

5. **Flexibility** - WorkSpace On-Demand should be sufficiently flexible in its implementation to allow the existing network infrastructure to be accommodated without the need for disruptive changes and should be adaptable to meet both current needs and any anticipated additional requirements.

6. **Upgradability** - WorkSpace On-Demand should be easily upgradable and should simplify the upgrading of other applications. It should allow the use of existing CID utilities for upgrade purposes.

7. **Usability of standard/proprietary products** - Shrink-wrapped applications should be easily implemented in the WorkSpace On-Demand environment.

8. **Maintenance** - WorkSpace On-Demand should simplify maintenance and administration.

9. **Distribution** - WorkSpace On-Demand should decrease the number of distribution points for software updates, and electronic distribution should be possible to all aspects of the applications being served.

10. **Easy development and implementation of new versions** - WorkSpace On-Demand should help reduce the development life cycle by making use of shared operating system and application images. Modification of the shared images should be easily achievable through electronic means.

11. **Accommodation of new business requirements** - A WorkSpace On-Demand implementation should be able to accommodate new and anticipated business requirements, and the strategic positioning of Standard Bank of South Africa should be taken into account.

The most important of these factors were performance, scalability, and capacity for growth. These requirements, and the subsequent findings and recommendations that arose from the proof of concept exercise, are detailed in the following sections.

3.5.2 Performance implications

Standard Bank required that the boot performance of the WorkSpace On-Demand clients must be within acceptable parameters and that the overall performance of the platform must be comparable to the bank's existing client-server platform. To ensure that these requirements could be met, the proof-of-concept team carried out extensive testing to measure the boot time performance and determine the required hardware and network resources to ensure optimal performance. These tests, and the results thereof, are described in Chapter 5, "Optimizing Performance" on page 33.

3.5.3 Scalability

Standard Bank required a retail banking platform that was easily scalable and could accommodate business growth as it occurred. For example, if a branch location required 10 additional client workstations, then these workstations must be able to be added without requiring reconfiguration of the platform or disrupting existing business operations.

After examining several potential solutions, the proof-of-concept team determined that the best way to ensure such scalability was to adopt a

modular approach to deploying WorkSpace On-Demand servers and client workstations. Servers and clients would be deployed in "units" comprising a single server and up to 40 client workstations. Depending upon the size of the branch location, one or more units would be deployed in each location.

In the event that business growth in a particular location requires additional clients, these clients can be added to the current unit(s) already deployed, subject to server capacity. If the size limit of the currently deployed unit(s) would be exceeded by deploying the additional clients, then the additional clients can be incorporated into a new unit along with an extra server.

From the performance testing done during the proof-of-concept exercise, it was determined that the maximum practical size for a unit is 40 clients. The unit, therefore, consists of a single server and up to 40 clients. All servers are identically configured and are capable of serving up to the maximum 40 clients, regardless of the number of clients actually deployed in a particular location. In this way, each server can immediately cater for limited growth (up to the maximum 40 clients) by simply connecting additional client workstations to the network. The number of servers is transparent to the user, and a user can be served by multiple servers for redundancy purposes.

The 40 client limit per server is based on acceptable performance levels during a "boot storm" situation; that is, an occasion when all clients are booting simultaneously from the server. This is obviously a worst-case scenario and if booting the clients can be staggered over a period of time, then testing showed that a larger number of clients (up to 65) can be accommodated by each server. You should note that such performance levels are determined by a large number of factors and are also dependent on the individual customer's definition of "acceptable" performance.

Testing during the proof-of-concept exercise also revealed that a larger number of smaller, less powerful servers can be preferable to a single, larger server. Since WorkSpace On-Demand allows a client workstation to be defined to multiple servers, having a larger number of servers on the network introduces additional levels of server redundancy, enhancing the reliability of the platform as a whole.

3.5.4 Scope for growth

Standard Bank's strategic direction requires a retail banking solution that will offer the bank a non-disruptive migration path to a full network computing environment. The implementation of WorkSpace On-Demand, therefore, needed to recognize the importance of emerging technologies, such as Java, and provide a migration path to new platforms as they become available.
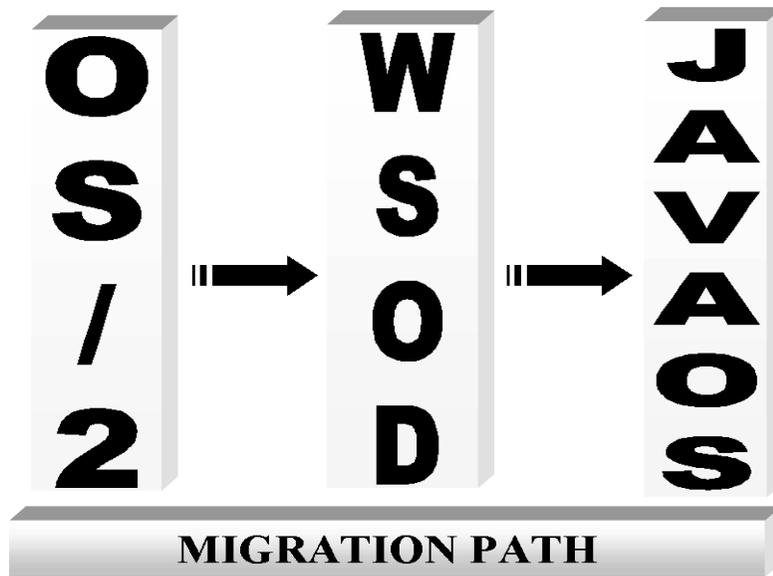
Figure 11. Migration path to network computing

WorkSpace On-Demand provides a "bridge" between the bank's existing OS/2-based retail business platform and the desired network computing platform using a combination of technologies such as Java. With WorkSpace On-Demand, the bank can begin to deploy Java-based applications into the retail network while still running the existing applications.

Chapter 4. Planning and deployment techniques

This chapter discusses some of the techniques used by different customers in gathering information before deploying WorkSpace On-Demand in a production environment and to ensure a smooth roll out with minimal disruption to existing operational systems.

4.1 Categorize sites for easier deployment

When deploying WorkSpace On-Demand into a geographically dispersed branch office environment, you can simplify the task of generating server configurations by classifying each location into a set of categories and assigning a standard network and server configuration to each category.

For example, Standard Bank chose three categories of branch office:

- Small configuration - Less than 40 workstations.
- Medium configuration - 41 to 80 workstations
- Large configuration - 81 to 150 workstations

Standard Bank conducted performance testing for each of these categories and decided upon a standard network configuration and a standard set of server tuning parameters to provide the optimum performance for each category. This significantly reduces the amount of work required to deploy WorkSpace On-Demand in the branch office network since the bank can create a standard server image for each category and use this image to load the software onto the servers required for any office within that category.

4.2 Define network applications prior to deployment

If you have already deployed an OS/2 Warp Server domain, and you intend to add WorkSpace On-Demand clients, you can accelerate the deployment of WorkSpace On-Demand by installing application code on your existing OS/2 Warp Servers and defining these applications as network applications in your existing domain prior to deploying WorkSpace On-Demand.

In this way, you can install and test the network applications before you begin to deploy the new boot servers and client operating systems. This phased approach reduces the logistical complexity of the deployment and lessens the likelihood of disruption to existing LAN services.

If you set up your applications as network applications on your existing OS/2 Warp Server servers, they can be accessed by users on existing "fat clients". When you deploy your WorkSpace On-Demand servers and clients, users on the WorkSpace On-Demand clients can log on to the existing domain and immediately have access to their network applications. See Section 4.4, "Configure WorkSpace On-Demand servers as additional servers" on page 52 for more information on deploying WorkSpace On-Demand into existing domains.

4.3 Segment your network

When designing the physical network topology, it makes sense to divide the local area network into multiple LAN segments. This segmentation improves network stability and redundancy while offering additional network management opportunities not available in passive single-segment environments. In high-traffic scenarios, segmenting the network can help to improve network performance by spreading the workload across several different physical network segments.

4.4 Configure WorkSpace On-Demand servers as additional servers

When deploying a WorkSpace On-Demand server in an existing OS/2 Warp Server domain, you can minimize disruption to the existing LAN services and avoid modifying existing server configurations by using a separate machine as a WorkSpace On-Demand server and configuring this machine as an additional server in the existing domain.

Users on WorkSpace On-Demand clients that boot from this server will, by default, log on to the existing domain. Any resources and network applications already defined for those users will be available to them on the WorkSpace On-Demand clients. See Section 4.2, "Define network applications prior to deployment" on page 51 for further details on setting up network applications.

4.5 Automate the collection of configuration data

It is necessary to supply a network adapter address when defining a client workstation to the WorkSpace On-Demand server. In networks with existing clients already deployed, it is necessary to retrieve the network adapter address for each particular machine. While doing this, it is good practice to collect as much additional data about the hardware as possible.

The collection of adapter addresses and configuration information at Standard Bank is automated by means of a REXX command file which is distributed to each server through Netview Distribution Manager on the host. After the command file is installed on the server, the process is started from the host and the REXX command file makes use of an INI file, which already contains client-specific data, to run new command files at each client workstation.

The command file on the workstation calls a number of EXE files and other command files to collect the configuration data. It then makes use of the Universal Naming Convention to write data files to a USER data structure on a central server. After the data is collected, it is manually copied from the server to the newly built WorkSpace On-Demand server.

When the USER data structure has been written to the WorkSpace On-Demand server, two automated processes are run on the WorkSpace On-Demand server:

1. A REXX command file is run, which modifies the contents of a flat ASCII file and then generates an OS/2-type INI file.

2. A command file is started, which automatically generates new client definitions by reading the INI file and copying required files from the USER data structure.

4.6 Use redundant servers to improve reliability

In a multi-server environment, using more than one WorkSpace On-Demand server improves the redundancy of the network. In the event that the primary WorkSpace On-Demand server fails, other servers can automatically assume the server's workload. This is known as *mutual failover*. The only likely disruption is that users will need to reboot their client workstations.

WorkSpace On-Demand is architected in such a way that any WorkSpace On-Demand server can reply to a RIPL request from a client workstation, provided that client is defined to the server. When working in a mutual failover environment, it is, therefore, sensible to duplicate the RPL.MAP file, which defines the clients that can boot from a particular server, to all WorkSpace On-Demand servers in the domain.

In situations where high availability is a critical requirement, you may wish to consider using a large number of small servers, with a reduced number of clients per server, rather than a small number of larger servers. This multi-server technique means that a server failure affects only a minimal number of clients, and the majority of end users will be able to carry out their

normal work. However, you must ensure that other single points of failure, such as file and database servers or communications gateways, are also provided with appropriate levels of redundancy.

4.7 Modify the client's boot drive

When installing applications on a reference client, it is typical to install the application's files to the client's boot drive, usually drive C. Indeed, some applications, such as LanDP produce configuration files that are hard-coded to include drive C and as such, the applications do not work correctly when installed on a different drive. This can create problems when integrating applications into the WorkSpace On-Demand client image on the server.

Standard Bank devised a simple but effective solution by defining the client's logical boot drive on the server as drive C rather than the default drive Z. The entries in the machine and user FIT files were adjusted accordingly. This approach has a number of benefits:

- It simplifies the process of transferring environment settings from a reference client to the client's boot image since, by default, locally installed applications refer to drive C. It was also found that certain applications can only be installed on drive C, and using drive C as the boot drive overcame this problem.

- The CONFIG.SYS file is easier to manipulate since it looks and feels exactly the same as that of a traditional OS/2 Warp client.

- Existing clients' installed applications can be copied to the WorkSpace On-Demand client image on the boot server (\IBMLAN\RPL\BB10.US) with little or no modification.

When you define the client's boot drive as drive C, the client's own hard disk, which may be used for swapping, becomes drive D. Note, however, that you must manually edit the client's CONFIG.SYS file and alter the SWAPPATH statement to point to drive D. If you do not make this change, the default SWAPPATH statement will point to drive C, and your clients will swap to the server, even if you have configured the clients for local swapping.

4.8 Have a fall-back option

Before you migrate your client workstations to WorkSpace On-Demand, it is advisable to have some way to return to your previous "fat client" environment in the event that something delays the deployment, such as an unforeseen application problem. In this way, you can revert to your previous environment

and continue normal operations until the problem can be fixed, and the WorkSpace On-Demand deployment can proceed. This is known as having a fall-back capability.

In most personal computers, the only change necessary to make them boot from the network is a modification to the machine's BIOS in order to change the default startup sequence. Should the client need to be booted from its own hard drive in "fat client" mode, it is simple to reconfigure the BIOS back to its original state.

Bank of America has implemented the fall-back option in a way that allows them to boot a limited-function, stand-alone system from the client workstation's hard disk. In the event of a server or communications failure, the client can boot in a stand-alone mode and run a reduced set of the normal banking functions. The stand-alone application is aware that it is not linked to a server or central site and automatically stores transactions for forwarding to the server/communications gateway when connectivity is restored.

Chapter 5. Optimizing performance

Standard Bank set up a test lab as part of their proof-of-concept exercise, to determine the likely performance of WorkSpace On-Demand clients using their current hardware and software.

5.1 Factors influencing performance

During performance testing, the following factors were found to affect overall system throughput:

- **Server's processor speed**

  With many clients per boot server, and a large HPFS386 disk cache on the server, a fast processor can enhance the overall boot performance. In an environment where the server has enough memory for cache, the server can process the clients' requests for IPL, application execution, and data by reading from/writing to the cache. The server's processor can be the first bottle neck if the workload imposed by the number of clients exceeds the capabilities of the processor.

  Note that using OS/2 Warp Server SMP and SMP hardware does not directly affect the boot performance of a WorkSpace On-Demand server. This is because the HPFS386 file system is tightly coupled to the base operating system kernel and only utilizes one of the CPUs in an SMP system.

  This implies that a dedicated boot server will not benefit from adding a second or subsequent processor. However, for installations with non-dedicated boot servers, an SMP system can provide additional performance for client/server applications where the server portion of the application is also running on the WorkSpace On-Demand server.

- **HPFS386 file system**

  In a WorkSpace On-Demand environment, most file access for the client is performed at the server. Indeed, after the initial contact is established, remote IPL is essentially a file-serving exercise. The file system performance of the server will, therefore, affect the client's IPL time as well as application execution.

  OS/2 Warp Server Advanced or OS/2 Warp Server SMP with the HPFS386 file system provide the fastest performance, both as a boot server and as a file server. We, therefore, recommend that WorkSpace On-Demand be installed on an OS/2 Warp Server Advanced or OS/2 Warp Server SMP system whenever possible.

- **HPFS386 cache size**

  As mentioned, the file system performance of the server is a highly important factor in determining boot performance. In turn, the size of the disk cache on the boot server is a major determining factor in maximizing boot server performance.

  To maximize the cache hit rate, adequate memory is required in the boot server. Standard Bank initially set the cache size to 32 MB and later increased this to 49 MB, so that the server can keep the client operating system and application image in the cache at all times. This effectively removes disk access speed as a potential bottle-neck to server performance.

- **Multiple network adapter cards on the server**

  Multiple LAN adapters can be installed on the server to balance the load. However, there is a limit to the amount of traffic that multiple network adapters can generate on the same LAN segment. If too many clients (typically more than 40) are connected to the same segment, traffic may become constrained. In such cases, the LAN should be separated into multiple segments.

- **Fast LAN (16 Mbps Token-Ring or 100 Mbps Ethernet)**

  At Standard Bank, each branch uses a 16 Mbps Token-Ring LAN. As noted above, the combination of remote IPL, application execution, and access to data files can generate substantial data traffic on the LAN. As both server and client CPU, memory, and hard drive performance continue to improve, it is possible that the LAN speed may become a performance bottle-neck.

- **Client memory**

  As with stand-alone systems, swapping can effect the performance of any application on a machine. If the client swaps to a local hard drive, adding memory will result in the same performance impact as on a stand-alone workstation. For clients that swap to the server, adding memory to reduce swapping also lowers the traffic on the LAN and the workload on the boot server. This can affect the overall performance of the WorkSpace On-Demand environment as well as the client itself since, if the server must handle the swapping workload for the clients, the workload on the server's disk subsystem is significantly increased.

- **Local swapping**

  Configuring the clients to use their local hard drive for swapping helps alleviate network traffic and server workload.

Each of these factors may affect the boot performance of a WorkSpace On-Demand client to varying degrees. The most likely order of impact is as follows:

1. File system
2. Disk cache size
3. Processor speed
4. LAN bandwidth
5. Number of network adapters on server
6. Client swapping configuration
7. Client memory size

5.2 Test lab environment

Standard Bank created a test lab environment with 35 client workstations. This lab was used to simulate the implementation of WorkSpace On-Demand in a branch office and measure the performance of the server and client workstations. Most measurements were performed using an IBM PC 320 server (90 MHz Pentium). The bank also ran a number of tests using an IBM PC 325 (200 MHz Pentium) as the server to determine whether a faster CPU would yield improved results in a heavy load scenario. On both servers, the HPFS386 cache size was set to 32 MB.

Four different types of clients were used, representing a typical branch environment:

- IBM PS/2 9576i (9 machines)

- IBM PC 730 (21 systems)

- IBM PC 750 (4 systems)

- IBM PC 350 (1 system)

The configuration for all 35 clients was generated automatically at the server using a REXX program named RIPLUSER.CMD, which was developed during the course of the project. This program reads an ASCII file named WKSTN.NDI, which contains definitions for all clients in a branch, automatically generates the WorkSpace On-Demand configuration files required by each machine and stores them on the server. Using this tool, Standard Bank is able to generate a working configuration for an entire branch in less than one hour.

A sample program named WSOD_NEW.CMD, similar in function to RIPLUSER.CMD, is included in Appendix A on page 127. A sample WKSTN.NDI file is included in Appendix B on page 137.

5.3 Types of measurements

The purpose of the tests was to measure the impact of multiple clients booting simultaneously from one WorkSpace On-Demand server. This simulates a worst-case "boot storm" scenario, such as a power loss, in which all clients would reboot at the same time when power is restored. It is expected that performance results will be better in normal mode of operation since it is unlikely that all clients will boot at exactly the same time.

Standard Bank conducted tests with 1, 5, 10, 15, 20, 25, 30, and 35 clients loading concurrently. This was achieved by stopping the RPL service at the server and then rebooting all client workstations in RPL mode. When all clients were ready and sending REQUEST frames on the network, the RPL service was restarted at the server, resulting in all clients beginning to boot at approximately the same time.

For each test, Standard Bank gathered the following performance data:

- LAN traffic (peak and average)
- CPU activity at the server (peak and average)
- Memory usage at the server (average)
- Response time at the client, measured from the commencement of the boot process to the display of the Branch Delivery System logon panel. Separate measurements were conducted for both a PC 730 and a 9576i system.

Note that during the loading of the BDS application, there is a period of two to three minutes where the program sets up control blocks and environment variables, checks that other programs are active, and verifies that proper communication is in place. During that time, the client workstation does not generate network traffic. The performance measurements include that period of two to three minutes, even though this time is not actually part of the WorkSpace On-Demand boot process since the goal was to measure response time as perceived by the end user.

The performance measurements also include loading LMU and DCAF at the clients, as is the case in Standard Bank's current (OS/2 Warp-based) retail banking implementation. In a WorkSpace On-Demand environment, it would actually be better not to load LMU and DCAF by default, since it is possible to enable these applications dynamically for a specific client workstation if the need arises. This dynamic enablement results in the client loading faster, using less memory, and provides improved overall performance at the client.

Standard Bank is currently assessing the viability of using the dynamic enablement approach for LMU and DCAF.

5.4 Performance measurements

Standard Bank recorded the following performance results in its testing. Note that the results are given in two separate tables for easier reading.

Table 1. Boot performance with PC 320 Server (90 MHz Pentium) Part 1

	Number of Workstations			
	1	**5**	**10**	**15**
LAN Traffic Peak (%)	45	84	84.3	84.6
LAN Traffic Avg. (%)	3.8	17.5	34.9	44.4
Server CPU Peak (%)	31.6	57.9	72	76.7
Server CPU Avg. (%)	11.6	20.4	31.8	42.4
Server Memory Avg. (%)	35.2	35.4	35.8	36.3
Response Time PS/2 9576i (s)	347	361	395	448
Response Time PC 730 (s)	280	293	366	418

As a measure of comparison, a typical 9576i client workstation booting from its own hard disk takes about 480 seconds (eight minutes) to display the BDS logon panel.

Table 2. Boot performance with PC 320 Server (90 MHz Pentium) Part 2

	Number of Workstations			
	20	**25**	**30**	**35**
LAN Traffic Peak (%)	85.8	86.2	86.6	86.6
LAN Traffic Avg. (%)	50.6	56.4	59.7	60.2
Server CPU Peak (%)	77.5	78	81	85.3
Server CPU Avg. (%)	47.3	53.6	54	55.7
Server Memory Avg. (%)	36.7	37.1	37.6	39
Response Time PS/2 9576i (s)	540	627	730	825
Response Time PC 730 (s)	490	533	646	750

In addition to the above measurements, Table 3 shows comparative measurements when using an IBM PC 325 server. This server uses a 200 MHz Pentium processor, as opposed to the PC 320 server's 90 MHz Pentium. All other factors (installed RAM, disk cache size, and so on) are the same.

Table 3. Boot performance with PC 325 Server (200 MHz Pentium)

	Number of Workstations	
	10	**35**
LAN Traffic Peak (%)	93.3	94.4
LAN Traffic Avg. %)	34.5	60
Server CPU Peak (%)	57.3	69.6
Server CPU Avg. (%)	17.2	22.5
Response Time PS/2 9576i (s)	410	678
Response Time PC 730 (s)	355	605

5.5 Interpretation of results

The tests confirm the general guidelines for a WorkSpace On-Demand implementation. The following conclusions were drawn:

1. Response time is improved with a fast CPU server under heavy load

   When using the 90 MHz Pentium server, the load time is approximately 12-13 minutes when booting 35 clients concurrently. This time includes loading LMU, DCAF, and the BDS application. When the 200 MHz Pentium is used instead, the load time drops to the 10-11 minute range, resulting in a gain of two minutes. Even though Standard Bank could not set up a 40-client scenario due to lack of available hardware, they believe that acceptable results would be obtained for this number of clients using the PC 325 server. For this reason, the proof-of-concept team recommended that Standard Bank use a 200 MHz Pentium system as the boot server and set a standard ratio of 40 clients to one server.

2. LAN traffic becomes very high in concurrent boot scenarios

   The 90 MHz Pentium system was able to drive LAN traffic to a peak of 87 percent, while the 200 MHz server reached 94 percent. Because the CPU in the PC 325 server is faster, it is able to read faster from the cache and deliver more files concurrently, therefore, driving LAN traffic higher and reducing response time at the clients. Once again, bear in mind that, under normal operational conditions, clients are not rebooted at the exact

same time, and LAN traffic numbers will be significantly lower. The performance tests measure the worst case scenario.

After the clients have booted and the BDS logon screen is displayed, LAN traffic reverts back to the two to three percent range, as the files required by the client are now loaded in the client's local memory. Traffic is then similar to the current "fat client" BDS implementation. Of course, additional traffic will be incurred if the user launches applications, such as Netscape Navigator or Lotus WordPro, since these applications will load from the server. However, the overall increase in LAN traffic will be limited and, as such, user-generated actions are very unlikely to occur at exactly the same time.

3. Memory size is not a limiting factor

   The tests revealed that the amount of memory used at the server during the various scenarios varies very little, from 35 MB for one client to 39 MB for 35 clients. With a 32 MB cache size, an overall amount of 71 MB of RAM was actually used on the server during the tests. Based on these figures, and adding a buffer to ensure that no swapping occurs, Standard Bank decided to use 96 MB of RAM on the server.

4. PC 730 clients load faster than 9576i clients

   This is no surprise; PC 730 machines have a faster CPU than the 9576i (90 or 100 MHz Pentium versus 486 DX2-66), and, regardless of LAN traffic, they always load faster than the 9576i clients. However, it must be noted that the difference in boot time is not as marked as one might expect given the difference in CPU performance between the two types of clients. This reflects the conclusion that the boot cycle is not CPU-bound.

In summary, Standard Bank concluded from the performance tests that a WorkSpace On-Demand implementation could meet the bank's performance requirements. The following recommendations were made:

- Use a 200 MHz Pentium system as the WorkSpace On-Demand server:

  - 96 MB RAM
  - 2 GB hard disk

- Use one WorkSpace On-Demand server for every 40 clients.

- Divide the LAN topology into multiple segments to minimize LAN traffic:

  - One segment for each unit of one WorkSpace On-Demand server and 40 clients

Chapter 6. Integrating applications

This chapter discusses the unique applications and middleware environments that were encountered in each customer installation and describes the techniques required to allow these applications and middleware products to work with WorkSpace On-Demand.

6.1 General methodology

When attempting to integrate any application into the WorkSpace On-Demand environment, the primary problem that arises is that most applications' installation procedures make the assumption that the application will be installed on the local client workstation. In the case of network applications that will be shared by WorkSpace On-Demand clients, however, this assumption is false. This means that simply installing the application from the server console will not result in correct environment settings for the application when it is run from a client.

To overcome this problem, it is useful to use a reference client. This is a "fat client" workstation running OS/2 Warp 4 and connected to an OS/2 Warp Server domain. You can install the application on the reference client itself or in a shared directory on the server to which the reference client has access. You can then take the resulting environment settings on the client and apply them to the WorkSpace On-Demand client image on the boot server.

1. Before starting the installation, turn off the archive attribute for all files on the reference client by using the following command:

   ```
   ATTRIB *.* -A /S
   ```

   This allows you to later determine which files are accessed during the application installation by querying the archive attribute.

2. Make copies of existing system configuration files including:

   CONFIG.SYS
   OS2.INI
   OS2SYS.INI
   WIN.INI
   SYSTEM.INI

   The installation procedure may modify these files, and keeping copies allows you to determine where changes have been made.

3. Install and configure the application on the reference client machine.

4. When the installation is complete, search for all modified files on the client by issuing the following command:

```
DIR *.* /A:A /S >ATTRIB.TXT
```

This command scans the client's hard drive for all files that have the archive attribute set, that is, all files that have been opened or modified during the application installation.

5. Create the application directories in the RIPL tree on the boot server and copy all application files into these directories. You can use a compression tool, such as ZIP.EXE from Infozip, to create a single file with the application's entire subdirectory structure. For example:

```
ZIP.EXE -r ibmav.zip C:\IBMAV\*
```

You can then move this file to the target server and unzip it into the \IBMLAN\RPL subdirectory:

```
UNZIP.EXE ibmav.zip -d Z:\IBMLAN\RPL
```

6. Check each modified file listed in the ATTRIB.TXT file and make the necessary changes to the corresponding files (such as CONFIG.SYS) in the client image on the boot server.

7. Most applications need read/write access to some files. Access to these files must be redirected to a read/write area on the server. Depending on the type of application and when it is to be started, read/write access can be granted to the client workstation itself (using the client's NETBIOS name) or to the end user who will run the application. For example, it is typical to start Communications Manager/2 at boot-time, and the application will, therefore, need access to its files prior to a user logging on.

The required redirection is done using FIT files. There are two different types of FIT files. The machine FIT file and the user FIT file. Each client workstation has its own machine FIT file, which contains redirection instructions for machine-specific files. Where an application requires files that are user-specific rather than machine-specific, the redirection instructions for these files are defined in the user FIT file. See Section 3.2.1.3 "The File Index Table" and 3.2.1.4 "User specific FIT Files" in the *WorkSpace on-Demand Handbook Release 2.0*, SG24-5117, for a detailed description.

Determine the files to which the application requires write access. Ensure that these files are located on an area of the server to which the client has write access and modify the appropriate FIT file to redirect file access requests from the client to the correct location on the server. See Section

6.2.2, "Client-specific application files" and 6.2.3, "User-specific application files" on page 71 for more information.

8. If necessary, define the application as a network application and grant access to a user for testing purposes.

9. Test the newly defined application by logging on from a WorkSpace On-Demand client and attempting to run the application.

Figure 12 shows Standard Bank's standard client software stack. This includes all the operating system, middleware, and application software loaded at boot-time.
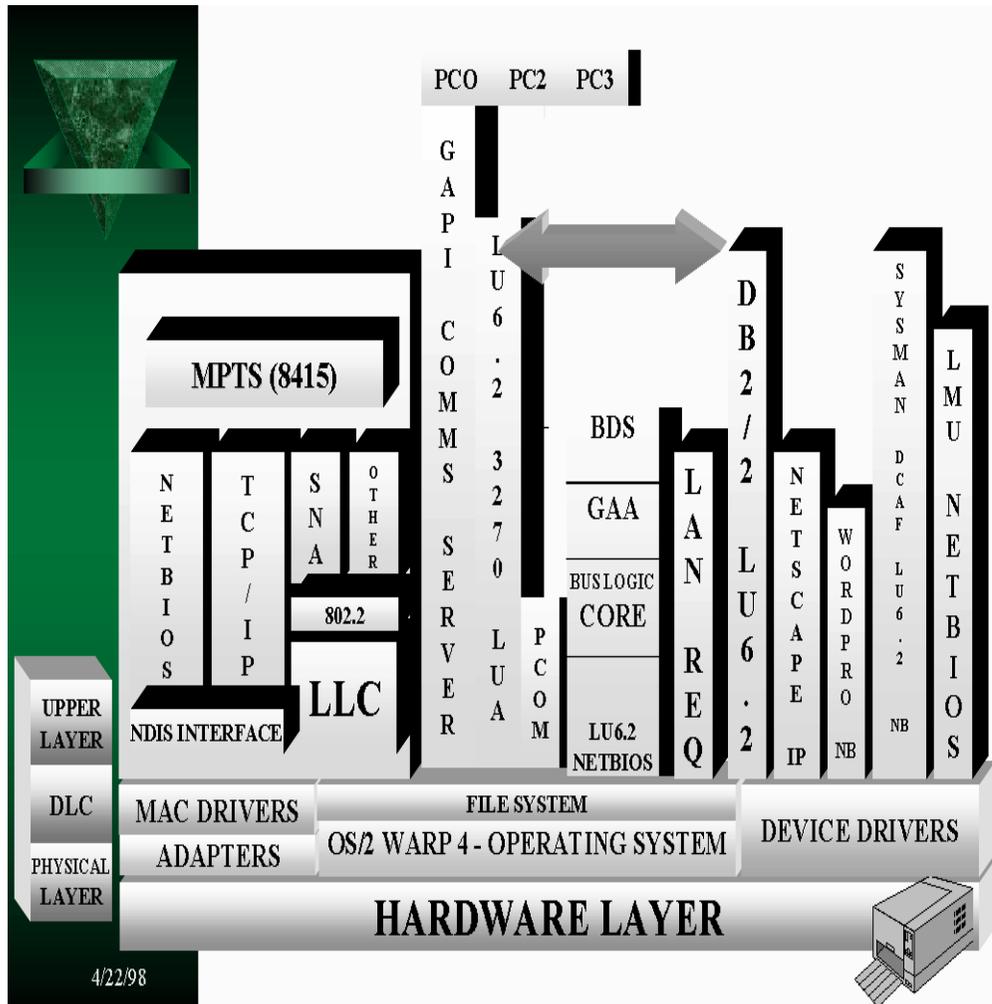
Figure 12. Client software configuration - Standard Bank

Note that the more application code you include in your client image to be loaded at boot-time, the larger the working set of your client becomes. Since this can affect the boot performance of your WorkSpace On-Demand clients, you need to find the right balance between loading code at boot-time or, alternatively, waiting until an application is needed before loading its modules. This balance will depend heavily on your particular application mix.

6.2 Placing your application files

There are three basic types of files used by an application:

- Shared files, such as programs, dynamic link libraries, or basic configuration files, which are shared by all users of an application.

- Client-specific files such as those configuration files that define a client's SNA address, and so on. These files are unique to a client workstation but are still shared by those end users who use that client.

- User-specific files, such as those configuration files that define an individual user's working environment, mail preferences, and so on. These files are unique to each end user.

In a WorkSpace On-Demand environment, you should place application files in specific locations, depending on which of the above types they match, and whether the application requires read-write access or only read access to the files.

Figure 13 on page 70 shows the directory structure installed by default on a WorkSpace On-Demand server and the file structures that support two of the three different types of files.

The \IBMLAN\RPL\BB10.US directory contains the operating system image and can also contain any shared application files common to all clients and end users. The \IBMLAN\RPL\MACHINES directory contains operating system and application files specific to a particular client workstation and to which the client requires only read access. These two structures are both shared to all client workstations at boot time, such as the RPLFILES alias.

The \IBMLAN\RPLUSER directory contains operating system and application files to which the client workstation requires read-write access, such as log files. This file structure is shared to all client workstations at boot time, such as the WRKFILES alias.

FILE AREAS IN WSOD
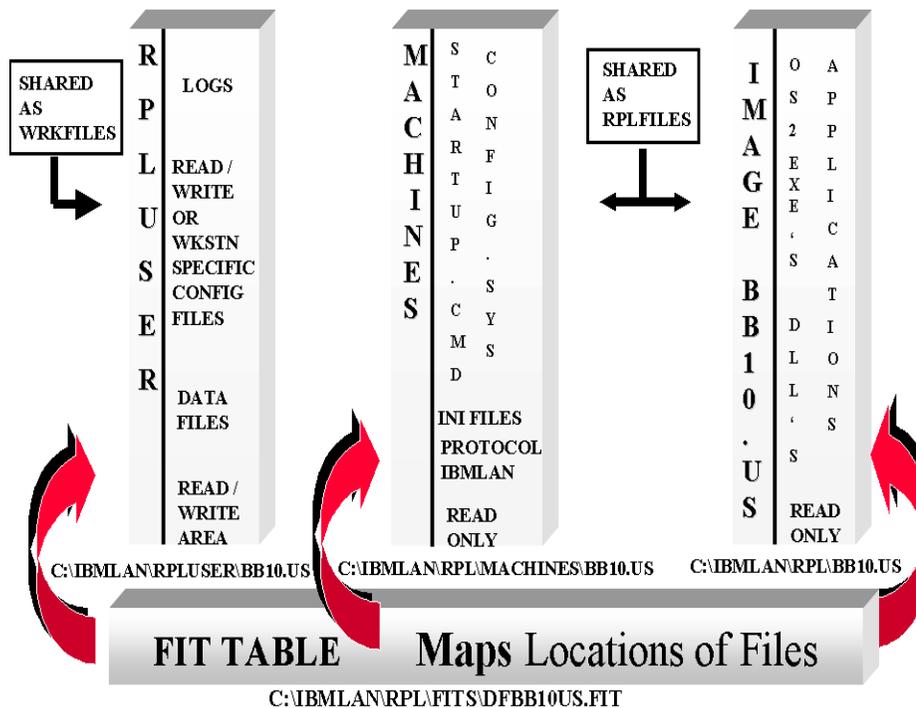
Figure 13. Major file areas in WorkSpace On-Demand

The third class of application files, those specific to an end user, are typically placed in the user's home directory. By default, this is located within the \IBMLAN\DCDB\USERS directory structure. Note that this directory structure is located on the domain controller. If you have defined your WorkSpace On-Demand servers as additional servers in your OS/2 Warp Server domain, the files in this directory structure will be on a different physical machine than those in the previous two categories.

6.2.1 Shared application files

Shared files, to which the client workstation requires only read access, can be located in one of two places on the server:

- In a shared directory to which the client workstation and/or end user is granted access. This works satisfactorily for applications that do not

require device drivers or other modules to be initialized at boot-time but require more work to define and grant access to users.

- In a directory within the client workstation's RIPL tree, that is, under the \IBMLAN\RPL\BB10.US directory. The application's directory is treated as part of the client's boot-drive and is immediately accessible to the client both at boot-time and after user logon. This is the preferred method of sharing application files.

Note that files to which the application requires write access cannot be placed under the \IBMLAN\RPL\BB10.US directory since the client workstation has only read access to this directory.

6.2.2 Client-specific application files

With many applications, certain configuration files are specific to the individual client workstation. For example, Communications Manager/2 includes configuration files containing SNA physical and logical unit IDs that are unique to each client workstation.

Standard Bank automated the creation of these client-specific files using the following technique:

- Place a default version of each client-specific configuration file in the \IBMLAN\RPLUSER\BB10.US directory structure. WorkSpace On-Demand automatically replicates the contents of this directory structure, including subdirectories, to the \IBMLAN\RPLUSER\machine_id directory for each client when the client is defined.

- Use REXX command files to modify the contents of each client-specific configuration file and add the required unique entries for each client. The information for these entries is gathered as part of the configuration data gathering performed prior to deploying WorkSpace On-Demand. See 4.5, "Automate the collection of configuration data" on page 52 for more details on how this information gathering is carried out.

The exact directories and files required for each application will be discussed later in this chapter.

6.2.3 User-specific application files

Some applications may incorporate files that are specific to an individual user. For example, Lotus Notes includes files, such as NOTES.INI and DESKTOP.DSK, that define the working environment for a specific user rather than the client workstation itself. In a WorkSpace On-Demand environment, these files must be placed in a location on the server from which they can be

accessed after the user logs on. This location will, of course, be different, depending on which user logs on to a client.

The simplest way to handle user-specific files is to provide redirection in the user FIT file. Remember that WorkSpace On-Demand supports both a machine FIT file, located in the \IBMLAN\RIPL\FITS directory, and a user FIT file, located in the \IBMLAN\DCDB\USERS\user_name directory, where user_name is the name of the user. The machine FIT file is loaded into the client's memory at boot time, and the user FIT file is merged with the in-memory copy when the user logs on.

Note that the user FIT file is merged with the machine FIT file by the default shell PMLOGON.EXE. If you replace this shell with a different shell, your shell will not be aware of the user FIT file.

When a user logs on to a WorkSpace on-Demand client using the PMLOGON shell, PMLOGON searches for a user FIT file. If it finds the file, it merges the in-memory copy of the machine FIT file with the user-specific FIT entries. If it cannot find the file, PMLOGON uses the default user FIT file, BB10USDU.FIT, which resides in the \DCDB\USERS directory.

In many cases, you can use the default user FIT file to make entries for multiple users since the file enables you to include variables for the name of the server and user, which are resolved at logon time. For example, your default user FIT file might contain an entry like that shown in Figure 14.

```
Z:\NETSCAPE\MAIL \\<DC_SERVER>\IBMLAN$\DCDB\USERS\<USER>\MAIL
```

Figure 14. User FIT file entry using variables

If a user named LSILVA logs on to a server named BRSRV99, this entry is automatically resolved so that the in-memory copy appears as shown in Figure 15.

```
Z:\NETSCAPE\MAIL \\BRSRV99\IBMLAN$\DCDB\USERS\LSILVA\MAIL
```

Figure 15. User FIT file entry with variables resolved

In this way, you can use the same default user FIT file for multiple users and servers, and even multiple domains, provided that you use the same directory structures across these servers and domains.

6.3 Commercial applications and middleware

This section examines the specific applications that were configured by the various customers as part of their proof-of-concept exercises and lists the steps necessary for these applications to run correctly on a WorkSpace On-Demand client.

6.3.1 AntiVirus 3.0.2

Bank of America

There are a number of reasons to use AntiVirus on a WorkSpace On-Demand client, even though the client boots from the server:

- If you load anything onto the local drive (you are not using PROTDISK.SYS), these files could become infected.

- If you leave the diskette drive as a choice in the client's startup sequence, then a user who leaves an infected diskette in the diskette drive and then reboots the machine could infect the local drive or the boot sector of the machine. While this will not prevent the machine booting from the network, it could cause problems in the future.

- DOS and WINOS/2 sessions are still vulnerable to viruses, especially macro-viruses and others that can be spread during the normal transmission of a "data" file as opposed to those viruses that require an executable to be run to infect a machine. Since an infected word processing document can be easily distributed via e-mail, it is important to protect any DOS and WINOS2 applications that might be used to transmit or open files that could be infected.

The general steps for setting up IBM AntiVirus are:

1. Install the AntiVirus software on a reference client and use the GUI to configure it as required.

2. Move the code to the target server.

3. Add the following entry to the client's CONFIG.SYS file to include the following environment variable:

   ```
   SET IBMAV=Z:\IBMAV
   ```

4. Make the following entries in the machine FIT file:

```
; IBM Antivirus support
Z:\IBMAV IBMAV
Z:\IBMAV\USER.PRF              \\SERVER1\WRKFILES\DEFAULT\IBMAV\USER.PRF
Z:\IBMAV\IBMAVDQ.LOC           \\SERVER1\WRKFILES\DEFAULT\IBMAV\IBMAVDQ.LOC
Z:\IBMAV\IBMAVBAD.LST          \\SERVER1\WRKFILES\DEFAULT\IBMAV\IBMAVBAD.LST
Z:\IBMAV\*.LOG                 \\SERVER1\WRKFILES\DEFAULT\IBMAV
Z:\IBMAV\DB_CHCKP._01          \\SERVER1\WRKFILES\DEFAULT\IBMAV\DB_CHCKP._01
Z:\IBMAV\DB_CHCKP._00          \\SERVER1\WRKFILES\DEFAULT\IBMAV\DB_CHCKP._00
Z:\IBMAV\DB_DCF._00            \\SERVER1\WRKFILES\DEFAULT\IBMAV\DB_DCF._00
Z:\IBMAV\0                     \\SERVER1\WRKFILES\DEFAULT\IBMAV\0
```

Figure 16. IBM AntiVirus FIT file entries

5. Create a \IBMLAN\RPLUSER\BB10.US\IBMAV directory so that every new client will have this directory available.

6. Ensure that the following files exist in the \IBMLAN\RPLUSER\machine_id\IBMAV directory for each client workstation. They must be present *before* AntiVirus starts up on the client:

   USER.PRF
   db_dcf._00

7. Modify the AUTOEXEC.BAT file in the \IBMLAN\RPLUSER\BB10.US directory to include the following statement:

   @CALL Z:\IBMAV\IBMAVDS Z:\IBMAV\

8. You can start AntiVirus on the WorkSpace On-Demand client with the following statement:

   START Z:\IBMAV\IAVTIMO2.EXE

9. You can remove the following files from the \IBMLAN\RPL\IBMAV directory:

   *.LOG (you may want to keep AVINSTAL.LOG but it is not necessary)
   USER.PRF
   IBMAVDQ.LOC
   IBMAVBAD.LST
   DB_CHCKP._01
   DB_CHCKP._00
   DB_DCF._00

6.3.2 Citrix WinFrame client

Sparkasse Freiburg - Noerdlicher Breisgau

Citrix Winframe is a third party multi-user product based on Windows NT Server Version 3.51. Citrix Winframe client allows client workstations running other operating systems, such as WorkSpace On-Demand, to access and run Win32-based application software.

Citrix Winframe server must be installed on a separate machine without an operating system. It comes with a multi-user version of Windows NT Server. The Citrix Winframe server must be installed and active when you install Citrix Winframe clients.

The general steps are:

1. Install the client software on the reference machine. Take care to locate all files that are changed during the installation process.

2. Copy the files from the reference client into the WorkSpace On-Demand RIPL tree.

3. Make the necessary changes to the Windows INI files in the RIPL tree and create the necessary FIT entries for the application.

4. Copy NWIPXSPX.DLL from the \OS2\MDOS\WINOS2\SYSTEM directory on the reference client to the server RIPL tree.

The following files are significant when implementing Citrix Winframe Client under WorkSpace On-Demand:

Files	Machine FIT	User FIT	Description
WFCNAME.INI	NO	YES*	Client's hostname [1]
WFC16.LOG	YES	NO	Logfile [2]
WFCMGR.INI	YES	NO	Interface configuration file [2]
APPSRV.INI	YES	NO	Server configuration file [3]
MODEM.INI	YES	NO	Modem list (for dial in) [3]
MODEL.INI	YES	NO	Client configuration module [3]
WFCLIENT.INI	NO	YES*	Client configuration file [3]
WFCSETUP.INI	YES	NO	Setup configuration for winframe client [3]
WFCWIN.LOG	YES	NO	Event logfile [3]

Files	Machine FIT	User FIT	Description

* Note: Depends on your configuration definition as to where to put the hostname and client configuration files.
[1] Root directory in the RIPL tree.
[2] Directory \OS2\MDOS\WINOS2\ in the RIPL tree.
[3] Files are located in WFC16 directory in the RIPL tree.

Make the following entries in the machine FIT file:

```
Z:\WFC16 BB10.US\WFC16
Z:\WFC16\*.LOG \\SERVER_NAME\WRKFILES\MACHINE-NAME\WFC16
Z:\WFC16\WFCMGR.INI \\SERVER_NAME\WRKFILES\MACHINE-NAME\WFC16\WFCMGR.INI
Z:\WFC16\APPSRV.INI \\SERVER_NAME\WRKFILES\MACHINE-NAME\WFC16\APPSRV.INI
Z:\WFC16\MODEM.INI \\SERVER_NAME\WRKFILES\MACHINE-NAME\WFC16\MODEM.INI
Z:\WFC16\MODEL.INI \\SERVER_NAME\WRKFILES\MACHINE-NAME\WFC16\MODEL.INI
Z:\WFC16\WFCMGR.INI \\SERVER_NAME\WRKFILES\MACHINE-NAME\WFC16\WFCMGR.INI
Z:\WFC16\WFCSETUP.INI \\SERVER_NAME\WRKFILES\MACHINE-NAME\WFC16\WFCSETUP.INI
```

Figure 17. Citrix Winframe client - Machine FIT file entries

Make the following entries in the user FIT file:

```
Z:\WFC16\WFCLIENT.INI \\SERVER_NAME\IBMLAN$\DCDB\USERS\USER_NAME\WFC16\WFCLIENT.INI
Z:\WFC16\WFCNAME.INI \\SERVER_NAME\IBMLAN$\DCDB\USERS\USER_NAME\WFC16\WFCNAME.INI
```

Figure 18. Citrix Winframe client - User FIT file entries

Note that the above entries assume that the users' home directories are located in the \IBMLAN\DCDB\USERS subdirectory. Many OS/2 Warp Server installations choose not to locate users' home directories there since to do so results in the home directories being replicated to a backup domain controller if one is present, therefore, causing additional network traffic. If your installation places home directories in a different location, you should modify the above entries to redirect the two INI files to the correct location for the user's home directory.

6.3.3 Communications Manager/2

Sparkasse Freiburg - Noerdlicher Breisgau

Communications Manager/2 V1.11 provides basic SNA communications functions. Note that it must be installed with the newest FixPak, or it will not work properly in a WorkSpace On-Demand environment.

The general steps are:

1. Install CM/2 on a reference client and configure it with the necessary features.

2. Copy the CM/2 and FFST/2 files from the reference client to the boot server's RIPL tree.

3. Modify the CONFIG.SYS file for each WorkSpace On-Demand client to include the necessary statements. Note that if you have not already created your WorkSpace On-Demand client definitions, you can simply modify the default CONFIG.SYS file, and the additional statements will automatically be included when each client is defined.

4. Make the necessary changes for each individual client (such as different SNA addresses) and copy these files to the appropriate client-specific locations on the server.

5. Make any necessary changes to the machine and user FIT files.

For more detailed information, see Section 9.3.1, "IBM OS/2 Access Feature in the WorkSpace On-Demand Environment" in the *WorkSpace On-Demand Handbook Release 2.0*, SG24-5117.

6.3.4 Communications Server Access feature

Standard Bank of South Africa

In order for Communications Server Access Feature to work correctly, you must copy the client's machine specific configuration files and a set of dynamically created files created at CMVERIFY time to the \IBMLAN\RPL\MACHINES\machine_id\CMLIB directory in order for the access feature to work correctly. At Standard Bank, these files were collected during the data collection from each specific client workstation and placed in a series of machine-specific directories on the server. The following files are copied to C:\IBMLAN\RPL\MACHINES\machine_id\CMLIB:

ACSCFG.NDF
ACSCFG.CFG
ACSCFG.SEC
ACSCFG.RSP
ACSCFG.CF2

You can programmatically generate these files using a batch file to call CMVERIFY with the correct parameters, then copy the required files to the correct location.

You must create a \IBMLAN\RPLUSER\BB10.US\CMLIB directory and copy the following files into this directory:

ACSRASTD.INI
APPCMS.DAT
CM.LOG

Modify the client's CONFIG.SYS file to include C:\CMLIB in the PATH statement and C:\CMLIB\DLL in the LIBPATH statement.

The DPATH must include C:\CMLIB and C:\CMLIB\EN_US. Note that the actual name of the EN_US directory may differ depending on the particular language version of Communications Server Access Feature that you are using.

Modify the SET HELP statement to include C:\CMLIB and C:\CMLIB\EN_US.

The SET BOOKSHELF statement must include C:\CMLIB\EN_US.

Add the SET CMPATH=C:\CMLIB statement.

The other statements in the CONFIG.SYS file may vary depending on your implementation of Communications Server Access Feature. However, all statements in the reference client's CONFIG.SYS that reference files in the \CMLIB directory or its subdirectories should be copied to the CONFIG.SYS file in the boot image on the server.

```
DEVICE=C:\CMLIB\ACSLANDD.SYS
DEVICE=C:\CMLIB\CMKFMDE.SYS
DEVICE=C:\CMLIB\ACSHPRDD.SYS
```

Figure 19. Communications Server Access Feature CONFIG.SYS entries.

The machine FIT file entries for the access feature are as follows:

```
C:\CMLIB                BB10.US\CMLIB
C:\CMLIB\*.CFG          MACHINES\DEFAULT\CMLIB
C:\CMLIB\*.NDF          MACHINES\DEFAULT\CMLIB
C:\CMLIB\*.SEC          MACHINES\DEFAULT\CMLIB
C:\CMLIB\*.RSP          MACHINES\DEFAULT\CMLIB
C:\CMLIB\*.CF2          MACHINES\DEFAULT\CMLIB
C:\CMLIB\*.LOG          \\SERVER_NAME\WRKFILES\DEFAULT\CMLIB
C:\CMLIB\ACSRASTD.INI   \\SERVER_NAME\WRKFILES\DEFAULT\CMLIB\ACSRASTD.INI
C:\CMLIB\APPCMS.DAT     \\SERVER_NAME\WRKFILES\DEFAULT\CMLIB\APPCMS.DAT
```

Figure 20. Communications Server Access Feature FIT file entries.

6.3.5 Current (OfficeVision/VM Front End)

Sparkasse Freiburg - Noerdlicher Breisgau

Current is an OfficeVison front end that runs under WIN-OS/2. Current provides functions to assist in OV/VM scheduling, mail, and document transmittal.

The general steps are:

1. Install Current on the reference client machine.

   Note that Current requires an active CM/2 session.

2. Copy the files from the reference client machine into the WorkSpace On-Demand RIPL tree.

3. Add the following entry to the client's CONFIG.SYS file:

   ```
   DEVICE=Z:\CMLIB\VHAPI.OS2
   ```

4. Make the necessary changes to the machine FIT file for the application.

   ```
   ; CURRENT Support
   Z:\OS2\MDOS\WINOS2\CURRENT.CFG
   \\RPLSRVNW\WRKFILES\DEFAULT\OS2\MDOS\WINOS2\CURRENT.CFG
   ```

Figure 21. Current - FIT file entries

   You must ensure that the user-specific path entries point to the correct user's directory. Depending on your configuration, the mail directory may reside in a number of locations. If you decide to place the mail directory within the boot image, you must also change the user FIT file to ensure that only the defined user has access to their mail file.

5. Current runs in WIN-OS2 mode; so, you must make some changes to the WIN.INI file. The WIN.INI file is located in the \OS2\MDOS\WINOS2 directory in the client's boot image on the server.

```
  [Current]
program=M:\CURRENT
data=H:\CURRENT\DATA
help=M:\CURRENT\HELP
workgroup=M:\CURRENT\WORKGRP
config=z:\os2\mdos\winos2
```

Figure 22. Current - WIN.INI entries

Note

Ensure that you have the following dates (or later) for the files below. Note that several products (Communications Manager, PC/3270, Passport) may include different versions of a file named PCSHLL.DLL. These versions are not interchangeable. If you are planning to use Communications Manager, Current must find the CM version of PCSHLL.DLL first; so, you must edit your LIBPATH statement accordingly.
PCSHLL.DLL.....06/08/92 and 11/20/92 - works for ES and CM/2
VHAPI.OS2.......11/20/92 and 05/28/93 - either works

6.3.6 DB/2 client software

Standard Bank of South Africa

Integrating DB/2 client software requires the standard steps plus some additional steps due to machine-specific files. The first step is to copy the installed application files to the client's boot image on the server.

Add the \SQLLIB directory to the PATH and DPATH statements in CONFIG.SYS.

Add the \SQLLIB\DLL directory to LIBPATH statement in CONFIG.SYS

Add the \SQLLIB\HELP directory to the SET HELP statement in CONFIG.SYS.

Add the C:\SQLLIB\BOOK directory to the SET BOOKSHELF statement in CONFIG.SYS.

Add the following statements to CONFIG.SYS:

```
SET QRWDR=C
SET QRWINST=C:\SQLLIB
```

Figure 23. DB/2 client CONFIG.SYS statements

Make the following additions to the machine FIT file:

```
C:\SQLLIB                    BB10.US\SQLLIB
C:\SQLLIB\SQLDBDIR           MACHINES\DEFAULT\SQLLIB\SQLDBDIR
C:\SQLLIB\SQLNODIR           MACHINES\DEFAULT\SQLLIB\SQLNODIR
C:\SQLLIB\SQLSYSTM           MACHINES\DEFAULT\SQLLIB\SQLSYST
```

Figure 24. DB/2 client FIT file entries

The DB2/2 client software uses certain binary configuration files that cannot be easily manipulated by means of a string-swapping utility. These files are similar to the access feature files. They are created during application installation time and, among other things, define the default database and node ID for database server connection. These files are:

SQLDBDIR
SQLNODIR

If you never catalog or change the databases you connect to, then these files can be placed in the read-only, machine-specific area of the boot image, that is, the \IBMLAN\RPL\MACHINES\machine_id\SQLLIB directory.

If you have existing clients with the DB2/2 client software installed, the files can be retrieved from the existing clients before deploying WorkSpace On-Demand. This was the approach taken at Standard Bank. Alternatively, the files can be created using the DB/2 DIRECT utility.

In addition to the above-mentioned files, there is one additional file named SQLSYSTM. This file must be copied from the reference client to the \IBMLAN\RPL\MACHINES\machine_id\SQLLIB directory.

6.3.7 Distributed Console Access Facility (DCAF)

Standard Bank of South Africa

DCAF requires that the application files and directories be copied from the reference client to \IBMLAN\RPL\BB10.US\DCAF on the WorkSpace On-Demand server. The following directories were created for DCAF:

- \IBMLAN\RPL\BB10.US\DCAF - This is for the single copy of the application image that was copied from the reference client's hard disk.
- \IBMLAN\RPLUSER\BB10.US - This directory is used for writable log files. Hence, no files are initially copied into this directory.

You must modify the OS2.INI file for DCAF for each specific client. You can do this in one of three ways:

- Via a set of REXX commands after generating the client using the NET RIPLMACH command.
- Manually, after the client has been successfully created.
- Via a set of REXX commands built into the client's STARTUP.CMD file.

Standard Bank found that the first method was the most practical. Clients are defined using the OS/2 Warp Server command line interface, with the necessary NET RIPLMACH command being built into a command file. The required REXX commands are also built into this command file and are set to execute after the successful completion of the NET RIPLMACH command. The changes to the OS2.INI can be made by means of a REXX utility function called SysIni, and are as follows:

```
Call Sysini 'c:\ibmlan\rpluser\' || req_name || '\os2\os2.ini' ,
'PMGRE', 'DISPLAYHOOK', 'EQNPMGRE'
Call Sysini 'c:\ibmlan\rpluser\' || req_name || '\os2\os2.ini' ,
'PM_ED_HOOKS', 'MODULENAME', 'EQNPMGRE'
Call Sysini 'c:\ibmlan\rpluser\' || req_name || '\os2\os2.ini',
'SYS_DLLS', 'Load', 'EQNCLHOT '
```

Figure 25. DCAF OS2.INI entries

You must modify the master copy of the client's CONFIG.SYS file in the \IBMLAN\RPL\MACHINES\machine_class\ directory. The entries in this file are then copied to each client's specific CONFIG.SYS file during client definition.

You must add a pointer to the DCAF directory (typically C:\DCAF) to the `PATH`, `LIBPATH`, and `DPATH` statements in CONFIG.SYS. You must also add the following three statements to the CONFIG.SYS file:

```
DEVICE=C:\DCAF\EQNRCSH.EXE
CALL=C:\DCAF\EQNRCLD.EXE
DEVICE=C:\DCAF\EQNVKBD.SYS
```

Figure 26. DCAF CONFIG.SYS statements

You must modify the machine FIT file to include the following entries:

```
C:\DCAF            BB10.US\DCAF
C:\DCAF\*.LOG      \\SERVER_NAME\WRKFILES\DEFAULT\DCAF
```

Figure 27. DCAF FIT File Entries

You can make these changes to the master copy of the machine FIT file, located in \IBMLAN\RPL\FITS\DFBB10US.FIT. As new clients are created, the client's own machine FIT file will automatically be generated with the necessary entries for DCAF.

6.3.8 First failure support technology (EPW)

Standard Bank of South Africa

DB2/2, Communications Server Access Feature, and LMU make use of EPW to log errors and transmit alerts to the host. To implement EPW under WorkSpace On-Demand, it is necessary to copy certain EXE and DLL files to the boot image and to make changes to CONFIG.SYS.

Copy the following DLLs to the client's boot image. If you are installing Communications Manager or Communications Server Access Feature, you should place them in the \CMLIB\DLL directory. Alternatively, you can place them in a directory of your choice, provided that directory is referenced by the `LIBPATH` statement in the client's CONFIG.SYS file.

```
EPWCUA.DLL
EPWELG01.DLL
EPWINIT.DLL
EPWNL001.DLL
EPWPRO.DLL
EPWPROB.DLL
EPWPROB2.DLL
EPWPSI16.DLL
EPWPSI32.DLL
EPWSVC16.DLL
EPWSVC32.DLL
```

Figure 28. DLLs to be copied to the WorkSpace On-Demand image

Copy the following files to the client's boot image:

```
EPW.EXE              EPWFOLD.ICO
EPW.INI              EPWH.MSG
EPW.MSG              EPWICON.EXE
EPWCONS.EXE          EPWMP.EXE
EPWDD.SYS            EPWMUX.EXE
EPWDDR3.EXE          EPWPCT.EXE
EPWDF.EXE            EPWPSI.EXE
EPWDFOLD.EXE         EPWROUT.EXE
```

Figure 29. Required EPW files

Add the following statements to the CONFIG.SYS and remember to modify the PATH, LIBPATH, and DPATH statements.

```
RUN=C:\EPW\SYSTEM\LOGDAEM.EXE
DEVICE=C:\EPW\LOG.SYS
RUN=C:\EPW\EPW.EXE
RUN=C:\EPW\EPWROUT.EXE 3
RUN=C:\EPW\EPWDDR3.EXE
DEVICE=C:\EPW\EPWDD.SYS
```

Figure 30. EPW CONFIG.SYS statements

Add the following entries to the machine FIT file:

```
C:\EPW                      BB10.US\EPW
C:\EPW\*.INI                \\SERVER_NAME\WRKFILES\DEFAULT\EPW
C:\OS2\SYSTEM\EPW\*.DAT     \\SERVER_NAME\WRKFILES\DEFAULT\EPW
C:\OS2\SYSTEM\*.DMP         \\SERVER_NAME\WRKFILES\DEFAULT\EPW
C:\OS2\SYSTEM\*.DAT         \\SERVER_NAME\WRKFILES\DEFAULT\EPW
```

Figure 31. EPW FIT file entries

6.3.9 LANDP applications

Sparkasse Freiburg - Noerdlicher Breisgau

Sparkasse Freiburg - Noerdlicher Breisgau uses a LANDP application named
ABPI, which was developed by dvg Karlsruhe. However, the steps listed
below can be applied to any application based on LANDP.

The general steps are:

1. Install LANDP on the reference client, specifying drive Z:\ as the target
   location for the installation.

   Note that Sparkasse Freiburg Noerdlicher Breisgau experienced a
   problem when transferring LANDP files from drive C: to the client's boot
   drive Z:. This problem was due to the fact that LANDP creates some files
   during the installation process, which are hard-coded to point to drive C:.
   To resolve the problem, a NET USE command was used to assign a drive Z:
   to the client machine (NET USE Z: \\servername\C$).

   An alternative to using a NET USE statement in this case would be to adopt
   the approach taken by Standard Bank of South Africa, whereby, the
   client's boot drive is set to C: and all FIT file entries redirect C: to the
   client's boot image on the server. This is a standard technique that can be
   used to overcome the issue of hard-coded paths within any application.
   See Section 4.7, "Modify the client's boot drive" on page 54 for more
   information on how to change the default boot drive to drive C.

2. Copy the files from the reference client machine into the WorkSpace
   On-Demand RIPL tree.

3. Make the necessary changes to the client's CONFIG.SYS file:

```
LIBPATH=Z:\LANDP
DPATH=Z:\LANDP
DEVICE=Z:\LANDP\4772PDD.SYS /D1 /C11 /B19600
```

Figure 32. LANDP CONFIG.SYS statements

4. Add the following entries to the machine FIT file:

```
; APBI Support
Z:\LANDP\*.CFG                \\RPLSRVNW\WRKFILES\DEFAULT\LANDP
Z:\LANDP\*.LOG                \\RPLSRVNW\WRKFILES\DEFAULT\LANDP
Z:\LANDP\AUTOFBSS.CMD\\RPLSRVNW\WRKFILES\DEFAULT\LANDP\AUTOFBSS.CMD
Z:\LANDP\*.L$G                \\RPLSRVNW\WRKFILES\DEFAULT\LANDP
Z:\LANDP\EHCLOG*.DAT          \\RPLSRVNW\WRKFILES\DEFAULT\LANDP
Z:\LANDP\VARPARM.SPC          \\RPLSRVNW\WRKFILES\DEFAULT\LANDP\VARPARM.SPC
Z:\OS2\DLL\TIMES.FON          \\RPLSRVNW\WRKFILES\DEFAULT\LANDP\TIMES.FON
Z:\OS2\DLL\SYSMONO.FON        \\RPLSRVNW\WRKFILES\DEFAULT\LANDP\SYSMONO.FON
Z:\LANDP                      BB10.DE\LANDP
Z:\EMU4700                    \\RPLSRVNW\WRKFILES\DEFAULT\EMU4700
```

Figure 33. LANDP FIT file entries

6.3.10 LAN Management Utilities (LMU)

Standard Bank of South Africa

Integrating LAN Management Utilities is relatively easy since there are no machine-specific files. Simply install LMU on a reference client and copy the installed application from the reference client to the client's boot image on the WorkSpace On-Demand server.

You must add the LMU directory (typically C:\LMU) to the PATH, LIBPATH, and DPATH statements in the CONFIG.SYS file in the client's boot image. In addition, you must add the following statement to the CONFIG.SYS file:

```
DEVICE=C:\LMU2\LMUIPL.SYS.
```

Figure 34. LMU CONFIG.SYS statements

Make the following additions to the machine FIT file for LMU:

```
C:\LMU2              BB10.US\LMU2
C:\LMU2\*.LOG        \\SERVER_ID\WRKFILES\DEFAULT\LMU2
```

Figure 35. LMU FIT file entries

6.3.11 Lotus Notes

Sparkasse Freiburg - Noerdlicher Breisgau

To install Lotus Notes, simply use the Client/Server installation option from within the Notes installation program. All application code and configuration files can be located entirely on the server.

Notes includes two user-specific configuration files named NOTES.INI and DESKTOP.DSK. You should place these files in a location to which the client workstation has write access, and include a reference to their location in the user FIT file (or the default user FIT file). The easiest way to do this is to place the files in the user's home directory and assign a standard drive letter (typically H:\) to this directory. The application will then load the correct files for each individual user.

6.3.12 Lotus SmartSuite

Sparkasse Freiburg - Noerdlicher Breisgau

In the proof-of-concept exercise for Sparkasse Freiburg Noerdlicher Breisgau, the customer selected AmiPro from Lotus SmartSuite. AmiPro is installed using the Client/Server installation option, and both the application and configuration files were located entirely on the server. The user-specific directories are pointing to the user's home directory on the server.

6.3.13 Lotus WordPro

Standard Bank of South Africa

WordPro requires a copy of the installed application to be placed in a directory within the client's boot image plus the normal CONFIG.SYS and FIT file modifications.

Add the C:\LOTUSOS2\COMPNENT directory to the `LIBPATH` statement in CONFIG.SYS.

Make the following addition to the machine FIT file:

```
C:\WORDPRO                    BB10.US\WORDPRO
```

Figure 36. WordPro FIT file entries

There is one additional modification that must be made. Depending on where your home directories will reside for WordPro or any other SmartSuite application, you must modify the LWPUSER.INI file. The INI file must be correct in order for WordPro to function correctly. You must then copy the modified INI file into the \IBMLAN\RPL\BB10.US\OS2 directory on the server.

6.3.14 Microsoft Excel

Bank of America

Microsoft Excel's application files are spread across several directories:

- The main application directory contains the majority of the executables and DLLs. You can place this directory within the client's boot image in an area to which the client has read-only access, such as \IBMLAN\RPL\EXCEL50.

- The MSAPPS directory contains Microsoft add-ins and files shared by other Microsoft applications. You can also place this directory in a read-only area of the client's boot image.

- The \OS2\MDOS\WINOS2\SYSTEM directory within the client's boot image contains a significant number of files (DLL's, executables, font files, and so on) that are required by Excel and Word. These files are listed in Table 4 on page 89.

Table 4. Microsoft Excel files in \OS2\MDOS\WINOS2\SYSTEM

DLL			Other
CCAPI200.DLL	MSJETDSP.DLL	RED110.DLL	ODBCINST.HLP
COMMTB.DLL	MSSETUP.DLL	SCP.DLL	DRVACCSS.HLP
COMPOBJ.DLL	MSTOOLBR.DLL	SDM.DLL	DRVDBASE.HLP
CTL3D.DLL	ODBC.DLL	SHARERES.DLL	DRVFOX.HLP
CTL3DV2.DLL	ODBCINST.DLL	SIMADMIN.DLL	DRVPARDX.HLP
DBNMP3.DLL	OLE2.DLL	SIMBA.DLL	DRVSSRVR.HLP
DDEML.DLL	OLE2CONV.DLL	SQLSRVR.DLL	ODBCADM.EXE
EXCEL_BB.DLL	OLE2DISP.DLL	STORAGE.DLL	CCARD200.EXE

DLL			Other
MAPIVIM.DLL	OLE2NLS.DLL	TYPELIB.DLL	OLE2.REG
MSCPYDIS.DLL	OLE2PROX.DLL	VBA.DLL	STDOLE.TLB
MSFFILE.DLL	PDX110.DLL	VBAEN.DLL	VBAEN.OLB
XBS110.DLL	XLCALL.DLL	XLCONVMP.DLL	
XLHELP.DLL	XLINTL.DLL		

You must ensure that all of these files are present in the
\IBMLAN\RPL\BB10.US\OS2\MDOS\WINOS2\SYSTEM directory on the
server. Note that some files may already be installed as part of the
WorkSpace On-Demand installation. Be sure to check the dates on the files
before you copy them to the server since over-writing a file with an older
version may cause unpredictable results.

Excel's INI file, EXCEL5.INI, must be located in the \OS2\MDOS\WINOS2
directory, but must also be writable in order for Excel to work properly. Since it
is not a good idea to allow write access to the \OS2\MDOS\WINOS2
directory, the best course of action is to place the INI file in the
IBMLAN\RPLUSER\machine_id directory for each client, and redirect the
access to this file using a FIT entry as shown in Figure 37.

```
;Microsoft Excel 5.0 support
Z:\EXCEL50    EXCEL50
Z:\MSAPPS     MSAPPS
Z:\OS2\MDOS\WINOS2\EXCEL5.INI
\\SERVER\WRKFILES\WSOD_CLIENT_NAME\OS2\MDOS\WINOS2\EXCEL5.INI
```

Figure 37. Microsoft Excel FIT file entries

Excel requires a number of changes to WIN.INI as shown in Figure 38. You must update the WIN.INI file for each client. One way to do this is by updating the WIN.INI in each machine class directory.

```
[Extensions]
xls=c:\excel50\excel.exe ^.xls    xlc=c:\excel50\excel.exe ^.xlc
xlw=c:\excel50\excel.exe ^.xlw    xlm=c:\excel50\excel.exe ^.xlm
xlt=c:\excel50\excel.exe ^.xlt    xll=c:\excel50\excel.exe ^.xll
xlb=c:\excel50\excel.exe ^.xlb    xla=c:\excel50\excel.exe ^.xla

[embedding]
Excel.Sheet.5=Microsoft Excel 5.0 Worksheet,Microsoft Excel 5.0
Worksheet,I:\EXCEL.EXE,picture
Excel.Chart.5=Microsoft Excel 5.0 Chart,Microsoft Excel 5.0
Chart,I:\EXCEL.EXE,picture
ExcelMacrosheet=Microsoft Excel Macrosheet,Microsoft Excel
Macrosheet,I:\EXCEL.EXE,picture
ExcelChart=Microsoft Excel Chart,Microsoft Excel Chart,I:\EXCEL.EXE,picture
ExcelWorksheet=Microsoft Excel Worksheet,Microsoft Excel
Worksheet,I:\EXCEL.EXE,picture

[SQLCONNECT]
ExcelFile=QEXLS
SQLServer=QESS
dBASEFile=QEDBF
TextFile=QETXT

[QEXLS]
Extension=XLS

[Q+E]
connect=SQLServer
NoLogon=ExcelFile,dBASEFile,TextFile

[QESS]
Server=

[QEDBF]
Extension=DBF
IndexExtension=NDX,MDX

[QETXT]
Extension=CSV
```

Figure 38. Microsoft Excel WIN.INI changes

6.3.15 Microsoft Word

Bank of America

The Microsoft Word application files are spread across several directories:

- The main application directory contains the majority of the executables and DLLs. You can place this directory within the client's boot image in an area to which the client has read-only access, such as \IBMLAN\RPL\EXCEL50.

- The MSAPPS directory contains Microsoft add-ins and files shared by other Microsoft applications. You can also place this directory in a read-only area of the client's boot image.
- The \OS2\MDOS\WINOS2\SYSTEM directory within the client's boot image contains a significant number of files (DLLs, executables, font files, and so on) required by Word and Excel. These files are shown in Table 5.

Table 5. Microsoft Word files in \OS2\MDOS\WINOS2\SYSTEM

DLL	TTF	Other
COMMTB.DLL	ALGER.TTF	MSFNTMAP.INI
COMPOBJ.DLL	ARLRDBD.TTF	MSTXTCNV.INI
CTL3DV2.DLL	BOOKOSB.TTF	TTEMBED.INI
GRAM.DLL	BRAGGA.TTF	ODBCADM.EXE
HYPH.DLL	BRITANIC.TTF	OLE2.REG
MAPIVIM.DLL	BRUSHSCI.TTF	PSCRIPT.DRV
MSCPYDIS.DLL	COLONNA.TTF	VSHARE.386
MSJETDSP.DLL	DESDEMON.TTF	DRVPARDX.HLP
MSSETUP.DLL	FTLTLT.TTF	DRVACCSS.HLP
MSTOOLBR.DLL	GOTHIC.TTF	DRVDBASE.HLP
ODBC.DLL	IMPACT.TTF	DRVFOX.HLP
ODBCINST.DLL	KINO.TTF	ODBCINST.HLP
OLE2.DLL	LATINWD.TTF	
OLE2CONV.DLL	LINEDRAW.TTF	
OLE2DISP.DLL	MATURASC.TTF	
OLE2NLS.DLL	MTEXTRA.TTF	
OLE2PROX.DLL	PLAYBILL.TTF	
PDX110.DLL		
PUBOLE.DLL		
RED110.DLL		
SDM.DLL		
SHARERES.DLL		

DLL	TTF	Other
SIMADMIN.DLL		
SIMBA.DLL		
STORAGE.DLL		
TTEMBED.DLL		
UNIDRV .DLL		
VER.DLL		
XBS110.DLL		
WORDCBT.DLL		
WORDHELP.DLL		
WORDRES.DLL		
WORD_BB.DLL		
WWINTL.DLL		

Note

Newer versions of some files (such as PSCRIPT.DRV, UNIDRV.DLL, and VER.DLL) may already exist in the client boot image. Overwriting these files with older versions could have an adverse effect on other programs.

Word's INI file WINWORD6.INI must be located in the \OS2\MDOS\WINOS2 directory but must also be writable in order for Excel to work properly. Since it is not a good idea to allow write access to the \OS2\MDOS\WINOS2 directory, the best course of action is to place the INI file in the IBMLAN\RPLUSER\machine_id directory for each client and redirect the access to this file using a FIT entry as shown in Figure 39.

```
;Microsoft Word 6.0 support
Z:\WORD60      WORD60
Z:\MSAPPS      MSAPPS
Z:\OS2\MDOS\WINOS2\WINWORD6.INI
\\SERVER\WRKFILES\WSOD_CLIENT_NAME\OS2\MDOS\WINOS2\WINWORD6.INI
```

Figure 39. Microsoft Word FIT file entries

Word requires a number of changes to WIN.INI as shown in the following:

```
[embedding]
   Word.Picture.6=Microsoft Word 6.0 Picture,Microsoft Word 6.0,Picture,winword.exe,picture
   Word.Document.6=Microsoft Word 6.0 Document,Microsoft Word 6.0,Document,c:\word60\winword.exe,picture
   MSWordArt.2=Microsoft WordArt 2.0,Microsoft WordArt 2.0,c:\msapps\wordart\wordart2.exe,picture
   MSGraph=Microsoft Graph,Microsoft Graph,c:\msapps\msgraph\graph.exe,picture
   Equation.2=Microsoft Equation 2.0,Microsoft Equation 2.0,c:\msapps\equation\eqnedit.exe,picture

   [MSAPPS]
   MSAPPS=Z:\MSAPPS
   WORDART=Z:\MSAPPS\WORDART
   PROOF=Z:\MSAPPS\PROOF
   TEXTCONV=Z:\MSAPPS\TEXTCONV
   GRPHFLT=Z:\MSAPPS\GRPHFLT
   MSINFO=Z:\MSAPPS\MSINFO
   MSGRAPH=Z:\MSAPPS\MSGRAPH
   EQUATION=Z:\MSAPPS\EQUATION

   [MS Proofing Tools]
   Spelling 1033,0=Z:\MSAPPS\PROOF\MSSPEL2.DLL,Z:\MSAPPS\PROOF\MSSP2_EN.LEX
   Spelling 2057,0=Z:\MSAPPS\PROOF\MSSPEL2.DLL,Z:\MSAPPS\PROOF\MSSP2_EN.LEX
   Thesaurus 1033,0=Z:\MSAPPS\PROOF\MSTHES.DLL,Z:\MSAPPS\PROOF\MSTH_AM.LEX

   [MS Text Converters]
   WrdPrfctDOS50=WordPerfect 5.0, Z:\MSAPPS\TEXTCONV\WPFT5.CNV, doc
   WrdPrfctDOS=WordPerfect 5.1 for MS-DOS, Z:\MSAPPS\TEXTCONV\WPFT5.CNV,doc
   WrdPrfctWin=WordPerfect 5.x for Windows,Z:\MSAPPS\TEXTCONV\WPFT5.CNV, doc
   WrdPrfctDat=WordPerfect 5.1 or 5.2 Secondary File,Z:\MSAPPS\TEXTCONV\WPFT5.CNV, doc
   WrdPrfctDat50=WordPerfect 5.0 Secondary File,Z:\MSAPPS\TEXTCONV\WPFT5.CNV, doc
   MSWordWin2=Word for Windows 2.0, Z:\MSAPPS\TEXTCONV\WORDWIN2.CNV, doc
   MSWordDos=Word for MS-DOS 3.x - 5.x, Z:\MSAPPS\TEXTCONV\WORDDOS.CNV,doc
   MSWordDos6=Word for MS-DOS 6.0, Z:\MSAPPS\TEXTCONV\WORDDOS.CNV, doc
   MSWordMac4=Word for Macintosh 4.0, Z:\MSAPPS\TEXTCONV\WORDMAC.CNV,mcw
   MSWordMac5=Word for Macintosh 5.0, Z:\MSAPPS\TEXTCONV\WORDMAC.CNV, mcw
   MSWordMac=Word for Macintosh 5.1, Z:\MSAPPS\TEXTCONV\WORDMAC.CNV, mcw
   RFTDCA=RFT-DCA, Z:\MSAPPS\TEXTCONV\RFTDCA.CNV, rft
   MSBiff=Microsoft Excel Worksheet, Z:\MSAPPS\TEXTCONV\XLBIFF.CNV, xls xlw xl5
   MSWord6=Word for Windows 6.0, Z:\MSAPPS\TEXTCONV\MSWORD6.CNV, doc
   MSWord6Mac=Word for Macintosh 6.0, Z:\MSAPPS\TEXTCONV\MSWORD6.CNV,doc
   MSWinWrite=Windows Write 3.1, Z:\MSAPPS\TEXTCONV\WRITWIN.CNV, wri
   Windows Write 3.0=Windows Write 3.0, Z:\MSAPPS\TEXTCONV\WRITWIN.CNV,wri

   [MSWord Text Converters]
   MSWord6=Word for Windows 6.0, Z:\MSAPPS\TEXTCONV\MSWORD6.CNV, doc
   MSWord6Mac=Word for Macintosh 6.0, Z:\MSAPPS\TEXTCONV\MSWORD6.CNV,doc

   [MS Graphic Import Filters]
   DrawPerfect(.WPG)=Z:\MSAPPS\GRPHFLT\WPGIMP.FLT,WPG
   Micrografx Designer/Draw(.DRW)=Z:\MSAPPS\GRPHFLT\DRWIMP.FLT,DRW
   Computer Graphics Metafile(.CGM)=Z:\MSAPPS\GRPHFLT\CGMIMP.FLT,CGM
   Encapsulated PostScript(.EPS)=Z:\MSAPPS\GRPHFLT\EPSIMP.FLT,EPS
   Tagged Image Format(.TIF)=Z:\MSAPPS\GRPHFLT\TIFFIMP.FLT,TIF
   PC Paintbrush(.PCX)=Z:\MSAPPS\GRPHFLT\PCXIMP.FLT,PCX
   CompuServe GIF(.GIF)=Z:\MSAPPS\GRPHFLT\GIFIMP.FLT,GIF
   Macintosh PICT(.PCT)=Z:\MSAPPS\GRPHFLT\PICTIMP.FLT,PCT

   [MS Graphic Export Filters]
   DrawPerfect(.WPG)=Z:\MSAPPS\GRPHFLT\WPGEXP.FLT,WPG
```

6.3.16 Netfinity 5.1

Bank of America

The majority of the Netfinity code can be added to the client boot image in a read-only directory, such as \IBMLAN\RPL\NETFIN. However, all of the *.INI, *.DAT, and *.LOG files must be writable; so, you should add a NETFIN directory to the \IBMLAN\RPLUSER\machine_id directory for each client.

You must add entries to the machine FIT file as shown in Figure 40.

```
Z:\NETFIN NETFIN
Z:\NETFIN\*.INI \\SERVER\WRKFILES\WSOD_CLIENT_NAME\NETFIN
Z:\NETFIN\*.DAT \\SERVER\WRKFILES\WSOD_CLIENT_NAME\NETFIN
Z:\NETFIN\*.LOG \\SERVER\WRKFILES\WSOD_CLIENT_NAME\NETFIN
Z:\NETFIN\DCAF.!!! \\SERVER\WRKFILES\WSOD_CLIENT_NAME\NETFIN\DCAF.!!!
Z:\NETFIN\CMBASE.EVT
\\SERVER\WRKFILES\WSOD_CLIENT_NAME\NETFIN\CMBASE.EVT
Z:\NETFIN\SLTFILES\REALTIME.SLT
\\SERVER\WRKFILES\WSOD_CLIENT_NAME\NETFIN\REALTIME.SLT
Z:\NETFIN\SLTFILES\TREND.SLT
\\SERVER\WRKFILES\WSOD_CLIENT_NAME\NETFIN\TREND.SLT
```

Figure 40. Netfinity FIT file entries

You should be sure to substitute the name of your server in the entries shown above or, alternatively, use the <DCSERVER> variable.

Netfinity requires a number of additions to the client's OS2.INI file. The applications, key names and values are shown in Table 6.

Table 6. Netfinity 5.1 OS2.INI entries

Application	Key	Value
Netfinity	Version	5.10.0
Netfinity	NFRootPath	Z:\NETFIN
Netfinity	Package	Passive
PMGRE	DISPLAYHOOK	EQNPMGRE
PM_ED_HOOKS	MODULENAME	EQNPMGRE
SYS_DLLS	Load	EQNCLHOT

It is critical that the last three entries be terminated with the null character. Figure 41 shows the REXX _Sysini_ statements that you can use to update the OS2.INI file:

```
    call Sysini OS2Inifile, 'NetFinity',  'Version',    '5.10.0'
    call Sysini OS2Inifile, 'NetFinity',  'NFRootPath', 'Z:\NETFIN'
    call Sysini OS2Inifile, 'NetFinity',  'Package',    'Passive'
    call Sysini OS2Inifile, 'PMGRE',      'DISPLAYHOOK','EQNPMGRE'||x2c(00)
    call Sysini OS2Inifile, 'PM_ED_HOOKS','MODULENAME', 'EQNPMGRE'||x2c(00)
    call Sysini OS2Inifile, 'SYS_DLLS',   'Load',       'EQNCLHOT'||x2c(00)
```

Figure 41. Netfinity REXX Sysini statements

You must create a Netfinity configuration file named NETDRVR.INI and copy this file into the \IBMLAN\RPLUSER\machine_id\NETFIN directory for each client. This file contains the unique client name and the protocols used by that client. You can create the file using the NFCONFIG.EXE program by issuing the following command:

NFCONFIG /R:NETFBASE.RSP

Figure 42 shows a sample NETFBASE.RSP file.

```
 Package = Passive
 Options = RWC
 ChangeConfig = FALSE
 RouteNMVT = FALSE
 Driver.TCPIP = 1
 Driver.NETBIOS = 0
 Driver.NETBIOS2 = 0
 Driver.IPX = 0
 Driver.SERIPC = 0
 Driver.SNA_APPC = 0
 Parm1.NETBIOS = WSOD_CLIENT_NAME
 Parm1.NETBIOS2 = WSOD_CLIENT_NAME
 Keyword.1 = WSOD_CLIENT_KEYWORD
 ;NetTimeout = 15
 SystemName = WSOD_CLIENT_NAME
 ForceRemoteLogons = 1
 ;ServiceAlerts = 1
 ;ShowSupportProgram = 1
 ;ReqUserAuthToScreen = 1
```

Figure 42. Netfinity configuration response file NETFBASE.RSP

To start Netfinity Services, add the following line to the STARTUP.CMD file for each client:

START Z:\NETFIN\NETFBASE.EXE

A known bug exists with Workspace On Demand and Netfinity's Capacity Management feature. This is a new feature that was added with Release 5.1 of Netfinity. The Capacity Management process polls the clients on a regularly scheduled basis and updates two files on the server:

```
X:\IBMLAN\RPLUSER\WSOD_CLIENT_NAME\NETIFN\REALTIME.SLT
X:\IBMLAN\RPLUSER\WSOD_CLIENT_NAME\NETIFN\TREND.SLT
```

A file named SF.TMP must be given write access for these files to be updated properly. REALTIME.SLT is updated 60 times per hour, and TREND.SLT is updated 12 times per hour. These two files grow without bounds and can rapidly take up significant disk space on the server. To avoid this problem, we recommend that you disable the Capacity Management feature by renaming \IBMLAN\RPL\NETFIN\CMBASE.EXE.

6.3.17 Netscape Navigator for OS/2

Standard Bank of South Africa

Standard Bank implemented Netscape Navigator in the same way as described in the *WorkSpace On-Demand Handbook Release 2.0*, SG24-5117. The only variation is the NETSCAPE.INI file which is specific to Standard Bank. Standard Bank also implemented several DLLs for enhanced security.

Add the following statement to the CONFIG.SYS file:

```
SET CLASSPATH=.;C:\netscape\njclass.zip;
```

Figure 43. Netscape Navigator CONFIG.SYS statements

Add the following entries to the machine FIT file:

```
; NETSCAPE support
C:\NETSCAPE                     BB10.US\NETSCAPE
C:\NETSCAPE\CACHE               \\SERVER_NAME\WRKFILES\DEFAULT\NETSCAPE\CACHE
C:\NETSCAPE\WINPLUG.REG         \\SERVER_NAME\WRKFILES\DEFAULT\NETSCAPE\WINPLUG.REG
C:\NETSCAPE\*.DB                \\SERVER_NAME\WRKFILES\DEFAULT\NETSCAPE
C:\NETSCAPE\BOOKMARK.HTM        \\SERVER_NAME\WRKFILES\DEFAULT\NETSCAPE\BOOKMARK.HTM
C:\NETSCAPE\NETSCAPE.INI        \\SERVER_NAME\WRKFILES\DEFAULT\NETSCAPE\NETSCAPE.INI
C:\NETSCAPE\NETSCAPE.!!!        \\SERVER_NAME\WRKFILES\DEFAULT\NETSCAPE\NETSCAPE.!!!
```

Figure 44. Netscape Navigator FIT file entries

6.3.18 Personal Communications/3270 for OS/2

Standard Bank of South Africa

Integrating Personal Communications/3270 (PCOMOS2) into the WorkSpace On-Demand client image begins with the normal steps. First, copy the application files into the client's boot image on the server.

Add the \PCOMOS2 directory to the PATH, LIBPATH, and DPATH statements in CONFIG.SYS.

Make the following additions to the machine FIT file:

```
C:\PCOMOS2                 BB10.US\PCOMOS2
C:\PCOMOS2\PRIVATE\*.WS    MACHINES\DEFAULT\PCOMOS2
```

Figure 45. PCOMOS2 FIT file entries

Integrating PCOMOS2 into the WorkSpace On-Demand client image has one complication due to a machine specific file named SESSIONA.WS, which contains the 3270 LUA ID required in order to get 3270 connectivity. The LUA ID must be unique for each client workstation.

Standard Bank used a template file that was changed by means of a string swapping utility during client definition. The command file used to generate the clients calls the string swapping utility to add the necessary information to the template file. The modified template file is then written to a directory under \IBMLAN\RPL\MACHINES\machine_id\PCOMOS2 on the server. The string swapping utility is an in-house utility, but similar tools can be obtained on the Internet.

6.4 In-House applications

Standard Bank of South Africa

Standard Bank runs an application named Branch Delivery System (BDS) on its retail banking clients. BDS is an OS/2 Presentation Manager application with a powerful underlying infrastructure.
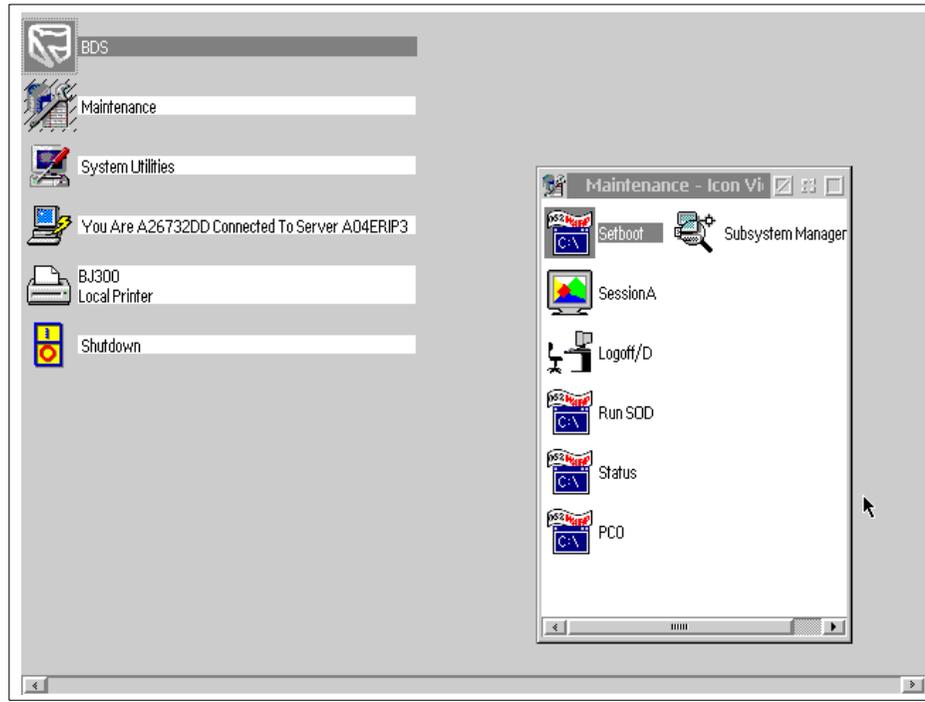
Figure 46. BDS desktop with an open folder

The BDS system interfaces with Communications Server, via middleware, called GAPI using LU6.2 protocols. BDS connects to DB2/2 on the database server and also communicates with the host database via CICS on an MVS mainframe.

Integrating the BDS application with WorkSpace On-Demand posed some problems since Standard Bank wished to use a single shared application image that could be accessed by many clients, but some configuration and data files within the application require read-write access by the client. These files, therefore, could not be stored in the \IBMLAN\RPL\BB10.US directory structure since the client is only granted read access to this structure.

Standard Bank examined three options:

- Duplicate the necessary files for each client workstation. This was not seen as a viable option since it required large amounts of disk space on the server and largely negated the advantages of having shared application code.

- Redirect access to the necessary files through the FIT. This was possible, but since the in-memory copy of the FIT is limited to 64 KB in size, there was a potential problem due to the large number of files involved.

- Examine the application code to determine whether files that are opened in read/write mode could in fact be opened in read-only mode, thus allowing them to be placed in the shared, read-only area of the client's boot image.

Standard Bank discovered that while many files were opened in read/write mode, only a few were actually written. The bank was, therefore, able to modify the application to open these files in read-only mode, thereby, reducing the number of files that needed to be duplicated for each client and allowing the majority of the application to be shared.

As you can see, integrating in-house applications requires not only a knowledge of OS/2 Warp Server and WorkSpace On-Demand but also requires significant experience with the application itself. You must examine your own applications using tools, such as FWATCH, to determine their I/O behavior and decide upon the best way to implement each application under WorkSpace On-Demand.

Chapter 7. Customizing the user interface

This chapter examines some of the ways in which customers have modified the default PMLOGON shell or replaced it with their own user interface. The chapter discusses the steps necessary modifying or replacing the user interface shell with your own customized shell.

7.1 The PMLOGON shell

For many years, OS/2 has provided a user interface known as the Workplace Shell (WPS). This shell is object oriented and highly customizable. Programmers can build common functions once and, using object-oriented programming techniques, reuse them everywhere that such functionality is required. This allows easy modifying or enhancing of the shell by making a major change in one place, and that change will automatically be utilized throughout the system.

With WorkSpace On-Demand, IBM has modified the Workplace Shell to restrict users' access to its features. The new shell eliminates folders and pop-up menus and prevents access to any type of configuration or customization by the end user. The new shell eliminates any means of obtaining access to the rest of the Workplace Shell, including command prompts.

Figure 47. Sample PMLOGON shell from Bank of America

The only icons that are accessible are those that are defined for the user as network applications in the WorkSpace On-Demand server's domain. These icons are dynamically built on the desktop for the user during the logon process. End users can do nothing with these icons except double-click on them to start them up. They cannot move, delete, or alter the icons in any way. The icons are deleted by the system when the user logs off or shuts down.

The new shell is started by the RUNWORKPLACE statement in the client workstation's CONFIG.SYS file. Figure 48 shows the default RUNWORKPLACE statement.

```
SET RUNWORKPLACE=Z:\OS2\PMLOGON.EXE
```

Figure 48. PMLOGON shell - Default RUNWORKPLACE statement

PMLOGON.EXE manages the construction and operation of the new shell. By default, PMLOGON initializes the shell with a basic desktop (only three icons), then brings up a logon panel as shown in Figure 49. Notice that prior to log on, the desktop is hidden behind a special blue screen and is not available to the user until a successful log on occurs.
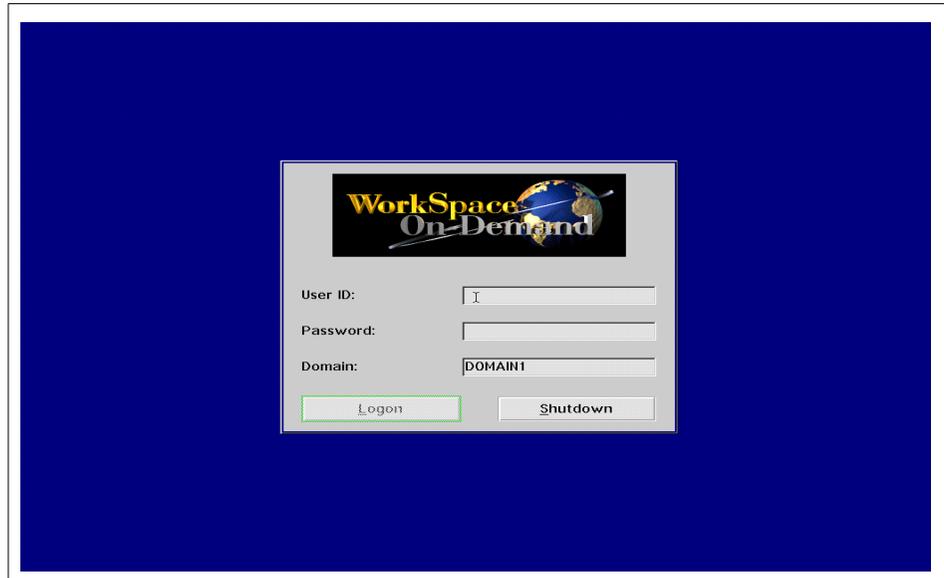
Figure 49. PMLOGON shell - Logon panel

The default desktop includes icons for logoff, shutdown, and refresh. These icons allow the user to log off and return to the logon panel, shutdown the machine, or dynamically "pull down" any changes that an administrator may have made to the user's application definitions.

When a user actually logs onto the system, PMLOGON calls a program named NCAPPUTIL.EXE to query the user's assigned network applications and builds an object on the desktop for each application in the list. After building the icons, PMLOGON removes the blue screen and reveals the desktop to the user.

PMLOGON arranges the icons in a horizontal row from left to right, starting at the top left-hand corner of the desktop. They are sorted in reverse alphabetical order based on the WorkSpace On-Demand application ID (a unique alphanumeric ID for every application available to users via WorkSpace On-Demand).   In the default PMLOGON shell, there is no way to control where icons are positioned, the ability to change setup strings for a WPS icon is not available, and there is no way to execute processing before or after logon.

7.2 Enhancing the PMLOGON shell

Bank of America

As part of Bank of America's work with IBM on WorkSpace On-Demand, the team identified several requirements that could not be handled by WorkSpace On-Demand in its default state. Bank of America wished to make use of the capabilities of the PMLOGON shell, such as user FIT files, but required the ability to carry out additional processing as part of the startup and logon sequences. This required IBM to make changes to the WorkSpace On-Demand code.

IBMs product development team, therefore, made changes to the PMLOGON shell and its subordinate processes. These changes affected a number of program files, which are listed in Figure 50.

```
X:\IBMLAN\RPL\BB10.US\OS2\DLL\APPDBUTL.DLL (23527 bytes 11-19-97 16:18)
X:\IBMLAN\RPL\BB10.US\OS2\DLL\TOBJECT.DLL (4966 bytes 02-06-98 13:25)
X:\IBMLAN\RPL\BB10.US\OS2\DLL\TDESK.DLL (3905 bytes 04/17/98 09:44)
X:\IBMLAN\RPL\BB10.US\OS2\NCAPPUTL.EXE (14588 bytes 12-16-97 10:52)
X:\IBMLAN\RPL\BB10.US\OS2\PMLOGON.EXE (40107 bytes 12-11-97 16:49)
X:\IBMLAN\RPL\BB10.US\OS2\TLOGOFF.EXE (9579 bytes 02-06-98 16:44)
X:\IBMLAN\RPL\BB10.US\OS2\TSHUTDWN.EXE (8613 bytes 02-06-98 13:26)
X:\IBMLAN\RPL\BB10.US\OS2\APPSTART.EXE (33892 bytes 01/29/98 15:06)
```

Figure 50. PMLOGON shell - Modified files for Bank of America

These modified files are not proprietary to Bank of America and will be made generally available by IBM. They are expected to be included in Fixpak 7, and IBM also plans to include them in the next release of WorkSpace On-Demand.

7.2.1 Application setup strings

IBM has added a feature to NCAPPUTL.EXE, which is the program that actually creates the icons on the desktop on behalf of PMLOGON. If an application definition in WorkSpace On-Demand contains an environment variable named NCC_SETUP_POST, the contents of this variable are placed into the desktop object's setup string before the object is created on the desktop. One feature this provides is the setting of the icon and icon position of each object. It also allows the customization of other features, which Bank of America found necessary to deliver their full environment.

```
NCC_SETUP_POST = ICONPOS=20,70;
ICONFILE=Z:\WORDPRO.ICO;
```

Figure 51. Example of NCC_SETUP_POST variable

Note that many setup strings that are currently used in the Workplace Shell, such as OBJECTID and TITLE, will not work using this method. This is due to the fact that NCAPPUTIL uses information from other sources to set these values for the object. Specifically, the OBJECTID is created as <NCID_ plus, the unique application ID>. For example, an application with an ID of WORDPRO would have its OBJECTID set to <NCID_WORDPRO>.

The icon's title is taken from the REMARK field in the network application definition and is, therefore, irrespective of the object's setup string. Note that if a carriage return is necessary in your title, specify the REMARK with the caret character (^) as in "WordPro^Startup".

7.2.2 User exits during startup and logon

The primary change made to the PMLOGON shell was the incorporation of user exits in the code. This modification allows PMLOGON to call a customer-written program to perform custom processing tasks at particular points in the startup and logon process.

There are five points at which the PMLOGON shell can call the user exit program. These are:

- Immediately upon shell startup, that is, immediately after the client workstation boots.

- After starting the LAN Requester but before displaying the logon panel. This exit allows you to display your own logon panel instead of the default logon panel.

- Immediately after logon is successfully completed.

- After the desktop icons are built.

- Immediately after logon if an error has occurred (such as a bad user ID or password).

To enable the user exit code, you must modify the RUNWORKPLACE statement in the client's CONFIG.SYS file as shown in Figure 52.

```
SET RUNWORKPLACE=Z:\OS2\PMLOGON.EXE /URX:Z:\MYEXIT.CMD
```

Figure 52. PMLOGON shell - Modified RUNWORKPLACE statement

The /URX parameter specifies a REXX program that contains the user exit code and which will be called from PMLOGON at the specified points listed above. Note that the user exit program must be a REXX program.

PMLOGON calls the same REXX program for all five user exits. However, it supplies an argument when it calls the program, specifying which exit it actually requires. This is known as the *mode* and is an integer indicating the number of the exit (0 through 4). The user exit program must check the mode argument then call the appropriate routine corresponding to that exit.

Figure 53 on page 107 shows the flow of control when PMLOGON calls a user exit program named MYEXIT.CMD.
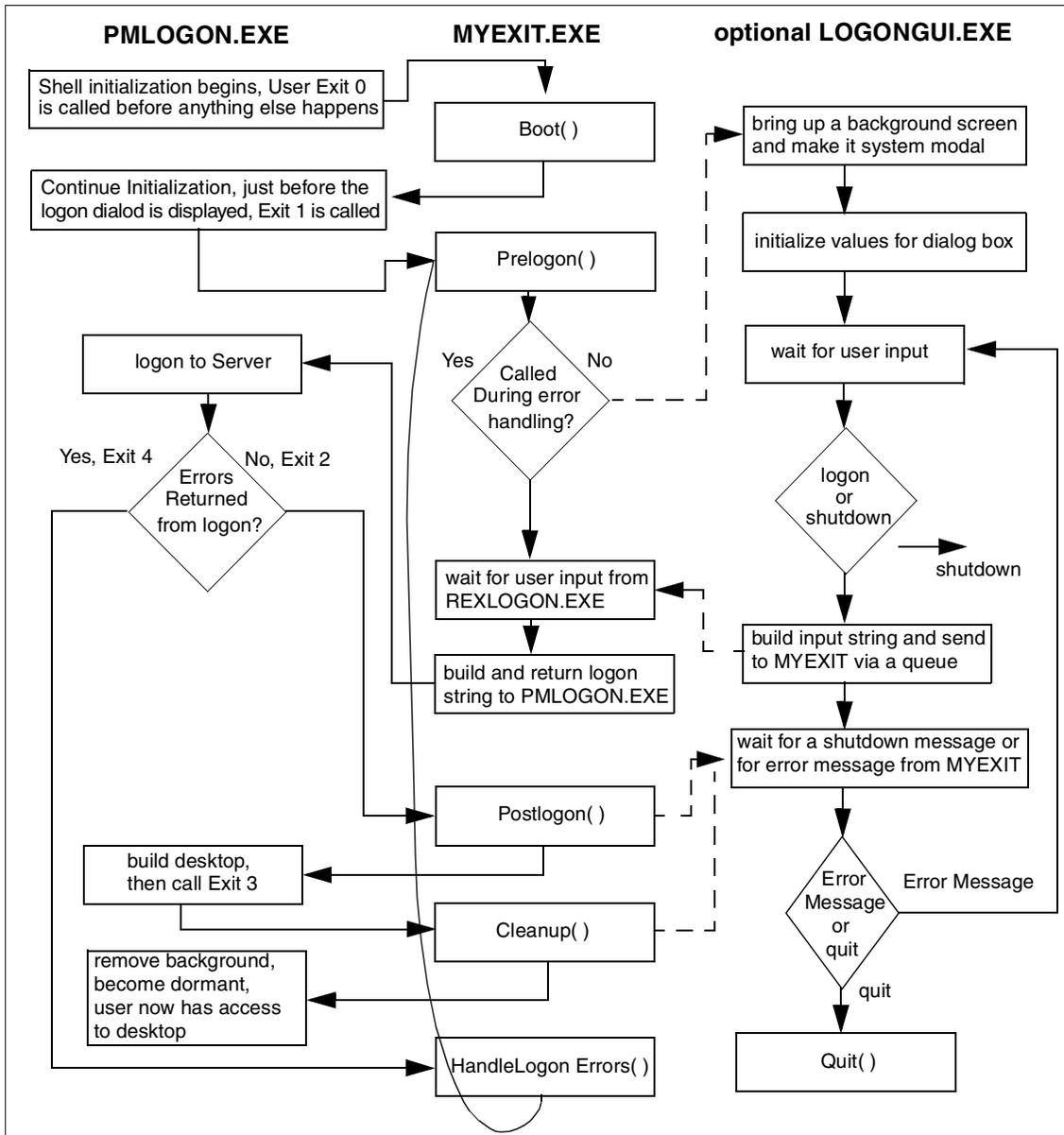
Figure 53. PMLOGON shell - Flow of control for user exits

The following sections will explain the processing that can be performed by each of the user exits. Sample REXX code for the user exit program,

MYEXIT.CMD, is included in Appendix B on page 137 and may be useful as you read the narrative.

7.2.2.1 Exit 0 - Boot time

PMLOGON.EXE calls user exit 0 immediately after it starts. In the sample MYEXIT program, this is the Boot() routine. Exit 0 allows you to start programs and handle issues before the shell is fully operational. Some examples of tasks that you can perform at this time are:

1. Checking IP connectivity

2. Initializing queues for REXX interprocess communications from MYEXIT.CMD

3. Starting programs that must run on all machines (for example, AntiVirus, Netfinity, and so on)

After completing these tasks, MYEXIT returns control to PMLOGON. In our sample program, MYEXIT does not return any data to PMLOGON.

7.2.2.2 Exit 1 - Prior to logon

After the user exit program returns control, PMLOGON starts the LAN Requester task. Before it displays the logon panel, PMLOGON calls exit 1. This is the Prelogon() routine in our sample MYEXIT.CMD.

This exit allows you to substitute your own logon panel for the default logon panel, normally displayed by PMLOGON, and to perform any custom processing prior to logon, or based on the user's input at logon time. This type of customized logon procedure is shown in the control flow illustrated in Figure 53 on page 107.

While our sample program, MYEXIT, simply returns a default user ID and password from exit 1, the user exit program might:

1. Display a custom logon panel, such as that implemented by Bank of America (see Figure 54 on page 109).

2. Wait for input from this custom logon panel.

3. Make changes to a user's LAN server profile or save key information based on the user's input

4. Return logon information to PMLOGON so that it can log on the user's behalf.

Bank of America implemented such a procedure to display a custom logon panel, allowing the user to choose a printer and a "desktop personality" at logon time, as shown in Figure 54.

```
PLT002                                                    OS Version 4.00




                    NationsBank LAN Sign-on

                    User ID              [              ]
                    Password             [              ]
                    New Password         [              ]
                    Workstation Access   [Tennessee Banking Center] [▼]
                    Printer              [1     ] [▼]

                    [      LAN Logon      ]  ▶  [      Shutdown      ]
```
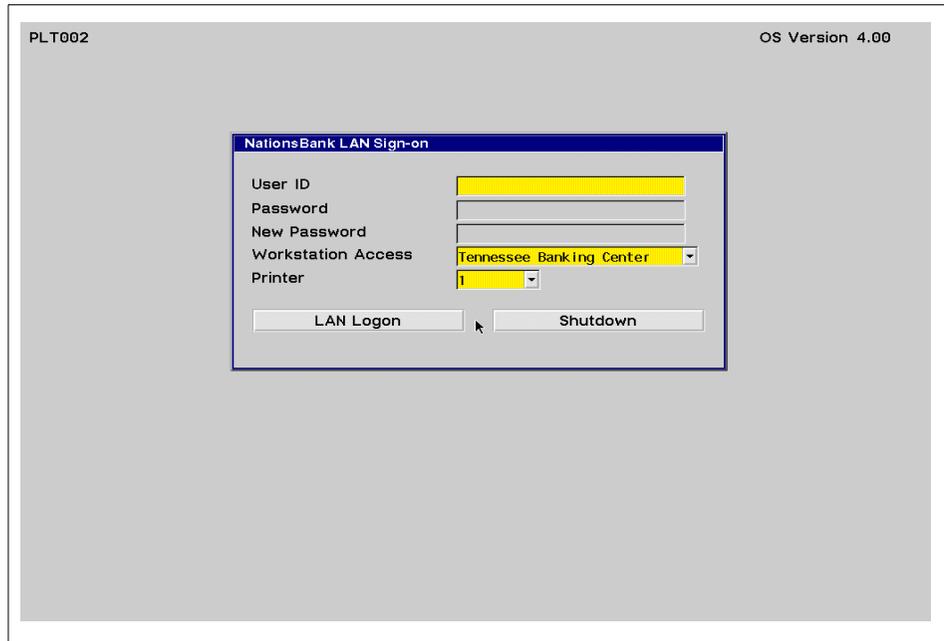
Figure 54. PMLOGON shell - Custom logon panel

When the user exit program gathers logon data as part of its processing for exit 1, it can return that data to PMLOGON, which will then perform the logon for the user. Figure 55 shows the required format of a returned logon string.

```
logonstring = "/AUTO /U:userid /P:password"
```

Figure 55. PMLOGON shell - Logon string format

PMLOGON parses the logon string to obtain the user ID and password and attempts to log on on behalf of the user ID specified. If the logon is successful, PMLOGON then calls exit 2. If the logon fails, PMLOGON calls exit 4 with the UPM return code as the second parameter.

7.2.2.3 Exit 2 - After successful logon

Immediately after a successful logon, PMLOGON calls exit 2. In our sample program, MYEXIT, this is the PostLogon() routine. You can use this exit to perform any required post-logon activities, such as:

1. Running NET USE commands to attach to network resources such as shared drives or printers.

2. Run any custom utilities.

3. Delete temporary files created as part of a custom logon procedure.

4. Back up the user's home directory if this is the user's first logon for the day.

When the user exit program completes its processing, it returns control to PMLOGON. No return values are passed from exit 2.

7.2.2.4 Exit 3 - After building the desktop

When the user exit program returns control after processing exit 2, PMLOGON builds the desktop based on the user's application definitions on the OS/2 Warp Server domain. The network application definition contains everything necessary to create an icon on the desktop, including the name of the executable, any necessary parameters, the icon file, position, and title.

After creating the desktop, PMLOGON calls exit 3. In our sample, MYEXIT, this is the Cleanup() routine.

You can use exit 3 to perform tasks, such as:

- Backing up log files.

- Autostarting applications, such as Personal Communications/3270.

- Closing down any custom logon procedures that might be in use.

After the user exit completes its processing for exit 3, it returns control to PMLOGON with no return data. If the user exit program provided its own custom logon panel, then PMLOGON has nothing more to do. However, if the default logon panel is used, PMLOGON clears it from the screen.

PMLOGON then goes into a dormant state. It is still running, but the logon panel is only reactivated when the user logs off (see Section 7.2.2.6, "Logoff and shutdown" on page 111).

7.2.2.5 Exit 4 - After unsuccessful logon

PMLOGON only calls exit 4 if an error has occurred during logon. In our sample program, MYEXIT, this is the HandleLogonErrors() routine. Exit 4 allows the user exit program to notify the user or take other corrective action.

The user exit program can return a logon string from this exit and must return a logon string if a custom logon panel is in use. The listing for MYEXIT.CMD in Appendix B on page 137 shows how the code for exit 2 is "reused" by exit 4. Note that the UPM error messages are defined in \MUGLIB\UPM.H.

7.2.2.6 Logoff and shutdown

When the user chooses Logoff, the shell performs the following operations:

1. Displays a dialog box warning the user that all programs will be closed and that the user will be logged off.

2. If the user clicks *OK*, all running programs are closed, the user is logged off, and the shell is closed (PMLOGON is "killed").

3. When PMLOGON restarts (it always will restart because it is the shell specified in the RUNWORKPLACE statement in CONFIG.SYS), it will call exit 1.

4. If the user selects **Cancel**, they will be brought back to the desktop with no changes.

Note that exit 0 is not called when PMLOGON restarts. This exit is called only once when the client workstation first boots.

PMLOGON calls the user exit program and invokes exit 1 for the first time when the client boots and every time the user logs off.

Exits 2, 3, and 4 always act the same way. They are called during and after any logon by the user.

The "Shutdown" icon prompts the user to confirm that they want to shutdown. If the user selects **OK**, then all programs will be closed, the user is logged off, and an OS/2 shutdown will occur. The user will know it is complete because OS/2 will display the standard message: "Shutdown has completed. It is now safe to turn off your computer, or restart the system by pressing Ctrl+Alt+Del."

7.2.3 Miscellaneous enhancements

IBM made some additional changes to the PMLOGON shell and its subordinate processes to meet Bank of America's requirements. These changes eliminate the system modality of the PMLOGON process and inhibit the progress indicators that are normally displayed during logon. These changes are invoked using additional parameters in the RUNWORKPLACE statement in CONFIG.SYS as shown in Figure 56.

```
SET RUNWORKPLACE=Z:\OS2\PMLOGON.EXE /NOPI /NOSM1 /URX:Z:\MYEXIT.CMD
```

Figure 56. PMLOGON shell - Additional RUNWORKPLACE parameters

The parameters in the RUNWORKPLACE statement are as follows:

- /NOPI turns progress indicators off. The progress indicators are the small dialogs that animate to show that PMLOGON is processing.

- /NOSM1 removes system modality from PMLOGON.EXE (this means that it won't switch to the foreground while it is processing).

- /URX: specifies the name of the user exit program as described in Section 7.2.2, "User exits during startup and logon" on page 105.

7.3 Replacing the PMLOGON shell

Standard Bank of South Africa

Standard Bank replaced the default PMLOGON shell provided by WorkSpace On-Demand with their own shell, which incorporates its own logon procedures integrated into OS/2 Warp Server's User Profile Management.

Standard Bank also makes use of SOM to eliminate the ability to right-click the mouse button and change settings or delete an object from the desktop. The enforcement of this standardized desktop introduces cost savings since support teams do not have to fix mundane problems created by users of the desktop. The security is implemented by means of subclassing the desktop classes and replacing them with in-house classes.

To implement this security, you can use the INI.RC file in WorkSpace On-Demand to replace the desktop object classes. Figure 57 on page 113 shows the entries made in the INI.RC file.

```
"PM_InstallClass" "WPSDesktop"     "c:\wps\WPS_SEC.dll"
"PM_InstallClass" "WPSProgram"     "c:\wps\WPS_SEC.dll"
"PM_InstallClass" "WPSFolder"      "c:\wps\WPS_SEC.dll"
"PM_InstallClass" "WPS_Printer"    "c:\wps\WPS_SEC.dll"
"PM_InstallClass" "WPSShadow"      "c:\wps\WPS_SEC.dll"
"PM_InstallClass" "WPSSwitch"      "c:\wps\WPS_SEC.dll"

"PM_InstallClassReplacement"  "WPDesktop"     "WPSDesktop"
"PM_InstallClassReplacement"  "WPProgram"     "WPSProgram"
"PM_InstallClassReplacement"  "WPFolder"      "WPSFolder"
"PM_InstallClassReplacement"  "WPPrinter"     "WPS_Printer"
"PM_InstallClassReplacement"  "WPShadow"      "WPSShadow"
```

Figure 57. Desktop class replacement in the INI.RC file

You can also create folders and program objects on the desktop by adding the
appropriate entries to the INI.RC file.

Chapter 8. Supporting additional hardware

This chapter discusses the hardware environments encountered in the different customer installations and describes the machine classes that were required to support the customer's hardware with WorkSpace On-Demand.

8.1 Using the standard machine classes

Sparkasse Freiburg - Noerdlicher Breisgau

For the proof-of-concept at Sparkasse Freiburg - Noerdlicher Breisgau, the bank decided to standardize on IBM PC 350 clients with IBM 16/4 Token-Ring adapters. This enabled the bank to use the standard machine class provided with WorkSpace On-Demand and avoided the need to create additional machine classes.

Subsequently, however, Sparkasse Freiburg - Noerdlicher Breisgau has discovered additional systems and hardware that must be supported and is, therefore, embarking on the creation of new machine classes. See Section 8.3.1, "Adding video adapters" on page 118 for an example.

8.2 Adding Network adapters

Bank of America
Standard Bank of South Africa

The following adapters were supported in the Bank of America environment:

- IBM 16/4 Token-Ring Adapter/A
- IBM MC16 LANSTREAMER
- IBM PCI LANSTREAMER
- IBM PCI Token-Ring Adapter

Standard Bank has two different types of network adapters in the production environment. These are the IBM MC16 Token-Ring Adapter and the IBM PCI Auto LANStreamer adapter. Neither of these adapters are included in the adapter list supplied with WorkSpace On-Demand. The IBM MC16 adapter is not yet supported by WorkSpace On-Demand but is currently being tested for approval. It is likely that the adapter will be approved since it is currently working in a production environment in South Africa.

Both adapters use the same IBMMPC.OS2 device driver, but in order to get both adapters working, you must modify the WorkSpace On-Demand client image as well as several configuration files.

The steps necessary to add the network adapters to a WorkSpace On-Demand server are as follows:

1. Download or obtain the latest DOS and OS/2 device drivers as well as the latest message files for the adapter concerned. The two above mentioned adapters both use IBMMPC.DOS and IBMMPC.OS2 device drivers.

2. Copy the OS/2 device driver and NIF file to the \IBMLAN\RPL\BB10.US\IBMCOM\MACS directory.

3. Copy the message files need to the \IBMLAN\RPL\BB10.US\IBMCOM directory. For example, copy the LT6.MSG file for the IBM PCI LANStreamer adapter.

4. Create a directory for the DOS device drivers and copy them into this directory. Alternatively, place them in the \IBMLAN\DOSLAN\LSP\DOS directory.

5. Create or copy PROTOCOL.INI files for both DOS and OS/2. Place the DOS PROTOCOL.INI file in the \IBMLAN\RPL\DOS\adapter directory, where *adapter* refers to the directory you have created for the new driver or the directory you have modified to incoporate this new adapter. Place the OS/2 PROTOCOL.INI in the \IBMLAN\RPL\DOS\adapter\OS2 directory.

6. Create a CNF file for the new adapter. It is easier to modify an existing CNF file than to create one from scratch. Use a CNF file that is closely matched to the type of adapter you are using. Standard Bank used the BB1USLS.CNF file.

   Both the IBM MC16 and the IBM PCI LANStreamer Token-Ring adapters used the same CNF file. In order for both adapters to use the same CNF file, some modifications were required. Figure 58 on page 117 shows the final CNF file.

```
OS/2 Boot Block Configuration
; (IBM LANStreamer MC 32 Adapter)
DAT DOS\MFSD20.SYS
ORG 1000H
LDR BB10.US\OS2LDR ~ OS2LDR UFSD.SYS MFSD20.SYS
DAT DOS\UFSD.SYS
RPL DOS\RPLBOOT.SYS
DAT DOS\TOKNLS32\PROTOCOL.INI
DAT c:\IBMLAN\DOSLAN\LSP\DXM.MSG
DAT c:\IBMLAN\DOSLAN\LSP\DOS\LTC.MSG
EXE c:\IBMLAN\DOSLAN\LSP\NETBIND.COM ~ ~ ~
DRV c:\IBMLAN\DOSLAN\LSP\DXMJ0MOD.SYS ~ 16 ~
DRV c:\IBMLAN\DOSLAN\LSP\DXMA0MOD.SYS 001 ~ ~
DRV c:\IBMLAN\DOSLAN\LSP\DOS\IBMMPC.DOS ~ 16 ~
DRV c:\IBMLAN\DOSLAN\LSP\PROTMAN.DOS /I: ~ ~
```

Figure 58. CNF file for MC16 TRN and Auto LANStreamer adapters

If incorrect settings are used in the CNF file, you may get unexpected results. For example, the adapter may not open. Remember that the required settings may not always be the same as on an ordinary desktop system.

7. If you created a new CNF file, you must modify the NDISDD.PRO file to reflect the new entries for the adapters. Standard Bank modified an existing CNF file, and, hence, there was no need to add a record to NDISDD.PRO.

8. If you created a new CNF file and changed the NDISDD.PRO file, you must also modify the RPL.MAP file to reflect your changes.

The adapter will now be available for use with WorkSpace On-Demand.

Note that these steps are generic and can be applied to add any network adapter to a WorkSpace On-Demand server provided that OS/2 device drivers exist for the adapter.

8.3 Modifying the existing machine classes

This section describes ways in which you can add support for different hardware by modifying the existing machine classes supplied with WorkSpace On-Demand. Note that Section 8.3.2, "Adding Micro Channel support" on page 119 describes how to add support for Micro Channel systems. This was implemented by Standard Bank of South Africa as a

modification to the existing ISAVGA.MC machine class, but could equally well have been implemented as a new machine class. Which of these two implementation methods you choose for your installation is simply a matter of choice.

8.3.1 Adding video adapters

Sparkasse Freiburg - Noerdlicher Breisgau

After completing the proof-of-concept exercise at Sparkasse Freiburg - Noerdlicher Breisgau, the bank decided to deploy a new video adapter in many of its client workstations. This adapter, the Matrox MGA 64 adapter, is not on the list of adapters supplied with WorkSpace On-Demand, and, consequently, the bank needed to create a new machine class to support this adapter.

The machine class was generated using the steps described in Chapter 8, "WorkSpace On-Demand Machine Classes" in the *WorkSpace On-Demand Handbook Release 2.0*, SG24-5117. Specific entries required in the CONFIG.SYS file for the machine class are shown in Figure 59.

```
REM **** NCVIDEO BEGIN ****
DEVINFO=SCR,VGA,Z:\OS2\BOOT\VIOTBL.DCP
SET VIDEO_DEVICES=VIO_MGA
DEVICE=Z:\MGA\OS2\KMGAX64.SYS
SET MGA=Z:\MGA\OS2
SET VIO_MGA=DEVICE(BVHVGA,BMGAX64)
DEVICE=Z:\OS2\MDOS\VVGA.SYS
DEVICE=Z:\OS2\MDOS\VMGAX64.SYS
REM **** NCVIDEO END ****
```

Figure 59. CONFIG.SYS Entries for the Matrox MGA 64 video adapter

Note that you must add these statements at the end of the CONFIG.SYS file. If they are added in any other location, the new video support will not work.

You must also add entries to the FIT file for the machine class as shown in Figure 60 on page 119. These provide the necessary redirections for the DLLs and video drivers.

```
; support for the I300PL8 machine class, 800x600 MGA
; video support for the Matrox MGA 64 driver

Z:\OS2\DLL\BMGAX64.DLL     BB10.de\OS2\VIDEO\MGA64\BMGAX64.DLL
Z:\OS2\DLL\PMGAX64.DLL     BB10.de\OS2\VIDEO\MGA64\PMGAX64.DLL


Z:\OS2\MDOS\VMGAX64.SYS BB10.de\OS2\VIDEO\MGA64\VMGAX64.SYS Z:\OS2\MDOS\VVGA.SYS
BB10.de\OS2\VIDEO\MGA64\VVGA.SYS Z:\OS2\MDOS\WINOS2\SYSTEM\SMGAX64.DRV
BB10.de\OS2\VIDEO\MGA64\SMGAX64.DRV
Z:\OS2\MDOS\WINOS2\SYSTEM\MGAX64.DLLBB10.de\OS2\VIDEO\MGA64\MGAX64.DLL
Z:\OS2\MDOS\WINOS2\SYSTEM\8514fix.fon  BB10.de\OS2\VIDEO\MGA64\8514fix.fon
Z:\OS2\MDOS\WINOS2\SYSTEM\8514oem.fon  BB10.de\OS2\VIDEO\MGA64\8514oem.fon
Z:\OS2\MDOS\WINOS2\SYSTEM\8514sys.fon  BB10.de\OS2\VIDEO\MGA64\8514sys.fon


Z:\MGA\OS2\KMGAX64.SYS  BB10.de\OS2\VIDEO\MGA64\KMGAX64.SYS Z:\MGA\OS2
BB10.de\OS2\VIDEO\MGA64
Z:\MGA                      BB10.de\OS2\VIDEO
```

Figure 60. Machine FIT file entries for Matrox MGA 64 video adapter

From the above entries in the FIT file, you can see the necessary files that must be copied into the correct locations within the machine class directory structure and the \OS2\VIDEO directory structure. See the *WorkSpace On-Demand Handbook Release 2.0*, SG245117, for more information and specific examples of how to create a directory structure to handle new video adapters.

8.3.2 Adding Micro Channel support

Standard Bank of South Africa

Standard Bank has two different client hardware platforms. The majority of client workstations are IBM PC 730 ISA/PCI machines, while a smaller number are IBM PS/2 Model 76i Micro Channel machines.

All machines are created from a single machine class that has been modified to accommodate both types of machines. The REXX procedure, which creates the machines, determines what type of machine it is building and manipulates the CONFIG.SYS accordingly.

A flat text file is read by the REXX procedure to determine the machine type. This flat text file is created at the data collection time when information on the installed adapters is collected. The EXE that determines the machine type is a BIOS call. This type of executable can be modified by any enterprise to determine exactly what type of hardware is being dealt with.

Standard Bank required additional hardware support in order to use the PS/2 Model 76i machines as WorkSpace On-Demand clients. Rather than create a

separate machine class for these machines, however, Standard Bank modified the existing ISAVGA.MC machine class to support both MCA and ISA bus machines.

This change requires certain files to be copied into the machine class directory structure and some changes to be made to the CONFIG.SYS file in order to get both machines working out of one machine class. The CONFIG.SYS file must then be further manipulated at client creation time, depending on the type of machine being defined.

The Advanced BIOS (*.BIO) files must be copied into the BB10.US image along with the ABIOS.SYS file. The following BIO files must be copied to the \IBMLAN\RPL\BB10.US\OS2 directory.

```
000000.BIO   F80A01.BIO   F80903.BIO
F80000.BIO   F80A02.BIO   F80904.BIO
F80100.BIO   F80C00.BIO   F80A00.BIO
F80200.BIO   F80D00.BIO   W020101.BIO
F80402.BIO   F80D01.BIO   W050000.BIO
F80403.BIO   F81000.BIO   W050100.BIO
F80404.BIO   F81B00.BIO   W050101.BIO
F80600.BIO   F88000.BIO   W060100.BIO
F80700.BIO   FC0400.BIO   W0F0000.BIO
F80701.BIO   FC0403.BIO
F80702.BIO   FC0500.BIO
F80703.BIO   SF83900.BIO
F80704.BIO   SF8B000.BIO
F80902.BIO   W020100.BIO
```

Figure 61. Advanced BIOS (.BIO) files copied into client image*

The ABIOS.SYS file must be copied to \IBMLAN\RPL\BB10.US\OS2\BOOT. Make sure that you copy the correct ABIOS.SYS file that will support your hardware type.

The CONFIG.SYS statements required are as follows:

```
BASEDEV=IBM2FLPY.ADD
BASEDEV=IBMINT13.I13
BASEDEV=PRINT02.SYS
```

You can load many device drivers in your CONFIG.SYS, and the drivers will co-exist. At Standard Bank, the CONFIG.SYS file copied from the machine class directory structure is modified at client creation time to REM out the

BASEDEV=PRINT02.SYS statement if the client is not a Micro Channel machine. For Micro Channel machines, however, this statement is required in order for the machines to print correctly.

It is also important to ensure that non-listed printer drivers are copied into the correct directories as installed on a desktop system. The DLLs or drivers that are required may require their own directory under the OS/2 directory. In this case, you must modify the FIT file to correctly redirect the new files.

8.3.3 Supporting peripheral devices

Standard Bank of South Africa

The peripherals supported at Standard Bank of South Africa vary from check readers to different types of printers. The additional hardware was supported by statements in the CONFIG.SYS and vendor supplied device drivers. There was no problem implementing these devices under WorkSpace On-Demand, and they worked in exactly the same manner as they would in a traditional client server environment. No special machine classes were derived to support these additional hardware types.

8.4 Creating new machine classes

Bank of America

Bank of America has six different types of client hardware, each of which uses a separate machine class. The six classes are as follows:

- IBM PS/2 Model 76
- IBM PS/2 Model 77
- IBM PC 330
- IBM PC 350
- IBM PC 300 XL
- IBM PC 300 GL

All of Bank of America's machine classes support a video resolution of 1024x768, with both SVGA and XGA adapters.

Many of these machine classes originated from the need to support the different token-ring adapters. The machines are generated automatically from a registration process, and the supporting machines classes have been developed in order to simplify coding at machine creation time. If these machine classes did not exist, then decisions, such as what PROTOCOL.INI

and what CONFIG.SYS to use, would have to be dealt with in the code used to create new machines.

8.4.1 General methodology

The machine classes have all been modified from existing machine classes that are close to the hardware type that the machine class is being created for. The machine class is then modified to support a specific adapter and video resolution. The ISA/PCI machine classes are typically taken from the \IBMLAN\RPL\MACHINES\BB10.US directory and modified to add PROTOCOL.INI, FIT file, CONFIG.SYS, OS2.INI, and hardware-specific device drivers or required files.

The Micro Channel machines also make use of these machine classes, but further work needs to be done in order to support Micro Channel machines. Once this is complete, the adapter and video specific files and additions are added.

8.4.2 Tools and utilities used to create machine classes

Bank of America
Standard Bank of South Africa

The Bank of America team made extensive use of the following tools to implement the new machine classes. The Bank of America team has several proprietary tools that they have used, along with generally available tools, including:

- DatagLANce
- FWATCH
- INI editors to obtain INI file changes. REXX code is available on the WorkSpace On-Demand CD-ROM.
- File comparison programs.

Standard Bank of South Africa used generally available tools to modify and customize WorkSpace On-Demand during machine class creation as well as during the proof of concept and the analysis and design phase. The tools used are as follows:

- Fluke LANMETER for electronic measurement of the network.
- INI Editors to manipulate the INI files.
- FWATCH to ascertain the return codes received from file I/O. This tool was also used for performance tuning of the LIBPATH and other similar statements in CONFIG.SYS.

- In-house REXX command files and executables to create printer icons and install printer drivers.
- REXX command files to create and delete users.
- FDISK.EXE to toggle between network boot and booting from a client's own hard disk.
- IEEERES.EXE to obtain adapter information.

This part of the book describes the technical aspects of implementing WorkSpace On-Demand in each customer enterprise. The experiences encountered during proof-of-concept projects divide these aspects into two major categories, each of which are examined separately.

Chapter 3, "Proving the Concept,"discusses the nature and scope of the proof-of-concept projects carried out by each customer. This chapter provides insight into how other organizations may design their own proof-of-concept activities for WorkSpace On-Demand.

Chapter 4, "Planning and Deployment Techniques," describes some of the techniques that you can use to assist in the planning phase of a WorkSpace On-Demand roll out and some helpful hints that improve the effectiveness of your WorkSpace On-Demand deployment.

Chapter 5, "Integrating Applications," examines the existing network applications and middleware environments that the customers implemented on the WorkSpace On-Demand client workstations and describes the techniques required to make these applications and middleware utilities work.

Chapter 6, "Customizing the User Interface," discusses the ways in which you can modify or replace the default user shell to customize the appearance of your WorkSpace On-Demand client desktop.

Chapter 7, "Supporting Additional Hardware," discusses the different types of systems and peripheral devices that were encountered during the proof-of-concept exercises and the techniques by which the customers provided support for these systems and peripherals in the WorkSpace On-Demand client operating system.

Appendix A. Client definition program WSOD_NEW.CMD

This is a sample program and must be rewritten and thoroughly checked
before being used. The command file does not do any checking to see if
directory structures are in place. The command file can be modified to add
error checking and logging.

```
/* WSOD_NEW.CMD                                                             */
/****************************************************************************/
/*                                                                          */
/* Date:     22-04-1998                                                     */
/* Author:   RM Van Der Walt                                                */
/* Customer: Standard Bank of  South Africa                                 */
/* Ver 1.08:                                                                */
/* Utility:  This utility gives you the ability to create and              */
/*           delete new WSOD users.                                         */
/*           This utility reads a ini file to obtain info about the users.  */
/****************************************************************************/
Call RXFUNCADD 'SysLoadFuncs', 'RexxUtil', 'SysLoadFuncs'
Call SysLoadFuncs

/* Trace ?r                                                                 */
ER = 0
TEMP = Arg(1)


/* initialize the variables                                                 */
NET_FUNC = '*'
MACADDR = '*'
REQ_NAME = '*'
ADAPTER = '*'


Parse Upper Var TEMP ARG.FUNCTION ' ' REQ_NAME ' '

ARG.FUNCTION  = STRIP( ARG.FUNCTION )
REQ_NAME = STRIP( REQ_NAME )

/* Collecting arguments                                                     */
/* arguments are req_name or all to add or delete users                     */

Parse Upper Var TEMP ARG.FUNCTION ' ' REQ_NAME ' ' MACADDR


/* Get Mac address if supplied as command line input                        */

ARG.FUNCTION  = STRIP( ARG.FUNCTION )
MACADDR = STRIP( '/MA:'|| MACADDR )


Parse Upper Var TEMP ARG.FUNCTION ' ' REQ_NAME ' ' MACADDR ' ' ADAPTER

ARG.FUNCTION  = STRIP( ARG.FUNCTION )
ADAPTER = STRIP( '/ADA:' || ADAPTER)


If ( ARG.FUNCTION == "ADD" )
 Then
    NET_FUNC = " /ADD "
```

```
If ( ARG.FUNCTION == "DELETE" )
 Then
   NET_FUNC = " /Delete "


/*** check the size and delete the log if it is too big **              */

If ( STREAM( "wsod_new.LOG" ,'c','QUERY SIZE') > '1240' )
 Then

   '@DEL wsod_new.LOG'

   If (STREAM( "wsod_new.log" ,'c','open write') <> 'READY:')
 Then

   ER = 1


 Else

   ER = Write_log( 'RIPLUSER.CMD STARTED  ' || NET_FUNC  )



/* Checking arguments                                                  */

Parse Upper Var TEMP ARG.COUNT

ARGC = WORDS(ARG.COUNT)

If ( ARGC < 2 & REQ_NAME \= 'ALL' )
 Then
   Do
    Say 'Usage of this program requires the following parameters:'
    Say 'RIPLUSER [ADD/DELETE] [REQUESTER NAME] '
    Say 'Replace [REQUESTER] with [ALL] to do all stations'
    Return( 1 )


   End


/* Obtaining server id's                                               */

DB_ID=STRIP(SysIni('C:\NDMSB\WKSTN.INI','GLOBAL','DATABASE_SERVER'))
FS_ID=STRIP(SysIni('C:\NDMSB\WKSTN.INI','GLOBAL','FILE_SERVER'))



ER = 0

I = 0

/* Determine the net riplmach function add                             */
/* or delete  / requester name or all                                  */
/* If function = delete  then delete the requester or all requesters   */
If (  NET_FUNC == ' /Delete ' )
 Then
   Do
    If ( REQ_NAME == 'ALL' )
     Then
       Do
        Call SysIni 'C:\ndmsb\WKSTN.INI', 'All:', 'Apps.'
```

```
                 Do I = 1 To APPS.0
                  If ( APPS.I \= 'GLOBAL'  &  APPS.I  \=  FS_ID
                  &  APPS.I  \=  DB_ID )
                    Then
                       Do
                        Say "Deleting ripluser: " || APPS.I
                        OS2_CMD = '@NET RIPLMACH ' || APPS.I || ' ' || NET_FUNC
                        Address CMD OS2_CMD
                        If (RC \= 0)
                          Then
                             Do
                              ER = Write_log( 'NET RIPLMACH ' || NET_FUNC
                                 || ' Failed for '
                                 || APPS.I )

                             End                                         /* do */
                           Else
                             Do
                              ER = Write_log( 'NET RIPLMACH ' || NET_FUNC
                                 || ' Successull for '
                                 || APPS.I )

                             End                                         /* Do */
                        End
                 End                                                     /* do */
               Else
                 Do
                  Say "Deleting ripluser: " || REQ_NAME
                  OS2_CMD = '@NET RIPLMACH ' || REQ_NAME || ' ' || NET_FUNC
                  Address CMD OS2_CMD
                  If (RC \= 0)
                    Then
                       Do
                        ER = Write_log( 'NET RIPLMACH ' || NET_FUNC
                           || ' Failed for '
                           || REQ_NAME )

                       End                                               /* do */
                     Else
                       Do
                        ER = Write_log( 'NET RIPLMACH ' || NET_FUNC
                           || ' Successull for '
                           || REQ_NAME )

                       End                                               /* Do */
                 End
            End                                                          /* Do */

/* if function = add then add requester or all requesters                   */
 Else
   Do
    If ( REQ_NAME == 'ALL' )
      Then
         Do
          Call SysIni 'C:\NDMSB\WKSTN.INI', 'All:', 'Apps.'
          Do I = 1 To APPS.0
           If ( APPS.I \= 'GLOBAL'  &  APPS.I  \=  FS_ID
           &  APPS.I  \=  DB_ID )
             Then
                Do
                 ER = Cre_del_user(APPS.I , NET_FUNC)
                End
```

```
                   End                                              /* do */
                 End
              Else
                 Do
                  ER = Cre_del_user(REQ_NAME , NET_FUNC)
                 End                                                /* do */
           End                                                     /* do */

   Exit

   /* Logging procedure                                                    */

   WRITE_LOG: Procedure
   MSG = Arg(1)


   ER = 0


   ER = LINEOUT( "wsod_new.log" , DATE('E') ||,
     ' ' ||,
     TIME() ||,
     ' ' ||,
     MSG )



   Return(ER)


   /* Function to add a requester or all requesters                        */

   CRE_DEL_USER: Procedure
   REQ_NAME = ' '

   REQ_NAME = Arg(1)

   NET_FUNC = Arg(2)

   If ADAPTER == '/ADA:'
    Then
       Do
        ADAPTER = ' /ADA:"IBM Streamer Family Adapter (IBMMPC.OS2)" '
       End


   BOOTDRV = '/B:C '
   MACHCLASS  = '/C:ISAVGA '
   ENABLED    = '/E:YES '
   OPSYSTEM = '/O:bb10.us '
   REMARKS = '/REM:"WorkSpace On Demand user Comment" '
   SWAPPING = '/SW:L '
   TCPDOM  = '/TCPD:IBM.NET '
   TCPNAM  = '/NI:9.3.53.58 '

   SERVER = SysIni('C:\CDM\TMP\DISTRIB.INI','Distribution','Wkstn_ID')
   SERVER = '/SE:' || SERVER  || ' '
   SERVER = '/SE:VANDEX16 '


   NEW = REQ_NAME    ||,
     NET_FUNC        ||,
     ADAPTER         ||,
```

```
    BOOTDRV         ||,
    MACHCLASS       ||,
    ENABLED         ||,
    MACADDR         ||,
    OPSYSTEM        ||,
    REMARKS         ||,
    SERVER          ||,
    SWAPPING        ||,
    SUBNET          ||,
    IPADDR          ||,
    ROUTER          ||,
    TCPDOM          ||,
    TCPNAM          ||,
    TCPHOST

/* Obtaining the parameters from the ini file                           */

PRINTER1 = '*'
NWPRINTER1 = '*'
ADAPT_TYPE = SysIni('C:\NDMSB\WKSTN.INI',REQ_NAME,'ADAPT_TYPE')
ADAPTER = '/ADA:"' || ADAPT_TYPE || '" '
ADAPT_ADDR = STRIP(SysIni('C:\NDMSB\WKSTN.INI',REQ_NAME,'ADAPT_ADDR'))
LU_2_ID = STRIP(SysIni('C:\NDMSB\WKSTN.INI',REQ_NAME,'LU_2_ID'))
MACADDR = '/MA:' || ADAPT_ADDR || ' '
PRN_DEVICE = SysIni('C:\NDMSB\WKSTN.INI',REQ_NAME,'PRN_DEVICE')
PRN_QUEUE2 = STRIP(SysIni('C:\NDMSB\WKSTN.INI',REQ_NAME,'PRN_QUEUE2'))
ALTBJ300 = STRIP(SysIni('C:\NDMSB\WKSTN.INI',REQ_NAME,'ALTBJ300'))
IP_ADDR = STRIP(SysIni('C:\NDMSB\WKSTN.INI',REQ_NAME,'IP_ADDR'))
IPADDR = '/I:' || IP_ADDR || ' '
ROUT_ADDR = STRIP(SysIni('C:\NDMSB\WKSTN.INI','GLOBAL','ROUT_ADDR'))
ROUTER = '/RI:' || ROUT_ADDR  || ' '
NET_MASK = STRIP(SysIni('C:\NDMSB\WKSTN.INI','GLOBAL','NET_MASK'))
SUBNET = '/SU:' || NET_MASK || ' '
TCPHOST = '/TCPN:' || REQ_NAME || ' '

/* The code below is not actually used, but                             */
/* is an example of using NET RIPLMACH                                  */
/* to create printers.                                                  */


If ( PRN_QUEUE2 == 'BJ300')
 Then
   Do
     PRN_DRV = 'IBMNULL'
    End
If ( PRN_QUEUE2 == 'BJ330')
 Then
   Do
     PRN_DRV = 'IBMNULL'
    End
If ( PRN_QUEUE2 == 'LBP8111R')
 Then
   Do
     PRN_DRV = 'CAPSL.LBP-8IIIR'
    End
If ( PRN_QUEUE2 == '')
 Then
   Do
     PRN_DRV = 'IBMNULL'
     PRN_QUEUE2 = 'BJ300'
    End

If (PRN_QUEUE2 == '')
```

```
              Then
                Do
                 PRINTER1 = '/PRINTER1:"' || 'PRINTER!,IBMNULL,LPT1"'
                 PRINTER2 = '/PRINTER2:"NQ BJ300,CANONBJ.Canon BJ-300,LPT4" '
                 PRINTER3 = '/PRINTER3:"WProQ,CAPSL.LBP-8IIIR,LPT3" '
                End                                                         /* do */
              Else
                Do
                 PRINTER1 = '/PRINTER1:"' || PRN_QUEUE2 || ',' || PRN_DRV || ',LPT1" '
                 PRINTER2 = '/PRINTER2:"LAN,' || PRN_DRV || ',LPT2" '
                 PRINTER3 = '/PRINTER3:"NQ BJ300,CANONBJ.Canon BJ-300,LPT4" '
                 PRINTER4 = '/PRINTER4:"WProQ,CAPSL.LBP-8IIIR,LPT3" '
                End                                                         /* do */
            /****************************************************************************/

            NEW = REQ_NAME    ||,
              NET_FUNC        ||,
              ADAPTER         ||,
              BOOTDRV         ||,
              MACHCLASS       ||,
              ENABLED         ||,
              MACADDR         ||,
              OPSYSTEM        ||,
              REMARKS         ||,
              SERVER          ||,
              SWAPPING        ||,
              SUBNET          ||,
              IPADDR          ||,
              ROUTER          ||,
              TCPDOM          ||,
              TCPNAM          ||,
              TCPHOST


            If ( PRN_QUEUE2 == ''  )
              Then
                Do
                 Say "Creating ripluser: " || REQ_NAME
                 /* This would the command line to include printers in NET RIPLMACH      */
                 /*  os2_cmd = '@NET RIPLMACH ' || new
                                                  || ' '
                                                  || printer1
                                                  || printer2
                                                  || printer3                            */
                 OS2_CMD = '@NET RIPLMACH ' || NEW
                 Address CMD OS2_CMD
                End                                                         /* do */
              Else
                Do
                 /* This would the command line to include printers in NET RIPLMACH      */
                 /* os2_cmd = '@NET RIPLMACH ' || new
                                                  || ' '
                                                  || printer1
                                                  || printer2
                                                  || printer3
                                                  || printer4                            */
                 OS2_CMD = '@NET RIPLMACH ' || NEW
                 Address CMD OS2_CMD
                End                                                         /* Do */

            If (RC \= 0)
              Then
                Do
```

```
              ER = Write_log( 'NET RIPLMACH ' || NET_FUNC
                || ' Failed for '
                || REQ_NAME )

            Return(ER)

          End                                              /* do */
       Else
         Do
           ER = Write_log( 'NET RIPLMACH ' || NET_FUNC
             || ' Successull for '
             || REQ_NAME )

         End                                               /* Do */
/* The section below copies files, manipulates the config.sys         */
/* and os2.ini for each specific                                      */
/* machine being created - This manipulation will vary from site to site. */
OS2_CMD = '@echo off'
Address CMD OS2_CMD
OS2_CMD = 'md c:\ibmlan\rpl\machines\' || REQ_NAME || '\cmlib'
Address CMD OS2_CMD
OS2_CMD = 'copy c:\user\' || REQ_NAME
   || '\acscfg.* '
   || 'c:\ibmlan\rpl\machines\'
   || REQ_NAME
   || '\cmlib'
Address CMD OS2_CMD
OS2_CMD = 'md c:\ibmlan\rpl\machines\' || REQ_NAME
   || '\pcomos2'
Address CMD OS2_CMD
OS2_CMD = 'copy c:\user\sessiona.ws c:\ibmlan\rpl\machines\'
   || REQ_NAME
   || '\pcomos2'
Address CMD OS2_CMD
OS2_CMD = 'c:\swapstr c:\ibmlan\rpl\machines\'
   || REQ_NAME
   || '\pcomos2\sessiona.ws "LUName=XXXXXXXX" "LUName='
   || LU_2_ID
   || '" -i'
Address CMD OS2_CMD
OS2_CMD = 'md c:\ibmlan\rpl\machines\' || REQ_NAME
   || '\sqllib'
Address CMD OS2_CMD
OS2_CMD = 'md c:\ibmlan\rpl\machines\' || REQ_NAME
   || '\sqllib\sqldbdir'
Address CMD OS2_CMD
OS2_CMD = 'copy c:\user\' || REQ_NAME
   || '\sqldb*.* '
   || 'c:\ibmlan\rpl\machines\'
   || REQ_NAME
   || '\sqllib\sqldbdir'
Address CMD OS2_CMD
OS2_CMD = 'md c:\ibmlan\rpl\machines\' || REQ_NAME
   || '\sqllib\sqlnodir'
Address CMD OS2_CMD
OS2_CMD = 'copy c:\user\' || REQ_NAME
   || '\sqlno*.* '
   || 'c:\ibmlan\rpl\machines\'
   || REQ_NAME
   || '\sqllib\sqlnodir'
Address CMD OS2_CMD
OS2_CMD = 'copy c:\user\' || REQ_NAME
   || '\sqlsystm '
```

```
                || 'c:\ibmlan\rpl\machines\'
                || REQ_NAME
                || '\sqllib\sqlsystm'
Address CMD OS2_CMD
OS2_CMD = 'copy c:\user\' || REQ_NAME
   || '\cnf*.* '
   || 'c:\ibmlan\rpluser\'
   || REQ_NAME
   || '\sb\data'
Address CMD OS2_CMD
OS2_CMD = 'c:\swapstr c:\ibmlan\rpl\machines\'
   || REQ_NAME
   || '\config.sys "SWAPPATH=C:\ 4096 16384" "SWAPPATH=D:\ 4096 16384" -i'
Address CMD OS2_CMD
Call Rxswap 'c:\ibmlan\rpl\machines\'
   || REQ_NAME
   || '\IBMCOM\PROTOCOL.INI  %NetAddress = "4000A9876543"%  %NetAddress = "4000' ||
REQ_NAME || '"%'
OS2_CMD = 'copy c:\user\' || REQ_NAME
   || '\BDCSB.CFG '
   || 'c:\ibmlan\rpluser\'
   || REQ_NAME
Address CMD OS2_CMD
Call SysIni 'c:\ibmlan\rpluser\'
   || REQ_NAME
   || '\os2\os2.ini' , 'PMGRE', 'DISPLAYHOOK', 'EQNPMGRE'
Call SysIni 'c:\ibmlan\rpluser\'
   || REQ_NAME
   || '\os2\os2.ini' , 'PM_ED_HOOKS', 'MODULENAME', 'EQNPMGRE'
Call SysIni 'c:\ibmlan\rpluser\'
   || REQ_NAME
   || '\os2\os2.ini', 'SYS_DLLS', 'Load', 'EQNCLHOT '
OS2_CMD = 'c:\ndm\bin\nvdmufm.exe f:\bds\9702\tsg\tmp\wslan.tmp c:\ibmlan\rpl\machines\'
   || REQ_NAME
   || '\ibmlan\ibmlan.ini /ndi:c:\ndmsb\wkstn.ndi /ws:'
   || REQ_NAME
Address CMD OS2_CMD
OS2_CMD = 'md c:\ibmlan\rpluser\' || REQ_NAME
   || '\SB\DOC'
Address CMD OS2_CMD
OS2_CMD = 'copy c:\user\' || REQ_NAME
   || 'tps_p001.cfg '
   || 'c:\ibmlan\rpluser\'
   || REQ_NAME
Address CMD OS2_CMD
FERNANDO = SUBSTR(REQ_NAME,2,7)
OS2_CMD = 'copy c:\user\rou_d001.dat c:\ibmlan\rpluser\'
   || REQ_NAME
Address CMD OS2_CMD
OS2_CMD = 'copy c:\user\' || REQ_NAME
   ||'\bdcsb.cfg c:\ibmlan\rpluser\'
   || REQ_NAME
Address CMD OS2_CMD
OS2_CMD = 'copy c:\user\spi.cfg c:\ibmlan\rpluser\' || REQ_NAME
Address CMD OS2_CMD
OS2_CMD = 'copy c:\user\' || REQ_NAME
   ||'\dimodule.cfg c:\ibmlan\rpluser\'
   || REQ_NAME
Address CMD OS2_CMD
OS2_CMD = 'copy c:\user\sbstart.cmd c:\ibmlan\rpl\machines\'
   || REQ_NAME
Address CMD OS2_CMD
OS2_CMD = 'copy c:\user\sbstart.cmd c:\ibmlan\rpluser\'
```

```
       || REQ_NAME
Address CMD OS2_CMD
OS2_CMD = 'rename c:\ibmlan\rpluser\'
   || REQ_NAME
   || '\sbstart.cmd NOPEER'
Address CMD OS2_CMD
Call Rxswap 'c:\ibmlan\rpl\machines\'
   || REQ_NAME
   || '\sbstart.cmd % \\XXXXXXXX % % \\'
   || FS_ID
   || ' %'
Call Rxswap 'c:\ibmlan\rpl\machines\'
   || REQ_NAME
   || '\CONFIG.SYS %CALL=C:\OS2\CMD.EXE /Q /C C:\MPTN\BIN\MPTSTART.CMD >NUL% %REM
CALL=C:\OS2\CMD.EXE /Q /C C:\MPTN\BIN\MPTSTART.CMD >NUL%'
/* change to add id's to desktop , You are connect to                    */
RIPL_SERV = SysIni('C:\CDM\TMP\DISTRIB.INI','Distribution','Wkstn_ID')
Call Rxswap 'c:\ibmlan\rpluser\'
   || REQ_NAME
   || '\os2\ini.rc % XXXXXXXX % % '
   || REQ_NAME
   || ' %'
Call Rxswap 'c:\ibmlan\rpluser\'
   || REQ_NAME
   || '\os2\ini.rc % YYYYYYYY % % '
   || RIPL_SERV || ' %'
OS2_CMD = 'del c:\ibmlan\rpluser\'
   || REQ_NAME
   || '\os2\os2.ini'
Address CMD OS2_CMD
OS2_CMD = 'makeini c:\ibmlan\rpluser\'
   || REQ_NAME
   || '\os2\os2.ini c:\ibmlan\rpluser\'
   || REQ_NAME
   || '\os2\ini.rc'
Address CMD OS2_CMD
Call SysFileSearch 'FALSE'  , 'c:\user\'
   || REQ_NAME
   || '\9576.sty'  , 'res.' , 'N'
If  RES.0 > 0
 Then
   Do
    OS2_CMD = 'c:\swapstr c:\ibmlan\rpl\machines\'
       || REQ_NAME
       || '\config.sys "REM BASEDEV=PRINT01.SYS" "BASEDEV=PRINT01.SYS" -i'
    Address CMD OS2_CMD
    OS2_CMD = 'c:\swapstr c:\ibmlan\rpl\machines\'
       || REQ_NAME
       || '\config.sys "BASEDEV=PRINT02.SYS" "REM BASEDEV=PRINT02.SYS" -i'
    Address CMD OS2_CMD
   End                                              /* then do */
OS2_CMD = 'c:\swapstr c:\ibmlan\rpluser\'
   || REQ_NAME
   || '\sb\cfg\bdcgf001.cfg "\\A9973233\PMON" "\\'
   || FS_ID
   || '\pmon" -i'
Address CMD OS2_CMD
Say "Created ripluser:  " || REQ_NAME
   || " successfully"
OS2_CMD = '@echo off'
Address CMD OS2_CMD
If (RC \= 0)
 Then
```

```
     Do
      ER = Write_log( 'ERROR: Certain files required to create the user '||
       'were not present for ' || REQ_NAME )

     End                                                            /* do */
    Else
     Do
      ER = Write_log( 'NET RIPLMACH ' || NET_FUNC
         || ' Successull for '
         || REQ_NAME )
     End                                                            /* Do */


    Return(ER)
```

Appendix B. Client definition data file WKSTN.NDI

This flat text file needs to be converted to an INI file. The WSOD_NEW program reads the INI files and obtains information about the machine being created from this file.

```
/* an example of what an INI file should consist of  */
/* This flat text file gets converted to an INI file */
/* with keys and applications.                       */

GLOBAL
     DOMAIN="XXXXDOM1"
     FILE_SERVER="XXXXACAE"
     DATABASE_SERVER="XXXXACED"
     CICS="PRT2CICS"
     COMMS_COMMENT="IBM TEST LAN"
     MAN_SRV_ID="XXXXACAE"
     FS_TIC_ID="400000000000"
     DB_TIC_ID="400000000000"
     AMP="&"
     FS_ID_NUM="BD005"
     DB_ID_NUM="BD006"
     LEN_APPN="L"
     SIZE="M"
     ADAPTER="A"
     COMMS_TYPE="R"
     BRANCH_IND="P"
     A02="\\XXXXACDC\AGNCY"
     DATABASE_NAME="RICHARD"
     SQLENSEG="XXXX"
     NUMRC="255"
     MAXAPPLS="200"
     BUFFPAGE="800"
     TOTAL_RECIEVERS="15"
     MAX_LINKS="160"
     RIP1="XXXXRIP1"
     RIP2="XXXXRIP2"
     RIP3="XXXXRIP3"
     ROUT_ADDR="9.1.3.1"
     NET_MASK="255.255.255.0"
ENDGLOBAL

// DATABASE SERVER
NODE XXXXACED
     WKSTN_ID="XXXXACED"
     LU_2_ID="XXXXPDZP"
     LOCATION="&BRN&"
     SRV_REQ="SRV"
     WS_TYPE1="9595"
     WS_TYPE2="S36"
     WS_SERIAL1="55"
     WS_SERIAL2="6D2C1"
     WKSTN_NUM="WKST0002"
     HOST_NAU_ADDRESS="002"
     LASER=""
     BJ330=""
     ALTBJ300=""
     PRINTER1="LPT1  : \\XXXXACD6\LAN"
     PRN_DEVICE=""
     PRN_COMMENT=""
     PRN_QUEUE2=""
```

```
                    LU_0_ID=""
                    HOST_NAU_0=""
                    NODE_ID="AACED"
                    LOGON_ID="XXXXXXXX"
                    DEST_ADDRESS="XXXXXXXXXXX"
                    ALTERNATIVE_FS_ADDRESS="XXXXXXXXXXX"
                    ALTERNATIVE_FS_ID="XXXXXXXX"
                    SERVER_TYPE="BACKUPDC"
                    IP_ADDR="9.1.3.44"
                    APPLICATIONS="00000000000000000000"
                    CENTER_NUM="0000"
                    APPL_SERVER="XXXXXXXX"
                    ROUT_ADDR="9.1.3.22"
                    NET_MASK="255.255.255.0"
            ENDNODE

            // FILE SERVER
            NODE XXXXACAE
                    WKSTN_ID="XXXXACAE"
                    LU_2_ID="XXXXPDXX"
                    LOCATION="&BRN&"
                    SRV_REQ="SRV"
                    WS_TYPE1="9595"
                    WS_TYPE2="S36"
                    WS_SERIAL1="55"
                    WS_SERIAL2="6D2A8"
                    WKSTN_NUM="WKST0004"
                    HOST_NAU_ADDRESS="004"
                    LASER=""
                    BJ330=""
                    ALTBJ300=""
                    PRINTER1="LPT1  : \\XXXXACD6\LAN"
                    PRN_DEVICE=""
                    PRN_COMMENT=""
                    PRN_QUEUE2=""
                    LU_0_ID=""
                    HOST_NAU_0=""
                    NODE_ID="XXXXX"
                    LOGON_ID="XXXXXXXX"
                    DEST_ADDRESS="XXXXXXXXXXX"
                    ALTERNATIVE_FS_ADDRESS="XXXXXXXXXXX"
                    ALTERNATIVE_FS_ID="XXXXACED"
                    SERVER_TYPE="DOMAINCONTROLLER"
                    IP_ADDR="9.1.3.33"
                    APPLICATIONS="00000000000000000000"
                    CENTER_NUM="0000"
                    APPL_SERVER="XXXXACAE"
                    ROUT_ADDR="9.1.3.22"
                    NET_MASK="255.255.255.0"
            ENDNODE

            // BRANCH WORKSTATION
            NODE XXXXACAF
                    WKSTN_ID="XXXXACAF"
                    LU_2_ID="XXXXPDXY"
                    LOCATION="&BRN&"
                    SRV_REQ="SRV"
                    WS_TYPE1="6876"
                    WS_TYPE2="4V1"
                    WS_SERIAL1="55"
                    WS_SERIAL2="9A5RV"
                    WKSTN_NUM="WKST0005"
                    HOST_NAU_ADDRESS="005"
```

```
        LASER="LPT9  : \\XXXXACCF\LAN"
        BJ330="LPT7  : \\XXXXACAF\LAN"
        ALTBJ300="LPT2  : \\XXXXACA0\LAN"
        PRINTER1=""
        PRN_DEVICE="IBMNULL"
        PRN_COMMENT="Bubble Jet 330"
        PRN_QUEUE2="BJ330"
        LU_0_ID=""
        HOST_NAU_0=""
        NODE_ID="0XXXX"
        IP_ADDR="9.1.3.46"
        APPLICATIONS="00000000000000000000"
        CENTER_NUM="0000"
        LOGON_ID="XXXXXXXX"
        DEST_ADDRESS="XXXXXXXXXXXX"
        SERVER_TYPE="ADDITIONALSERVER"
        APPL_SERVER="XXXXACAE"
        ROUT_ADDR="9.1.3.22"
        NET_MASK="255.255.255.0"
        ADAPT_ADDR="0004ACXXXXXX"
        ADAPT_TYPE="IBM T-R Shared RAM Family (UP/SMP, IBMTOK.OS2)"
ENDNODE
```

Appendix C. User exit program MYEXIT.CMD

```
/* MYEXIT.CMD */
/* load external functions */
call RxFuncAdd 'SysLoadFuncs', 'RexxUtil', 'SysLoadFuncs'
call SysLoadFuncs

parse arg mode error .

select
   when mode = 0 then
      call Boot()
   when mode = 1 then
/* if you bypass the logon screen, you must return a logon string here! */
      return Prelogon( "N" )
   when mode = 2 then
      call Postlogon
   when mode = 3 then
      call Cleanup
   when mode = 4 then
/* a logonstring must be returned here! */
      return HandleLogonErrors( error )
otherwise
   /* log your error here */
end  /* select */
exit
/**********************************************************************/
Boot:

/* insert your code here */

return
/**********************************************************************/
Prelogon:

parse arg internal

/* this CAN BE called as a separate exit (internal = "N") AND from */
/* HandleLogonErrors (internal = "Y") */
/* insert code here that should not be run AGAIN if an error occurs */
if internal \= "Y" then
   do
      /* if you have a custom logon GUI, start it here */
   end /* do */
/* if you have a custom logon GUI: */
/*    we pause here until the user enters data/makes choices */
```

```
/*     and clicks on Logon in the GUI, assume that we */
/*     have gotten the following returned: */
userid = "USERID"
password = "PASSWORD"
/* then we build the logonstring to pass back to PMLOGON */

logonstring = "/AUTO /U:"userid" /P:"password

/* return the userid and optional password so that PMLOGON can continue */
return logonstring
/************************************************************************/
Postlogon:

/* insert your code here */

return
/************************************************************************/
Cleanup:

/* insert your code here */

return
/************************************************************************/
HandleLogonErrors:

parse arg lsrc

/* convert the return code to HEX */
lsrc = d2x( lsrc )

/* see muglib\upm.h for a list of these values */
select
   when lsrc = FB05 then
      errmsg = errtext"Invalid user ID. RC = "lsrc
   when lsrc = FB16 then
      errmsg = errtext"User is already logged on elsewhere.  RC = "lsrc
   when lsrc = FB17 then
      errmsg = errtext"Password has expired.  RC = "lsrc
   when lsrc = FB18 then
      errmsg = errtext"The domain server is unavailable.  RC = "lsrc
otherwise
   errmsg = errtext"Unknown error from LAN Logon.  RC = "lsrc
end  /* select */

/* if you have a custom logon GUI: */
/* send the contents of errmsg to the logon GUI for display to the user */
```

```
/* call Prelogon() so that it can properly build the logon string again */
logonstring = Prelogon( "Y" )

return logonstring
/**********************************************************************/
```

Appendix D. Special notices

This publication is intended to help IBM Customers and Business Partners to evaluate and implement WorkSpace On-Demand in their business and technical environments. The information in this publication is not intended as the specification of any programming interfaces that are provided by WorkSpace On-Demand. See the PUBLICATIONS section of the IBM Programming Announcement for WorkSpace On-Demand for more information about what publications are considered to be product documentation.

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Appendix E. Related publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this redbook.

E.1 IBM Redbooks

For information on ordering these publications see "How to get IBM Redbooks" on page 151.

- *WorkSpace On-Demand Handbook Release 2.0*, SG24-5117
- *WorkSpace On-Demand 2.0 Feature for Windows Clients*, SG24-5396

E.2 IBM Redbooks collections

Redbooks are also available on the following CD-ROMs. Click the CD-ROMs button at `http://www.redbooks.ibm.com/` for information about all the CD-ROMs offered, updates and formats.

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Glossary

Additional Server. A server in an OS/2 Warp Server domain other than the domain controller. An additional server may be configured as a backup domain controller and will automatically take over the functions of the domain controller should the domain controller fail.

Administrator. A person who manages a LAN or group of LANs running OS/2 Warp Server and WorkSpace On-Demand and who is responsible for creating and maintaining client workstation, end users, and application definitions.

Alias. A name by which a resource can be referenced and accessed on a LAN. Aliases are normally referenced using the Universal Naming Convention (UNC).

Application Server. Server on which network applications are installed for access by end users on client workstations. Note that an application server may also act as a file, print, or boot server.

Backup Domain Controller. A additional server running OS/2 Warp Server to which user, resource, and access control information is replicated dynamically from the domain controller. In the event of a system failure at the primary domain controller, the backup domain controller can take over transparently to the end user.

Boot Image. Directory structure on a boot server that contains the clients' operating system files and, optionally, shared application files.

Boot Server. A server, running OS/2 Warp Server and WorkSpace On-Demand Server, used to remotely boot client workstations.

Boot Storm. Scenario whereby a large number of client workstations are simultaneously booting from a boot server, thus, creating a heavy demand on the server and network resources. A boot storm typically occurs as a result of a power outage, after which all clients boot simultaneously when power is restored.

Client. See Client Workstation.

Client Workstation. A physical machine, typically a personal computer, that is used by an end user to perform business tasks. In a WorkSpace On-Demand environment, a client (also known as a client workstation) loads its operating system from a WorkSpace On-Demand server.

Domain. A group of servers running OS/2 Warp Server, which share their resources for use by end users on client workstations. Resources in a domain can typically be accessed using only a resource's alias, without regard to the particular server on which the resource resides.

Domain Controller. Primary server in an OS/2 Warp Server domain, which authenticates end users' and client workstation's access requests for resources.

End User. A person who uses a client workstation to perform business tasks.

File Index Table. Table used to redirect file access requests from a client workstation's logical "boot drive" to the appropriate location on the boot server. Commonly known as a FIT or FIT file. There are two distinct types of file index table: The *machine FIT* and the *user FIT*.

File Server. Server that shares its disk space on a LAN for access by end users on client workstations. Note that a file server may also act as an application, print, or boot server.

IBM. International Business Machines.

ITSO. International Technical Support Organization.

Machine Class. Set of device drivers and other hardware-specific files that are required to support a particular hardware configuration. Each client workstation in a WorkSpace On-Demand environment must belong to a particular machine class from which it derives its hardware-specific operating system components.

Machine FIT. File index table that contains redirection entries for operating system files and for those application files that are shared by all users of the application.

Mutual Failover. Situation whereby two or more servers provide automatic backup for one another. In WorkSpace On-Demand, this feature is provided automatically as part of OS/2 Warp Server's RIPL architecture whenever a client workstation is defined to two or more boot servers; it does not need to be explicitly configured.

Network Application. An application that is installed on a server and accessed by one or more end users on client workstations on a LAN.

Network Resource. See Resource.

OS/2 Warp Server. 32-bit Intel-based network server operating system.

Print Server. Server that shares its attached printers on a LAN for access by end users on client workstations. Note that a print server may also act as an application, file, or boot server.

Public Application. See Network Application.

RIPL Server. See Boot Server.

Reference Client. A network client workstation running OS/2 Warp 4, which is used to determine the correct file locations and environment settings when installing network applications.

Resource. An item such as a directory, printer, or serial device, which can be shared by a server and accessed by client workstations on a LAN.

Segment. A single local area network in which network traffic passes freely between attached systems without the need to pass through a bridge or router.

Server. A machine running OS/2 Warp Server, which shares its resources on a LAN for use by end users on client workstations. When running OS/2 Warp Server, a server may be defined as a domain controller or an additional server.

Shared Resource. See Resource.

Universal Naming Convention. System of nomenclature, whereby a network alias is referenced by its server name followed by the alias name within the server. For example, an alias might be \\RPLSRVR\WRKFILES, where RPLSRVR is the server name, and WRKFILES is the alias name.

User. See End User.

User FIT. File index table that contains redirection entries for operating system and/or application files that are unique to a particular end user.

WorkSpace On-Demand. A set of management utilities that enables an OS/2 Warp Server server to remotely load a thin client operating system, known as WorkSpace On-Demand Client, into a client workstation across a LAN.

WorkSpace On-Demand Client. The client workstation component of WorkSpace On-Demand, which is loaded into a client workstation from a server machine running OS/2 Warp Server and WorkSpace On-Demand Server.

WorkSpace On-Demand Server. (1) The server component of WorkSpace On-Demand, which is installed on top of OS/2 Warp Server. See also WorkSpace On-Demand Client. **(2)** A server running OS/2 Warp Server and WorkSpace On-Demand, which is used to boot client workstations.

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