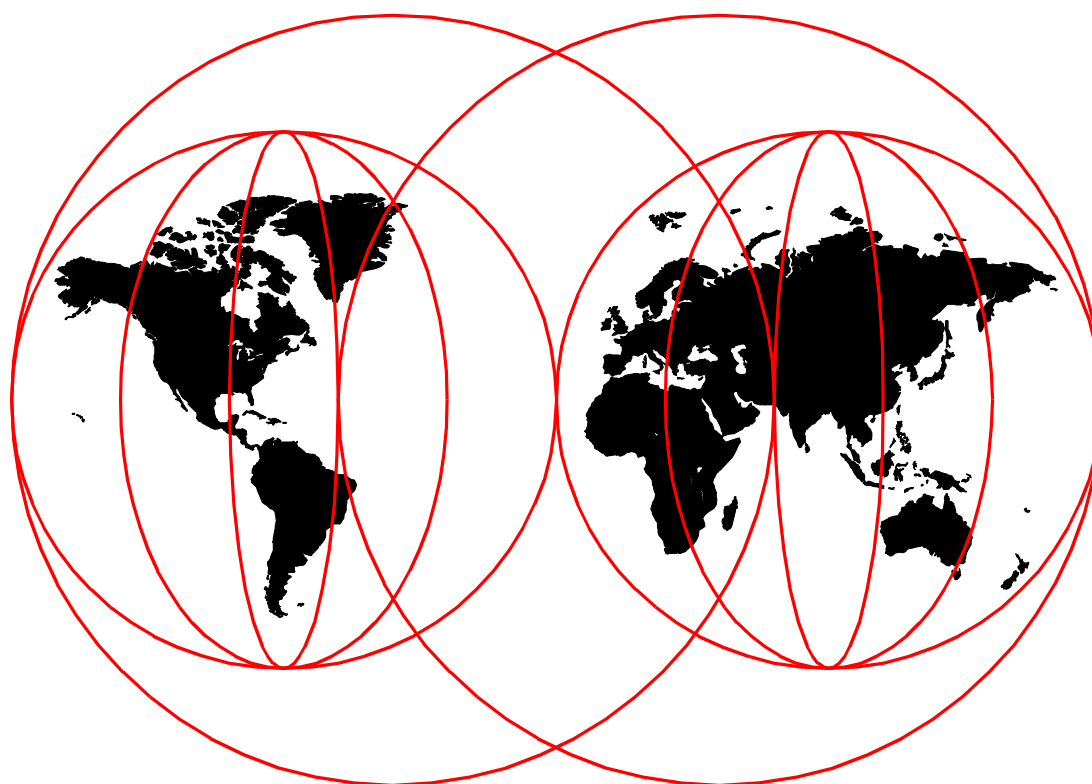# Multiprise 3000 Technical Introduction

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Multiprise 3000 Technical Introduction

November 1999

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│                                                                            │
│  Before using this information and the product it supports, be sure to read the general information in Appendix E, │
│  "Special Notices" on page 123.                                            │
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First Edition (November 1999)

This edition applies to the first shipments of the IBM Multiprise 3000 systems.

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Contents

Preface

This redbook describes the Multiprise 3000 system, with emphasis on configuration and device emulation details. It is intended for readers quite knowledgeable in S/390 and OS/390 areas, and uses common S/390 and OS/390 terms and acronyms without further explanations.

Author and Contributors

The author of this document is **Bill Ogden**. He is a retired IBM Systems Engineer who enjoys working with entry-level OS/390 systems and with the users of such systems. Bill has been with the ITSO for many years. Since his retirement, he participates part-time with the ITSO, and also works as an independent consultant.

Contributors:

Chuck Berghorn, with the P/390 development group, designed and guided much of the emulated I/O capabilities used with the Multiprise 3000.

Karen Miller, with S/390 Customized Solutions, built several of the preloaded OS/390 systems used with the Multiprise 3000.

Mike Fick and **Marilyn Zeppetelli**, with S/390 Customized Solutions, helped with initial system software.

Dennis Ng, with the Washington Systems Center**,** helped with IOCDS examples and with configuration discussions.

Reza Kaffashan, with the IBM PartnerWorld for Developers group, helped provide the Application Development CD-ROM for this system.

Jay Hall, with the P/390 development group, helped us understand LAN adapter customization.

Martin Ziskind, system design owner, provided special hardware details and updates.

John Hupcey, with the P/390 development group, helped us with the Emulated I/O device managers and configurator.

Lou Voerman, with the P/390 development group, provided the emulated ECKD functions used with the Multiprise 3000.

Bill Spraul, with the S/390 division, provided coordination for the pre-release Multiprise 3000 we obtained.

Carmine Castaldo, with P/390 development, helped us understand channel operations and options.

Krisanne Wallner, program manager for the Multiprise 3000, helped us review much of the material in this redbook.

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Chapter 1. Introduction and Positioning

The Multiprise 3000 is a significant new S/390 family of processors. It *potentially* replaces many of the S/390 systems between P/390s (on the small end) and the smaller 9672 processors (on the large end). This includes S/390 Integrated Servers model B01, Application StarterPaks, many of the Multiprise 2000 systems, 9221 systems, and older S/390 machines.

Multiprise 3000 uses P/390 technology to provide inexpensive connections for LAN 3270s and other LAN/WAN connections. The P/390 technology also provides for use of CD-ROM distribution of software, without requiring corresponding OS/390 support for CD-ROM devices. However, a Multiprise 3000 provides much more processing power than P/390 systems, and provides full LPAR, cryptographic (optional), and internal Coupling Facility functions. In a sense, Multiprise 3000 mixes the convenience and packaging of P/390 systems with the processor power and facilities of a larger S/390 machine, resulting in a very attractive entry-level S/390 machine.

Multiprise 3000 is a fully-compatible S/390 system. It can use any (or all) of the current S/390 operating systems. This redbook, however, concentrates on its use with OS/390. Other documentation discusses the VM and VSE operating systems.

IBM intends to offer a number of *preloaded* operating system options for Multiprise 3000s. These are based on standard OS/390[1] releases, and will include various other priced software features and program products. The preloads are intended as convenience packages and, in some cases, will offer a package price that may be more attractive than the sum of the individual prices of the components. The preloaded software will, in general, also be available on removable media (such as CD-ROMs). System usage is not limited to these preload packages, of course. With appropriate licensing, any current S/390 software can be used.[2]

A small Multiprise 3000, using only internal I/O, can be used in an office environment, using "wall plugs" for power. A larger Multiprise 3000 system, with many channel cables, would be better used in a raised-floor environment. In both cases, power and cooling requirements are minimal. Multiprise 3000 includes a considerable range of internal disk capacities, as well as internal functions for connecting LANs, WANs, and a limited tape capability. ESCON and parallel channels may be used to connect to external S/390 I/O control units and devices.

1.0.0.1 Multiprise 3000 Positioning

As the product name implies, the Multiprise 3000 is related to the existing Multiprise 2000 series. In terms of raw MIPS performance, the Multiprise 3000 overlaps the larger range of Multiprise 2000 systems; in particular, it is in the range of Multiprise 2000 models 227 through 246. Internal disk capacities of the 3000 are somewhat larger than these 2000 models, but are within the same general range.

Clearly, the Multiprise 3000 could replace all the Multiprise 2000 models below, say, the 227 model, as well as many older S/390 models, if the comparison

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[1] Preloads are not limited to OS/390, but *this* redbook deals only with OS/390 and does not discuss options for other operating systems.
[2] One OS/390 SPE (Small Program Enhancement, a software update) is required before internal disks can be used. This is discussed in a later chapter.

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factors are limited to MIPS and disk space. In this range, the Multiprise 3000 price/performance is clearly superior--which is not surprising, since it represents a new generation of technology.

However, some of the price/performance advantages of the Multiprise 3000 are obtained through emulated I/O functions. These are described throughout this redbook. For the purposes of positioning the Multiprise 3000, we must note that the RAS characteristics are quite different than those of the Multiprise 2000 or 9672 systems. Some Multiprise 3000 RAS features are more advanced than the Multiprise 2000 or older 9672 systems, and some are not as good. This gives an additional dimension to any positioning discussion, with the result being that the prospective owner must decide on his own tradeoffs between RAS and price/performance.

1.1 Hardware: Brief Overview

A Multiprise 3000 system includes both processors and I/O devices. This differs from traditional larger mainframes where I/O devices, including control units, are external to the basic system "box." The Multiprise 3000 processor(s) provide significant price/performance and packaging advantages, but are otherwise typical of current S/390 CMOS processors. The integrated I/O functions include implementations that differ considerably from current S/390 CMOS processors.

1.1.1 Processor(s)

A Multiprise 3000 system includes one or two S/390 processors. These are based on the same CMOS chips used in the "G5" series of larger S/390 systems. These processors provide the full range of S/390 central functions, including:

- S/390 performance much faster than previous entry-level OS/390 systems

- PR/SM and LPAR definitions, with shared chpid and shared device capabilities

- Full IOCDS definitions

- Ability to define internal Coupling Facility partitions, with both IC and ICMF functions

- Service Element (SE) console functions

- Extensive internal RAS functions

- Allocation of main storage between LPARs, central storage, extended storage, and Hardware Service Area (HSA) usage.

- Inclusion of a System Assistance Processor (SAP), in addition to the one or two S/390 processors.

- Use of an optional cryptographic processor

- Full S/390 instruction set, including all the "new" instructions (and including the binary (IEEE) floating point instructions)

- Subsystem Storage Protect function

The system design permits one or two S/390 processors, plus the SAP. The design precludes adding more processors.

1.1.2 Types of I/O Connections

There are three distinct types of I/O for Multiprise 3000. These are:

1. Conventional ESCON and parallel channels connected to traditional S/390 control units and devices. In this redbook, we will use the term *external I/O* for these devices.

2. Internal disks, using SAP functions to *appear* as IBM 3380 and/or 3390 drives connected through an IBM 3990-2 control unit. We use the term *primary disks* for this I/O.

3. Emulated devices, using P/390 technology. These include emulated disk drives, emulated 3174 local control units, LAN connections, WAN connections, tape drives, printers, and card readers. We use the term *emulated I/O* for these functions.

All of these types of I/O are discussed throughout this redbook. We briefly describe them here as part of the system overview. The terms *external I/O*, *primary disks*, and *emulated I/O* are not standard terms. However, we will use them consistently in this document and attempt to avoid unnecessary confusion when discussing various types of I/O. We suggest you pay particular attention to these terms when they appear in the text.

1.1.2.1 External I/O

A Multiprise 3000 can have up to 24 (in the base system box) or 56 (including an expansion box) conventional channels. These can be a mixture of ESCON and parallel channels. These are standard channels, and can access switches and control units that are parts of existing installations.

The ESCON channels can operate through ESCON directors, and can appear as CNC, CTC, or CVC channels[3]. Distance and connection specifications are the same as for existing S/390 systems. Likewise, the parallel channels have the same specifications as similar channels on existing S/390 machines.

1.1.2.2 Primary Disks

A considerable amount of disk space is available internally. The S/390 operating systems sees this space as 3380 or 3390 devices connected through 3990-2 control unit(s) connected to a single channel. The actual disk drives are SSA drives in RAID-5 arrays[4]. Similar drives might be found on large PC servers or UNIX machines. A mixture of hardware (a special adapter) and software (Licensed Internal Code in the SAP) creates the appearance of ECKD 3380/3390 units.[5] Using SE console controls, the system owner can define various combinations of 3380 and 3390 volumes on these disks.

The *smallest* Multiprise 3000 with internal primary disks has 72 GB of effective primary disk space, while the largest current system has 792 GB. We say *effective* disk space, because allowance must be made for RAID-5 overhead and *hot spare* drives. The smallest system has, for example, 108 GB actual disk space, but this becomes 72 GB after subtracting the hot spare and RAID-5 overhead.

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[3] A CNC ESCON channel is connected to an ESCON control unit or director. A CVC ESCON channel is connected to an IBM 9034 converter, often known as a *Pacer* unit. A CTC ESCON channel is connected to a CNC ESCON channel to provide a connection between two systems (or within the same system).

[4] The recovery characteristics of the RAID-5 arrays are somewhat different from "standard" RAID-5; this is disucssed later.

[5] This is obviously an emulation function, but this term *emulation* is not used for these drives.

Primary disks are not required; a Multiprise 3000 system may have no primary disks. This might be appropriate when S/390 DASD requirements can be met with external connections (via ESCON or parallel channels).

These primary disks are currently based on 18 GB, 10000 RPM, SSA drives. The base system box has room for 16 drives, while expansion boxes (maximum of two) each hold up to 20 drives.

1.1.2.3 Emulated I/O

This is the most unusual area of the Multiprise 3000, although for users of P/390, R/390, or S/390 Integrated Server machines it will be quite familiar. The Multiprise 3000 includes an internal PC system, based on a Single Board Computer (SBC), running OS/2. This SBC subsystem has its own disk drives: three 9 GB drives in a RAID-5 array. These are separate drives from the primary system drives. These three drives are always present and should not be confused with the primary disks described earlier.

OS/2 programs are used to provide the Service Element (SE) function, various utility functions, and to provide emulated I/O functions and devices. The SE and utility functions are described later and are incidental to the emulated I/O functions.   The SBC is attached to a PCI bus, and has the usual PC array of on-board I/O connections including a display adapter, a keyboard, serial and parallel ports, and an Ethernet adapter. A CD-ROM drive, a 4mm tape drive, and a diskette drive are included with the system. In addition, a number of LAN adapters can be installed on the PCI bus, and SDLC/BSC adapters on an internal ISA bus.

Using these PC-type adapters and devices, this subsystem can emulate a wide range of S/390 devices, including:

- A local IBM 3174 control unit. This permits LAN tn3270 sessions connected through OS/2 TCP/IP to appear as local, non-SNA, channel-attached 3270 terminals. The MVS master console, for example, can use a 3270 session connected in this manner.

- An IBM 3172 SNA control unit, for LAN connections to VTAM.

- An IBM 3172 TCP/IP control unit, for LAN connections to OS/390 TCP/IP.

- A special IBM 3172 SNA control unit that permits WAN (up to 16 SDLC lines) connections to appear as LAN SNA sessions.

- An IBM 9221 Integrated Communications Adapter (ICA) for both bisync and SDLC connections. (OS/390 does not support these interfaces.)

- Emulated disk drives, limited to the space available on the 9 GB drives. Emulation can include 3390, 3380, 3350, 3330, 9345, and FBA devices, with non-standard numbers of cylinders for the defined drives. (These are known as *emulated disk drives*, whereas the 18 GB drives described earlier provide the *primary disk drives*.) After allowing for OS/2, the SE functions, and the various device manager and utility programs, about 14 GB of space is available for emulated disks. The emulated disk function can be especially useful as a staging mechanism from CD-ROM to the primary disks.

- Emulated mainframe tape drives, using SCSI-attached drives (with the IBM 3490-F01 being the primary supported drive).

- Emulated line printers, using PC laser printers.

The emulated I/O capabilities are described in more detail later. As an overview, we should note that they provide very attractive functions for entry-level systems. Based on PC-type adapters, the hardware involved is inexpensive yet provides useful connectivity and service capability. For example, a quite useful system serving dozens, or even hundreds, of users can be built with only the primary disks and emulated devices found in the base Multiprise 3000 box.

1.2 System Limitations

The Multiprise 3000 does not have all the functions and features of the current, larger S/390 systems. In particular, it has the following limitations:

- No external (ISC or ICB) Coupling Facility (CF) channels are available, meaning that the Multiprise 3000 cannot be part of an external Parallel Sysplex. (Internal Coupling Facility functions are available, and a Parallel Sysplex can be created within a single Multiprise 3000.)
- The internal disks (primary and emulated) cannot be shared with other S/390 systems. However, the Multiprise 3000 can share external S/390 disks with other S/390 systems.
- No OSA adapters are available. However, emulated I/O devices provide the same services as OSA adapters, although possibly with less usable bandwidth.
- No CPU sparing is available. That is, there are no extra S/390 or SAP processors in the system, to be used as spares in the event of a failure.
- No FICON channels are available.
- The design is limited to two processors plus the SAP processor.
- Portions of the system, particularly in the Single Board Computer (SBC) area, do not have redundant hardware for recovery purposes.
- Portions of the system, particularly in the SBC area, do not have concurrent maintenance capabilities.
- The storage sizes available (1 to 4 GB) are tied to the system model. There is currently no option to add more storage to models H30 and H50.
- An SPE (Small Product Enhancement, a software upgrade) is required for OS/390 operation using the chpid types required for the internal disks (both primary and emulated disks). This limits use with older OS/390 releases and prior versions of the operating system.

Chapter 2. System Structure and Configurations

The following table provides one view of the system. Note that a system will have two or three processors; the System Assist Processor (SAP) is another S/390 processor that is used (internally) to manage the I/O subsystem. Either one or two S/390 processors are available for OS/390 and user applications.[1]

The P30 model is effectively the same as the H30 model, and we ignore it in the remainder of this document. The different model number (P30) is used when specifying a total package for members of IBM's PartnersWorld for Development organization (formerly known as S/390 Partners in Development).

Standard Models S/390 Partners-in-Development Models	Common specifications	7060-H30 7060-P30	7060-H50	7060-H70
Performance (typical TSO workloads)[a]		0.52 x	1.0 x	1.83 x
Number of processors		1+SAP	1+SAP	2+SAP
Main Storage (incl disk cache, HSA)		1 GB	2 GB	4 GB
LPAR partitions	Up to 15			
Cryptographic processors	0 (standard), 1(feature)			
Maximum number of channels	24 in base box, 56 with expansion box (ESCON and/or parallel)			
Maximum primary disks, base unit	16 x 18 GB drives. 10000 RPM. RAID-5. Effective 216 GB			
Maximum primary disks, expansion unit	20 x 18 GB in each of two expansion units. Effective 288 GB			
P/390 emulated 3380/3390/etc	3 x 9 GB (RAID 5). Usable space 14 GB. 10000 RPM.			
LAN connections (emulated)	4, Ethernet or token ring or mixture			
Number of expansion units allowed	Two: "cage A" and "cage B"			
Size (base and each expansion unit)	20" (W) x 43" (D) x 31.5" (H) [52cm x 111 cm x 81.9cm]			
Weight	220 - 340 pounds [100 - 155kg] (max weights include battery backup)			
Integrated Battery Feature (IBF)	0 (standard), 1 (feature), 2 (feature)			
Power (base, each expansion unit)	1320 Watts 120-240 volts, 50/60 Hertz, single phase			
Software Group number[b]		H30	H50	H70

a. MIPS numbers vary, depending on the nature of the workload, and are often misused for comparison purposes. IBM has not provided "official" MIPS numbers for these systems and the numbers shown here represent the relative performance of the three models.

b. These software group numbers are new and do not correspond to any previous software pricing groups.

This table reflects the maximum number of external channels (24 in the base system box), but does not reflect the internal channels. One internal channel (chpid) is used for all the primary internal disks in the base frame, and another internal channel is used for all the emulated I/O devices.[2] These two internal

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[1] Larger S/390 products use the term PU to mean a processor that might be used as a CPU (OS/390 processor), a SAP, or a spare. Thus a Multiprise 3000 can have two or three PUs and one or two CPUs plus a SAP.

[2] Emulated I/O means I/O devices that are emulated by P/390 technology. This can include several types of CKD and FBA disk drives, 3274 control units and devices, 3172 control units and LAN/WAN attachment, 34xx tape drives, and so forth.

channels are chpids FD and FC, respectively. We can configure a useful system with no external channels. We will explore several configuration examples later.
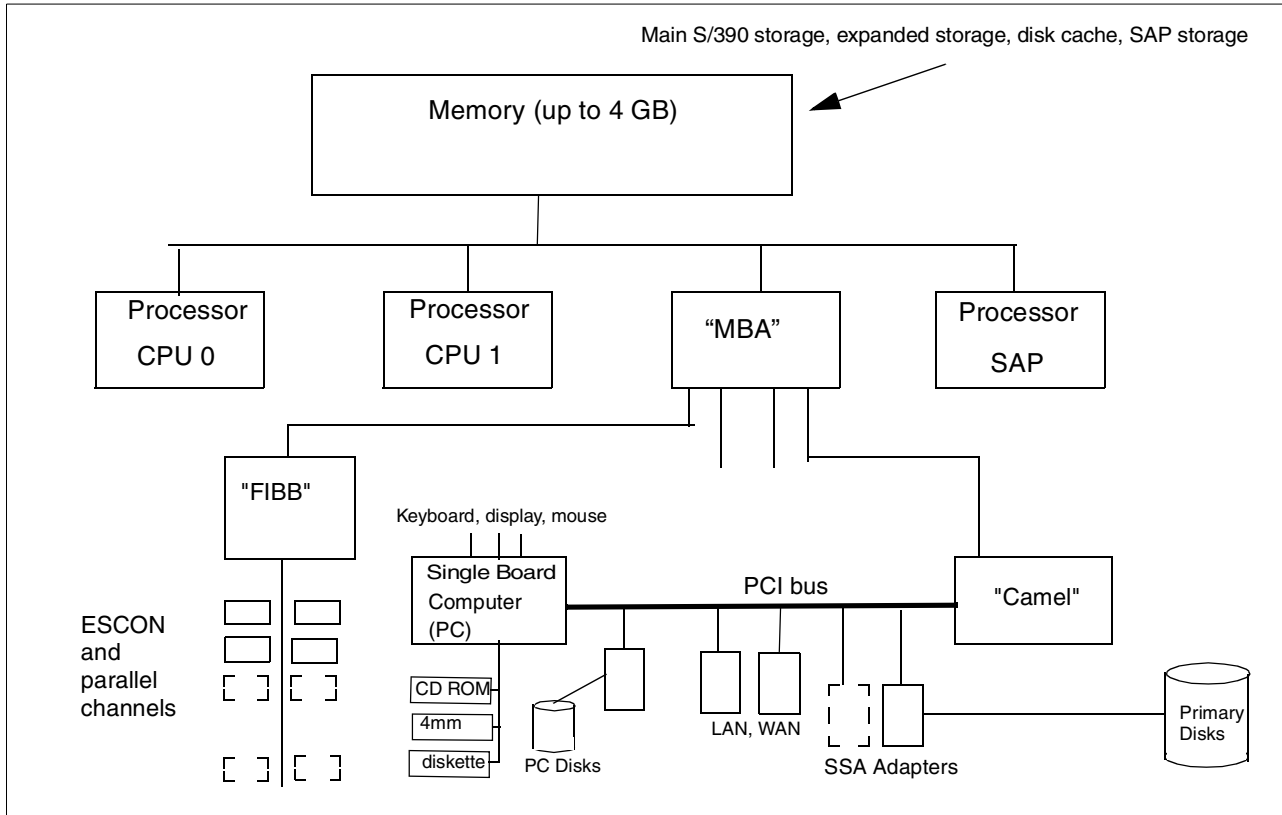
Figure 1. Conceptual Internal Functional Components of the Multiprise 3000

2.1 Internal Structure

Figure 1 represents a conceptual view of a Multiprise 3000 system. As shown, it is structured around access to memory. As mentioned, a system has one or two processors for user work, plus a System Assistance Processor (SAP). The SAP is actually another S/390 processor that is dedicated to I/O work; it is not available to OS/390 or user applications.

Memory sizes are 1, 2, or 4 GB. Using SE controls, the system administrator can divide memory between the Hardware System Area (HSA) (including the disk cache), central storage, and expanded storage. If LPARs are used, each partition can allocate central storage and expanded storage from the single pool of main storage.

The box (in Figure 1) marked MBA (Memory Bus Adapter) provides the memory interface for all the other elements of the system. It creates several bus interfaces, each running at 333 MB/sec. As shown, one such bus goes to the FIBB (Fast Internal Bus Buffer), which in turn interfaces up to 24 normal S/390 channels (ESCON or parallel). Another bus goes to an optional expansion box, which may contain more channels (and more primary disks). The last fast bus interface goes to the Camel[3] chip.

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[3] As mentioned, names such as *Camel* are simply *development names* and have no significant meaning. They are not meant for continued use after product development ends, but, nevertheless, they tend to become part of the vocabulary of a product.

The Camel chip is a link between a PC-style PCI bus and the fast internal S/390 bus. It contains logic that, in a simplified sense, allows the S/390 portions of the system to appear as a busmaster adapter on the PCI bus. All of the internal I/O (for the primary disks and for emulated I/O devices) flows through this path.

Connected to the PCI bus is a Single Board Computer (SBC), which is a PC running OS/2. Also connected to the PCI bus are various adapter cards for LAN, WAN, SCSI, and SSA connections. All the primary disks are connected to the SSA adapters. OS/2 is not directly involved in running the primary disks; they are controlled by programs in the SAP, but are accessed through the PCI adapters.[4]

The SBC is a PC processor, running OS/2. It provides several functions for the Multiprise 3000 system:

- The SE functions run under OS/2. IOCDS files, for example, are stored as OS/2 files.

- OS/2 programs known as *device managers* are used to emulate various S/390 control units and I/O devices. This emulated I/O is discussed in detail later.

- A number of utility programs run under OS/2. These can configure emulated devices, use PC I/O devices (CD-ROM, SCSI tape drives, diskettes) for various functions, and so forth.

Some of the OS/2 functions are required for system setup and startup. For example, the SE functions are required to load an IOCDS and IPL the system. The emulated I/O functions, provided through OS/2 device managers, are optional. They are likely to be used in isolated Multiprise 3000 systems, where they can provide low-cost user connectivity. In other cases, where the Multiprise is integrated into an existing S/390 environment with channel connections to a variety of existing control units, the emulated I/O functions might not be used at all.

In general, the emulated I/O functions provide low-cost ways to emulate traditional S/390 control units and I/O devices. The negative side is that the emulated devices sometimes do not exhibit the same performance as the "real" devices.

2.1.1 Power and Cooling

The Multiprise 3000 has a robust power system. It has duplex power supplies, either of which can power the system. (This corresponds to an N+1 design.) The system uses 100 - 240 volts, 50/60 Hertz, single phase, and requires approximately 1300 watts. This can be termed a "universal" power capability and, in principle, can be operated from common wall power outlets.

Two power line cords are used, one for each power supply. In an optimal environment, these would be connected to separate power feeders on the theory that one might remain available if the other fails. In smaller environments, both power cords might be plugged into the same outlet. Multiprise also has an optional battery backup feature, known as the Integrated Battery Feature (IBF).

With the N+1 power supplies, the optional battery backup, dual cooling fans, and *hot replacement* of power/cooling components, Multiprise 3000 provides the potential for high-availability power and cooling functions. The user must decide

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[4] From the PCI viewpoint, the system might be seen as an asymmetrical multiprocessor, with the SBC being one processor and the SAP + Camel being the other processor. These two "processors" run asynchronously with each other, and share the PCI bus.

to what extent these are needed and configure the system and power connections accordingly.

One or two optional battery features may be installed. Two IBF features provide additional redundancy and more than twice the operational time as a single IBF. The exact operational time provided by batteries depends on many factors, but initial planning might use the following:

```
Operational Mode          Large System & Load      Medium System & Load

Two IBF, fresh batteries      10 minutes               30 minutes
Two IBF, aged batteries        4 minutes               12 minutes
One IBF, fresh batteries       4 minutes                8 minutes
One IBF, aged batteries      1.6 minutes              3.2 minutes
```

The state of the batteries can be monitored through SE functions, and messages indicate when the batteries should be replaced. Note that the display attached to the SBC is not powered through the IBF. This display is used for SE functions and is likely to also be used for the OS/390 master console on smaller configurations. An external UPS would be needed to ensure power availability for this display.

Emergency Power Off (EPO) connections are available, although usage is optional. It is possible to integrate Multiprise 3000 EPO with other EPO controls for other systems and devices.

2.2 System Frame

Figure 2 on page 11 contains a sketch of two Multiprise 3000 frames, with the end covers removed. (That is, the sketch shows both "ends" of the base frame of a system.) The figure contains the frame dimensions and approximate weights. The internal disks (both the primary 18 GB drives and the 9 GB drives used by OS/2 and emulated I/O) are installed in the "front" of the frame. This end also contains a CD-ROM drive, a diskette drive, and a 4mm tape drive.

The other end of the frame provides access to all the cable connections. These include:

1. Power line cords (two)
2. Keyboard, mouse, speaker connection,[5] and display cables to the Single Board Computer
3. Cables to expansion frames
4. Channel cables (ESCON and parallel channels)

The keyboard, mouse, and display connections for the PC display are rather short. For practical purposes, these devices are often placed on top of the Multiprise 3000 frame or on a table immediately next to it.

Although not shown in the sketches, one "side" cover is removable and provides access to the PCI adapter cards and slots. These card slots are a bit more complex than a PC adapter slot and, in fact, have two interfaces (PCI and BiDi[6])

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[5] A speaker is shipped with the system. The purpose is to produce various "beeps" generated by OS/2 to denote urgent error situations.
[6] This is an internal IBM term for an intermediate interface between ESCON and parallel channel interface cards and the internal bus that connects them to system storage and the SAP.

available in most slots. Understanding the slot layout will help in understanding some of the channel and adapter configuration limitations.

End views, with end covers removed
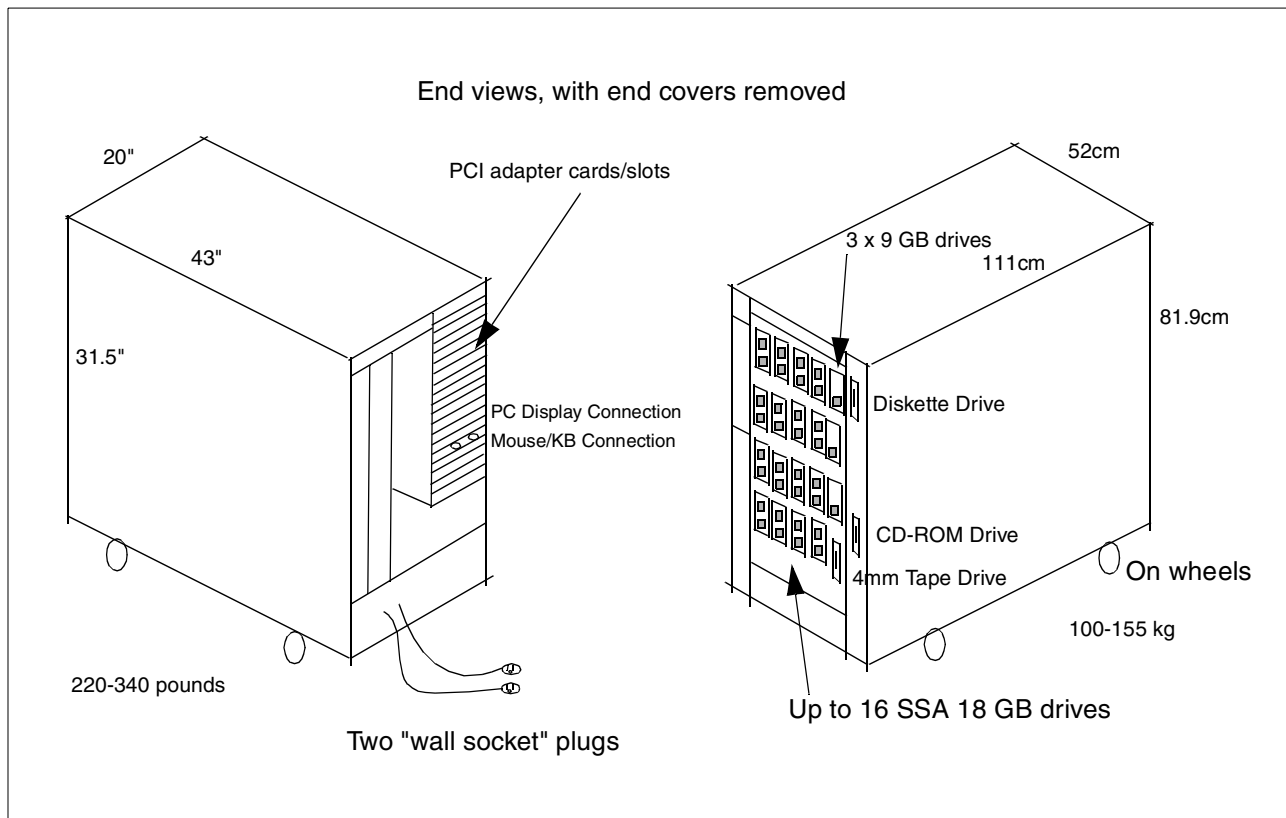
Figure 2. External Views, With End Covers Removed

Figure 3 on page 13 contains a sketch of the adapter slots available in a Multiprise 3000 base frame. There are a total of 21 slots. Some are reserved for fixed purposes and some can be used for multiple purposes (but, once configured, they cannot be readily changed). The adapter slots differ from normal PC adapter slots because these have two completely independent bus connections in each slot. A given adapter card (except for the Camel card) will use only one of the two bus interfaces. These dual purpose slots save space and provide considerable flexibility in configuring a system.

Adapter slots can be used as follows:

Slot	Interface	Use	Uses
1	PCI, BiDi	Optional	Differential SCSI adapter or BiDi
2	PCI	Required	SSA adapter for OS/2
3	BiDi	Optional	BiDi, same as slot 4
4	BiDi	Optional	BiDi, same as slot 3
5	BiDi	Optional	BiDi, same as slot 6
6	BiDi	Optional	BiDi, same as slot 5
7	BiDI	Optional	BiDi, same as slot 8

Slot	Interface	Use	Uses
8	BiDi	Optional	BiDi, same as slot 7
9	PCI or BiDi	Optional	BiDi or token ring adapter
10	PCI or BiDi	Optional	BiDi or token ring or Ethernet adapter
11	PCI or BiDi	Optional	BiDi or token ring or Ethernet adapter
12	PCI or BiDi	Optional	BiDi or token ring or Ethernet adapter
13	PCI	Optional	SSA Adapter for Expansion Frame
14	PCI	Optional	SSA adapter for base frame
15	PCI, special	Required	Camel card
16	PCI	Required	RS422 adapter
17	none	Required	Connectors for SBC
18	PCI	Required	SBC
19	ISA	Optional	WAC adapter
20	ISA or BiDi	Optional	BiDi or WAC or MPM2
21	ISA	Optional	WAC or MPM2

This table and figure contain several new terms that are explained in the following paragraphs. Also note that some Multiprise documentation may number the slots starting with number zero; in this redbook, we will count starting with number one.

Several of the adapter slots are used for fixed purposes. For example, the Single Board Computer (SBC) used by OS/2 is on an adapter card that must be placed in slot 18. The SBC has too many connectors (display, keyboard, mouse, parallel, speaker, serial, Ethernet) for one adapter "end" plate, so a second (dummy) adapter is placed in slot 17 to provide more connector space for the SBC.

BiDi connectors (from Bi-Directional) are used by the circuit cards used to provide two ESCON or parallel channel interfaces. We use the PC terminology of *adapter cards* to refer to them here, but, strictly speaking, this is incorrect. They are not PC adapter cards. However, because they look like PC adapter cards (same shape, same fittings) and share slot usage with PCI adapter cards, they are easily called *adapter cards*. Each BiDi card provides either two ESCON channels or two parallel (bus and tag) channels. Furthermore, any two adjacent BiDi cards (starting with slot 3, in odd/even slot numbers) must be of the same type. If there is a BiDi card in slot 4, it must be the same type (ESCON or parallel) as in slot 3. (This requirement is due to internal circuitry that handles channels in groups of four; all four must be the same type of channel.)

The RS422 adapter, not previously mentioned, is used for internal power monitoring. The Camel card and the SSA adapter in slot 2 are required. The other slot usage is optional. SSA adapters in slots 13 and 14 are required if the associated primary disks are present.

In order to have the maximum number of BiDi channels, 24 ESCON and/or parallel, the system must have 12 BiDi adapters. That system would not have room for the differential SCSI adapter, or any token ring or Ethernet adapters.[7]

Conversely, a system with the differential SCSI adapter and a full complement of LAN and WAN adapters has room for only six BiDi adapters, or 12 channels.

```
                    PCI Connectors              BiDi Connectors

                 ┌──────────────────────┐
                 │  ┌────────────────┐   ┌─┐   │
External ends of │  │ PCI 1          │   │1│   │
adapter cards are│  │ PCI 2          │   │2│   │
on this side.    │  │ PCI 3          │   │3│   │
                 │  │ PCI 4          │   │4│   │
The ends of the  │  │ PCI 5          │   │5│   │
adapter cards    │  │ PCI 6          │   │6│   │
have             │  │ PCI 7          │   │7│   │
external         │  │ PCI 8          │   │8│   │
connectors,      │  │ PCI 9          │   │9│   │
such as ESCON or │  │ PCI 10         │   │10│  │
parallel (for    │  │ PCI 11         │   │11│  │
BiDi cards)      │  │ PCI 12         │   │12│  │
or Ethernet,     │  │ PCI 13         │   │13│  │
token            │  │ PCI 14         │   │14│  │
ring, SCSI,      │  │ PCI 15         │   │15│  │
modem,           │  │ PCI 16         │        │
for PCI or ISA   │  │ PCI 17         │        │
cards.           │  │ SBC            │        │
                 │  │ ISA 1          │        │
Certain slots are│  │ ISA 2          │   │16│  │
reserved for     │  │ ISA 3          │        │
certain          │  └────────────────┘        │
adapters.  See   │                            │
the text for     └────────────────────────────┘
details.
```

Figure 3. Adapter Slots in a Multiprise 3000 Base Frame

2.2.1 Portability and Noise

Multiprise 3000 frames are on casters, and can be easily rolled on level floors.

The sound level, in normal operation with both power supplies operating, is reported as 68 db (A weighting) for a single frame.[8] This is not loud, but, in our experience, it would probably not be placed in a relatively quiet office environment. In a rough sense, the system might be placed in a room with office copiers and other equipment whose power requirements, cooling requirements, and noise levels are similar. In a raised-floor situation, a Multiprise 3000 would have minor impacts on environmental facilities.

2.3 Small Configuration Example

A small, but useful configuration is shown in Figure 4 on page 14. Exploring this configuration in some detail may help in understanding Multiprise 3000 systems. This system might be a model H30 or H50, since the only difference between these models is the speed of the processor. This system has two processors; one for S/390 programs (that is, a S/390 operating system and applications under

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[7] One Ethernet adapter is present on the SBC, and this could be used.
[8] It is slightly louder if only one power supply is operational, because this causes the operational fan to run faster.

it) and a second processor for the SAP function.[9] This configuration *could* be divided into several LPARs, but we will use a single (non-LPAR) base system for this discussion.[10]

This configuration contains the smallest primary disk configuration.   It has six 18 GB hard disks as the primary drives and three 9 GB hard disk for emulated disk I/O. One of the 18 GB drives is a hot spare, the other five are in a single RAID-5 array. This provides 72 GB of useful disk space that can be defined in almost any mixture of 3380 and 3390 volumes. This definition is performed using *SE console functions*, described in a later chapter. These disks will contain OS/390 and application libraries and data.

For discussion purposes, we will define 20 3390-3 drives and use these for our OS/390 volumes and our application libraries and data. There is still about 12 GB of unused disk space that could be defined as various models of 3380 and 3390 drives.
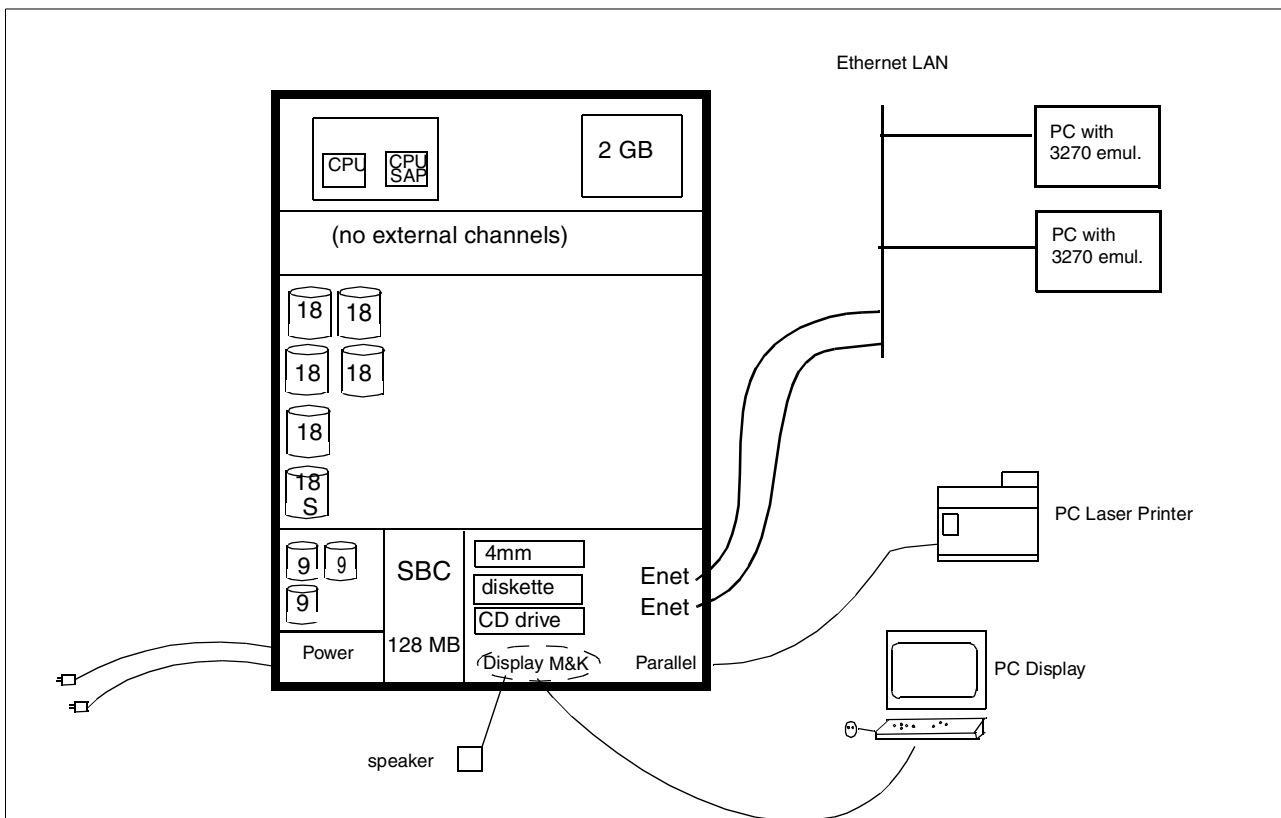
Figure 4. Conceptual Drawing of Small Model H30 or H50

The three 9 GB drives are in a second RAID-5 array, providing about 18 GB total usable space. There is no hot spare for this array.[11] This array contains OS/2, the SE programs, the P/390 I/O emulation programs, and about 14 GB free space. This free space can be configured as emulated 3390, 3380, 3350, 3330,

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[9] Although the SAP function is run in a separate S/390 processor, this SAP processor is not normally counted when discussing the number of processors in a system. Thus, we are discussing a uniprocessor here, in normal terminology. This might also be termed a 1+1 system (one S/390 application CPU plus one SAP processor).

[10] Any LPARs would share the single S/390 processor. The SAP processor is completely dedicated to the SAP function and never shares any of the application workload. OS/390 sees only a single processor.

[11] Normal RAID-5 recovery applies to this array. A single disk failure can be tolerated without loss of data.

or FBA drives (including nonstandard size drives) using the *Emulated I/O Configurator* program. This configurator program is also described later. These emulated drives are useful as staging areas for installing new software releases, if they are distributed on CD-ROMs.

Two power plugs are shown in Figure 4 on page 14. Multiprise 3000 systems contain dual, redundant power supplies; either one can run the system. In principle, the two plugs should be connected to separate power feeds.[12] The complete system uses about 1.3 KW and any common wall outlet should be suitable.

A set of display, speaker, mouse, and keyboard ("M&K") connectors are included in the base system and these connect to a typical PC display, mouse, and keyboard. The display, mouse, and keyboard are used for multiple functions:

- The OS/2 desktop, with icons for various system functions.

- A 3270 emulator session to provide an OS/390 master console. This appears as a local, non-SNA DFT 3270 to OS/390.

- Additional 3270 emulator sessions, via VTAM, as local, non-SNA DFT 3270 terminals, for use with TSO, CICS, or other VTAM applications.

- Support Element (SE) functions, which are GUI applications running under OS/2. SE functions are used to define 3380/3390 volumes on the primary disks, to IPL the system, to manage LPARs, and so forth.

- Configurator functions, which are line-mode applications running under OS/2. OS/2 utility functions, such as UNZIP, that are used to install new OS/390 software via the CD-ROM drive, or to use OS/2-bases tape utility functions to back up files on the 9 GB drives. (These functions cannot access the 18 GB primary drives.)

The display attached to a Multiprise 3000 can be quite *"busy"*, with multiple 3270 emulator windows and other functions, even on a small system. We strongly recommend using a good quality monitor, with a display size of *at least* 19 inches. It is typically used with 1024 x 768 resolution and a refresh rate faster than 60 Hz.[13] A standard Multiprise 3000 order includes a feature code for a suitable display.

A parallel printer adapter is included, and, for this small configuration, we will assume it is connected to a typical PC laser printer. The emulated I/O functions can use the PC printer to emulate an IBM 1403 or 3211 line printer. By using additional functions of the printer emulator program, we can produce printed output (compiler listings, utility listings, application output in line mode) that appears very similar to IBM 38xx output in line mode. The printer emulation functions will not handle IPDS print data, but otherwise provide quite acceptable output from JES2.

One Ethernet adapter is included in the base machine and we ordered a second Ethernet adapter for this system. In general, we recommend at least two LAN adapters for these systems. (We discuss Ethernet LANs here, but the same principles apply to token ring LANs.)

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[12] This is probably not practical for a small system in an office environment. In this case, both plugs would probably be plugged into adjacent outlets. An additional outlet is needed for the display (and for a printer, if present). Another power outlet is required for the modem's power brick, if the "call home" modem is used.

[13] At the time of writing, Multiprise 3000 systems include a display that is either 19 or 21 inches.

There are a number of ways to configure and use LAN adapters with a Multiprise 3000. We outline here a method that might be considered most "normal" for smaller systems. In this case the LAN adapters are used as follows:

1. One adapter is used through OS/2 TCP/IP. An emulated device manager (provided with the system) acts as a tn3270 server. This device manager, in turn, causes tn3270 sessions to appear as local, non-SNA 3270 terminals to the S/390. Users connecting to this LAN interface (typically via 3270 emulators in PCs) appear to OS/390 VTAM as local, channel-attached 3270 terminals. Each session has a S/390 address ("UCB address"). The VTAM definitions for such terminals are fairly simple, and terminals connected this way usually provide the base TSO interfaces for administering the system, as well as TSO or CICS interfaces for general users. OS/390 is unaware that these connections originate as OS/2 TCP/IP LAN connections.

2. The other adapter, operating through another emulated device manager, appears to the S/390 as an IBM 3172 TCP/IP control unit. OS/390 TCP/IP can use this interface for all the functions usually done through OS/390 TCP/IP, such as tn3270 connections, telnet (to OpenEdition), ftp, nfs, Web serving, and so forth. The proper OS/390 TCP/IP software customization must be established before these interfaces can be used, of course.

Two LAN adapters are needed because two TCP/IP *stacks* (OS/2 and OS/390) are involved and multiple TCP/IP stacks cannot share a LAN adapter. If the local, non-SNA 3270 sessions are confined solely to the directly attached display (where they use the internal TCP/IP loopback connection), then a system with only one LAN adapter could be used. However, LAN adapters are inexpensive and we strongly recommend the flexibility provided by two LAN adapters. (If you have both Ethernet and token ring users, you might have two of each type of adapter.)

With these LAN adapters, any reasonable number of users can connect to the system. With the two LAN adapters, users can select which LAN interface they want to use, by selecting the appropriate IP address. This small system might be appropriate for something like 20 to 40 developers, or up to several hundred "light" CICS users.

A maximum of four LAN adapters can be used. This includes the Ethernet adapter that is integrated in the SBC. A maximum of three additional Ethernet adapters can be added. A maximum of four token ring adapter can be added, if no additional Ethernet adapters exist and the integrated Ethernet adapter is not used.

A 4mm tape drive, a CD-ROM drive, and a PC diskette drive are included in all Multiprise 3000 systems. The 4mm tape can appear (to OS/390) as a 3480 or 3490 tape drive, although there are a number of recommended restrictions on the usage of this drive. OS/390 cannot directly access the CD-ROM[14] or the diskette drive.[15]

While not shown in Figure 4 on page 14, many customers would probably purchase an external SCSI tape drive (IBM 3480- or 3490-compatible) to allow direct tape interchange with mainframes. The IBM 3490-F01 drive can be used for this purpose.

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[14] An exception is the use of an OMA drive, typically used only by VM systems. The CD-ROM can be used to emulate an OMA drive.
[15] Both the CD-ROM and diskette drives can be involved in loading new releases of OS/390 software.

Also not shown in the figure are Ethernet hub(s) that would be needed for the LAN connections. These are minor items that are required in any LAN environment.

2.4 Larger Configuration

Figure 5 on page 17 illustrates a larger configuration. In practice, this would probably have more channel connections to existing S/390 control units and devices, but the limited illustration is useful for discussion. Note the following differences between the small system (in Figure 4 on page 14) and the larger system:
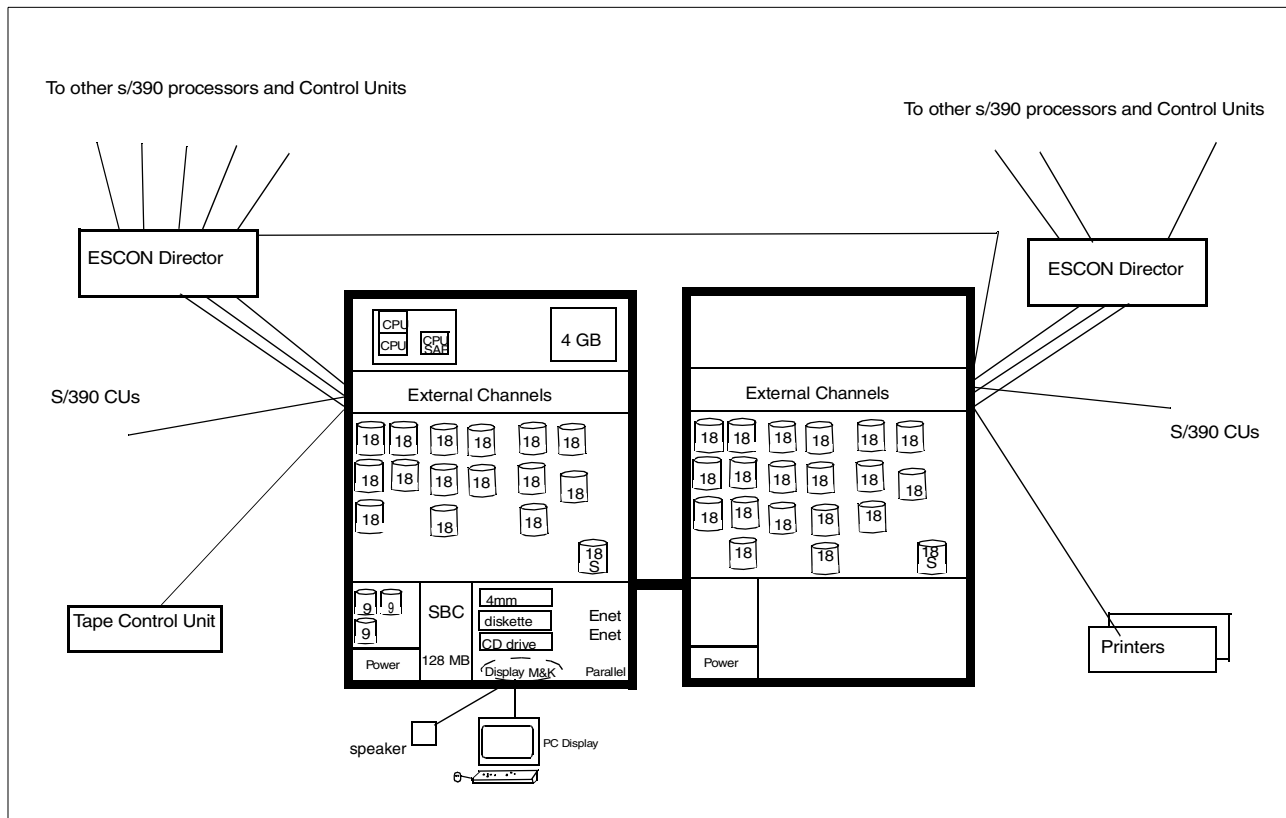
Figure 5. Example of Larger Multiprise 3000, Integrated With Other S/390 Systems

- No external LAN connections are shown. We assume users are connected through channel links to existing VTAM or TCP/IP systems. (Of course, LAN connections to the Multiprise 3000 could also exist.)

- Two Multiprise 3000 frames are shown. Only the first has processors and memory. The expansion frame can contain only disks and channels.

- The "local" PC display and keyboard are still attached to the Multiprise 3000. For practical purposes, these are always required.

- The Multiprise 3000 primary disks cannot be shared with other systems. The Multiprise can share external disk drives, via standard channel links, but there are no external channel paths to the internal Multiprise 3000 disks. (The disks can be shared indirectly, of course, through nfs, ftp, or something similar.)

- A considerable amount of internal Multiprise 3000 disk space is shown: the effective amount is 504 GB (after subtracting space for RAID-5 overhead and two hot spares). This might be divided into 170 x 3390-3 drives, for example.

- The systems are not part of a Parallel Sysplex. Multiprise 3000 does not include Coupling Facility (CF) channels.

- While not explicitly shown, the system might be part of a base sysplex, using a GRS ring. Multiprise 3000 ESCON channels can connect to CTC functions on other systems. Parallel channels could also be used for CTC functions if an external IBM 3088 (or similar) unit is available.

- Not explicitly shown, this system is probably defined with several LPARs. The external ESCON and parallel channels are typically not shared between LPARs, although such sharing is available through EMIF. Providing each LPAR with sufficient channels is one reason for the potentially large number of channels available with Multiprise 3000. The configuration shown (with two frames) could have up to 56 channels (24 in the base frame and 32 in the first expansion frame).

- The emulated disk drives (as with all the emulated I/O functions) exist only in the base frame. The number of drives (3) used for emulated disks is not expandable.

Multiprise expansion frames must have exactly the same power supply characteristics (and IBF optional features) as the base system frame.

2.5 Primary Disk Configurations

The primary (18 GB) disk drives are installed in RAID-5 configurations, and are installed in units of a complete array. That is, one cannot install a single additional drive. The array sizes are either five or seven drives. The minimum system with primary disks contains a five-disk array (plus a hot spare, that is not counted as part of any array).

Frame	Config ID	HDDs	Arrays	Configuration
Base Frame	B1	6	1	4+P, S
Base Frame	B2	11	2	4+P, 4+P, S
Base Frame	B3	16	3	4+P, 4+P, 4+P, S
Expansion Frame	E1	6	1	4+P, S
Expansion Frame	E2	13	2	4+P, 6+P, S
Expansion Frame	E3	20	3	4+P, 6+P, 6+P, S

The notation in this table is important because it is used throughout this redbook and in other Multiprise 3000 documentation. Consider the base frame configuration B1. It has a total of 6 hard disks,[16] arranged in one RAID-5 array. The 4+P notation indicates five disks, with the space equivalent of one disk lost to RAID-5 overhead (the "parity" overhead); that is, the effective usable space is equivalent to four drives.

[16] This discussion excludes the three 9 GB drives used for OS/2 and emulated I/O. These drives are always present in the base frame (and not in expansion frames) but are not counted in this discussion.

The S notation indicates a hot spare. Each frame contains one spare drive. This drive is not associated with any RAID array. If a drive in an array fails, the spare is then automatically incorporated into that array.[17] Maintenance personnel can replace the failed drive (without disrupting system operation) and the new drive becomes the spare.

Only the disk configurations shown in this table are permitted. The smallest upgrade from the base system (6 drives) would be to 11 drives. (The option to have no primary disk drives is also valid, although not shown in the table.) The base frame must have all three disk arrays installed before disks can be added in a second frame, and all the possible disks in the second frame must be installed before third frame disks can be added.

Primary Multiprise 3000 disks are Serial Storage Architecture (SSA) drives mounted in special carriers. The disk carriers are not interchangeable with PC-style or RISC-style system disks.

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[17] If a drive fails, the spare drive is used to recreate the redundant information normally found in a RAID-5 array.

Chapter 3. Implementation Topics

This chapter discusses several Multiprise 3000 areas that are unusual (from a mainframe viewpoint) or especially interesting. These topics are not presented in any particular order, and there is some duplication of information among the various topics.

3.1 Enable OS/2 Desktop

As shipped, you cannot access the OS/2 functions in the Multiprise 3000. This is to prevent inadvertent changes to the system. In practice, you need to access OS/2 functions for a number of reasons. You can enable access to the OS/2 desktop by doing the following:

1. Start the SE function. (This is normally started automatically by OS/2.)
2. Log onto the SE function with userid ACSADMIN. The default password is PASSWORD.
3. Click the **Console Actions** icon in the upper left area of the SE display.
4. Click the **User Profiles** icon.
5. Disable the Secure Desktop function.

You should now be able to use icons on the OS/2 desktop.

At this point, you would probably log off the SE function, and log on again with the userid SYSPROG. (The ACSADMIN userid has a restricted set of functions available.)

3.2 Internal Disks

The internal disks of Multiprise 3000s are interesting. There are two completely separate sets of disks, *both* of which use ECKD emulation (but only one set is known as *emulated drives*). This creates a terminology problem. We can group the disks as follows:

- The *primary disks* for Multiprise 3000s. There are up to 16 of these hard disk drives (HDD) in the base frame of the system, and more drives can be added in expansion frames. These are fixed-sector SSA disks, with 18 GB per drive, used in RAID-5 arrays with special recovery characteristics. SAP and hardware assists emulate 3380 and 3390 units using these HDDs.

- The *emulated disks*, using P/390 emulation technology. These normally use three 9GB SSA hard disk drives, also in a RAID-5 array. These drives can emulate 3390, 3380, 9345, 3350, 3330, and FBA drives, using an OS/2 device manager program to do the emulation.

The primary disks provide the "normal" disks for Multiprise 3000 applications, while the emulated disks will tend to be used for special purposes. However, either (or both) can be used for OS/390 system volumes and data volumes. One special purpose for emulated volumes may be to stage OS/390 software that is distributed on CD-ROMs. This is discussed later.

3.2.1 Primary Disks

The primary drives have the following characteristics:

Capacity	18 GB
Rotation	10000 rpm
Peak transfer rate	40 MB/sec (20/40 negotiation)
Format	524 byte fixed blocks
Initiators	up to 32
Buffer size	1 MB
Average seek	6.5 ms
Average latency	3.0 ms
Typical data rate	22.6-30.2 MB/sec

A special SSA adapter is used with the drives.[1] This is a PCI adapter card that includes these characteristics:

- RAID-5
- 32 bit width or addresses and data
- Hardware scatter/gather read/write
- Full duplex communication
- HDD device hot plugging
- Non-volatile write cache on daughter card
- Error detection and correction
- Data scrubbing
- 64 MB DRAM and 32 MB NVRAM

Two adapters are included in the base Multiprise 3000 frame (one for OS/2 and one for the primary disks), and an additional adapter is used if expansion boxes are added. All primary disks in any box are on a single SSA loop within that box. The 32MB non-volatile memory in the adapter is used as a *fast write* cache during normal operation.

The SAP emulates channel and control unit functions for the disks. It emulates ECKD 3380 and 3390 devices. OS/390 sees only these emulated devices, and cannot directly access the physical fixed-block, RAID-5 organized disks. Standard OS/390 access methods are used, without modifications[2], and appear to be using 3990-2 controls unit with 3380/3390 drives. The 3990-2 control units, as seen by the S/390 processor and operating system, contain a read cache.

The SAP uses a portion of main storage as the disk read cache. The user can configure the amount of storage to be used, in the range 32 MB to 1 GB, in 32 MB increments. Any storage used for the disk cache is not available for use as S/390 main storage or expanded storage, therefore the amount used as the disk cache must be balanced with other demands for memory. The cache size can only be changed during a POR (Power On Reset).

[1] The IBM internal development name for the adapter was *Santa Cruz*, and this name may appear in other documents.
[2] Well, almost. You need the SPE for OS/390. This should be standard for OS/390 V2R8 and later, and can be added to earlier systems from V2R4 forward. You should check for recent IBM announcements to determine if the SPE is available for earlier releases.

This cache is a write-through cache. That is, disk writes are immediately sent to the disk controllers and drives.[3] The disk cache in HSA does not provide a fast write function; it provides only read caching.

The RAID stripe size is equal to a single 3390 track, or approximately 56 KB.

The effective space available on these drives is a function of the number of drives available, minus drives for RAID-5 parity overhead and minus one drive (per frame) as a hot spare. Effective capacity of these disks was discussed previously. Disk capacity discussions can be confusing because some references use "rounded" numbers for MB and GB values, while others use exact values. Likewise, "formatted" and "unformatted" values differ; also, RAID overhead (and hot spare capacities) are handled in various ways. The storage unit (SU) values described in the next section provide a consistent way to describe useful capacity of Multiprise 3000 primary disks.

The RAID-5 arrays used by the primary disks have different recovery characteristics than typical RAID-5 arrays. See "Hard Drive Failure" on page 55 for more details.

3.2.1.1 Drive Allocations

Each disk array is divided into *storage units* the size of the 1113 cylinders in a 3390-1 drive.[4] Emulated 3380 and 3390 drives are assigned an integral number of these storage units.

Logical Volume	Cylinders	Storage Units
3390-1	1113	1
3390-2	2226	2
3390-3	3339	3
3390-9	10017	9
3380-J	885	1
3380-E	1770	2
3380-K	2655	3

Only the drive types shown in the table are emulated. Older drives, and FBA devices, are not emulated. Some space is wasted when emulating 3380 drives, since the "real" 3380 device size is smaller than the space in the Storage Units assigned. This has been accepted because use of 3380s has diminished over the last few years, and 3380 usage is now considered an exception rather than a normal configuration.[5] "Odd size" volumes, with a different number of cylinders than the standard sizes shown here, are not supported for the primary disks.

All the primary disks appear to be connected to 3990-2 control units, with one control unit per Multiprise 3000 frame. The control units appear connected to a single chpid. With the maximum of two expansion frames, there could appear to be three control units for the primary internal disks. Only certain combinations of

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[3] The disk controller contains a 32 MB cache that provides a fast-write function, but this is independent of the HSA disk cache.

[4] Each Storage Unit is 1,869,840 blocks on the disk, where each block is a fixed size of 524 bytes. Some of this space is for overhead functions. The effective usable space is equal to a 3390-1 drive.

[5] There are still many "real" 3380s in use, of course. This is because they have been purchased (years ago) and still provide useful service. The comments here are directed at newer system environments.

disks are used. For example, there may be 6, 11, or 16 primary HDDs in the base frame. Other combinations are not supported. The following tables contain key HDD configuration information:

Base Frame. chpid FD, CU 00				
Number of HDDs	Configuration	Effective Storage Units	Effective Capacity	Unit Addressing (hex)
6	4+P, S	73	72 GB	00-3F
11	4+P, 4+P, S	73 + 73	144 GB	00-3F, 40-7F
16	4+P, 4+P, 4+P, S	73 + 73 + 73	216 GB	00-3F, 40-7F, 80-BF

Expansion Frames (maximum 2). chpid FD, Control Units 01 and 02				
Number of HDDs	Configuration	Effective Storage Units	Effective Capacity	Unit Addressing (hex)
6	4+P, S	73	72GB	00-3F
13	4+P, 6+P, S	73 + 109	180GB	00-3F, 40-9F
20	4+P, 6+P, 6+P, S	73 + 109 + 109	288GB	00-3F, 40-9F, A0-FF

In the configuration column, P means a drive to account for the parity overhead of RAID-5, and S means a spare drive. The term 4+P means a RAID-5 array with 5 HDDs, with the effective space of 4 HDDs. Thus, with 6 HDDs, the effective space for user data is equivalent to 4 HDDs, with an effective total usable capacity of 72 GB. This is divided into 73 Storage Units, and these can be assigned as a mixture of various 3390 and 3380 drive models. An additional restriction is that only 64 unit addresses (X'00' to X'3F') are available for these units. We could not create 73 3390-1 drives, because we do not have enough unit addresses. We could create, for example, 20 x 3390-3, 3 x 3390-2, 4 x 3390-1, 1 x 3380-E, and 1 x 3380-J drives.

Unit addresses are assigned to drives in ascending order within the Unit Address range associated with the array. The first array in the base box is Control Unit 00 (because it is the base frame) array 0, and has the Unit Address range 00-3F. When logical 3380 or 3390 volumes are defined in this array, they are assigned Unit Addresses starting with 00. The first logical volume in the second array would be 40.

The process to extend the disk allocation logic to more hard disks, as shown in the tables, is readily apparent. A given logical volume cannot extend over a RAID array boundary. A given frame will have 1, 2, or 3 RAID arrays, with the number of drives shown in the table.

Logical volumes (3380/3390s) are created using SE panels and utilities. New logical volumes can be added to an array if there is free space available in the array. Rearranging an array (changing a group of 3390-3 drives to a larger number of 3390-2 and 3390-1 drives, for example) does not cause any data loss on other logical volumes in the array. (Any data on the volume being deleted is lost, of course.) The process for defining logical volumes is described in some detail in Chapter 5.

RAID-5 usage spreads (in stripes) the data of a logical volume over all the HDDs in an array. This makes tuning quite different from tuning an equivalent number of "real" drives. There is less gain in spreading a job over several logical volumes if all the volumes are in the same RAID-5 array.[6] Spreading data sets over multiple volumes in different RAID-5 arrays, however, should still be effective (allowing for the use of other volumes in the arrays by other concurrent jobs, of course).

3.2.2 Emulated Disks

A Multiprise 3000 normally contains three 9 GB disk drives shared between SE ffunctions and *emulated disks.* These disks are managed by a P/390-technology device manager. The physical disks are SSA drives, on their own SSA segment, in a 2+P RAID-5 array (with no spare drive). The effective space is about 14 GB, after subtracting the space used by required OS/2 programs. (This includes OS/2 itself, the SE code, the device managers, and so forth.) Only three bays are assigned for these drives and there are no current, standard options to increase the usable space by using drives larger than 9 GB or by using more bays.

All P/390-technology emulated I/O appears on chpid X'FC', including any logical volumes on these disks. A maximum of 255 device addresses can be used for all P/390 emulated devices, including local 3270 devices and logical disk volumes.

Using the *Emulated* I/O C*onfigurator* function, logical disk volumes can be created in the available disk space. A variety of drives can be emulated, including drives with fewer cylinders than a corresponding "real" unit. For example, a 3390 with 50 cylinders can be created.[7] Emulated drives always have an integral number of cylinders. The largest 3390 supported is 3339 cylinders, and the largest other drives supported are equal to the largest "real" drive of the corresponding machine type.

Emulated I/O, in general, is discussed in more detail in a later section.

3.3 Tape Drives

There are two quite different ways to attach tape drives to a Multiprise 3000 system. These are:

1. Through traditional channel-attached control units and associated drives. Using this method, a Multiprise 3000 can be attached to any currently-supported S/390 tape drive, using either ESCON or parallel channels. It could, for example, share a pool of tape drives with existing mainframes.

2. Through SCSI tape drives. There are two categories of these:

    • The 4mm tape drive that is included in the base system frame

    • Additional, external SCSI tape drives. This is typically a single drive, although several can be SCSI-chained together.

The 4mm tape drive is included as a standard feature, to provide a standard, low-cost method of receiving software distributions and fixes if a 3480 drive is not available. Users with extensive experience using 4mm drives with P/390 and R/390 systems generally accept that these drives are not general-purpose

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[6] There may still be a slight benefit to spreading data sets over multiple volumes. This is related to the optimal use of *track buffers* used internally in the ECKD emulation process.

[7] OS/390 supports these "odd size" drives without taking any special actions.

substitutes for more robust types of tape drives. In particular, these drives have not been satisfactory for large-scale disk backups. For smaller-scale usage, they are may satisfactory for limited data exchange, especially if an occasional requirement to re-create a tape is not burdensome.

4mm tapes drives on P/390, R/390, Application StarterPaks, and S/390 Integrated Server B01s are DDS2 units. The 4mm drive on the Multiprise 3000 is a DDS3 unit. In principle, these are upward compatible; that is, the Multiprise 3000 should be able to read 4mm tapes written on P/390-based machines. We verified this on a small scale, but did not try extensive use of 4mm tape as a migration medium.

Tape emulation is discussed in more detail in Chapter 3.7.0.6, "AWS34XX (SCSI Tape Drives)" on page 39.

3.4 Power Up, Power-On Reset, IPL

A typical startup process might be the following:

- Turn on system power, using the breaker switch on the front of the Multiprise 3000. Turn on the attached display.

- The system will "count memory" and display normal PC-type BIOS startup messages.

    - Ignore the `SCSI BIOS NOT INSTALLED!` message.

    - Several BIOS setup options are presented. You should normally ignore them. *Do not change anything you do not understand.* The options include:

        ```
        DEL to enter the primary PC BIOS setup function
        <Ctrl><A> to perform SCSI setup
        Ctrl-S to control additional setup
        TAB (at the right instant) to control CBIOS (Santa Cruz adapters)
        ```

    - You will see startup messages for CBIOS. The *tab key* can be used to toggle CBIOS *on* or *off*. These messages refer to the SSA RAID adapters ("Santa Cruz"). The first message(s) are for the adapter(s) for the primary disks (if you have primary drives) and the last message is for the adapter for the OS/2 and emulated I/O disks. The CBIOS for the last adapter should be ON and the CBIOS for the other adapters must be OFF. If there is only one SSA adapter, it is for OS/2 and the CBIOS should be enabled. *Do not enable the CBIOS for the adapter(s) used for the primary disks.*

- The WARP full-screen banner should appear for a few seconds.

- Various OS/2 device driver messages appear. You should scan these for unusual conditions. For example, messages about LAN adapters not starting may appear here.

    - The following messages may appear after OS/2 configuration changes. Ignore these and press Enter to continue.

        ```
        AWSCAMDD.SYS 000 Version n.n.n Compiled .......
        AWSCAMDD.SYS 028 DEVID and VENDID from PCI EMIO: FFFFFFFF
        AWSCAMDD.SYS 029 ERROR Expected 0x........ got: FFFFFFFF
        AWSCAMDD.SYS 030 Press Any Key to Continue
        ```

- Wait for the SE program to start. (A License Agreement is displayed for a long period while it is starting. Do not assume the system is hung.)

- Log onto the SE program. Use the userid SYSPROG and the password PASSWORD. (In principle, someone should set a more secure password, but most installations leave the default passwords for the SE application.)

- Assuming you plan to IPL a S/390 operating system, click the 3270 Emulator Sessions icon on the OS/2 desktop to start the 3270 sessions. (This assumes your S/390 operating system will use at these sessions. The AD and 390ADS preloaded systems use these.) Each session should contain a message that it is connected to IP address 127.0.0.1:7490. If it does not contain this message, then OS/390 will not be able to use the session.

- In the SE window, select the Group icon (in the upper left screen) and find the CPC Recovery window in the right side of the screen. Select and drag the CPC icon to the Power-on Reset icon, to start the Power-on Reset function. This function will start (or restart) the emulated I/O subsystem, and load an IOCDS. Note that the physical *power on* action does not provide the logical *power on reset* function.[8]

- From the popup window, select the IOCDS you want to load, and select the Perform Power-On Reset button. Select the Power-On Reset button on the following window. This function takes about three minutes.

- If you are using a 3270 emulator session on the Multiprise 3000 display for your OS/390 master console, verify that the correct session exists. For example, both the AD and the 390ADS system use address 700 for their master console. The initial DEVMAP and IOCDS distributed with these systems associates emulated I/O subchannel 70 with address (device number) 700. 3270 emulator sessions display the subchannel address when the emulator session is first connected to the emulated I/O subsystem. If one of the emulated sessions does not display 70, then OS/390 will not find its normal master console.[9] If none of the emulator sessions display the right address, stop all the sessions (double-click at top left) and restart them. As distributed, only emulator session A can be used; this is related to the /R=OP option in the DEVMAP and the LU=OP parameter in session A).

- Select and drag the Image icon (left side of SE screen) to the Load icon (right side of screen). This should produce a pop-up window where you enter the IPL address and IPL parameter. (We assume we are using a basic mode system; operation with LPARs can be a bit more complex at this point.)

- After the IPL function completes, you can *shrink* the SE application window and leave only the 3270 emulator sessions on the display. Alternately, you can bring the emulator sessions on top of the SE application window.

We stop our system (to power down or completely reboot) with the following steps:

- Log off TSO sessions.

- Stop DB2 if it is running. (Or add DB2 commands to the SHUTDOWN script.)

---

[8] You could create a profile to perform the POR and LOAD functions listed here. We usually do these manually when in basic mode. When using LPARs, the use of profiles is a practical necessity.

[9] In this case, the AD system and the 390ADS system will usually revert to the minimum function console that is built into the SE application. OS/390 can be run from this minimum function terminal session, but it is awkward to use.

- Issue the S SHUTDOWN command. (This is a procedure included with the AD system and some other proloaded systems. It executes a script of shutdown commands.) A $PJES2 command is needed after the script finishes.

- If you want to ensure that the S/390 processor is stopped, use the SE function to drag the CPC image to the DEACTIVATE icon. (You can do this even if you did not use an ACTIVATE profile or function.)

- Close the PCOM sessions.

- Log off the SE session. (We usually skip this step and have seen no unwanted side effects.)

- Click the shutdown icon on the OS/2 desktop. Reply OK to the various OS/2 messages about stopping tasks.

Turn power off, or press Ctrl-Alt-Delete to reboot OS/2.

The key points here are:

- Turning power on does not automatically run the POR function

- The emulated I/O device managers are started by the POR function

- Remember to start the 3270 emulator sessions before you IPL OS/390. If OS/390 cannot find the master console, it will default to a special terminal session through the SE application. This SE function roughly emulates a 3215 console (which was a typewriter-style system console). It is accessed through the Operating System Messages icon in the SE window.

3.5 3270 Interfaces

An OS/390 system requires at least one *local, non-SNA* 3270[10] terminal for the master console. For practical purposes, several other similar terminals are needed for TSO sessions for systems maintenance.[11] A Multiprise 3000 can use any of the traditional S/390 connections for 3270 terminals. These typically involve IBM 3174 control units. Another method is with tn3270 sessions through OS/390 TCP/IP. Additional connection methods are through the emulated I/O functions that are based on P/390 technology. These options include the following:

- tn3270 sessions to an OS/2 device manager (AWS3274)[12], using an OS/2 loopback TCP/IP address. These sessions appear on the PC display connected to a Multiprise 3000 and require no external connections whatsoever. These sessions appear to be local, non-SNA connections to OS/390 and can be used for the OS/390 master console, for TSO, and for other similar uses.[13] A 3270 emulator package is required for OS/2, and one is included with Multiprise 3000s.
- tn3270 sessions to an OS/2 device manager (LAN3274), using OS/2 TCP/IP over a LAN. (The LAN could be interconnected with other LANs, with the

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[10] A *local, non-SNA 3270* terminal is (or appears to be, via emulation) connected to a local, non-SNA 3174 control unit. A *local 3174* control unit is channel (ESCON or parallel) attached to the S/390 system. No remote links are involved. Each 3270 terminal has a S/390 address (channel, control unit, unit address).

[11] In practice, OS/390 TCP/IP connected or SNA connected terminals are not sufficient because OS/390 TCP/IP or SNA connectivity might be lost while adjusting various system parameters and procedures. If all TSO connectivity is lost, there is no way to log onto TSO to correct the problem. Having a few TSO terminals available via local, non-SNA connections provides connections that are least likely to be lost due to system parameter changes.

[12] All the emulated device terminology mentioned here is described in some detail, starting in "Emulated Devices" on page 34

[13] The OS/390 master console terminals are directly managed by OS/390 code. The TSO sessions are managed by VTAM, using a simplified control process for local, non-SNA terminals.

Internet, and so forth.) These connections also appear to OS/390 as local, non-SNA 3270 terminals, and are typically used for TSO and CICS terminals. They could be also used for OS/390 master consoles, but this use has potential integrity and security exposures.

- tn3270 sessions to an OS/2 device manager (LCS3172), using TCP/IP over a LAN. These connections appear to be through an IBM 3172 control unit and are managed by OS/390 TCP/IP. This same method can be used for ASCII terminal connections to OpenEdition. These can be used for tn3270 sessions (which OS/390 TCP/IP hands to VTAM), ASCII telnet sessions to OpenEdition, ftp, and so forth.
- SNA 3270 connections to an OS/2 device manager (LAN3172), over a LAN. These connections appear to be through an IBM 3172 control unit and are managed by VTAM. A variety of terminal connection methods might be used, including the use of LAN 3174 control units and/or SNA 3270 terminal emulation products.
- SNA 3270 connections to an OS/2 device manager (WAN3172), over leased lines through suitable modems. The remote end of these lines might have a variety of devices, including IBM 3745 control units, IBM 3174 control units, and so forth.

All of the above connection methods use emulated interfaces provided through OS/2. These have the advantage that no additional hardware is needed, other than a few PCI adapter cards. These provide simple, low-cost connectivity interfaces. The more traditional interfaces that can be used include:

- Channel attached (ESCON or parallel) IBM 3174 control units. These can be SNA or non-SNA.[14]
- Remote IBM 3174 control units, with SNA connections to the host. The SNA connections could be through "real" control units (IBM 3745, or something similar) or through an emulated SNA interface (using the LAN3172 device manager under OS/2).
- Channel attached IBM 3745 (or similar) control units, connected to a wide range of remote SNA devices.
- Channel attached IBM 3745 (or similar) control units acting as LAN TCP/IP interfaces.
- Channel attached IBM 3172 control units. There are several models and modes for using these for SNA and TCP/IP connections.

Not available for Multiprise 3000 are the OSA-2 adapters that are commonly used on larger S/390 systems. The various emulator device managers, running under OS/2, provide functions similar to the OSA-2 adapters.

One Ethernet (10/100 Mbps) adapter is included with Multiprise 3000s, for use by the emulated device managers. A maximum of four LAN adapters (token ring and/or Ethernet) may be used for the emulated device managers. Direct LAN interfaces, not through the emulated device managers, will require channel-attached control units ("real hardware").

More specific details of the emulated I/O connections are discussed in "Emulated Devices" on page 34.

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[14] Remember that at least one local, channel-attached, non-SNA 3270 terminal is needed for an OS/390 master console. This could be through a "real" control unit or through an emulated control unit.

3.5.1 Keyboard Assignments

The basic Multiprise 3000 includes IBM's eNetwork Personal Communications product, commonly known as PCOM. This provides a 3270 emulator for the system console and other 3270 sessions on the main system display. For the Multiprise 3000, this is already configured to start three 3270 sessions, using a single icon on the OS/2 desktop. Typically, one of these sessions is used for the OS/390 master console and the other two for VTAM applications such as TSO or CICS.

As distributed, these PCOM session use the large keyboard Enter key and the right Cntl key to both produce the 3270 *enter* function. This is not what most 3270 users expect. Normal 3270 usage is for the large Enter key on a keyboard to produce the 3270 *new line* function. You can use the keyboard any way you like, but having the expected new line key perform the 3270 enter function can be very disconcerting to an experienced ISPF user.

You can change the key assignments easily. The following steps outline the procedure:

1. Start or select any PCOM session.
2. Select the ASSIST menu item, and the KEYBOARD SETUP option from the pull-down menu.
3. Examine the next display carefully. You will see that the current keyboard is User Defined and that a Keyboard File Name is shown. Select the CUSTOMIZE button on this display.
4. This should display a map of the keyboard. Using the mouse, select the large **Enter** key. This will show that the Base assignment of the key is [enter]. Change this to [newline] and then click the **Change Key** button.
5. Double click the small tab in the upper left of the window to exit. This should produce a pop-up message offering to save the changes. Select YES.
6. The same keyboard file is used for all three predefined emulator sessions, so a single change will affect all sessions.

3.6 Emulated I/O

The emulated I/O capabilities of the Multiprise 3000 are important because they can substantially reduce the cost and complexity of an entry-level system. However, discussions about emulated I/O can be confusing to someone who has not encountered this area before. This section provides background information about emulated I/O, as used in the Multiprise 3000.

Computers have been emulating[15] other computers, or using one type of device to emulate another type of device since the early days of computers. The emulation we associate with the Multiprise 3000 is a specific instance of emulation design that became common with P/390 systems.[16] A brief, and rather simplistic, review of S/390 I/O operations may help explain how it works.

In the good old days, with S/360 machines, I/O processing went something like this:

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[15] Or "simulating." The distinction between these words, in the context used here, can be very fine. We think "emulating" is the more correct word, and it is consistently used by IBM in describing these functions.

[16] It actually began with P/370 systems (and their predecessors), but these were not commonly available. The P/370 system evolved into the P/390 system, which has been widely used.

1. A user application requested an I/O operation, probably by using a READ or GET function in the application code. The request went to an access method, such as QSAM. The access method built a channel program, consisting of channel command words (CCWs), that contained instructions for the channel and control unit involved. The access method then asked the operating system to execute the channel program. The commands in a channel program might be something like (a) seek to cylinder 27, track 9, (b) search this track for record 3, (c) read 500 bytes of this record.
2. The operating system eventually issued an SIO instruction.[17] The SIO instruction specified the address of the I/O device and the address of the channel program. The device address was three hexadecimal digits, such as 3C6. This meant channel 3, control unit C, device 6; every device in the system had a unique address. (This was sometimes known as the UCB address, named after an associated operating system control block.)
3. As part of executing the SIO instruction, several checks were made for the state of the channel and the accessibility of the device. If these were acceptable, the SIO instruction completed with an appropriate condition code setting. The next sequential instruction for the processor usually tested the condition code; eventually control went back to the application program or to the operating system dispatcher. The SIO instruction, including the initial tests and condition code setting, took a few microseconds to execute.
4. In parallel with the continued operation of processor, which was now executing more application instructions, the channel and control unit performed the requested operations. CCWs in the channel program contained the address of the data (or input buffer) in memory, and the channel/control unit combination transferred data accordingly.
5. When the channel program completed, an I/O interruption was generated. This interrupted whatever program was executing. The operating system processed the interrupt and eventually notified the access method that the requested I/O had completed. The access method would notify the original application that the data was available (or had been written, if it was an output operation) and the application proceeded with its operation.

The key point here is that a single instruction, SIO, provided an interface between all the internal software processing and the actual I/O operation. The SIO instruction required the address of a channel program and the address of a device (including channel and control unit) that was expected to process the channel program. The SIO instruction started the external I/O process working.

This simplified flow has become a little more complex for modern S/390 systems. The SIO instruction has evolved into an SSCH (Start Subchannel) instruction that involves a few more control blocks. The device address that originally specified a channel, control unit, and device has evolved into an arbitrary device number. Skipping over these minor details, the general flow is the same as on the S/360. An SSCH instruction starts the external I/O process, and (indirectly) points to a channel program and a device address.

On a normal S/390, the external I/O process (started by the SSCH instruction) is controlled by the SAP. The SAP tests channel availability, locates the correct device, and eventually causes the target control unit and channel to execute the channel program.

---

[17] SIO stands for Start I/O. This was a basic instruction in the S/360 instruction set.

For a P/390 and its emulated I/O, the process is only slightly different. The application program and operating system are unchanged. When the S/390 processor (contained in the P/390 adapter) issues an SSCH instruction, an interrupt is generated in the P/390 server system. This is an OS/2 system running on a PC Server. The interrupt causes an OS/2 device driver (supplied with the P/390 system) to obtain control. At this point the SSCH instruction is still executing and the S/390 processor is effectively "hung" waiting for the instruction to finish.

The OS/2 device driver works with several OS/2 application programs that are supplied with the P/390. These programs emulate S/390 channel functions. Some preliminary tests are done and a PC control instruction is used to set a condition code in the S/390 processor and complete the SSCH instruction. The S/390 processor then executes the next sequential instruction and continues operation.

In parallel, the OS/2 programs examine the CCWs and device address sent with the SSCH instruction. Depending on the device address (which might be for a 3390 disk, or a tape drive, or a LAN adapter), a particular *device manager* program is given control. A device manager is an OS/2 application program, provided with the P/390 system. The device manager, using PC devices and interfaces, does whatever it needs to do to emulate the requested S/390 I/O function.

For example, the application may request a record from a 3390 disk drive. The S/390 operating system (OS/390, in this redbook) does all the setup processing appropriate for a 3390 device. The device manager, running in OS/2, reads an OS/2 file and transforms the data so that it appears to come from a 3390. There can be considerable processing involved in emulating an ECKD device, such as a 3390, when actually using PC sectorized hard disks. Device managers tend to be moderately complex programs. Using PC control instructions that work with microcode in the P/390 adapter, the device manager (and associated OS/2 programs) can move data to or from S/390 memory. When the device manager finishes processing the CCWs, it uses another control instruction to generate an I/O interruption in the S/390.

The S/390 operating system processes this interrupt, just as if it came from a "real" channel, control unit, and device. The operating system is unaware that the I/O operation was emulated.

In a simple sense, a set of PC programs replaced the hardware channel, control unit, and device that the S/390 appears to be using.[18]

Multiprise 3000 emulated I/O works much the same way, except no P/390 adapter is involved. When a S/390 program issues an SSCH instruction, the SAP inspects the device address. If the address is associated with an emulated device, the SAP generates a PC interrupt (via the PCI bus). OS/2 accepts this interrupt and the emulation process is about the same as for a P/390 system.

All emulated devices must be addressed on chpid X'FC', allowing the SAP to easily recognize an emulated device. Instead of the direct access to S/390 memory in a P/390 system, Multiprise 3000 OS/2 emulation programs have a set

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[18] Similar emulation is available in R/390 systems. These use the same P/390 adapter, but the server is an IBM RS/6000 using the AIX operating system. Similar device managers are used, although the actual device manager code is different since it runs in a UNIX environment instead of an OS/2 environment.

of control instructions that (again, via the PCI bus) work with the SAP to transfer CCWs and data. There is an absolute maximum of 255 emulated devices. This corresponds to the normal maximum for the number of control units and devices that can be addressed on a single channel.[19]

Although it does not contain a P/390 adapter, a Multiprise 3000 system uses some (but not all) of the P/390 support programs and device drivers. Some of these have been slightly modified, and a few are quite different. The program that emulates S/390 channel operations, and that is the primary interface between the S/390 and the device managers, is quite different for the Multiprise 3000.

Unlike a P/390, there is no requirement to use emulated I/O with a Multiprise 3000 system. If sufficient "real" control units and devices are available, the emulated I/O capabilities can be ignored. This does not mean that the OS/2 element can be ignored; it is still needed for Service Element (SE) functions.

3.6.1 Advantages and Disadvantages of Emulated I/O

Emulated I/O, using inexpensive PC adapters and devices, tends to be much less expensive than corresponding "real" S/390 I/O devices. It also tends to take less power and space, and the hardware involved may be more commonly available from various sources.

There are disadvantages to emulated I/O, and these need to be weighed against the advantages. For example, emulated I/O is often slower than corresponding "real" devices. This is usually caused by the design techniques needed for emulation, rather than by inherently slower PC devices. All the emulated I/O tends to pass through a single interface, the emulated channel and PC processor, whereas "real" channels can produce more parallel operations.

Emulation of CCWs is not complete. All the "normal" CCWs used by routine OS/390 and application processing are emulated, of course. Unusual CCWs, typically used only for diagnostic functions, are generally not emulated.[20] Likewise, it is possible to construct channel programs that will not give the same results on emulated devices and real devices. Such channel programs are not found in "normal" operation, but might be generated by older, home-written utility programs. These programs may have self-modifying CCWs, time-dependent CCW chaining, or similar techniques. (Such channel programs are likely to produce varying results on different "real" S/390 configurations, as well.)

Emulated I/O depends on the emulation programs (the device managers) and their operating environment (that is, OS/2 and a PC processor). This has been quite acceptable for most P/390 users, but it is not as robust as traditional mainframe hardware. There are various reasons for this. For example, PC hardware is not designed and built to the same standards as mainframe hardware. The additional operating system used to run the emulation processes, OS/2 in our case, is subject to customization errors, and program failures that would not apply to a purely hardware mainframe environment. And so forth.

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[19] For a parallel channel, this is a correct statement. For a Multiprise 3000, the emulated devices appear to be on a slightly special version of an ESCON channel. The maximum of 255 devices still applies.
[20] Each S/390 control unit has a defined set of CCWs that it recognizes and processes. In addition there are often undocumented CCWs that are intended only for IBM diagnostics.

3.7 Emulated Devices

The previous section discussed general concepts of emulated I/O. This section discusses the specific I/O emulation available with Multiprise 3000. This emulation is organized around the *device managers* (OS/2 programs) used to provide various types of emulation. We discuss the types of emulation available here, and discuss the specific setup of emulation configurations in a later chapter. It is convenient to organize this discussion by device manager (using their OS/2 program names), and the available device managers include:

Device Manager	CU Emulated	Emulated Devices and Actual Devices
AWSCKD	3990-2	3390, 3380, 9345, 3350, 3330, using PC hard disks
AWS3274, LAN3274	local non-SNA 3174	3278, etc, use LAN-connected tn3270 sessions. These appear as local, channel-attached, non-SNA 3270s
LAN3172	3172 (SNA)	LAN (token ring, Ethernet) SNA connections to VTAM
LCS3172	3172 (TCP/IP)	LAN TCP/IP connections to OS/390 TCP/IP
WAN3172	3172 (SNA)	SDLC modem lines, when appear as LAN SNA devices
AWS34XX	3803, 3480/3490	3420, 3480, 3490, 3490E drives, using SCSI tape drives
AWS2821	2821, 3211	1403 or 3211 line printer, using PC (laser) printers
AWS2540	2821	2540 card reader, using an OS/2 disk directory
AWSTAPE	3803	3420 tape drive, using OS/2 disk files

These device managers[21], together with several common programs that provide the emulated channel functions, are packaged with the OS/2 code supplied with the Multiprise 3000. Again, we stress that there is no requirement to use any emulated I/O devices. Standard S/390 control units and devices can be used for all necessary I/O. The emulated I/O functions are typically used for smaller, less expensive entry-level systems. The following sections discuss each of these device managers, and the general nature of their services.

3.7.0.1 AWSCKD

This device manager emulates mainframe disks. Its primary function is to emulate CKD and ECKD[22] functions and drives. For a P/390 system this is, perhaps, the most important device manager, since disks (meaning CKD or ECKD disks) are the starting point for OS/390. For a Multiprise 3000, this device manager is not as important because the primary Multiprise 3000 disks (which are not considered as emulated drives and have no connection to OS/2 or AWSCKD) are used for most OS/390 disk volumes.

Nevertheless, emulated disk volumes may be used for various purposes. Two uses, in particular, might be important:

- Emulated volumes may be used as staging volumes when loading an OS/390 system from CD-ROM. This is discussed in a later section.

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[21] Several other minor device managers, not listed here, are also included.

[22] CKD means Count Key Data. This refers to the internal format of disks used by OS/390. OS/390 only uses disks in this format, and this format is substantially different than the fixed sector (512 byte) disks commonly used by PCs and UNIX systems.

- Mini disks, for example a 3390 with 50 cylinders, can be easily created with emulated volumes. The primary disks do not support mini volumes; the smallest volume on a primary disk would be a 3380-J or a 3390-1 (both of which use the same amount of hard disk space: one SU). There are cases where a separate volume, for a trivial amount of data, is very convenient, and using a primary disk might be too wasteful.

AWSCKD can emulate any (or all) of the disk types listed in the table, including FBA disks. An emulated volume will be an integral number of cylinders, up to the size of the largest "real" volume of that type. (The largest 3390 volume emulated is 3339 cylinders.) Emulated volumes are created using the Configurator (described in the next chapter) and then must be initialized (with the ICKDSF utility) just like any other disk volume. The initialization process creates a volser and VTOC (and, optionally, a VTOC index) like any other volume. OS/390 handles "odd sized" volumes, with no special actions required.

The only apparent difference (as seen by OS/390 and application programs) between emulated volumes and "real" volumes is that the emulated volumes do not contain an extra CE cylinder with spare tracks.[23] This is only relevant for error recovery, and OS/390 recognizes that the emulated volumes are different in this respect. In all other aspects, OS/390 and applications use emulated volumes just like real CDK disk volumes.

Any number of volumes can be emulated, provided the total of emulated devices does not exceed 255. (A Multiprise 3000 can quite likely have a considerable number of emulated local 3270 connections, and these count against the maximum of 255 devices. In this case, the number of emulated disk volumes might be a factor for close consideration.)

3.7.0.2 AWS3274 and LAN3274 (LAN non-SNA 3270 Connections)
For a Multiprise 3000, these are likely to be the most important device managers. Two are listed (AWS3274 and LAN3274), but, in effect, these are the same device manager with different entry points. AWS3274 works with tn3270 sessions within the host PC (that is, the SBC inside the Multiprise 3000) and LAN3274 deals with LAN-attached tn3270 sessions, otherwise they are identical. To simplify the discussion, we will generally discuss LAN3274.

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[23] Logical volumes on the primary disks do not have CE cylinders, either.
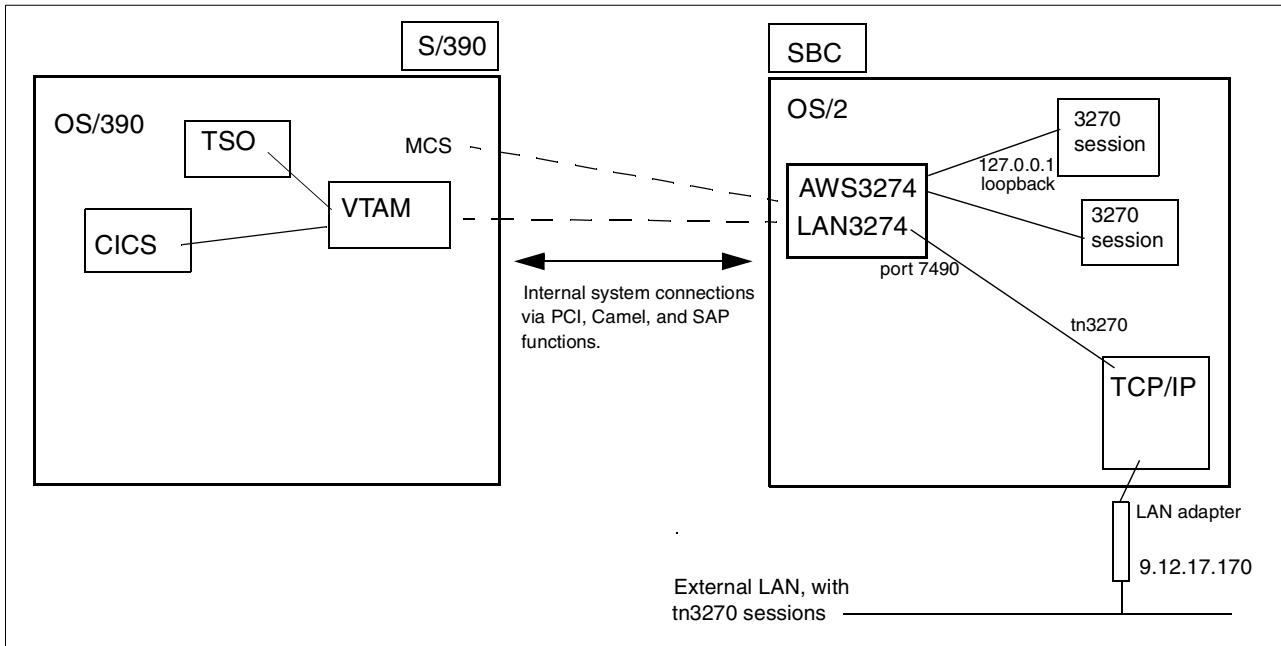
Figure 6. Highly Conceptual View of LAN3274 Operation

Figure 6 provides a conceptual illustration of LAN3274 operation. The S/390 processor and the PC processor are the two main elements shown in this figure, with some of the key software components in each processor. LAN3274 is a tn3270 server; that is, it *listens* on a TCP/IP network (at the non-standard port address of 7490[24]) for tn3270 sessions. The TCP/IP stack is provided by OS/2, and the LAN adapter is connected to OS/2 TCP/IP. (AWS3274 does exactly the same thing, except it listens for tn3270 sessions from within OS/2, using the loopback address instead of the external LAN interface.) (Not directly indicated in the figure, the loopback address goes via the OS/2 TCP/IP stack also.)

When a tn3270 session, from any 3270 emulator capable of originating tn3270 connections, is accepted, the LAN3274/AWS3274 module transforms the data and protocol so it appears to originate from a local, channel-attached, non-SNA 3174 control unit. S/390 (and OS/390) see only this appearance. Each instance of this type of device (local 3270) has a device address (UCB address), and the LAN3274 device manager assigns the next available address from a pool that it manages.[25]

Local 3270 connections are used for OS/390 master consoles and for VTAM connections. Typically, one or two are designated as master consoles and the rest are defined to VTAM. (Although VTAM manages these sessions, they are not SNA sessions.) Using the address examples in the figure, an external user--anywhere on the IP network--could connect to OS/390 as a simple, local 3270 by opening a tn3270 session to 9.12.17.170 port 7490. The system administrator can define the maximum number of such sessions he will allow, by defining the number and address of LAN3274 devices in the Configurator

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[24] This port address was intentionally chosen to be non-standard. The standard port address of 23, in the configuration shown, will connect to an OS/2 telnet server (and this is not a tn3270 server). The system administrator can change the LAN3274 port address to any number he wishes; however, to use port 23, it is necessary to disable the OS/2 telnet server.

[25] The system administrator sets up these addresses, using the Emulated I/O Configurator program described in the next chapter. The administrator can exercise additional controls to force certain connections to specific UCB addresses. This would typically be done for the tn3270 session(s) that are used as OS/390 master consoles.

program. Each of these sessions requires a different UCB address, and these each count against the 255 maximum number of emulated devices.

Using this arrangement, with external PCs as sources of tn3270 connections, is the most convenient and economical method of connecting users to the Multiprise 3000. These connections have the strong advantage that they *do not* appear to be SNA or TCP/IP connections to the S/390 and OS/390. This means that no OS/390 TCP/IP administration is needed, and almost no VTAM administration is needed to use these connections.

The OS/2 system provided with the Multiprise 3000 contains IBM's eNetwork Personal Communications product (often known as PCOM) that can be used to provide tn3270 sessions from the OS/2 screen. These local PCOM sessions typically provide the initial OS/390 master console and TSO sessions needed to further customize the system. The only limitation on these sessions is that they are on the OS/2 screen (and mouse and keyboard) and these must be within a short distance of the system frame.

3.7.0.3 LAN3172 (LAN SNA Connections)
This device manager provides SNA connections for LAN devices. It accepts SNA connections via OS/2 interfaces and transforms them to appear as though they are connected to an IBM 3172 Lan Station. VTAM then manages these connections, with full SNA functions.

Figure 7 illustrates the position of the LAN3172 module in the OS/2 system. It may be able to share a LAN adapter with a TCP/IP function.[26] The LAN3172 interface requires only a single S/390 address (UCB address) regardless of the number of SNA connections over it. It may be used for 3270 SNA connections, but some VTAM administration will probably be needed before such connections can be used.

3.7.0.4 LCS3172 (OS/390 TCP/IP Connections)
This device manager provides TCP/IP connections from LAN devices to OS/390 TCP/IP. It does not use OS/2 TCP/IP (and cannot use the same LAN adapter that is used by OS/2 TCP/IP). OS/390 sees this as an IBM 3172 LAN Station, and OS/390 TCP/IP administration is necessary to define an IP address and the nature of the connections and services available.

LCS3172 requires two S/390 addresses (UCB addresses), an adjacent even/odd pair,[27] regardless of the number of connections established on the IP address.

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[26] This is true for token ring adapters, and is sometimes true for Ethernet adapters. This is a slightly complex topic and is discussed in some detail in the redbook *P/390, R/390, S/390 Integrated Server: OS/390 New User's Cookbook*, SG24-4757-01, starting on page 292.
[27] The subchannel addresses (in the DEVMAP) and the ADDRESSes in the IOCDS must both consist of an even/odd pair.
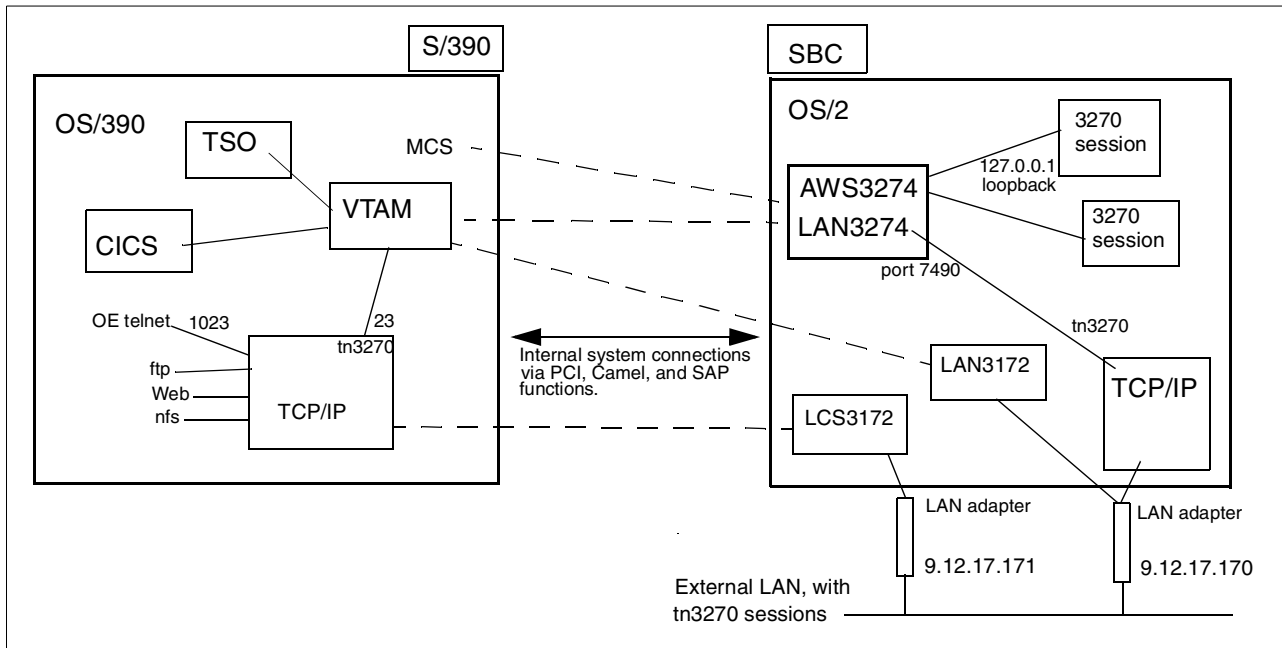
Figure 7. Conceptual View of Several Emulated LAN Types

Figure 7 illustrates the position of LCS3172 in the system. Note that OS/390 TCP/IP has a tn3270 server integrated with it. This tn3270 server normally links tn3270 sessions to VTAM, since 3270 applications (TSO, CICS, IMS) are normally VTAM applications.

Figure 7 is worth additional discussion. It is highly conceptual, of course, and does not represent the actual data paths in a Multiprise 3000 system. As shown, it illustrates a basic S/390, without LPARs. Emulated I/O can be used with LPARs, but attempting to show this in the figure would make the drawing too complicated. An external user, connected to the LAN, can access this system in a number of ways:

1. He can open a tn3270 session to IP address 9.12.17.170, port 7490. OS/390 VTAM will see this as a local 3270 that the user just switched on, and will display the USSTAB message 10 logo screen. The user would then probably log onto TSO or CICS.

2. He can open a tn3270 session to IP address 9.12.17.171, port 23. OS/390 TCP/IP will see this and provide tn3270 server functions. The OS/390 TCP/IP profile controls normally connect tn3270 sessions to VTAM. In this case, the user will not see the USSTAB message 10 logo, and may default to a specific application such as TSO.

3. He can open a telnet session to IP address 9.12.17.171, port 1023 and be connected to OS/390 Unix System Services (sometimes known as OpenEdition) in ASCII mode. (Port 1023 is not standard, but several of the preloaded OS/390 systems available for the Multiprise 3000 use this port definition.)

4. He can establish an SNA connection to OS/390, provided he has the appropriate SNA network information.[28]

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[28] The required information depends on whether VTAM is defined as a subarea network or an APPN network, and whether generic 3270 definitions exist in VTAM. In other words, the user would require several VTAM details in order to establish the connection.

5. While not indicated in the figure, the user could open a telnet connection to 9.12.17.170, port 23. This connects to the OS/2 telnet server, provided it is active. This connection can be useful for some administrative purposes, but is typically limited to systems programmers due to the lack of security controls in OS/2. (Such connections do provide multiuser capabilities for OS/2, but are limited to "DOS window" facilities.)

3.7.0.5 WAN3172 (SDLC Modem Connections)

OS/390 sees this as a LAN SNA 3172 control unit. Two types of PC adapter cards that connect to SDLC modems can be used. WAN3172 transforms the SDLC modem interfaces to appear as LAN interfaces, and VTAM is configured to work with LAN SNA devices. This generally simplifies the use of SDLC modem connections.[29]

The adapter cards used have up to eight ports, and up to two adapters can be used.[30] This provides a maximum of 16 SDLC modem connections. The specified maximum data rate is 8 x 9600 bps per adapter. If more lines are needed, an IBM 3745 or similar control unit must be used.

Another type of adapter (the WAC or Wide Area Connector) can be used. A WAC adapter has one or two lines per adapter. The maximum configuration is two eight-port adapters and one two-port WAC, providing a total of 18 lines.

WAN3172 setup is a bit more complex than the other device managers, and involves its own configuration functions (using a utility under OS/2). The details are beyond the scope of this overview redbook, and can be found in the WAN3172.DOC file (in OS/2) provided with the device manager.

3.7.0.6 AWS34XX (SCSI Tape Drives)

Use of tape drives is important in most OS/390 production environments, but may be less important in development environments. Normal mainframe-type tape control units and drives can be connected to Multiprise 3000 channels. On a smaller scale, it is possible to emulate mainframe-type drives using smaller tape drives with SCSI interfaces.

SCSI tape drives include the 4mm drive that is standard in a Multiprise 3000, IBM 3490-F01, and IBM 7205-311 drives. These are the only drives formally supported. It is important to note that the Multiprise 3000 provides only a *differential SCSI* adapter (and this is an optional feature that must be ordered, if needed). Most of the industry SCSI tape drives are provided with *single-ended* SCSI interfaces, and these cannot be used.[31] However, some vendors can provide alternate adapters for their drives, and differential to single-ended converters are available from several vendors.

The IBM 3490-F01 drive is intended to be completely compatible with tapes written or read on the corresponding "real" drives. This can be a critical requirement if tape data must be exchanged with traditional S/390 operations.

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[29] The more traditional SDLC connections involve an IBM 3745 control unit (or a predecessor, or something similar), with its own operating system.

[30] This refers to the Multiport Model 2 adapters, which are built on an ARTIC base. (The ARTIC base is an adapter card with an on-board processor intended for real-time applications. A different adapter card, the Wide Area Connector (WAC) can also be used. WACs provide only two lines, and up to three WACs can be used if no Multiport adapters are used.

[31] An exception is the IBM 3490E-F01 drive, which is available only with a differential SCSI interface. This is the recommended drive if an emulated drive is required.

The AWS34XX device manager potentially emulates any of the standard mainframe tape types when using the 4mm drive; however, we recommend that it be used to emulate 3480 drives with the IDRC feature. P/390 experience indicates these drives are not completely suitable for extensive backups or for wide interchangeability of tape data. IBM recommends that the 4mm drive be used primarily for receiving software products and fixes.

Using the differential SCSI interface and suitable cables, a number of tape drives can be chained together and supported by the AWS34XX device manager.[32] However, the system, as delivered, makes provision for only two drives (in addition to the 4mm drive). AWS34XX is a combined OS/2 device driver and device manager. It appears in the CONFIG.SYS file for OS/2, and needs to have the SCSI address(es) of the tape drives specified with it if multiple SCSI tape drives are used.

Tape drive emulation can be slightly complex. It is possible, for example, to emulate a 3490E drive (36 tracks) using a 3480-type (18 tracks) drive. Such cross-device emulation usually works, but is not recommended. (Such emulation may fail in error recovery situations, and so forth.) IBM generally recommends that the physical tape drive type should correspond closely to the emulated drive type. (No mainframe tape drive type corresponds closely to the 4mm drive. We generally recommend that it be emulated as a 3480 with the IDRC feature.)

An special case occurs if a SCSI drive is used that can read *and* write both 18 and 36 track tapes. No standard mainframe drive does this,[33] but the 3490-F01 has this ability. AWS34XX can use one of these drives to emulate two tape drives, one for *writing* 18 track tapes (3490) and one for *writing* 36 track tapes (3490E). (Both 18 and 36 track tapes can be *read* in either case.) Only one of the two logical drives can be online to OS/390 at any given time.

Another option is a **DLT**drive, such as the IBM 7205-311 unit. These have proven quite reliable and fast when used with P/390 systems. They are best used for emulating 3490 drives. However, few mainframes can accept DLC tapes. At the time of writing, the DLT drives had not been tested for the Multiprise 3000 systems and no formal IBM support exists.

The AWS34XX device driver/manager also provides an OS/2 interface[34], and the XTAPE utility is included with Multiprise 3000 to use this interface. AWS34XX can sense when one of its drives is varied online or offline by OS/390, and it uses this information to permit or prohibit accessing the drive with the XTAPE utility, which is described in "The XTAPE Utility" on page 54.

Emulated tape drives are defined through the Emulated I/O Configurator, described in the next chapter. Appendix D describes the customization of AWS34XX in more detail.

3.7.0.7 AWS2821 (PC Printer Usage)

A Multiprise 3000 system can use many types of channel-connected printers, and these would be the primary choices for production printing. However, smaller operations, and especially development organizations, often have very minor

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[32] We are aware of a P/390 system with six SCSI tape drives, but this is unusual. The typical P/390 system may have one of these mainframe-type tape drives, in addition to its 4mm drive.

[33] A standard 3490E drive can read both 18 and 36 track tapes, but it can only write 36 track tapes.

[34] This is not a documented programming interface, and is intended only for use by the XTAPE utility.

printing requirements. An emulated printer, using one (or more) low-cost PC printers may be all that is needed.

The AWS2821 device manager emulates IBM 1403 and 3211 line printers, using physical PC printers. The PC printer could be a matrix printer, but is typically a laser printer and we will consider laser printers to be the normal case in this discussion.

IBM 1403 and 3211 printers are antique devices and are involved only because they represent prototypical line printers. The difference between the two is in the handling of carriage control functions--that is, functions related to skipping to the top of the next page, or skipping to a particular line position on a page. 1403 emulation includes a fixed set of carriage controls,[35] while 3211 emulation includes the emulation of Forms Control Buffer (FCB) operations. If none of these functions are familiar to you, we suggest using 1403 emulation.

JES2[36] can drive 1403 and 3211 printers, and sees an emulated 1403 or 3211 as a standard printer. The physical printer is driven by standard OS/2 printer controls. OS/2 includes printer spooling. JES2 also spools printer output. For practical purposes, the use of JES2 is not optional. The use of the OS/2 spooling function is optional. If both are used, then double spooling occurs, and there are advantages and disadvantages to this. These include:

- If OS/2 spooling is used, then multiple 1403/3211 printers can be emulated with only a single OS/2 printer. JES2 could have multiple printers started, corresponding to different SYSOUT classes, and so forth. This multiple, parallel output from multiple JES2 printers is accepted by AWS2821 and used to create multiple parallel print jobs to the OS/2 spooling function. OS/2 will then print the jobs, one at a time, on the physical printer. (OS/2 spooling can also handle multiple physical printers correctly.)
- If OS/2 spooling is used, JES2 cannot sense the state of the printer. For example, it might have a paper jam, but JES2 cannot sense this because all output from AWS2821 is immediately absorbed by the OS/2 spooling function. If a job needs to be sensitive to printer restarts[37], this will not work.
- The OS/2 spooling function will normally not start printing until an job has been completely transferred from JES2. (Exactly what this means to AWS2821 emulation is described in the AWS2821.DOC file provided with the system.) This means that JES2 controls cannot be used to cancel or reset a job while it is printing. As far as JES2 is concerned, the job completed printing when it was send to the emulated printer (and placed in OS/2 spool); this occurs before actual printing occurs.
- If OS/2 spooling is not used, then there is a one-to-one match between physical PC printers and emulated printers. For simple development environments, this may be acceptable. However, JES2 controls for cancelling or resetting printer output may not work, due to internal buffering in the printer.

It is easy enough to try emulated printing with and without OS/2 spooling. Most P/390 users elect to use OS/2 spooling after experimenting with it both ways. Also note that any mention of JES2 in this discussion could be replaced by JES3.

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[35] These include a "channel 1" punch corresponding to the third line of the next page, and so forth.
[36] This discussion assumes the printer is defined to JES2.
[37] For example, an OS/390 job that prints checks might drive a line printer directly (not through JES2) and may need to be synchronized with preprinted check numbers.

3.7.0.8 Line Printing versus Page Printing

Most modern systems, from PCs to mainframes, use laser printers and these are often known as *page* printers. The use of a *page printer* should not be confused with the printing of *page data*. A page printer can print both page data and line data. In the PC world, page data might be represented by a Postscript file. Postscript includes controls for using various fonts, printing figures, and so forth. The equivalent S/390 function involves IPDS print streams.[38] A billing statement, from an electric company or a telephone company, is probably generated with an IPDS print stream. OS/390 utilities, JCL listings, compiler listings, and similar functions generate line data listings, not IPDS listings. Furthermore, these are all in formats (132-character maximum line lengths) suitable for printing on 1403 line printers. Large S/390s typically have only page printers, but much of their output is line data. The page printers are used in line printer modes.

AWS2821 does not emulate IPDS printers; there are no emulated I/O device managers to do this. It does emulate line printers, and this is all that is needed for many S/390 users. In general, a Multiprise 3000 owner will know if he has specific requirements for IPDS output.

Line data, such as a compiler listing, printed on a mainframe page printer is usually handled in a standard way. The output page is rotated into landscape mode, a font is selected to permit 60 lines per page, with 132 characters per line, and data is printed on both sides of the paper.

Using a PC laser printer, AWS2821 can produce output in a similar format. It may be difficult to distinguish a COBOL listing, for example, produced on a 38xx mainframe printer from the same listing produced through a PC printer and AWS2821. To create this similarity, the system administrator must create an AWS2821 control file (per physical OS/2 printer) containing printer control characters to rotate the page, print on both sides (assuming the printer has this feature), and so forth.[39]

3.7.0.9 AWS2540 (Emulated Card Reader)

Very few mainframes have "real" card readers now, but "virtual" card readers are common. If a TSO user submits a batch job from ISPF, ISPF uses an *internal reader* (a form of virtual card reader) to send the job to JES2.

AWS2540 provides an emulated card reader, which JES2 sees as a "real" card reader.[40] The operator may need to *start* the reader to make it active, or the systems programmer can define it as a *hot reader*. On the PC side, AWS2540 constantly monitors a disk directory (defined in the Emulated I/O Configurator). If a file appears in this directory, AWS2540 assumes it is a job and sends it to JES2 as card images. It then deletes the file from the OS/2 directory.

The normal process is for the user, in OS/2, to edit a file and create the necessary job (including a JOB statement and JCL) and then copy this file into the directory monitored by AWS2540. When AWS2540 sends the card images to JES2, it will translate them from ASCII (the normal form of OS/2 text files) to EBCDIC. It will also convert the variable length OS/2 records (delimited by CR/LF characters) to 80-byte images.

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[38] IPDS means Intelligent Printer Data Stream and includes controls for fonts, figures, and so forth. IPDS print data is sometimes known as LIST3820 data, AFP data, or LIST3800 data.

[39] Control file examples are discussed at some length in the redbook *P/390, R/390, S/390 Integrated Server: OS/390 New User's Cookbook*, SG24-4757.

[40] This discussion assumes the 2540 card reader is defined to JES2.

This process can be convenient for a number of purposes. It can be especially useful if the systems programmer has made an error that prevents TSO (or VTAM) from starting. It may be possible to create a batch job (in OS/2) to correct the problem, and submit the job through AWS2540.

Only a single emulated card reader can be used.

3.7.0.10 AWSTAPE (Emulated Tape Drives)

This device manager emulates an IBM 3420 tape drive, using a PC disk file. From the OS/390 viewpoint, it is seen as one or more 3420 tape drives. Using normal JCL, a job can allocate the drive(s). Special action is needed when OS/390 issues a *mount* message for the drive.

An OS/2 utility named AWSMOUNT is included with the system. The system operator would use an OS/2 window to issue an AWSMOUNT command that names the OS/2 file that is used to hold the emulated tape data. Any number of OS/2 files can be used to hold emulated tapes.

Performance of AWSTAPE is unusual. Writing output, using AWSTAPE, is considerably slower than using a "real" tape drive.[41] However, reading data through AWSTAPE is quite fast. In principle, the emulated tape could be on diskette. In practice, this is far too slow for writing data. However, once the data is written to a disk file, the file can be copied to diskette (if it fits, of course) and sent elsewhere. AWSTAPE files can be a convenient way to exchange small tape volumes. These files are compatible between P/390, R/390, S/390 Integrated Server, and Multiprise 3000 systems.

The file format written by AWSTAPE contains control blocks in addition to the application data. These are documented, and it is possible to write PC programs to read or create AWSTAPE data. See the AWSTAPE.DOC file in the OS/2 system for more information. An example of using the AWSMOUNT command is given in the *Cookbook*.

3.8 Required Changes to OS/390

A minor Small Programming Enhancement (SPE) software change is required in order to use any of the internal Multiprise 3000 disks (primary and/or emulated disks), or any other emulated I/O devices. This update will be included with any of the preloaded systems and their corresponding distribution media. This SPE can be installed on any release of OS/390 as early as OS/390 V2.4 at the time we worked with our early system. You should verify the earliest system level supported.

The following service is, at the time of writing, is included in the SPE.

Component	APAR	PTF
IOS	OW39508	UW63054, UW63055, UW63056, UW63057, UW63058
ICKDSF	PQ26800	UQ90018
DFSMS	OW39122	UW62959, UW62960
	OW39380	UW62961, UW62962

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[41] This is due to the need to emulate the end-of-reel marker, which occurs near, but not at the end of a physical tape.

Component	APAR	PTF
	OW39010	UW58731, UW58732
RMF	OW37816	UW99263, UW99264, UW99265
HCD	OW38749	UW90659, UW90660, UW90661, UW90662, UW90663, UW90664
IOCP	OW40605	UW90665
EREP	IR40683	UR51196

The release 2.8 version of the AD system and the initial version of 390ADS should have this SPE installed. Note that some of the listed PTFs have prerequsite and corequsite PTFs not listed here, and additional PTFs may be added to this list; the total package needed is likely to be somewhat larger than listed.

3.9 LAN Adapter Specifications

The OS/2 LAN adapters used for Emulated I/O interfaces must be specified to OS/2 MPTS. In order to do this, the exact adapter type (as expressed by the list in MPTS) must be known. For the first Multiprise 3000 systems, these are:

Adapter Description	MPTS Name
Integrated Ethernet adapter	Intel(R) PRO PCI ADAPTER
Additional Ethernet adapters (the shipping box for the adapter says "IBM 10/100 Etherjet PCI Management Adapter)	IBM 10/100 Ethernet PCI Adapter
Token Ring Adapters	IBM Token-Ring PCI Family Adapter (IBMTRP.OS2)

As LAN adapter technology progresses, later Multiprise 3000 systems might have newer adapters. The exact MPTS name is important when configuring MPTS, because a large number of adapters with very similar names are listed within MPTS.

If you have more than one Ethernet adapter, additional setup steps are needed in MPTS.[42] The basic requirement is that you identify which slot is used for each Ethernet adapter you define. Unfortunately, the slot numbers used for this identification do not match the physical adapter slot numbers; furthermore, we have not found a definitive description of how to map the slot numbers. Therefore, we used a trial-and-error method.

To start MPTS,[43] go to the OS/2 desktop and open an OS/2 window. Then enter the command MPTS. Figure 8 on page 45 illustrates the MPTS *Configure* screen, with two Ethernet adapters defined. The general process for using this screen is:

1. Select an adapter in the Network Adapters window. Click **ADD**. The adapter will appear in the Current Configuration window.

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[42] More complete step-by-step instructions for setting up LAN adapters for P/390 systems are given in the *New User's Cookbook*. Setup for the Multiprise 3000 is the same, except for case of multiple Ethernet adapters.
[43] You would normally do these steps without IPLing any S/390 operating system or performing the Power-on Reset function.

2. Select a protocol in the Protocols window. Click **ADD**. The protocol will appear under the adapter in the Current Configuration window. Select another protocol, if appropriate, and **ADD** it.

3. Make other adjustments, as needed. (See text below.)

4. Select another adapter in the Network Adapters window, and repeat the steps.

5. You can add and remove adapters and protocols until you have the right configuration. Nothing is saved until you click **OK**.

Adapters and Protocol Configuration

Network adapters

```
IBM Adapter X Y Z
Some other adapter name
IBM 10/100 Ethernet PCI Adapter
..............
................
```

[ADD] [Change] [Other Adapter]

Protocols

```
NetBIOS
IEEE802.2
TCP/IP
Other
```

[ADD] [Other Protocol]

Current Configuration

```
Intel(R) PRO PCI ADAPTER
   0 - IEEE802.2
   0 - TCP/IP
IBM 10/100 Ethernet PCI Adapter
   1 - IEEE802.2
```

[Edit] [Remove] [Change Number]

[OK]

[Cancel]

[Help]
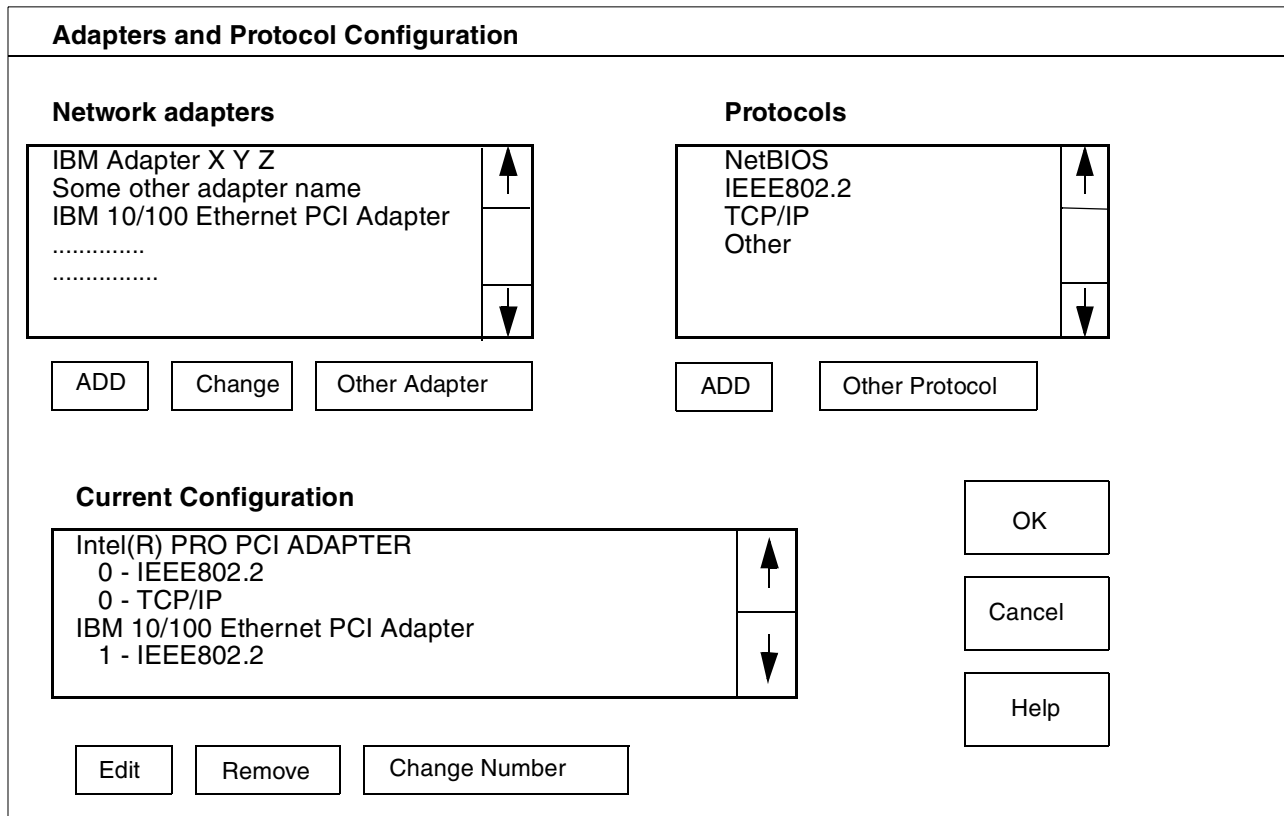
Figure 8. MPTS Configuration Screen With Multiple Ethernet Adapters

In the example shown, we plan to use the Intel adapter for OS/2 TCP/IP (which will use the AWS3274 and LAN3274 device managers to emulate local 3270 terminals).[44] The IBM adapter will be used for OS/390 TCP/IP (via the LCS3172 device manager). Our system had a third Ethernet adapter, for use with SNA, that we had not yet configured.

After defining the adapters as shown in the figure, we made additional refinements. With the mouse, double-click on the IEEE802.2 protocol name in the Current Configuration window. This displays a pop-up window with a number of parameters. Find the *Type of Ethernet* parameter and change it from I to D; this changes the protocol from IEEE802.3 Ethernet to DIX Ethernet. DIX (or "Standard") Ethernet is commonly used, and this is probably what you want. Make this change for both adapters. (However, do not make the change for an Ethernet adapter that will be used for SNA.) This subject is discussed at length in

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[44] The TCP/IP protocol specified in MPTS refers only to OS/2 TCP/IP. An adapter cannot be shared between OS/2 TCP/IP and OS/390 TCP/IP. If the adapter is intended for OS/390 TCP/IP, then the MPTS definition must not include the TCP/IP protocol.

the *New User's Cookbook*. Do not change any other protocol parameters unless you understand what you are doing.

Double-click on the adapter name in the Current Configuration window. This displays a popup window with a few additional parameters, including a *slot* parameter. If there is more than one Ethernet adapter, we will need to place a value in this *slot* parameter--however, at this point, we do not know what value to use.

Click **OK** to end MPTS configuration. After clicking **OK** and **Exit**, MPTS will update OS/2 CONFIG.SYS parameters. You must reboot OS/2 to make the changes effective. During the reboot there will be error messages about no slot numbers in PROTOCOL.INI (if you have more than one Ethernet adapter). The error messages will list all the slot numbers that contain Ethernet adapters. *Copy these numbers.* In our case, the numbers were:

```
000B      The integrated Ethernet adapter
0066      Ethernet adapter in physical adapter slot 11
0067      Ethernet adapter in physical adapter slot 12
```

Press Enter to continue the booting process. (The error messages will be displayed twice if you have defined two adapters in MPTS.) It appears that the integrated adapter is always considered to be in slot 000B. The other slot numbers may be different on your system. (We later, by experimentation, found which logical slot number (0066 or 0067) was associated with which physical adapter slot number.)

After OS/2 is running, start MPTS again and double-click on the first Ethernet adapter name in the Current Configuration window. In the pop-up screen, enter the logical slot number of the adapter. Do the same for the second adapter. In our case, we entered 000B for the first adapter (which is the integrated INTEL(R) PRO adapter) and selected 0066 for the second adapter we defined. Reboot again to activate the changes.

The OS/2 file C:\IBMCOM\LANTRAN.LOG should be examined for errors, or reports that the LAN adapters started normally. This file often contains valuable information for debugging LAN problems. When using Ethernet adapters, the LANTRAN messages appear to contain token ring information. This is not an error; it is merely the terminology used to present the MAC addresses in another format (in "token ring" format).

3.9.1 OS/2 TCP/IP Configuration

OS/2 TCP/IP should be already configured to use the loopback address. OS/2 TCP/IP is used by the emulated I/O device managers (AWS3274 and LAN3274) to transform tn3270 sessions to local, channel-attached 3270 devices. OS/390 will use one of these devices for its master console. The PCOM 3270 emulator sessions that are started on the Multiprise 3000 display use the OS/2 loopback address to connect to OS/2 TCP/IP.

The default setup has no LAN adapter configured. This still requires an MPTS definition, with the adapter type *No Network Adapter*. This is the first entry in the MPTS list of possible network adapters. This adapter should have been added to the Current Configuration window, and assigned protocols IEEE802.2 and TCP/IP. If this is not done, OS/2 TCP/IP will not start automatically, with the end result that the local 3270 sessions are not usable.

OS/2 TCP/IP configuration can be started by clicking the icons: **OS/2 System** -->
Programs --> **TCP/IP Shadows** --> **TCP/IP Configuration** --> **TCP/IP
Configuration (Local)**[45]. Once in the TCP/IP configurator, select the Networking
panel. This should have the loopback address enabled (shown with a check mark
in the appropriate box) with address 127.0.0.1.

We added the integrated Ethernet adapter to this list. In our example, it is the first
(and only) entry in MPTS that has TCP/IP assigned as a protocol. This makes it
adapter 0 in the TCP/IP configurator. We enabled this interface (by clicking on
the appropriate box) and manually assigned the IP address 9.12.17.170, with
netmask 255.255.255.0.[46] In the advanced panel, we set the Maximum
Transmission Unit size to 1492. (Without going into details, we recommend this
size. In some cases a smaller MTU may be needed.)

We rebooted OS/2 to start TCP/IP. We connected our integrated Ethernet
adapter to a hub. From an external PC, we started a tn3270 session to
9.12.17.170, port 7490 and were able to log onto TSO. (Port 7490 is the default
tn3270 port for the device managers involved. You can change this through the
Emulated I/O Configurator.)

For normal usage, each TCP/IP LAN adapter must have a different IP address.

3.10 Disk Cache and Buffer Interactions

Cache interactions, both for primary disks and emulated disks, make
performance predictions difficult. Figure 9 on page 48 provides a conceptual
overview useful for discussion. Notice the following caches and buffers:

- A 1 MB buffer on each 18 GB drive and a smaller buffer on each 9 GB drive.
  These are primarily buffers, but have cache effects due to *read ahead* and
  write behind characteristics.
- A 32 MB nonvolatile cache in the RAID/SSA adapter (the *Santa Cruz* card)
  plus a 64 MB buffer. This 32 MB cache provides the fast-write function for the
  primary disks.
- A track cache in OS/2 memory (only for emulated drives). (The size of this
  cache is equal to a single track per emulated volume in the initial release of
  the system.)
- The HPFS cache in OS/2, normally 2 MB in size and set to cache records up
  to 64K.
- An independent buffer in the *Camel* interface
- A potentially large (32 MB to 1 GB) cache in HSA. This is used as a *write
  through* cache.
- Normal OS/390 buffering, for QSAM for example, plus the more general HFS
  caching recently introduced in OS/390.

The difference between a cache and a buffer is clear in theory, but can be fuzzy in
practice. In general, a cache is intended to store data for reuse, while a buffer is
intended only as a temporary store while awaiting data transfer. However, many
buffer mechanisms can provide data reuse under appropriate timing conditions.

The fast write cache in the SSA adapters is preserved across power off/on cycles.
In principle, if the system crashes, pending updates in this cache will be written to
disk after power and operations are restored.

[45] You may find other ways to start the OS/2 TCP/IP configurator, starting within SE panels.
[46] This is an unassigned address that is not connected to the real Internet; do not try to connect to it.
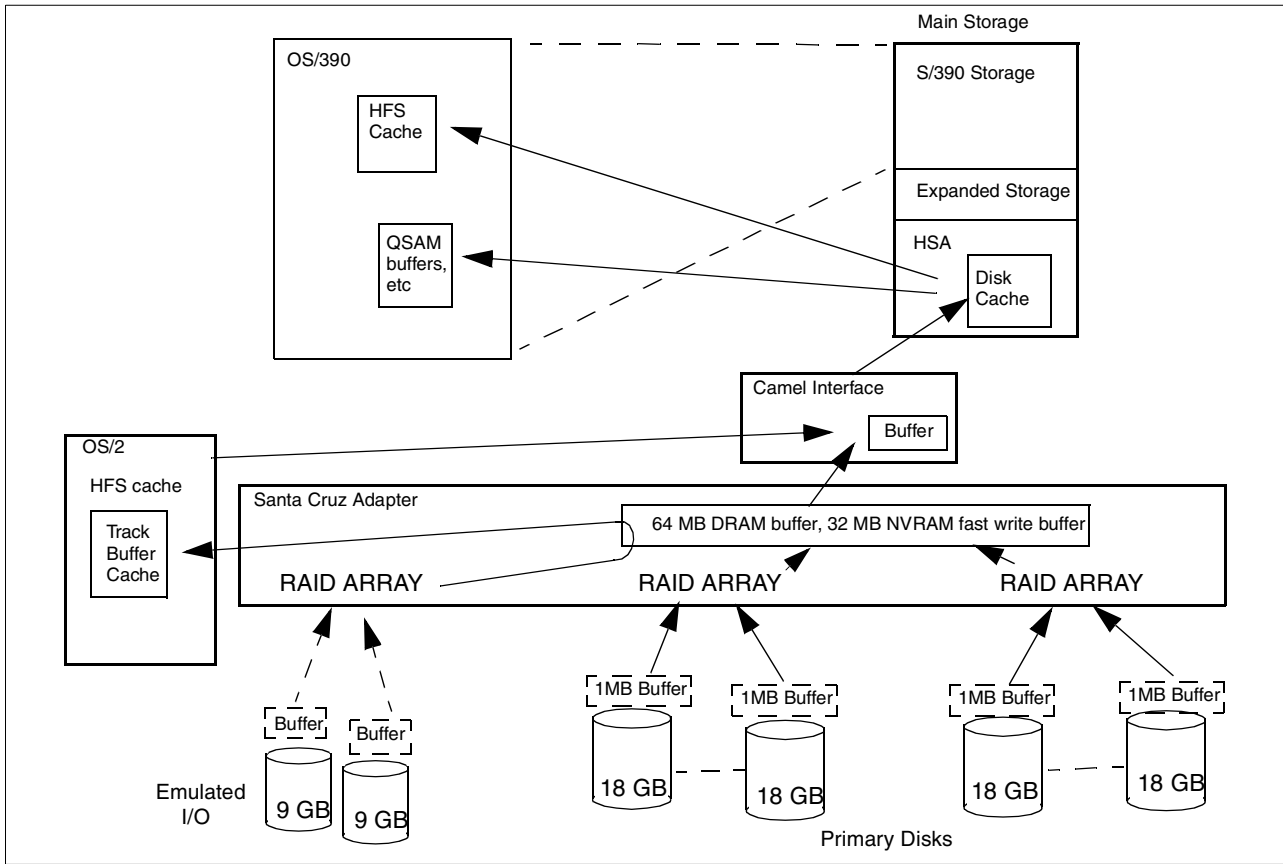
Figure 9. Disk Buffer and Cache Flows

When disk data is found in a cache, the apparent access speed is very fast. The access and latency times are almost zero and the transfer rate can approach bus speeds. The relatively large storage used for caches makes it likely that highly-utilized records will remain in at least one of the caches. This should result in disk I/O rates equivalent to a traditional mainframe that has many more channels, disk control units, and disk drives.

The caches, and especially the interaction between caches, makes performance and capacity prediction difficult. In the worst case, with widely-spread disk I/O patterns, every I/O operation would require real disk I/O.

3.11 Utility Programs on CD-ROM

A CD-ROM is supplied with each Multiprise 3000 system. This is a bootable CD-ROM (and the SBC, by default, includes the CD-ROM drive in its boot list). When booted, the CD will offer an option to install all the OS/2 functions required[47] or to update existing OS/2 code.

The CD-ROM can be used without booting from it   In this case, it is a normal PC CD-ROM and contains a number of directories. One directory is DIAG. This directory contains, among other things, diagnostics for PC-related functions of the Multiprise 3000 and SSA/RAID utility functions. Both the diagnostics and SSA/RAID utilities are in a format used to create diskettes. That is, you must

[47] This includes the emulated I/O device managers and other utility functions.

produce the diskettes before you can use the programs. The utility used to create diskettes (LOADDSKF) is also in the DIAG directory.

This version of LOADDSKF can be run under OS/2, DOS, or various versions of Microsoft Windows. You can create the diskettes by running under OS/2 on the SBF, or by taking the CD-ROM to another PC and creating diskettes there.

You will need the SSA/RAID utility function if you ever need to create your OS/2 RAID arrays from bare hard disks. The RAID utility function (which is normally used from an OS/2 window) is started with the command `issacfg -p -l`.

3.12 Availability and Recovery Characteristics

A Multiprise 3000 system contains an interesting set of reliability, availability, and serviceability (RAS) features and functions. These provide considerable advances over many older systems and P/390-based systems, but not all elements are at the level provided by the larger S/390 Servers and Multiprise 2000 machines.

Among the externally visible characteristics are:

- Dual power feeds (potentially from different power sources)
- Dual power supplies (N+1) and cooling fans, with concurrent maintenance
- One or two optional Integrated Battery Facilities, with automatic monitoring of battery conditions
- Dual S/390 processors (H70 model)
- RAID-5 for all internal disks
- Hot spare disk (per frame) for the primary internal disks, with concurrent maintenance
- Concurrent replacement of any failed disk drive, or any active drive (assuming the hot spare is available)
- The normal SSA dual loop ensures that a cable failure or removal will not interrupt access to disks. Among other benefits, this allows replacement of disks while the system is operating.

The internal RAS functions may be more interesting. These include:

- Dual instruction/execution (I/E) units in each processor. In effect, every instruction is executed twice, in parallel, and the results compared. Failures are automatically retried. This eliminates almost all soft errors in the processors.[48]
- Dynamic SAP reassignment (in the H70 model, with two primary S/390 processors). If the SAP fails, its function is automatically shifted to one of the S/390 processors. This involves OS/390 handling to avoid any application loss.

---

[48] Random "soft errors" have become an increasingly important topic in recent years, sometimes under the label of "undetected errors." The most common discussion example is an error due to a cosmic ray hit. This does not damage the component that was hit, it merely creates a "soft error" that can probably be successfully retried *if it is detected*. The ability of a system to detect these internal errors is important. S/390 design has traditionally been very strong in this area--somewhat at the expense of performance and increased cost. Other architectures have designed for higher performance and price/performance by minimizing internal checking, personal computers being a good example. This is a large area of interesting discussion, but beyond this redbook. Discussions at this level should be resolved before ordering *any* system.

- *Application Preservation* (in the H70 model, with its two S/390 processors). If one of the processors fails (after all applicable internal instruction retries), the system will attempt to scan out the processors internal state and signal an external interruption to the other S/390 processor. If the scanout was successful, the surviving processor can recover the state information (in its machine-check logout area), and pick up application processing at the point of failure. The failure is transparent to the application. This is a very sophisticated level of hardware recovery and, depending on the nature of the original failure, the scanout of state information may not always be successful. (If it is not successful, normal machine-check processing will be used. This will drive RTM and existing FRRs and/or ESTAEs will have a chance to recover whatever module is executing.)

- Memory checking uses ECC for checking and correction of single bit errors and errors due to a single memory chip. This last part is important because multi-bit errors are usually due to a single defective chip.

- Memory sparing provides spare memory chips on the memory card. The card keeps track of errors, and threshold points cause a spare memory chip to automatically replace a failing chip. The operating system is notified, but this function is transparent to application software.

- Memory scrubbing (by the hardware) cycles through all real memory, detecting errors in memory areas that may not currently be used by the software.

In some areas, the Multiprise 3000 is not quite at the RAS levels provided by the large S/390 servers. Factors include:

- The Single Board Computer. This is a single PC processor board, with its own memory. In some cases, the system can function without it, but in most instances a failure in the SBC will stop the system. This is obviously the case if any emulated I/O is being used. If absolutely no emulated I/O is being used, the system may survive the loss of the SBC, provided that the failure process did not impact the PCI bus. The single most common cause of PC failures--power supply problems--should be rare, since the SBC is supplied from the dual primary power supplies.

- SBC adapter cards, such as Ethernet adapters, are PC-style components and may have higher failure rates than mainframe-style components. However, LAN adapters tend to be very reliable elements in PCs and there is no reason to expect different characteristics here.

- No spare processors (S/390 or SAP) are provided, and the normal S/390 Server *sparing recovery* mechanisms are not available. (However, SAP reassignment to a second S/390 processor, or Application Preservation to a second S/390 processor are both available on Multiprise 3000 systems with two S/390 processors.)

- Concurrent (that is, concurrent with system operation) replacement of channel cards is not possible.

- A single, optional, cryptographic processor may be used. This has extensive internal error checking but has no sparing in the event of a failure.

3.13 Call Home Function

A Multiprise 3000 can have an optional modem connection that is used by the SE application. If the standard modem is operational (and connected to a standard

analog telephone line), the SE application will automatically call an IBM service facility when a serious error is detected. The telephone number to be used is set during installation.

Errors are logged by an SE function, using OS/2 files for the log. When a modem connection to IBM service is established, the complete log contents are sent.[49] A number of logged incidents may have accumulated before connection is established, and all are sent.

The connection uses IBM's RETAIN service system, and, in effect, ftp's data to an IP address established by IBM. During the dial up function, the ISP provides a temporary IP address for the Multiprise 3000--a similar procedure for any PC dialing into an ISP. This temporary IP address has no impact or interaction with the IP addresses you may have established for your networks.

If OS/2 TCP/IP is connected to a LAN, the Call Home function will attempt to *ping* an IBM Service Facility, using several IP addresses over the LAN. If one of these pings is successful, a LAN connection to IBM will be used instead of a dial-up function. We found that, if a LAN connection is used for the Call Home functions, then the definition required (in SE panels) appeared to override our use of the same LAN adapter for other uses. That is, it appeared that a LAN connection required a dedicated LAN adapter. (This may have been due to our lack of understanding of the setup and customization used.)

The Call Home function can be controlled from the SE *Console Actions* panel, under the *Enable Console Services* icon.

3.14 Use and Care of OS/2

Recent larger S/390 systems contain a Support Element (SE). This provides a GUI interface for all the hardware controls, LPAR management, hardware diagnosis, and so forth. The GUI program is an OS/2 application, and the SE itself is a Personal Computer running under OS/2. In the larger systems, the underlying OS/2 in the SE is not directly accessible. That is, there is no standard way to obtain an OS/2 command window,[50] and the usage of OS/2 is intended to be transparent.

The Multiprise 3000 is both the same and different. The SE function operates under OS/2. However, all the emulated I/O functions also operate under OS/2 and several OS/2 interfaces are directly available. The use of OS/2 is not transparent. Configuration and use of some of the emulated I/O functions may require changes to CONFIG.SYS and use of the Emulated I/O Configurator function. The Configurator was discussed at length in the previous chapter.

The OS/2 release that is provided with the initial Multiprise 3000 machines is Warp 4. As part of routine system maintenance, IBM may later replace or upgrade the OS/2 release in the same manner that other microcode/firmware/LIC functions are upgraded. On our early Multiprise 3000, the SYSLEVEL command indicated that the OS/2 base operating system level was 4.00 with CSD XR0M011. PCOM was 4.20 with CSD level IP21450, and TCP/IP indicates several levels, including 5.30 and 4.10.

---

[49] This is so the IBM support team can review incidents leading up to the current problem. Sending a complete log can take some time, on the order of 10 - 20 minutes.

[50] We are quire aware than many users modify OS/2 to obtain a command window. However, we are speaking here of standard, unmodified systems.

Can you run other applications on OS/2? You could, but IBM does not support this mode. That is, if there is a problem, you are on your own. We strongly recommend against doing this. P/390 experience has shown a number of problems when trying to run significant OS/2 applications (while using emulated I/O to run S/390 applications), and owners generally do not attempt to do this.

3.14.0.1 OS/2 Disk Organization
The RAID-5 array used by OS/2 has been partitioned to provide five logical disks: C through G. These are used as follows:

Drive	Org	Size	Free	Usage
C	HPFS	1.54 GB	1.26 GB	OS/2, various OS/2 products, many files
D	HPFS	722 MB	543 MB	SE, P/390 programs, IOCDS, many directories
E	FAT	320 MB	320 MB	OS/2 dumps, some logs
F	HPFS	722 MB	687 MB	OS/2 SWAPPER, traces, logs
G	HPFS	14.4 GB	14.4GB	for emulated I/O drives

The sizes and free space shown here correspond to our early system. Production models may differ. Note that there is considerable free space on several of the drives. If you fill the G drive (with emulated I/O volumes) you could temporarily allocate more volumes on C, for example. However, allocating your emulated I/O drives anywhere other than the G drive is not supported by IBM and might impact service.

The CD-ROM drive is OS/2 drive H.

3.15 LPAR Capping

Software developers sometimes wonder how well their product would work with *x* MIPS available. In an LPAR environment, it is possible to *cap* a partition to a specified portion of the total available MIPS. To make this effective, it is necessary to idle the other partitions or also cap them, so as to ensure that sufficient MIPS are available for the partition being tested. The SE panel *Change Logical Partition Control* looks something like this:

```
Change Logical Partition Control

    Logical    Active    Processing    Capped    Non-dedicated
    Partition            Weight                  Processors

    MVS1       YES       10            X         1
    MVS2       NO        20                      1
    CF1        NO        10                      1
```

The Processing Weight is an arbitrary number that has no absolute meaning.[51] It is the ratio between partition weights that is important. In this example, the total of the weights is 40 and partition MVS1 has weight 10. This means that MVS1 is intended to have 25% of the MIPS available. In this example, MVS1 is capped; this means it will not be allowed to have more than 25% of the possible MIPS,

[51] We were told to never use a weight less than 10.

even if the other partitions are idle. You can change the weights and indicate any partitions that are capped by manipulating this SE panel.

Note that no absolute MIPS numbers are used. You must translate the weight percentages into an approximate MIPS evaluation.[52] A few quite unscientific trials indicate that the capped percentages are reasonably accurate.

3.16 Emulated I/O and LPARs

Emulated devices cannot be shared by multiple LPARs. This means, for example, that *emulated disks cannot be shared by multiple LPARs*. Logical volumes, on the primary disks, *can* be shared (assuming appropriate IOCDS definitions).

LAN interfaces used for S/390 TCP/IP (via the LCS3172 device manager) cannot be shared. For S/390 TCP/IP, each LPAR would need its own LAN adapter. The Multiprise 3000 is limited to four emulated I/O LAN adapters. One of these is normally dedicated to OS/2 TCP/IP for the AWS3274 and LAN3274 device managers.

Multiple LAN SNA devices (defined in the DEVMAP, using device manager LAN3172) can be defined using a single LAN adapter.[53] (This adapter might be shared with OS/2 or S/390 TCP/IP, provided there are no conflicts concerning DIX vs IEEE802.3 packet protocols). A given SNA LAN device cannot be shared, but you can define one SNA device for each LPAR.

3270 emulator sessions routed through OS/2 TCP/IP and the AWS3274/LAN3274 device managers can be connected to multiple LPARs. These device managers connect to remote tn3270 clients, and cause each client session to appear to OS/390 as a local, non-SNA 3270. Each session is assigned a separate subchannel (in the DEVMAP) and a separate UCB address (via IOCDS and IODF). Any single tn3270 session will belong to a single LPAR, and cannot be shared. The setup for these sessions requires some thought.

A typical DEVMAP contains many definitions for 3270 devices, for use by the AWS3274/LAN3274 device managers. In normal usage, a new tn3270 session (connecting to port 7490 of the OS/2 TCP/IP) is assigned to the next available 3270 definition in the DEVMAP. Review the DEVMAP and IOCDS listings in Appendix A. Note the many 3270 devices defined in the DEVMAP, starting at subchannel address 70. A new tn3270 session is assigned the next available definition in this list. Each subchannel is defined, by your IOCDS, to a particular LPAR. A given subchannel cannot be shared by multiple LPARs.

If the typical setup is used, a new tn3270 session will be assigned to whatever LPAR owns the next available subchannel address. This is probably not what you want for your LPAR operation. The method around this could use the following DEVMAP definitions:

```
Addr Device  Label  Atype   Size  Mgr  FN/P
  70   3278                         3   /R=OPMVS1
  71   3278                         3   /R=OPMVS2
  72   3278                         3   /R=OPMVS3
  73   3278                         3   /R=MVS1
  74   3278                         4   /R=MVS1
```

---

[52] Also note that MIPS numbers for modern S/390 processors are very dependent on the workload mix and can vary over a wide range.
[53] The multiple VTAMs using the adapter, in this case, must use different SAP numbers.

```
75    3278                          4    /R=MVS1
..    3278                          4    /R=MVS1
7F    3278                          4    /R=MVS1
80    3278                          4    /R=MVS2
..    3278                          4    /R=MVS2
8F    3278                          4    /R=MVS2
90    3278                          4    /R=MVS3
..    3278                          4    /R=MVS3
9F    3278                          4    /R=MVS3
A0    3278                          4
..    ....                          .
```

In this example, device manager 3 is AWS3274 and device manager 4 is LAN3274.[54]   The /R operand is used to force a client tn3270 session to connect to certain subchannel addresses. On the client side, the 3270 emulator should have a field to specify an LU name. The LU name should match one of the names in this list. Note that three addresses are set aside for the MVS master consoles; a master console emulator session would specify LU=OPMVS1, for example. Incoming tn3270 sessions with LU=MVS1 will connect to the next available address in the block 74-7F, and so forth. Note subchannel address A0, which does not specify an operand. The IOCDS definitions would assign this subchannel definition to a particular LPAR, and an incoming tn3270 session that does not specify an LU parameter would use this subchannel address.

Almost everything in this example is arbitrary. You might have many 3278 definitions that do not specify an operand; these would probably be defined (in IOCDS) as connecting to your primary production LPAR. There is no need to start 3278 definitions at subchannel 70; there is nothing special about this address.

Typically, users want to use the "same" OS/390 in multiple LPARs. This means that all the OS/390 libraries are shared, while instance-specific data sets (such as paging data sets) are created for each LPAR. There are many ways to do this, all of which are beyond the scope of this redbook. See *P390plex: A Technology Demonstration*, SG24-5632, for a description of adapting a preloaded system (the AD system) for shared-library use, using the simplest techniques we could devise.

3.17 The XTAPE Utility

The XTAPE utility is provided with the Multiprise 3000. It runs under OS/2, and is intended for working with SCSI tape drives (including the 4mm drive that is standard with the Multiprise 3000). The XTAPE.DOC file (in the P390 directory on the OS/2 D drive) contains documentation for XTAPE. We suggest you print this file, which is about 45 pages. An OS/2 command such as COPY D:\P390\XTAPE.DOC LPT1   can be used if you have a PC printer attached to the parallel port.

XTAPE provides approximately 25 commands for tape functions. It can be used with more than one tape drive, and is normally used interactivley from an OS/2 command line. An example of a session might be:

```
C:>  xtape *                        start XTAPE
XTP> rew 560                        rewind the tape
```

---

[54] AWS3274 is normally used for sessions that appear on the OS/2 display, which LAN3274 handles sessions connected via LAN.

```
XTP> scan                          list tape labels, etc
     (output from scan)
XTP> rew 560                        rewind it again
XTP> init 560 TAPE01                create standard label
XTP> run 560                        rewind and unload tape
XTP> quit                           end XTAPE program
```

This example assumes that an XTAPE.INI file exists containing the line SET 560 /DD AWS34X0 and that your OS/2 CONFIG.SYS contains a corresponding definition in the emulated I/O section.   The XTAPE.DOC file contains extensive setup information.

XTAPE has proven very useful for a variety of purposes, including dumping OS/2 files and whole drives. XTAPE cannot access logical volumes on the primary disks, but it can access any volumes on the emulated disks, since an emulated volume is an OS/2 file.

3.18 Hard Drive Failure

What happens when a hard drive fails? The follow pseudocode describes the logic involved:

```
If the failed drive is in the emulated drive array (OS/2) then
    { Use the RAID-5 exposed mode, running with two disks;
      Use the Call Home function to report the problem;
          {repeat the call every hour;}
      Place a message in the Hardware Messages display;
          {repeat the message every hour;}
      Continue system operation;
      If a second failure occurs, there is data loss and system is down;
    };
If the failed drive is in a primary disk array then
    { Automatically rebuild the failed drive on the hot spare;
      Use the Call Home function to report the problem;
      Place a message in the Hardware Messages display;
      Continue system operation;
      If a second disk failure occurs then
         { Place the array offline mode;
           Use the Call Home function to report the problem;
           Place a message in the Hardware Messages display;
           If possible, continue operation without this array;
         }
    }
Perform concurrent replacement of single failed drive.
```

This represents "standard" RAID-5 processing for the emulated (OS/2) disks where no hot spare is available and a single disk failure is tolerated.

The handling of the primary disks is not standard RAID-5. A single failure causes the hot spare to be used; it is automatically initialized from parity information remaining in the array. System operation continues. When this is done, the array still has RAID-5 redundancy. If another drive then fails (before the first bad drive is replaced), the array involved is placed offline. This is not common RAID-5 operation; most RAID-5 implementations would allow operation to continue (without any redundant protection) since no data loss has occurred.

The Multiprise 3000 designers have elected to use a more conservative data protection design than typical RAID-5 usage. If an array is permitted to continue read-write operation without its parity drive[55] it is possible that data could be corrupted as part of the failure process. The basic exposure is that the RAID adapter considers data as written when the drive accepts it; however, the drive typically buffers the data and writes it later. There is a timing window where data could be corrupted as part of the transition to degraded mode.[56]

What happens when an array is suddenly placed offline? OS/390 will begin by generating *intervention required* messages. If the array contains OS/390 system volumes, there may be no useful recovery. If the array contains only data volumes, you might be able to continue system operation by cancelling the jobs that use logical volumes on the failed array. Note that no data has been lost. When the second failed drive is replaced (and rebuilt), you can resume normal operation. In this scenario, the first failed disk (which was replaced by the hot spare) would probably be replaced at the same time.

The Multiprise 3000 does not provide "beeps" or a popup window to notify an operator of a drive failure. The Call Home (if used) and Hardware Messages entry are the only notification.

3.19 Preserving SE Critical Data

All of the Licensed Internal Code (LIC) (such as the SE application), along with OS/2 and various OS/2 applications, is provided on a bootable CD-ROM that comes with the system. You may later receive updates to various LIC modules and data. These updates could be installed via modem (or LAN) connections or by 4mm tape.

The SE *Service* function, with the *Backup Critical Data* icon, provides a method to backup changes to LIC code and data, as well as your IOCDS and DEVMAP data.[57] Backup is to a 4mm tape (or to a optical disk (ROC) if you have an optional HMC). You should perform this process after you receive LIC updates. (We strongly suggest you keep copies of DEVMAPs and IOCDS source on diskette, as well.[58])

To restore, you need to boot from the Multiprise 3000 system CD-ROM and select the option to restore critical data. There two restore modes: one will reformat the G drive (losing any emulated disks on it) and the other will not reformat the G drive. Be certain to select the correct option!

You can restore the Critical Data by booting from the system CD-ROM and invoking the relevant function.

3.20 Uploading with IND$FILE

We noticed a minor problem when using SEND commands from the PCOM emulator session, sending PC data to OS/390. The SEND and RECEIVE

---

[55] This is not a distinct, separate drive, of course. It is the space equivalent of a single drive, with the space distributed over all the drives in the array.

[56] *Degraded mode* is the common terminology for a RAID-5 array running without parity redundancy; that is, with one drive failed.

[57] The function depends primarily on the standard OS/2 archive bits to detect which files have been changed.

[58] This can be done by simply copying the four DEVMAP files (using the *copy* command in an OS/2 window), and by using the Export Source function of the IOCDS functions.

commands, included with PCOM and several other 3270 emulator programs, invoke the IND$FILE program under OS/390. The IND$FILE program is included with the AD system, and is usually included in other OS/390 software "stacks."

To use the process, the user logs onto TSO and waits at a READY prompt or in ISPF option 6. The user then opens an OS/2 window and issues SEND and/or RECEIVE commands. With our early Multiprise 3000 system, we found that using the ISPF option 6 method often failed with "ISPF screen error" messages. However, using the TSO READY prompt worked in every case.

We have seen similar problems on P/390-based systems. The developers involved are aware of the problem and it may be resolved in a future fixpack. In most cases, using the READY prompt instead of ISPF option 6 is a minor difference for the user.

We have not seen the problem with RECEIVE commands, but we did not use these as heavily.

3.21 Verifying Format of Emulated Disks

Emulated CKD drives are internally formatted to the blocks needed for this emulation. In rare cases, an OS/2 system disturbance may corrupt the OS/2 file used to emulate a CKD volume. The CKDCHECK command, included in the P390 directory, can be used to verify the correct format of an emulated disk volume. Note that this command only verifies the emulated track formatting, not the data contents or logical contents of the data.

The command `CKDCHECK G:\OS39M1.A82 /F` will verify that OS/2 file G:\OS39M1.A82 is in the correct format for use with the AWSCKD device manager. The optional /F flag instructs the program to reformat any emulated track that is not in the correct format. The CKDCHECK program writes a log file in CKDCHECK.LOG (in the current directory) when it is used.

This command is best used when OS/390 is not running; that is, when only OS/2 is running on the SBC.

A format error in a CKD emulation file can cause the AWSCKD device manager to abnormally end. If this happens, OS/390 sees a device failure, issues intervention required messages, and may invoke various kinds of error recovery, depending on what was happening at the exact instance of failure. In general, you will need to POR again to restart AWSCKD.[59] (If you are not using emulated CKD drives, you do not have this exposure, of course.) Using the /F flag to automatically reformat a bad track is drastic, because it loses any data content of the track; however, there is no other practical recovery. If the track is in a VTOC, for example, the whole volume may be lost, whereas if the track is in unallocated space, there will be no side effects. After reformatting bad tracks (with the /F) option, you could restore the whole volume (if you have a recent backup).[60]

If used without the /F flag, the program will simply report the CCHH of bad tracks. You will need to reformat the basic emulated track structure (with CKDCHECK)

---

[59] This would be the most appropriate time to use the CKDCHECK program, of course. If you simply POR and re-IPL, AWSCKD may encounter the invalid track format again and repeat the process.

[60] The program reports the CCHH of any track it reformats. You could use the IEHLIST utility, or something similar, to determine which data set (if any) contains the bad track and then take steps to recover or recreate only that data set. The output of IEHLIST is not in a format that is convenient for determing track ownership by CCHH, unfortunately.

before you can either read or write the track under OS/390. Writing to the data set (including "formatting writes") by S/390 programs will not reformat the underlying emulation structure.

An equivalent function is available for P/390-based systems. Format errors in emulated drives have been very rare, and most installations never use (or need) the AWSCHECK function.

3.22 PC Reset Switch

The Multiprise 3000 has a reset switch for the Single Board Computer. This causes an immediate reboot (effectively killing anything running in the system). It avoids the need to completely power down the system. The reset switch is inside the front cover, on the bottom of the small EPO connector plate. (This is below the main power switch.) There is a label for the switch, in very small type.

3.23 Support Element Web Server

The OS/2 system includes a Web Server. The sole purpose of this Web Server is to provide a remote interface for the Support Element function. That is, when this Web Server is activated, you can use a remote Web browser to access and operate the Support Element functions. Not all functions are supported for remote access, but the primary functions needed to routinely operate the system are available.

Before activating the function, be certain your OS/2 TCP/IP customization has assigned an IP address for your system. You may have two IP addresses: 127.0.0.1 for the internal loopback address, and another address for whatever LAN interface you intend to use. (We used the integrated Ethernet adapter and assigned it IP address 9.12.17.170 for our test system. This system is not connected to the Internet, so do not try to use this IP address.)

The Web Server is activated by logging onto the SE function with userid ACSADMIN. The default password is PASSWORD. Go to the **Console Actions** window. Select **Console Services**. In the Web Server option, select **Enabled**. Return to the SE **Console Actions** window and select **User Profiles**. Select the **Systems Programmer** tab (or whichever other role tab you wish). Click the **Create** button. Enter a userid (your choice) and a password; select the **Allow access through Web Server** option. Double-click in the upper left corner to exit from these panels.

You can use the Web Server from any PC that has a recent browser and is connected to your network. If you connect your Multiprise 3000 to a network in this manner (with the OS/2 Web Server running) *remember to select good (non-guessable) passwords.*

Chapter 4. Preloaded Systems and CD-ROM Packages

Several preloaded systems are available for Multiprise 3000. We will discuss only two of them in this redbook. These two are the Application Development (AD) system and the 390ADS system.

The names of these two packages are similar, and you should note the two different names:

- The **AD** system, sometimes known as the AD CD-ROM system, has the full name Application Development System for OS/390 (order number LCD4-0382, with restricted availability)[1].

- The **390ADS** system, with the full name S/390 Application Development Solution System.

Both these packages are built from a similar base, but they contain different software products and different customization. Do not confuse these two names.

4.1 Application Development (AD) System

The AD system is available only to members of IBM's PartnerWorld for Developers.[2] This is a prepackaged OS/390 system that has been available for some time (since the MVS 5.2.2 release) for P/390 and R/390 systems. It is often known as the "AD CD-ROM System" because it is normally released on CD-ROM media. More informally, it is simply known as the AD system. The volumes distributed with this system are shown in Figure 10 on page 60. Starting with OS/390 V2R8, the same AD system will be available for Multiprise 3000 systems. The release 8 AD system will have the Multiprise 3000 SPE integrated, and the same CDs can be used for Multiprise 3000, P/390, R/390, and the S/390 Integrated Server.

The AD system is intended for PartnerWorld members who are porting or developing software intended to run under OS/390. The system contains OS/390 and a considerable number of additional features and products. These include:

- OS/390 Security Server (including RACF)
- JES3 (not started automatically; user customization required)
- Systems Management Services, including DFSMSdss, DFSMSrmm, DFSMShsm, RMS, SDSF
- Application Enablement Services, including DFSORT, C/C++ compiler (with Debug Tool), High Level Assembler Toolkit, SOM and VisualLift Environments
- Distributed Computing Services, including DCE Encryption, OS/390 Print Server
- eNetwork Communications Server, including Kerberos, TCP/IP Network Print Facility, IP Security (SSL)
- Network Computing Services, including WebSphere Application Server
- Additional Program products, including TME 10, ADSM, Java for OS/390, DITTO/ESA, MQSERIES, IBM COBOL for OS/390 and VM, PSF, PL1 Compiler, REXX Compiler, CICS TS, IMS/ESA, DB2, QMF

---

[1] There have been two versions of the AD system, one for North America and one for other locations. The difference was due to cryptographic restrictions on components in TCP/IP, the Web Server, and so forth. We discuss the North American version in this chapter. The other version is the same, except for the level of cryptographic modules included and except for the volume serial numbers used. Starting with OS/390 V2R8, only one version of the AD system will be provided.

[2] This IBM organization replaces the IBM Partners In Development for S/390, commonly known as PID. PID members have been automatically transferred to the PartnerWorld for Developers organization.

The AD system is intended to be easy to install and use. It is unzipped from CD-ROMs and is ready to IPL. A number of userids are already defined and are ready for use. Basic customization for RACF, ISPF, SDSF, SMS, and similar administrative functions has already been done. No additional SMP/E type of work is needed to make the system usable.

Earlier releases of the AD system used a mixture of 3380 and 3390 volumes. Starting with OS/390 V2R8, only 3390 volumes are used.

3390-3 A80	OS39R8		IPL volume. OS/390 Libraries.
3390-3 A81	OS3R8A	2200 Cyl	More OS/390 libraries.
3390-3 A82	OS39M1		Master catalog, paging, spool, PARMLIB, PROCLIB, RACF. Storage volume.
3390-2 A83	OS39P8		DB2, IMS, CICS. DLIBs and Operational Libraries.
3390-2 A84	OS3P8A		More DB2, IMS, CICS.
3390-2 A85	OS39D8		OS/390 DLIBs
3390-2 A86	OS3D8A		More OS/390 DLIBs
3390-2 A87	OS39H8	1500 Cyl	HFS data sets provided with system
3390-2 A88	OS3HUS	200 Cyl	HFS data set mounted at /u. Intended for user files.

Figure 10.   Volumes Used For the AD System, based on the OS/390 V2R8 Release.   Addresses shown are for emulated volumes.

A new version of the AD system has been released to match each new version of OS/390, at six-month intervals. The AD releases, based on the General Availability (GA) release of the underlying OS/390, occur about three months after the corresponding OS/390 release.

Key external details of the AD system are based on a pattern that has varied little during the last several releases. For example, volume serial numbers tend to have names such as OS39Rn, where n corresponds to the OS/390 release number, R indicates a basic OS/390 volume, D indicates a DLIB volume, H an HFS volume, and so forth. The OS39M1 volume replaces the SCPMV5 volumes used in previous releases. The change to using all 3390 volumes (starting with Release 8) may require previous system owners to do additional migration planning for this release.

In principle, an OS/390 volume can be mounted at any disk address that is known to OS/390 software (the IODF) and hardware (IOCDS). In practice, the AD V2R8 system assumes the addresses shown in the figure when emulated drives are used, and most documentation reflects these addresses.[3] Also note that some of the volumes shown have nonstandard sizes. For example, HFSUS1 is an emulated 3390 volume with 200 cylinders. Such nonstandard volumes are fully supported by OS/390, and are commonly used with P/390-based emulation. The primary Multiprise 3000 disks do not emulate nonstandard sizes. If you want to place HFSUS1, for example, on a primary disk, you must copy the nonstandard emulated volume to a standard-sized primary (or external) volume. (The OS/390 physical volume copy utility will do this.)

4.1.0.1 CD-ROM Structure

The OS/390 V2R8 version of the AD system is contained on a set of CD-ROMs. These contain zipped copies of the OS/2 files that are used to emulate 3380 and 3390 volumes. There is one OS/2 file per volume[4], and these are large files. A 3390-3 volume, for example, is approximately 2.8 GB and the corresponding OS/2 file used to emulate the volume is the same size. The zipping process works well, and the zipped files are about 20 - 25% as large as the working volumes. The UNZIP program is included on each CD-ROM.

The CD-ROM contents are:

- CD-ROM 1: OS39R8 (the IPL volume), DEVMAPs, IOCDSs
- CD-ROM 2: OS3R8A, OS3HUS, OS39SV
- CD-ROM 3: OS39P8, OS3P8A
- CD-ROM 4: OS39M1, OS39H8
- CD-ROM 5: OS39D8
- CD-ROM 6: OS3D8A

(Last-minute changes may alter the CD-ROM layout; you should verify it before use.) CD-ROM 1 also contains READ.ME files, installation scripts (OS/2 and AIX), and several other small files.

4.2 Predefined Device Addresses

The AD system (in its IODF) contains device definitions for many more devices than would be found on a typical P/390 or Multiprise 3000. The intention is to allow the user to add devices (emulated or real) without having to use HCD to define a new IODF. (HCD requires some skill and practice to use correctly, and many AD users would prefer to skip this, if possible.) Manipulating IOCDS files and DEVMAPs, while using the distributed IODF, is one way to expand the devices used by the system.

The predefined IODF device address for the AD system are:

```
ADDRESSES          DEVICE

  000C             2540 card reader
  000E             1403 printer
  000F             3203 printer (or 1403 printer)
  0120-015F        3380 disks  (64 addresses)
```

[3] Earlier versions of the AD system used several 3380 volumes, in the 12x address range. These volumes (with the old volsers) have been changed to 3390 volumes, starting with release V2R8.

[4] If the file is larger that 2 GB (as for 3390-3 volumes) there are two OS/2 files per volume. This is an implementation detail due to the maximum file size permitted by the 32-bit OS/2 system.

```
01C0-01FF          3390 disks  (64 addresses)
0240-025F          3380 disks  (32 addresses)
0260-027F          3390 disks  (32 addresses)
0300-03FF          3390 disks  (256 addresses)
0550-055F          3420 tape drives (round tapes, AWSTAPE)
0560-056F          3480 tape drives (no compaction)
0570-057F          3480 tape drives (COMPACT option)
0580-058F          3490 tape drives
0590-059F          3490E tape drives
0700               3270 display (OS/390 master console)
0701-073F          3277 terminals  (63 addresses)
0900-091F          3277 terminals  (32 addresses)
0A80-0ADF          3390 disks  (96 addresses)
0E20-0E27          CTCs  (8 addresses)
0E40-0E47          CTCs  (8 addresses)
```

This list generally matches the addresses used in previous releases of the AD system, with a few additional ranges of 3390 addresses. Also, the tape definitions have been expanded and rearranged slightly to provide definitions for all of the tape devices (real or emulated) that are likely to be used.

By "predefined" we mean these addresses are defined in SYS1. IODF00 of the AD system, and this IODF is the production IODF normally used for IPL. These addresses are not all known to the "hardware", meaning the IOCDS and DEVMAPs distributed with the AD system. As we have mentioned several times, you can generate (IODF, IOCDS, DEVMAP) any set of addresses you find appropriate for your system. For the AD system, the designers chose the large set of addresses listed above for their IODF definition.

A small subset of these addresses is used for the initial IOCDS and DEVMAPs distributed with these two systems.

4.2.0.1 System Volume Addresses

Specific addresses for system volumes are unnecessary, provided the addresses used are defined (in the IOCDS and IODF) as the correct device types. However, users typically elect to use the addresses that are referenced in the setup instructions. For example, P/390 users of the AD CD-ROM usually IPL from a 3390 volume at address A80.

This becomes more complex for the Multiprise 3000 because the IPL volume might be on an emulated volume, or a logical volume on the primary disks, or a disk on an external channel[5]. If the A0 IOCDS distributed with the AD system is used, there are different addresses assumed for emulated volumes and logical volumes on primary disks. Documentation and setup for the AD system assumes the following addresses for system volumes:

VOLSER	Emulated Drive	Logical Volume on Primary Disks
OS39R8	A80	AA0
OS3R8A	A81	AA1

---

[5] We will largely ignore external channels in this discussion. If your system is connected to external channels, you will probably need to construct HCD (and IOCDS) definitions that are quite different than the self-contained Multiprise 3000 system we are discussing here.

VOLSER	Emulated Drive	Logical Volume on Primary Disks
OS39M1	A82	AA2
OS39P8	A83	AA3
etc.	etc.	etc.

The pattern is clear. If a volume is on an emulated drive, it uses the address range A80-A88; if the volume is on a logical volume on the primary disks, it uses the address range AA0-AA8. It is up to the user to decide which volumes are used on emulated disks and which are placed on primary disks. The AD documentation will continue to reference the A8x range of addresses, and the user must interpret this to mean AAx addresses if he has chosen to move the volume to the primary disks.

In general, the AD system will assume the following usage of addresses:

Device Type	Emulated Drive	Logical Volumes on Primary Disks	External Channels
3380	120-13F	140-15F	240-25F
3390	A80-A9F	AA0-ADF, 300-3FF	1C0-1FF, 260-27F

We stress that this is simply a convention. You can use IOCDS definitions to rework the IODF addresses in the AD system many different ways; you can use HCD to redefine both the IODF and IOCDS addresses in many different ways. However, the address conventions shown here are used in AD documentation and are partly reflected in the initial IOCDSs distributed with the AD CD-ROMs.

We mention the conventions here because you, if you use the AD system, are involved. When you define a new logical volume on the primary disks (or add a new emulated volume) you need to update your IOCDS and assign the new volume an address usable by OS/390. An orderly addressing convention is helpful for this process.

4.2.0.2 Initial IOCDS and DEVMAPs
Two IOCDSs (in source form) and several DEVMAPs are distributed on the OS390 V2R8 AD CD-ROMs. One DEVMAP (file name DEVMAP.MVS) is for conventional P/390 use. Two other DEVMAPs are for the Multiprise 3000; the content of both is the same and is listed in Appendix A. Two IOCDS source files are provided. The CD-ROM files are shown in the following table:[6]

CD-ROM file name	Purpose
AWSMAPA3.DVM	Assumes all AD volumes on emulated disks. Use after UNZIPing OS/390 from CD-ROM.
IOCDSA3	Assumes all AD volumes on emulated disks. Use after UNZIPing OS/390 from CD-ROM.
AWSMAPA0.DVM	Initally a copy of AWSMAPA3.DVM. You will modify it during staging process.

[6] We obtained preliminary information here; the file names and contents may change by the time the AD system is shipped.

CD-ROM file name	Purpose
IOCDSA0	Defines emulated disks and ten 3390 logical volumes on primary disks. Use for staging AD volumes to primary disks. Can be easily expanded.

You will probably modify these files, but they provide a useful starting point.

4.2.1 Predefined IPL Parameters

The AD system has four defined IPL parameters. These are:

```
Parameter    Meaning
   CS        CLPA (no DB2/CICS/IMS) and cold start JES2
   WS        Warm start (existing CLPA) no DB2/CICS/IMS
   DC        CLPA (with DB2/CICS/IMS) and cold start JES2
   DB        Warm start (existing CLPA) with DB2/CICS/IMS
```

The DC and DB options select LPA, LKNLST, and subsystem definitions that include DB2, CICS, and IMS libraries. (It does not start these automatically, but the necessary libraries are in place to use these products.)

The AD system includes a SYS1.IPLPARM data set with the appropriate LOADxx members. This is on the OS39M1 volume, along with the appropriate IODF, and this volume is normally mounted on address A82. Thus, the full IPL parameter for the first IPL of the AD system would probably be:

```
0A82CS
```

This parameter provides the address (0A82)[7] of the required volume, and the parameter (CS) that indicates a cold start. You would probably change this to 0A82WS for subsequent IPLs. If you are using DB2 or CICS or IMS, the corresponding full parameters would be 00A82DC (first IPL) and 0A82DB (subsequent IPLs). Do not attempt to use CS followed by DB--this would result in missing modules in PLPA.

4.2.1.1 Predefined UserIDs

The AD system has a number of predefined userids. These include the following:

```
USERID     PASSWORD   GROUP   UID   Attributes.....

P390       SYS1       SYS1    0     SPECIAL OPERATIONS
IBMUSER    IBMUSER    SYS1    0     SPECIAL OPERATIONS AUDITOR
SYSADM                              SPECIAL OPERATIONS AUDITOR
SYSOPR
OPEN1      SYS1       SYS1    0     none
P390A      TEST       TEST    -     SPECIAL OPERATIONS GRPACC
P390B      TEST       TEST    -     none
...
P390Z      TEST       TEST    -     none
```

In some shipments, the password for userid P390 is P390. Userids P390A through P390Z do not have OMVS segments defined in RACF and cannot use OpenEdition (UNIX System Services) functions.

---

[7] We are using the address conventions discussed in the previous section. Address 0A82 is assumed to be an emulated drive; if you have moved the OS39M1 volume to the primary disks, we assume the address would be 0AA2. Again, we stress that you can use any suitable address.

Many other userids are defined in the AD system, mostly for use by started tasks. The userids listed here are intended for TSO usage. We strongly suggest you remove the SPECIAL and OPERATIONS privileges for P390A (if they are still present) and change the passwords for userids P390 and IBMUSER. Normal system administration is typically done with the P390 userid. The IBMUSER userid uses a limited TSO logon procedure and is intended only for recovery situations.

4.2.1.2 Assumed Volume Expansion

The distributed AD system has no volumes for user data, and has only the available space on OS39M1 for temporary data sets[8]. Users almost always create several additional volumes for work data sets and for their own source and data libraries. If the new volumes are on the primary disks, then the normal process of creating new primary disk volumes would be used. This is briefly covered in Chapter 5.

If the new volumes are on emulated drives, then care must be taken to generate the emulated drives with addresses that will work as expected on the Multiprise 3000. That is, you must use compatible DEVMAP, IOCDS, and IODF definitions for new devices/volumes you add.

4.2.1.3 Initial VTAM and 3270 Customization

The AD system attempts to use local, non-SNA 3270 terminals at addresses 701-71F and 900-91F. (Address 700 is reserved for the OS/390 master console.) A terminal detected at these addresses will be sent the USSTAB message 10 message, and a user can log onto TSO from the terminal.

These addresses (701-71F and 900-91F) are assumed to be emulated I/O devices when using the AD system with a Multiprise 3000. Each terminal must be defined in the Emulated I/O Configurator (DEVMAP), and must also be defined in the IOCDS. The DEVMAP and IOCDS distributed with the AD V2R8 system has only a small number of terminals defined in this range. You will probably need to extend both the DEVMAP and IOCDS in this area.

The emulated 3270 terminals are actually tn3270 sessions, connected to a device manager (AWS3274 or LAN3274) running under OS/2. There are two IP addresses involved: a loopback address (127.0.0.1, usually) and an IP address for the Ethernet or token ring adapter managed by OS/2 TCP/IP. You can set the this "real LAN" IP address to whatever you want (or need) by configuring OS/2 TCP/IP.. The loopback address is used for tn3270 sessions that appear on the Multiprise 3000 display. The LAN IP address is used for users connected via that LAN. In both cases, the tn3270 client must be directed to port 7490.[9]

TCP/IP setup for a P/390 is described at some length in Chapter 14 of the *New User's Cookbook*. Setup for Multiprise 3000 emulated I/O is very similar. There are a number of steps involved, including MPTS and OS/2 TCP/IP customization

4.2.1.4 Initial TCP/IP Customization

OS/390 TCP/IP is not quite ready to use in the distributed AD system. It requires customization of the LAN interface (which is probably an emulated 3172 device)

---

[8] This is not completely true. The AD CD-ROMs contain volume HFSUS1. This is a mini-volume that is mounted as /u in the UNIX directory and is intended for user data.

[9] This is a nonstandard port that has been used for several years with P/390 systems. You can change it (probably to the standard port number 23) by making a change in the Emulated I/O Configurator.

and customization of a few OS/390 TCP/IP control parameters. This is described in Chapter 13 of the *New User's Cookbook* (SG24-4757-01). The first edition of the *Cookbook* (SG24-4757-00) did not contain this material; you will require the second edition, which is denoted by the -01 in the order number.

4.2.1.5 Other Key Characteristics

The distributed AD system is configured for only 10 concurrent TSO sessions. You need to change PARMLIB and VTAMLST members to increase this. More information can be found in Chapter 8 or the *New User's Cookbook.*

4.2.2 AD Installation

With the exception of IOCDS requirements and a different DEVMAP, the AD system can be installed on the emulated disks in a Multiprise 3000 system in about the same way it is installed in a P/390-based system. That is, OS/2 is used to unzip CD-ROM files that contain the OS/390 volumes. This unzip process works only on disks accessible to OS/2, of course. This means that only emulated drives can be used initially. However, once OS/390 is running, it can access volumes on the primary disks (assuming they have addresses known to OS/390 and appear in your IOCDS). You can then copy volumes from emulated disks to primary disks, and move all the AD volumes to primary disks if you want to do so. The A0 IOCDS (and matching DEVMAP) on the AD CD-ROM are the starting point for this process.

A standard Multiprise 3000 has approximately 14 GB available on the OS/2 disks. This is sufficient space to install the AD volumes needed to IPL OS/390. It may not be sufficient space for all the AD volumes in future releases. In order to install all the AD volumes, it may be necessary to install the base volumes, IPL, and then move the base volumes to the primary disks. You would then, using the emulated I/O configurator, delete the emulated volumes and re-IPL from the primary disks. Additional volumes could then be unzipped to emulated disks. This is a *staging process*, where volumes are first unzipped to emulated drives and then copied (under OS/390) to primary disks. It is necessary because the unzipping process runs under OS/2 and OS/2 cannot directly access the primary disks. Of course, if you obtain your OS/390 system in tape form, you could restore directly to primary disks. The AD system is normally distributed in CD format, and this is why we need to consider this staging process.

We believe that Multiprise 3000 users will normally want their system volumes on the primary disks. The space available for emulated disks can be reserved for mini-volumes and for staging future releases of the AD system. The following discussion assumes that you will eventually place all the AD system volumes on the primary disks.

4.2.3 Step-By-Step Overview For Installing AD System (Preliminary Information)

The OS/390 V2R8 AD system can be installed from CD-ROM by following these basic steps. You may need to make minor adjustments to fit your particular requirements. You should read the next chapter, about IOCDS and DEVMAP manipulation, before starting an installation. The following text assumes you have a Multiprise 3000 system with at least one array of primary disks, and that you want your AD system resident on these disks. (If you plan to use only the emulated disks, you can use a subset of the following instructions, and use the distributed A3 IOCDS instead of the A0 IOCDS.)

The installation steps are:

- Verify that OS/2 boots correctly. Enable the OS/2 desktop, as described in the previous chapter. Using an OS/2 window, verify that approximately 14 GB free space is available on the G drive. You might want to *shrink* the SE application window while performing some of the following steps.

- Using the SE function, perform a POR with any valid IOCDS in your system. You may need to use the D0 IOCDS, since you have not installed your own yet. (Some of the following steps require that POR is complete, but do not actually use the selected IOCDS.)

- Assuming drive H is the CD-ROM drive, copy two DEVMAPs to drive D:
  ```
  COPY H:\AWSMAPA3.DVM D:\IOCP\AWSMAPA3.DVM
  COPY H:\AWSMAPA0.DVM D:\IOCP\AWSMAPA0.DVM
  ```

- Obtain a formatted diskette and copy two IOCDS source files to it:
  ```
  COPY H:\IOCDSA0  A:IOCDSA0
  COPY H:\IOCDSA3  A:IOCDSA3
  ```

- UNZIP the following volumes from the CD-ROMs. This step may take 60 to 90 minutes for these volumes. You will need to change CD-ROMs (within the AD package) to access all the files:
  ```
  UNZIP  H:\OS390\OS39R8.ZIP  *.*  -d  G:\
  UNZIP  H:\OS390\OS3R8A.ZIP  *.*  -d  G:\
  UNZIP  H:\OS390\OS39M1.ZIP  *.*  -d  G:\
  UNZIP  H:\OS390\OS39H8.ZIP  *.*  -d  G:\
  UNZIP  H:\OS390\OS39P8.ZIP  *.*  -d  G:\
  UNZIP  H:\OS390\OS3P8A.ZIP  *.*  -d  G:\
  UNZIP  H:\OS390\OS3HUS.ZIP  *.*  -d  G:\
  ```
  These volumes are sufficient to IPL OS/390. You could unzip the remaining volumes from the CD-ROMs if there is sufficient space on your G drive. You need to verify the volume names, of course, and make any necessary changes to this list. If you do not have room on the G drive for all these volumes, you can defer the OS39P8 and OS3P8A volumes until later.

- The following steps use the A0 IOCDS, which includes both emulated disks and logical volumes on the primary disks.

- From the SE application, select the Emulated I/O Configuration function. Display the AWSMAPA0 DEVMAP (using the F2 key) to verify that it includes the volumes you UNZIPed. The display should indicate the number of cylinders in each of the volumes you UNZIPed; this indicates that the DEVMAP found the files on disk.

- From the SE application, select the *Internal Disk Subsystem* function. Use of this function is described, in some detail, in the next chapter. Use this function to define ten 3390 volumes, as shown in the following table. *First define the 3390-3 volumes* and then define the 3390-2 volumes[10]. This order is required if you want your unit addresses to match the addresses in the AD documentation. You will define the drives in Subsystem 00, array 0. The MVS address, initial volser, and final volser are established in later steps. (Defining the WORK01 volume is optional.) (We used a mixture of 3390-3 and 3390-2 volumes solely to save disk space; you could define all 3390-3 volumes if you

---

[10] This is optional. You can define your logical volumes in any order. However, if you follow our instructions your system should exactly match the volume addresses that are used for AD system documentation. OS/390 does not care which model 3390 is being used at an address, provided that the address is defined (via HCD and IODF) as a 3390. If you define mixtures of 3390 and 3380 volumes, then the order of definition can become critical, or, more likely, you will need to adjust your IOCDS to match the unit addresses of your newly created 3380 and 3390 logical volumes.

prefer that.)

Unit Address	Device	MVS address	Initial volser	Eventual volser
00	3390-3	AA0	VOLAA0	OS39R8
01	3390-3	AA1	VOLAA1	OS3R8A
02	3390-3	AA2	VOLAA2	OS39M1
03	3390-2	AA3	VOLAA3	OS39P8
04	3390-2	AA4	VOLAA4	OS3P8A
05	3390-2	AA5	VOLAA5	OS39D8
06	3390-2	AA6	VOLAA6	OS3D8A
07	3390-2	AA7	VOLAA7	OS39H8
08	3390-2	AA8	VOLAA8	OS3HUS
09	3390-2	AA9	WORK01	WORK01

- *Import* (from your diskette) and *Build* the A0 IOCDS. *Open Source* for the file after the *Build* process to check for error messages. This process is described in more detail in the next chapter. (You might want to import and build the A3 IOCDS now, although it is not needed for the installation described here. The A3 IOCDS is a minimal definition using only emulated drives.)

- From the SE application, perform a POR, using the A0 IOCDS. (In these steps, we are not using a *profile* to *activate* the system. You could include the POR and IPL in a profile that you build sometime later.)

- From the OS/2 desktop, start the PCOM emulator sessions. Verify that each session displays a line containing the subchannel number and IP loopback address. Verify that one of the subchannel addresses is 70. (This subchannel address is mapped to address 700, and this is the address OS/390 uses for its master console.)

- From the SE application, *Load* (IPL) the system from address A80, with IPL parameter 0A82CS. This should produce a normal OS/390 startup. The CS parameter causes a CLPA and JES2 cold start.

- After the IPL process is complete, log onto userid P390 (password P390 or SYS1 or TEST) and verify that the system is generally working correctly.

- VARY AAx,OFFLINE (if necessary) and run batch jobs to initialize all the new logical volumes on the primary disks with temporary volume serial numbers. A prototype job is in SYS1.P390.CNTL and another is listed in Appendix C. Vary the volumes online. The WORK01 volume (optional) can be used immediately for scratch purposes. Ensure that you can allocate a data set on it.

- Using the prototype JCL listed in Appendix C (and possibly present in SYS1.P390.CNTL), copy each of the AD volumes on the emulated drives to the corresponding logical volume on the primary disks. The job copies the volser of each volume. The new volumes will be forced offline because they will have duplicate volume serial numbers. The copy should require only a few minutes per volume.

- Shut down OS/390. IPL from AA0, with IPLPARM=0AA2CS. There will be a series of messages about duplicate volume serial numbers. For each message, vary offline the emulated volume (in address range A80-A89).

- Verify that the system appears to be working correctly. Shut down OS/390 again.

- Use the SE Emulated I/O Configuration function to delete all the emulated volumes. You now have a working system on the primary disks.

- UNZIP and stage the remaining AD volumes, as needed, using the same process.

You can leave some of the AD volumes on the emulated disks, but we strongly suggest that you keep most of the emulated disk space clear for installing future releases. (You might use it for scratch volumes, or small mini-volumes, between system updates.)

4.3 S/390 Application Development Solution (390ADS)

The 390ADS system is available, under special contract, to *bona fide* development organizations, with emphasis on COBOL, CICS, and e-business development. In general, these organizations are likely to be departments in large, existing S/390 customers. The assumption is that 390ADS users will have access to OS/390 systems programming skills elsewhere in their organizations.

This is a prepackaged OS/390 system that is new for Multiprise 3000. 390ADS is usually described as a preload (that is, it is preloaded onto a Multiprise 3000 by IBM), but this is only part of the story. 390ADS users need to install new releases, and these will be shipped in CD-ROM and/or 4mm format[11]. The volumes distributed with this system are shown in Figure 10 on page 60. Starting with OS/390 V2R7.

The 390ADS system is intended for developers within existing S/390 customers, and other similar users. It is somewhat oriented to COBOL and CICS, but is useful in other environments. The 390ADS system is a combination of hardware (a specific Multiprise 3000 model) and software, and is available only under a special license arrangement.[12] The system contains OS/390 and a considerable number of additional features and products. These include:

- OS/390 Security Server (including RACF)
- JES3
- Systems Management Services, including DFSMSdss, DFSMSrmm, DFSMShsm, RMS, SDSF
- Application Enablement Services, including DFSORT, C/C++ compiler (with Debug Tool), High Level Assembler Toolkit, SOM and VisualLift Environments
- Distributed Computing Services, including DCE Encryption, OS/390 Print Server
- eNetwork Communications Server, including Kerberos, TCP/IP Network Print Facility, IP Security (SSL)
- Network Computing Services, including WebSphere Application Server

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[11] This was undecided at the time of writing.
[12] See the official IBM announcement materials for details. The description here is only a rough overview and is not intended to fully describe the specific terms and conditions required for the 390ADS system.

- Additional Program products, including TME 10, ADSM, Java for OS/390, DITTO/ESA, MQSERIES, IBM COBOL for OS/390 and VM, PSF, PL1 Compiler, REXX Compiler, CICS TS, IMS/ESA, DB2, QMF.

A number of userids are already defined and are ready for use. Basic customization for RACF, ISPF, SDSF, SMS, and similar administrative functions has already been done. No additional SMP/E type of work is needed to make the system usable.

4.4 External Differences Between AD and 390ADS Systems

We expect a number of AD system users may move to 390ADS systems. Both are simply prepackaged versions of OS/390 and various other features and products. The basic OS/390 components are very similar. Different default addresses, volsers, and userids were intentionally used, so that both systems could be installed at the same time. Furthermore, they can be run simultaneously in different LPARs, without volser conflicts. (The IOCDSs and DEVMAPs provided are not intended for this. You would need to provide additional customization to run multiple LPARs.)

Chapter 5. IOCDSs, Configurators, and Other Customization

A system's I/O configuration is defined in a number of ways:

- Current S/390s (other than P/390-based systems) use an IOCDS to define their hardware I/O configuration.

- P/390-based systems use a device map (DEVMAP) to define their emulated I/O configuration. DEVMAP is a generic name for the OS/2 files maintained by the Emulated I/O Configurator; it is a shortened form of the words *device map*.

- OS/390 uses an IODF file to determine its I/O definitions, as seen by software.

A Multiprise 3000 system, running OS/390, uses all three of these methods. It uses an IOCDS *and* a DEVMAP to define its hardware I/O configuration. The IOCDS contains entries for all I/O devices (external, primary disks, and emulated devices) and the DEVMAP contains more details for the emulated devices. The OS/390 IODF must reflect all I/O devices.

It is possible to use a Multiprise 3000 without using any emulated I/O. A DEVMAP would still be required, although it probably would contain only a dummy entry. We believe such installations will be rare, and discussion in this chapter assumes that a Multiprise 3000 system will use some emulated I/O devices.

In current OS/390 usage on current S/390 machines, the HCD utility function (under TSO and ISPF) is used to generate both an IODF and an IOCDS. It is also possible to produce an IOCDS (in the form of source statements[1]) and to perform a standalone installation of this IOCDS by using SE functions. Installing a standalone IOCDS is generally discouraged because it would probably not match the IODF exactly and having an IODF and IOCDS *out of sync* might lead to a variety of errors.

The HCD utility does not produce a DEVMAP. It is necessary to customize DEVMAPs by using the SE function *Emulated I/O Configurator*, or by copying a DEVMAP from a diskette or other OS/2 device. A DEVMAP is an OS/2 file, and a DEVMAP might be distributed as part of a larger software package on CD-ROM, for example. A source IOCDS is also an OS/2 file, and can be loaded from diskette.[2] (While any DEVMAP and an *operational* IOCDS are OS/2 files, they are *binary* files; never attempt to edit either one with a PC editor. PC editing applies only to an IOCDS *source* file.)

The different ways of handling these files becomes relevant if preloaded systems are used with the Multiprise 3000. A preloaded system means that it is loaded on the Multiprise 3000 by IBM or a business partner, before the machine is shipped to you; the required IOCDS and DEVMAP are also preloaded. However, the "preload systems" have new releases and some of these are supplied on CD-ROM and/or tape. When you install a new release of the "preload" from CD-ROM or tape, you may need to install a new IOCDS and DEVMAP with it.

Furthermore, some of the preloaded systems (such as the AD system) have large numbers of devices generated in the IODF used by OS/390. The goal is to cover a variety of hardware device addresses the customer may have and to allow for easy expansion of devices. No IOCDS was shipped with earlier AD systems

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[1] These would typically be created in a PC file.
[2] The SE functions that do this are rather rigid and appear to work only with diskettes.

because these were intended for use with P/390-based machines which do not require an IOCDS. Future releases of the AD system will include an IOCDS, but this IOCDS will not reflect all the devices defined in the IODF. The IODF and IOCDS are intentionally out of sync.[3] The Multiprise 3000 owner or administrator may want to directly manipulate the distributed IOCDS, without using HCD, and will probably need to customize a DEVMAP and customize a few OS/2 functions.

When IPLed in this situation (the IODF and IOCDS out of sync), OS/390 produces the message:

```
IOS505A DYNAMIC I/O CONFIGURATION CHANGES ARE NOT ALLOWED,
        THE HARDWARE AND SOFTWARE CONFIGURATION DEFINITIONS
        DO NOT MATCH
```

Provided the IODF and IOCDS definitions do not actually conflict, this message can be ignored. (An example of a conflict might be where the IOCDS defines a 3380 at address 0123 and the IODF defines a 3490 at the same address.)

5.1 Quick Review of HCD, IOCDS, IODF, POR, and OS/390 Relationships

A discussion about producing or customizing I/O definitions can be complex, and there are many ways to approach the topic. This section is not meant as a tutorial for IOCDS or HCD, but might serve as a brief review. Figure 11 on page 73 provides a conceptual diagram for this review. Except for the DEVMAP functions, operation with a Multiprise 3000 is about the same as for other current S/390 machines.

The POR (Power On Reset) function loads a *profile* (optional) and an IOCDS. The profile defines LPAR partitions and associated storage. In a basic system (no LPARs), we can ignore *profiles*, and will do so for the remainder of this discussion. The IOCDS defines the hardware I/O configuration. There are four IOCDS data sets[4] and the operator can select which one to use for the POR.[5] An IOCDS contains a variety of information, including:

- Path definitions defining channels
- Control unit definitions, indicating the path(s) (chpid(s)) to the control unit, the type of control unit, ESCON switch information, and the hardware address of the control unit
- Device definitions, indicating the control unit connection, the device address(es) on the control unit, and the address to be used by software

A key point here is that the software address (for example, "IPL from A80") is an arbitrary number (in the range X'0000' to X'FFFF') that is assigned when the IOCDS is built. For older S/360 and S/370 machines, the software address was also the hardware address (channel A, control unit 8, device 0 in this example). By appropriate IOCDS customization, we can map hardware addresses (which are no longer as simple as they were on older systems) to a completely different set of software addresses. The AD system and some other preload systems do this. (The reason for doing this is to permit a single OS/390 customization, such

---

[3] These preload systems are intended for smaller environments, where there may not be an existing OS/390 available for customizing the new system. By providing a larger number of devices and addresses in the IODF, a single version of a preload system can be made to function in a wide range of I/O configurations. However, it may be necessary to customize its DEVMAP and/or IOCDS before IPLing the system. Also, this approach makes it possible to use the same system for P/390-bases machines and for larger systems, such as the Multiprise 3000.

[4] In current S/390 machines, these are four OS/2 files. Older S/390s stored their IOCDS files in other ways.

[5] The IOCDS identifier can also be built into a profile. The operator then activates the profile.

as the AD system, to be used with a wide variety of actual hardware channels, control units, and devices.)

A fifth IOCDS data set is provided (for diagnostics) and cannot readily be altered by the user. It could be used for POR if no other valid IOCDS exists.
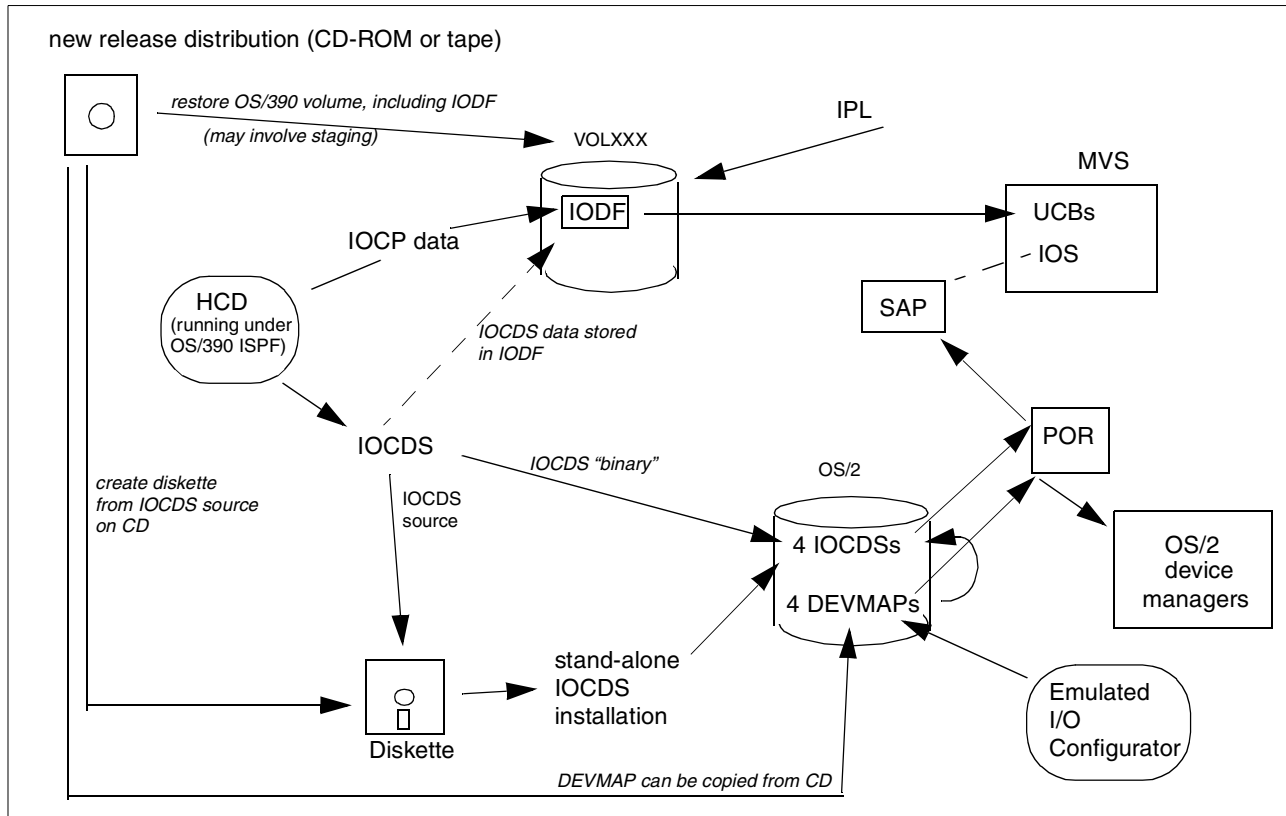
Figure 11. One Conceptual View of IOCDS-Related Tools and Files (for Multiprise 3000), Assuming CD-ROM Distribution

An IOCDS can be installed two different ways: via HCD (under OS/390) or via a standalone installation under the SE program. If HCD creates/installs the IOCDS, it is as a binary process and no IOCDS source file is produced. Alternately, an SE function can be used to read an IOCDS source file (typically from diskette) and create a functional IOCDS from it. The source file can be created with a PC editor, downloaded from an optional HCD function that creates IOCDS source, disassembled from a working IOCDS, or copied from some other distribution mechanism.

At the time we worked with our early Multiprise 3000, the direct installation of an IOCDS from HCD was not ready. (HCD did not recognize machine type 7060, used for Multiprise 3000.) We used HCD to create an IOCDS source (which specified a different machine type), downloaded the IOCDS source to a PC, altered the IOCDS source file (to specify machine type 7060), and performed a standalone IOCDS installation (because the standalone process did accept machine type 7060).

The Multiprise 3000 also uses DEVMAPs to define emulated I/O devices. There are four DEVMAPs and these are automatically associated with a corresponding IOCDS when a POR function is done.

OS/390 also needs to know the I/O configuration. It does not use the IOCDS for this.[6] It uses an IODF data set. The IODF is built by HCD. It could also be built from an IOCP source definition, although this is fairly unusual today. During IPL, OS/390 reads the IODF and uses the information to construct the control blocks (UCBs) it uses to manage I/O operations.

5.2 IOCDSs for "Preloaded" Systems

Earlier discussions imply that some portions of preloaded systems may require special handling. This can be confusing, even to experienced OS/390 administrators. This topic is discussed in more detail in this section; we apologize if this discussion becomes too simplistic, but the concepts are important. In this discussion, a *preload system* means the AD or the 390ADS system or something similar. If you do not plan to use one of these, this discussion may not apply to you. The concepts here are not unique to the Multiprise 3000, but could apply to any S/390 which might be used with these preload systems.

A preloaded system means the software is already loaded when you get your system[7]. A suitable IOCDS (and DEVMAP) should already exist. At this point, you can ignore this whole discussion; you should have a working system. This discussion becomes relevant when you need to install a new release of your software, or you need to alter your I/O configuration. New releases of these systems are usually distributed on CD-ROMs, although they could also be distributed on tape. The use of the term *preload system* to describe a new software release that you receive on a set of CD-ROMs is odd, but this is the terminology commonly used. (The same CD-ROMs could be used to preload a system before it is shipped to a customer, and the is part of the reason for the terminology.)

These preload systems are generated (using HCD to build a production IODF) with a large number of device addresses. For example, over three hundred 3390 devices are defined in the AD system. The same preload system is intended for use with P/390, R/390, S/390 Integrated Servers, Multiprise 3000 systems, and possibly other smaller S/390 machines. These machines might be installed with a wide variety of I/O devices. The intention is to have a sufficient number of devices already defined to OS/390 (in the IODF) to work with most of these machines. This accomplishes several goals:

1. It provides a working system for initial use by the customer. (OS/390 customization is done under OS/390. That is, you must have a working OS/390 in order to further customize a working OS/390 for your installation.)

2. It avoids requiring the customer to perform detailed customizations using HCD. Usage of HCD can be complex, especially for a first-time user.

3. It provides simple expansions for P/390-based systems, where only a simple DEVMAP update is needed to "create" new devices.

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[6] Why not have OS/390 also use the IOCDS? The IOCDS (stored in the SE) is outside the architected interface of the S/390 instruction set. OS/390, using standard software, cannot *see* the IOCDS. Likewise, the POR function cannot see OS/390 data sets (containing an IODF, for example) because OS/390 is not active (or selected) at the time of POR. An IOCDS applies to all define LPARS, whereas an IODF applies to a single instance of OS/390. An IOCDS is needed regardless of what S/390 operating system is used, while the IODF is unique to OS/390.

[7] Again, we stress that we are discussing the Application Development (AD) or ADSolution preloaded systems here. Other preloaded systems might have completely different characteristics.

If you already have a working OS/390, you could use HCD to create I/O definitions for your particular hardware configuration and create a new IODF and IOCDS from these definitions. (We did this to create the Basic IOCDS listed in Appendix A.) Doing this requires considerable work with HCD. This is the normal way larger OS/390 installations are managed; the local systems programmers maintain IODF definitions (using HCD) to describe their hardware configuration. The preload systems were initially built this way, at IBM, although the exact hardware used (chpids, control unit paths, and so forth) are unlikely to match any of the intended users of the preload systems.

When you install a new version of a preload system, you have a choice of ways to customize the I/O definitions to fit your installation:

1. By running under a previous version of OS/390, you can use HCD to create a new IODF (including an IOCDS) to match your actual I/O configuration. (You might just use your old IODF and IOCDS, if no changes are needed). This option requires HCD skills.

2. You can modify an IOCDS to make your I/O hardware appear as a subset of the I/O already defined (when the preload was built by IBM) in the IODF. This may be easier than going through the whole HCD definition process. A disadvantage is that your IOCDS (defining just your actual hardware) does not match the preload system IODF (which defines a larger set of devices). However, this can work quite well as long as there are no conflicts in the two definitions.

We have skipped over the definitions of DEVMAPs so far. Assuming your system will use some emulated I/O devices, you must have a proper DEVMAP defined. The DEVMAP is closely related to the IOCDS; every DEVMAP device must have a corresponding definition in the IOCDS. HCD does not produce DEVMAPs. You must customize DEVMAPs by using an SE utility. (If your system was preloaded by IBM or an IBM business partner, it should have a valid initial DEVMAP that matches your initial IOCDS. If you change your emulated I/O configuration, you will need to change your DEVMAP.)

DEVMAPs are distributed with the preload systems. As with IOCDSs, these distributed DEVMAPs may need to be customized to match your exact hardware. However, the distributed DEVMAPs are usually immediately useful (without customization). This is because the scope of definitions in the distributed DEVMAPs is rather limited. The most likely change you will need for the distributed DEVMAPs is to add additional 3278 definitions; this can be done after you have your initial system up and running.

5.3 File Relationships

Current S/390 systems have four IOCDS files, known as A0, A1, A2, and A3. (There is also a D0 IOCDS that is intended for diagnostic purposes. You cannot readily alter D0 and we will ignore it the the following discussions.) The systems programmer or operator selects one of these when starting the system. This is done by the POR function in one of the SE displays.[8] Each of the four IOCDS files has a specific DEVMAP file associated with it.

---

[8] The POR function will also be part of a *profile*, if profiles are used. Once profiles are defined, the operator can activate a profile and this will perform the POR, IPL the system, and so forth. The appropriate IOCDS number is included in the profile definition.

The DEVMAP is used automatically when the corresponding IOCDS is loaded. These DEVMAP files are:

```
IOCDS      DEVMAP FILE      IOCDS SOURCE      IOCDS OPERATIONAL
  A0       AWSMAPA0.DVM     IQZKSRA0.DAT      IQZKDSA0.DAT
  A1       AWSMAPA1.DVM     IQZKSRA1.DAT      IQZKDSA1.DAT
  A2       AWSMAPA2.DVM     IQZKSRA2.DAT      IQZKDSA2.DAT
  A3       AWSMAPA3.DVM     IQZKSRA3.DAT      IQZKDSA3.DAT
           AWSMAPAC.DVM     (active DEVMAP)
        (All files listed here are in the D:\IOCP\ directory)
```

Unlike a P/390-based system, the DEVMAPs for the Multiprise 3000 must have the indicated OS/2 drive, path, and file names. *Never attempt to edit a DEVMAP with a PC editor program*. They are binary files. An editor will attempt to insert CF/LF characters and destroy the files. When a IOCDS is used for a POR function, the associated DEVMAP is copied to D:\IOCP\AWSMAPAC.DVM and this copy is used for processing. This active copy cannot be altered, but the other four DEVMAPs can be updated at any time (using the SE Emulated I/O Configurator program). Alterations are not effective until a POR is performed.

The same OS/2 directory (D:\IOCP\) contains IOCDS files in various binary and source forms, including those listed in the previous table. As best we could determine, you should not work directly with any of these files. You can use menu options in the SE functions that deal with IOCDS to *import* or *export* source images of a selected IOCDS file.

5.4 Emulated I/O Configurator

The Emulated I/O Configurator is accessed from the CPC panel of the SE application. When started, the initial panel is similar to:

```
                    Device Map Filename

    Active Device Map   > D:\IOCP\AWSMAPAC.DVM
          Device Map 0  > D:\IOCP\AWSMAPA0.DVM
          Device Map 1  > D:\IOCP\AWSMAPA1.DVM
          Device Map 2  > D:\IOCP\AWSMAPA2.DVM
          Device Map 3  > D:\IOCP\AWSMAPA3.DVM

   Place cursor under any device map name to edit or view,
   The Active device map cannot be edited, only viewed


  Note: The Active device map was copied from D:\IOCP\AWSMAPA0.DVM
```

In this particular example, the Multiprise 3000 has IOCDS A0 loaded. The active device map was copied from AWSMAPA0 and this corresponds to IOCDS A0.

The next screen in the Emulated I/O Configurator is the FUNCTIONS panel; only the F2 option is useful in this panel. (The other options, including nondisplayed ones, are for P/390 compatibility.) Pressing F2 produces a screen similar to the following:

```
Active Devices: 22                      Available disk space in Gbytes: 4.04
Addr Device Label  Atype  Size     Mgr   FN/P           Path->G:\OS390
 >     >     >       >       >       >     >
 0C   2540                                7
 22   3380  SCPMV5  CKD    1770C    2     G:\SCPMV5.122
 23   3380  WORK01  CKD    500C     2     G:\WORK01.123
 70   3278                                3




Mgr Codes: 1=AWSFBA    2=AWSCKD   3=AWS3274  4=LAN3274  5=AWS3215  6=AWS2821
7=AWS2540   8=LAN3172  9=LCS3172  A=MGR3172  B=WAN3172  C=AWSICA   D=AWSTAPE
E=SCSI3480  F=SCSI3420 G=AWS3480  H=AWS3420  I=AWSOMA   J=AWSPCSRV
```

This is where emulated I/O devices are defined. The Addr column indicates the subchannel on chpid FC. For example, the emulated card reader (2540), defined at address 0C in this example, would appear as a control unit at address 0C on chpid FC in the IOCDS. All emulated devices appear to be on chpid FC; this is a fixed chpid number. There are a maximum of 255 possible emulated I/O devices, corresponding to 255 subchannel addresses on chpid FC.

The full use of the Emulated I/O Configurator is described in *Emulated Input/Output Subsystem User's Guide and Reference*, GC38-0410, and only a few highlights will be described here. Interesting points include:

- Except for the limited address range (two hex digits), the configurator works just like corresponding configurators for P/390-based systems.
- New lines are added by typing into the formatted line under the header line that begins "Addr .....".
- Lines are deleted by moving the cursor to the line and pressing F9 two or three times (read the prompts *carefully* after each F9 action).
- The FN/P portion of existing lines may be overtyped by moving the cursor to the appropriate place, making changes, and then pressing Enter. (You must press Enter after changing any line.)
- The OS/2 drive specification in the PATH field may be overtyped (followed by Enter). This will display the free space on the indicated drive, and is useful when deciding where to allocate a new emulated disk volume. (By default, most of the free space is on the G drive.)
- The letters in the Mgr column correspond to the device managers listed at the bottom of the screen. The single Mgr characters have no intrinsic meaning and are not saved in the DEVMAP. They are used only on this screen to conserve space in the data lines.
- Disk volumes with an unusual number of cylinders can be defined, such as the 3380 volume with 500 cylinders shown in the example.
- The DEVMAP is likely to be longer than one screen. You can scroll with the PageUp and PageDown keys (full screen scroll) or with the F8 and F7 keys (single line scroll).
- In the example shown, drive G contains ample space for, say, a 3390-1 volume. We could define one at subchannel address A1 with volser 123456 by entering the following:

```
>A1 >3390 >123456  >CKD >1113C   >2  >G:\123456.A81
```

- The A1 address is arbitrary, but must match your IOCDS definition for CNTLUNIT A1.
- The volser is arbitrary. You must initialize the volume (with ICKDSF) to create a proper VTOC after you IPL OS/390. You can change the volser at that time.
- You can set the size parameter to any number of cylinders. For 3390s, the maximum supported is 3339 cylinders. For other supported disk types, the maximum is the largest size of the corresponding real device. A 3390 with 1113 cylinders requires slightly more than 900 MB disk space from OS/2.
- The number corresponding to AWSCKD must be set for the Mgr column.
- The FN/P field, for emulated disks, contains the path and file name of the OS/2 file that is created to hold the emulated volume. The name need not correspond to the volser, but it is common practice to use the volser name. The A81 extension name is also arbitrary, but is customarily the same as the software address ("UCB address") that will be used.
- Be certain there is sufficient space on the OS/2 drive before allocating a new disk volume.
- A full drive and path name, with a leading backslash in the path name, must be used in any FN/P definition.
- Changes to a DEVMAP are not effective until a POR operation is performed with the corresponding IOCDS. For example, assume we added volume 123456 to DEVMAP 2. We would need to have a corresponding device defined in IOCDS A2. We would then need to perform a POR, using IOCDS A2.[9] After the POR, we could IPL OS/390 and initialize the volume, assuming that OS/390 has a 3390 device defined (in the active IODF) at the address corresponding to the new volume. (This address is determined by the IOCDS definition.)

5.5 The DEVMAP and IOCDS Links

Every device in the DEVMAP must be defined in the corresponding IOCDS in a compatible way. Furthermore, *every DEVMAP device must be defined as a control unit* **and** *a device in the IOCDS.* This is an unusual requirement, and is different than any other IOCDS definition rules. Why? It is simply the way the Multiprise 3000 I/O subsystems work.

For example, assume we have two 3390 drives defined in DEVMAP 2:

```
Addr Device  Label   Atype  Size   Mgr   FN/P
 40   3390    VOL001  CKD    1113C  2     G:\LOCAL\VOL001.A87
 41   3390    VOL002  CKD    1113C  2     G:\VOL002.A88
```

The IOCDS definitions (in IOCDS A2) for these emulated drives could be:

```
CHPID PATH=FC,TYPE=EIO
CNTLUNIT CUNUMBR=FC40,PATH=(FC),UNITADD=((40,1)),UNIT=3990
IODEVICE ADDRESS=(0A87),CUNUMBR=(FC40),UNIT=3390,UNITADD=40
CNTLUNIT CUNUMBR=FC41,PATH=(FC),UNITADD=((41,1)),UNIT=3990
IODEVICE ADDRESS=(0A88),CUNUMBR=(FC41),UNIT=3390,UNITADD=41
```

There are many important concepts in this small example. These include:

- The new chpid type of EIO, meaning emulated I/O.
- The PATH for emulated I/O is always FC.

---

[9] Or the equivalent POR for a partition, if LPARs are being used.

- Do not attempt to define multiple devices in a single statement. The count subfield in the UNITADD is always one. If you define a large number of devices (such as 3270 terminals), you will have a large IOCDS source listing.
- The CUNUMBR is an arbitrary number, but is often written as the path (first two digits) and the CU/device address (last two digits).
- All the IODEVICE definitions could appear after all the CNTLUNIT definitions (typical), but the interleaved listing shown here is convenient for reading examples.
- The UNITADD value is the same as the Addr field in the DEVMAP. This is the link between the IOCDS and the DEVMAP. The UNITADD value must be the same in the CNTLUNIT and IODEVICE definitions.
- The ADDRESS in the IODEVICE statement defines the software address that will be used by OS/390 (via the IODF definitions). It is an arbitrary number. In most larger S/390 installations, the software address usually reflects the hardware address, but this is not required. The first device in our example has the hardware path shown (FC and the control unit/first device address of 40), while the software address is assigned as A87. OS/390 would use address A87.
- This complete remapping of addresses by IOCDS definitions is especially useful for the preload systems, as discussed previously.

The IOCP definitions (normally not directly used, although it reflects the HCD definition for the IODF) for this example would be:

```
IODEVICE ADDRESS=(0A87,1),UNIT=3390,CUNUMBER=FC40
IODEVICE ADDRESS=(0A88,1),UNIT=3390,CUNUMBER=FC41
```

Again, a single IODEVICE statement could not be used, since each unit has a different CUNUMBR.

We stress that the concepts in this section are critical for understanding Multiprise 3000 administration. Key concepts include:

1. The one-to-one correspondence between IOCDS files (A0 - A3) and DEVMAP files (0 - 3). POR with a certain IOCDS *always* implies use of the corresponding DEVMAP.
2. The ADDRESS field in the IODEVICE statement in an IOCDS can assign an address that is completely unrelated to the hardware addresses involved.
3. An OS/390 system (such as the AD system) can use this fact to map Multiprise I/O into the previously defined address ranges used by these software systems.
4. Changes to a DEVMAP are not effective until a POR with the corresponding IOCDS.
5. Emulated disk I/O volumes can be placed on any OS/2 drive that has room for them. They are not restricted to the G drive. (However, filling the other drives could create OS/2 (including the emulated device managers, the SE applications, and so forth) maintenance problems sometime later.)

5.6 Primary Disk Definitions

This section discusses how logical volumes are defined on the primary disks, and how these volumes are addressed. Before getting into details, we need to review the higher-level aspects of defining and addressing the primary disks.

Key points include:

- A single chpid (x'FD') is used to access all primary disks, whether in the base Multiprise 3000 box or in one of the expansion boxes. There is no way to use more than one channel for these drives.

- These disks cannot be shared with other systems. There are no direct external hardware paths to the disks.

- Each box (the base CPC and up to two expansion boxes) appears as a separate control unit (3990-2) on chpid FD, for a maximum of three control units on the channel. The control unit addresses are 00, 01, and 02.

- Within a box, there may be up to three RAID-5 arrays. Expansion occurs only in units of a whole new array.

- Each array is divided into Storage Units (SUs), and a storage unit is equivalent to space for a 3390-1 volume. The first array (five 18 GB drives, in a 4+P configuration, plus a hot spare that is shared by all the arrays in the box) has 73 SUs available.

- A logical volume uses an integral number of SUs, and cannot span arrays.

- Each array has a range of unit addresses reserved for it, within the logical 3990-2 CU associated with all the arrays in a frame. The first array has addresses 00-3F, for example.

The arrays and SU concepts were introduced in an earlier chapter. The RAID-5 administration for the primary disks is largely handled within the system; there are no external interfaces (through the SE functions, or any other function) that are intended for normal administration.[10]

Logical volumes on the primary disks are defined by using a series of panels within the SE application. The flow and GUI characteristics of these panels is slightly different than many of the other SE functions. Figure 12 on page 81 is a conceptual diagram of navigation through these panels. Note that to display the most useful information (shown in Figure 13 on page 82), it is necessary to use the Right Mouse Button (RMB) while the mouse pointer is in a white area of one of the displays.

---

[10] This is not true for the RAID-5 array used for the OS/2 (and emulated I/O) disks. For these, there are normal RAID-5 functions available, typically through a bootable diskette.
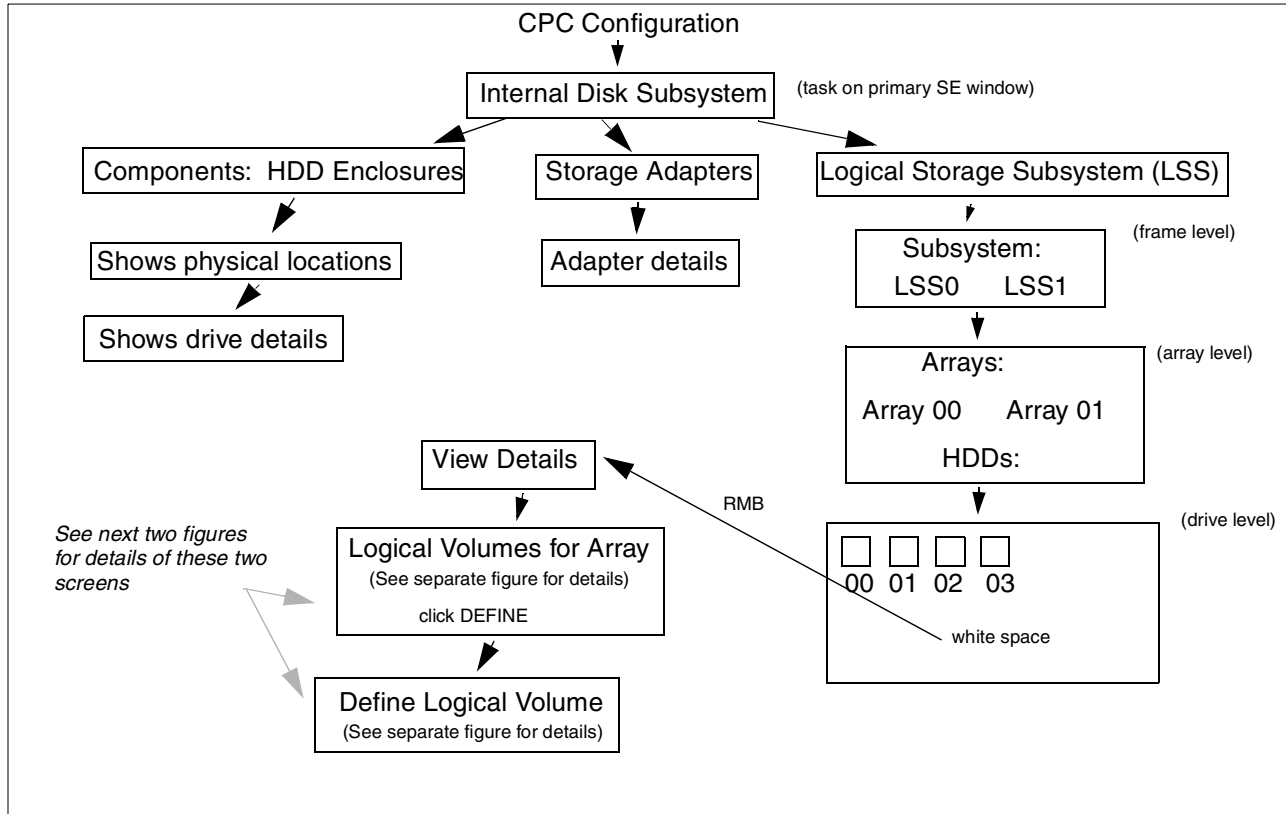
Figure 12. Accessing Internal Disk Configuration Screens In the SE Application

Each array is treated as a pool of space (in units of SUs). Provided sufficient SUs are available, the user can define new volumes. A volume can be the size of any standard 3380 or 3390 unit. Likewise, a volume can be deleted and its SUs are returned to the available pool for the array. Different size 3380 and 3390 volumes can be created and deleted in any order, without fragmentation effects. (This implies that the SUs for a given volume need not be contiguous, although we were not able to directly observe this--or to find any confirming documentation.)

Each logical volume is assigned a unit address when it is created. This is done by the SE application and cannot be directly controlled by the user. You can indirectly control unit addresses by defining volumes in a planned order, but you must devise the plan carefully and not delete/add volumes later. Unit addresses are assigned in ascending order, within the range associated with each array. (These ranges are explained in Chapter 3.) If a volume is deleted, its associated unit address will be reused (if it is the lowest available unit address) for the next volume that is created.

```
                    Internal Disk Subsystem

                   Logical Volumes For Array

    Enclosure: CPC Box        Adapter Location: LG14         Subsystem ID = FD00

    Adapter Note: B           CHPID= FD

                                                            CU Address 00


    Array ID: 00              Array State: online
    _____

                                Array 00


  Icon   Name          Unit Address          Type/Model        Size in Mbytes        State
  [  ]   00            00                    3390-3            2838                  online
  [  ]   01            01                    3390-3            2838                  online
  [  ]   02            02                    3390-2            1892                  online
  [  ]   04            04                    3380-J             630                  online



       [ Define ]


          Press Define to add logical Volume
```

Figure 13. Display With Logical Volume Details

As previously mentioned, Figure 13 shows one of the most useful displays associated with logical volumes. Figure 12 shows the path used to obtain this display. In a higher portion of the path, the user selected which box and which array to display. In this example, four volumes are defined in the selected array: two 3390-3, one 3390-2, and one 3380-J. Note that Unit Address 03 is missing; we assume a volume was deleted sometime earlier. The next volume defined in this array will have address 03; the next volume after that will have address 05. Note that the Unit Address is independent of the type of volume (3380 or 3390), and various device types and models are mixed together in the array. Your IOCDS must sort these out so that OS/390 addresses 3380s and 3390s separately. (OS/390 does not care which *model* of 3380 or 3390 is defined at a given address, but it must know which volumes are 3380s and which are 3390s.)

The Logical Volume display (Figure 13) contains a button to define new logical volumes. Clicking this button produces the display shown in Figure 14 on page 83. This display shows the amount of free space (in terms of SUs) available in the current array. It shows the types of volumes that can be defined; these include all models of 3390s and 3380s. You can overtype the *number* field to indicate how many new volumes to define. For example, if you enter 2 in the number field for 3390-2 and 1 in the number field for 3380-J and then click *Create*, the system will create two 3390-2 volumes and then one 3380-J volumes. Creation is in the order of the list in the display. As each new volume is created, it is assigned the next available Unit Address.

Volume creation does not initialize a volume to OS/390 requirements. You must run an ICKDSF job to create a VTOC (and VTOC index, if used).

```
                            Define Logical Volume

        Enclosure: CPC Box          Adapter Location: LG14          Subsystem ID = FD00

        Adapter Note: B             CHPID= FD

        Array State: online                                         CU Address 00


        Storage Units:      total  73

                            used  65              selected   -

                            free   8              still left   8


                            Types of Logical Volumes

    Icon    Name             Type/model           Storage Units          Number

            3390-1              3390-1                  1                    0

            3390-2              3390-2                  2                    0

            3390-3              3390-3                  3                    0

            3390-9              3390-9                  9                    0

            3380-J              3380-J                  1                    0

            3380-E              3380-E                  2                    0

            3380-K              3380-K                  3                    0

                  Create
```

Figure 14. SE Display Used To Create New Logical Volume

A new volume (with the correct Unit Address) must be reflected in the IOCDS and the IODF before OS/390 can access it. If the current IOCDS and IODF both correctly include the volume, then you can define it (via the SE function) while OS/390 is running. As soon as the definition complete, an attention interrupt is presented to OS/390. This will probably be followed by an I/O error, because OS/390 will attempt to read the label and VTOC and these do not exist yet. You would vary the unit off line, run an ICKDSF initialization, and vary the unit back online.

If you elect to work only (or primarily) with 3390 volumes (or with only 3380 volumes), then it should be possible to include extra definitions in your IOCDS and IODF in anticipation of future volumes you might define. If you have mixtures of 3380s and 3390s, this could be difficult, because you cannot easily control the Unit Address that will be assigned and this makes it difficult to build a correct IOCDS in advance.

Figure 15 on page 84 illustrates the relationship of the Unit Address (assigned when a logical volume is created) and the final address seen by OS/390. In this example, part of the Unit Address (05) is carried through to become part of the OS/390 address.[11] If we added a UNITADD operand to the IODEVICE statement, we could completely separate the hardware address component from whatever "address" we wanted to assign for OS/390 use.

---

[11] Strictly speaking, we should refer to the OS/390 address as a *device number*. However, "address" is widely used for this purpose, although the OS/390 device number can be completely arbitrary. On earlier S/360 and S/370 machines, the I/O addresses used by the operating system was directly related to hardware parameters and connections, and the older terminology continues to be used.
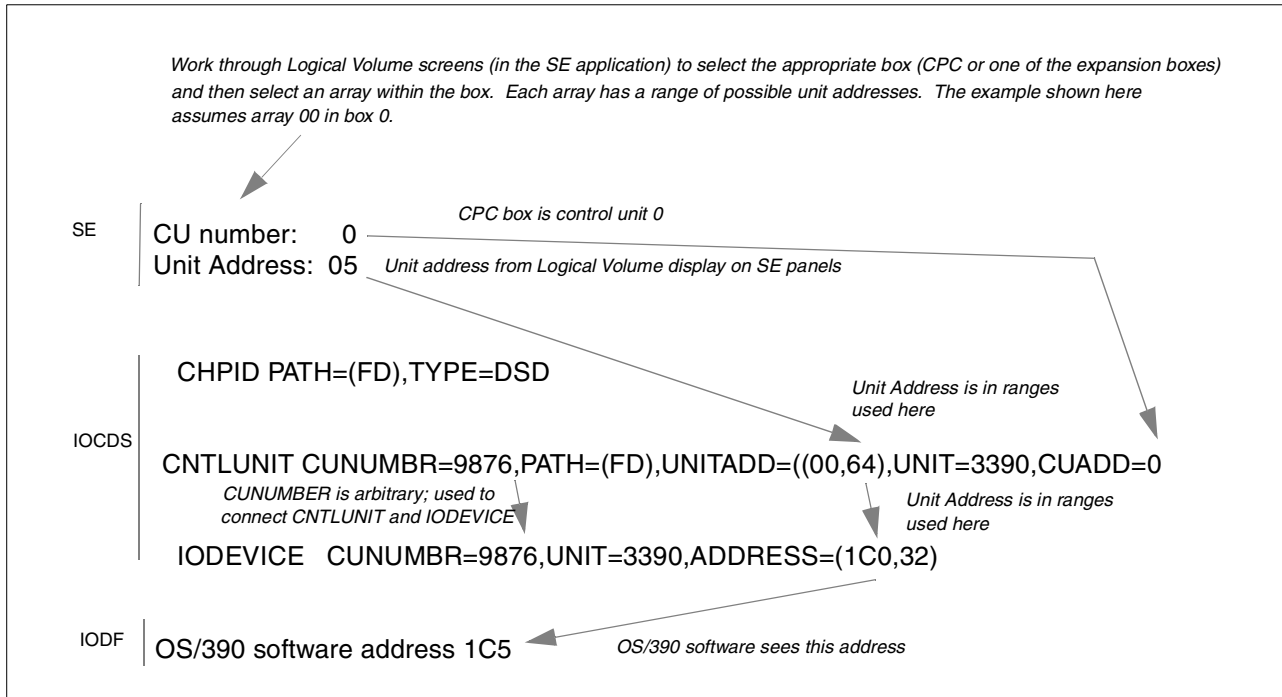
Figure 15. Addressing Chain for Logical Volume on Primary Disks (Using a Range of Unit Addresses)

In the following example, a single 3390 is defined and is assigned an MVS address that is completely unrelated to its unit address:

```
Assume CU 0, Unit Address 05

CNTLUNIT CUNUMBR=1,PATH=FD,UNITADD=05,UNIT=3990,CUADD=0
IODEVICE CUNUMBR=1,UNIT=3390,ADDRESS=123,UNITADD=05

MVS software address 123
```

Using IOCDS definitions like this, you can translate a "hardware" address into a completely different "software" address. This would normally be done device by device, not using a range of addresses.
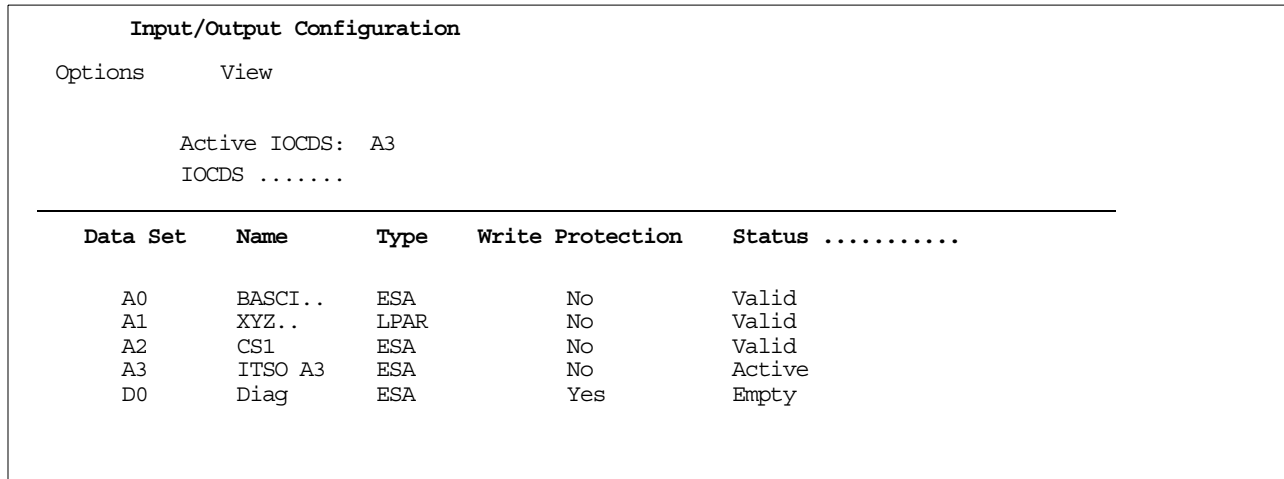
Suppose you want to define a new 3390-3 volume. How would you start? One way would be to display the Define Volume (Figure 14) screen for each array on each system box to determine which arrays have enough free space for your new volume. We did not find a way to display all the free SUs (on all the arrays on all the boxes) in a single display. An alternate method would be to keep track (manually) of the space available.

Does it matter which array or box you use for a new volume (assuming there is space available)? Within an array, the normal RAID-5 mechanisms use data stripes on all the disks in the array, so using separate logical volumes within a single array does not create any physical separation performance advantages. Placing busy volumes in separate arrays may, in theory, provide a performance advantage, but the author has found no positive demonstrations (and measurements) to prove this. The large cache (in HSA) and the caching effects of the SSA adapters make performance predictions difficult; specific measurements may relate uniquely to the specific workload being measured.

5.7 Working With IOCDSs

This section contains a few notes about working with the IOCDS panels in the SE application. The IOCDS functions are not more complex than other areas of systems programming, but a few tips for those new to this area may be useful.

The basic SE frame dealing with IOCDSs is shown in Figure 16. This frame is accessed by dragging the CPC icon (left screen) to the Input/Output (I/O) Configuration icon in the CPC frame (right screen).

```
        Input/Output Configuration

   Options      View


           Active IOCDS:  A3
           IOCDS .......


    Data Set     Name        Type     Write Protection     Status ...........

       A0        BASCI..     ESA             No            Valid
       A1        XYZ..       LPAR            No            Valid
       A2        CS1         ESA             No            Valid
       A3        ITSO A3     ESA             No            Active
       D0        Diag        ESA             Yes           Empty

```

Figure 16. IOCDS Frame in SE Application

Click on **Options** (in the frame shown in Figure 16) to produce a window with the following action steps:

```
            Enable Write Protection
            Disable Write Protection
            Copy Configuration.....
            Open Source File......
            Inport Source File.....
            Export Source File.....
            Delete Source File.....
            Build Data Set.....
            Disassemble Data Set.....
            Print data set report .....
            Exit
```

These are the actions used to work with IOCDS files. Most of these options, when selected, produce additional windows for more parameters. The following points may help explain aspects of IOCDS processing:

- There are four IOCDS data sets (A0 - A3) plus a diagnostic data set (D0). After a POR, one of these is the *active* IOCDS. You would not normally edit the IOCDS source or otherwise revise the *active* IOCDS. For example, if you are working with A3 and need to edit it, you may need to POR with another IOCDS (A0 for example), then edit and rebuild A3, and then POR with A3 to test it. We found that a cycle of this process takes 15 to 20 minutes.

- Just because an IOCDS builds without errors, do not assume it is correct until you IPL with it.

- Always be certain you have at least one IOCDS that is functional with your OS/390. We have a secure, minimal IOCDS in A0 that we use if we have errors with A1, A2, or A3. Alternately, with the Multiprise 3000, it is easy to keep an IOCDS source on diskette and import/build it if necessary. Remember that there needs to be a reasonable match between the operating system's IODF and your IOCDS.

- The IOCDS functions (in the SE application) contain an editor, accessed with the Open Source File option. We found this useful for trivial corrections to an IOCDS source file, but not to our taste for more extensive changes. If you export (Export Source File) an IOCDS source file to diskette, it becomes a flat ASCII text file. You can edit this with almost any PC editor. (Do not use a *word processor*; these tend to place extra control characters in their files.)

- The OS/2 system on the Multiprise 3000 has two editors, **e** and **tedit**. Either of these can be used. The **e** editor is probably more intuitive and is often used for making changes to CONFIG.SYS.

- The general cycle for working with IOCDS changes is this:

  1. Edit the IOCDS source (probably on diskette), using a PC editor.

  2. Use the Import Source File option to load the file from diskette to the SE file. You must select (in a parameter window) which IOCDS file (A0 - A3) you are importing; or course, this overwrites the previous contents of this IOCDS source file. The file can have any name on the diskette.

  3. Use the Build Data Set option to process the source file (now in one of the A0 - A3 files) into a working IOCDS (in the same A0 - A3 set). This overwrites the previous contents of the operational IOCDS file.

  4. Use the Open Source File option to inspect the source file again. The Build process denotes errors by adding comment lines to the source file. If there are errors, you can make corrections from the Open Source File window (which is also an editor) or correct your diskette source file and import it again. If you correct the IOCDS source file directly, you might want to delete the comment lines added by the Build process.

  5. When you think you have a correct IOCDS, exit from the IOCDS function and perform a POR with your new IOCDS.

- Remember that each IOCDS (A0 - A3) has a DEVMAP associated with it. The DEVMAP definitions will usually be a subset of the IOCDS devices, since the DEVMAP deals only with emulated I/O. The definitions must be compatible. For example, if the DEVMAP defines a 3390 volume at subchannel address 40, then the IOCDS should define a 3390 on path FC, at unit address 40.[12]

- You may see IOCDS listings with the UNIT= parameters in the CNTLUNIT and IODEVICE statements set to names you do not recognize. In some cases these fields are effectively ignored, and can contain any value. In these cases, the purpose of the IOCDS is simply to connect a hardware address (chpid, CUADD, UNITADD) to a software device number (ADDRESS in IODEVICE). When these statements are built with HCD, they are processed by both IOCDS building and by the IOCP function that builds a new IODF. This IOCP function requires correct UNIT information.

---

[12] All emulated I/O devices always appear on chpid FC in the Multiprise 3000.

5.7.1 Additional Notes For IOCDS and HCD

During our work with a pre-production Multiprise 3000, we made the following note:

- If you are updating the existing copy of an IODF, the HCD user must have RACF authorization in order access the Network name and CPC name using the PROMPT key.

```
                           Add Processor
Specify SNA address only if part of part of an S/390 microprocessor
cluster:
Network name . . . . . . . . _____  +
              CPC name . . . . . . . . . . _____   +
```

Chapter 6. Discussions and Common Questions

This chapter contains a number of common questions about the Multiprise 3000.

Q: If one of the OS/2 (9 GB) disk drives fails, will the system fail?

A: No. The OS/2 drives are in a RAID-5 array, described as a 2+P array. This means there are three drives with the effective space of two drives. A RAID-5 array always loses the space equivalent of one drive. This "lost space" is scattered over all the drives in the array, and contains sufficient parity information such that the array will still function if it loses any single drive. Operation in this mode (with one drive lost) is known as *degraded mode* or *exposed* operation. The OS/2 drives cannot survive the loss of *two* drives.

Q: If a RAID-5 array already contains recovery parity information, why do the primary disks *require* a hot spare?

A: The design for the primary disks uses a slightly unusual RAID-5 design.   It will not permit full operation in degraded mode. If one drive of an array is lost, and no hot spare is available, the array is placed offline. In a practical sense, the original failed drive must be replaced (and now becomes the new hot spare) before normal operation can continue. This conservative design eliminates potential timing windows where data might be lost while switching to degraded mode.

Q: Can I define a new logical volume (on the primary disks) while OS/390 is running? What do I need to do?

A: Yes, provided the address for the new volume is already defined in your IOCDS and IODF. When a new logical volume is defined, it presents an attention interrupt to OS/390. At this point there is no VTOC on the disk, and it is placed offline. You will need to run an ICKDSF job to initialize the volume and then vary it online. A POR is not required (assuming you do not need to load a new IOCDS).

Q: Can I define a new emulated volume (on the emulated disks) while OS/390 is running?

Y: You can create the new volume (using the Emulated I/O Configurator), but it is not accessible until after the next POR.

Q: What is the difference between an HDD and a disk drive?

A: In this redbook there is no difference. They are used as equivalent terms. There is no completely standardized terminology in this area. Some documents use HDD to indicate a physical disk drive, and "drive" or "disk drive" to indicate a logical drive of some type. (This document uses "volume" to indicate a logical drive.)

Q: Can I exchange 4mm tapes between this system and my P/390?

A: The P/390 4mm drives are DDS2 units, while the Multiprise 3000 4mm drive is a DDS3 unit. These should be upward compatible. You should be able to move data from a P/390 to the Multiprise 3000, but not necessarily the other way. Remember that IBM has recommended that the 4mm drives not be used for

routine, production work. P/390 owners have had rather mixed success using these drives, and you should not depend on routine data transfer this way.

Q: My P/390 worked with unmodified OS/390 releases. Will Multiprise 3000 do the same?

A: The answer depends on two things: what you mean by "modified", and which Multiprise 3000 disks or emulated I/O functions you use. The primary disks (based on the 18 GB SSA drives, which emulate 3380 and 3390 units) cannot be used with unmodified OS/390 releases; likewise for any emulated device, including emulated drives. Any (or all) of these require an SPE to be installed in OS/390. If you consider this a "modification", then you cannot use the primary drives or any emulated devices with an unmodified OS/390. No OS/390 modifications are needed to use external (ESCON or parallel channel) DASD.

Q: I do regression testing of our products against many old releases of MVS. Can I use the Multiprise 3000 for this?

A: This is related to the last question. You must have the SPE installed on the "old" releases if you use any of the internal disks (primary or emulated). At the time of writing, the SPE was planned to be available for OS/390 V1.3 and later. (You should verify this release number, as it may have changed after this was written.) Based on this, you would need to have external DASD to use releases older than this. (If you have a P/390, you might retain it for use with older releases.)

Q: Are the internal 3380 drives CKD or ECKD?

A: There are two types of internal drives: the primary disks, based on the 18 GB drives, and the emulated drives (bases on the three 9 GB drives). Both types may appear as 3380 drives. Emulated 3380 drives (on the 9 GB disks) always appear as ECKD devices. 3380 drives on the primary 18 GB disks also appear as ECKD devices.

Q: I need to print a few AFP documents. How do I emulate the correct printer?

A: We assume that "AFP document" means an IPDS (often known as a LIST3820) document. The only printer emulation is for 1403 and 3211 line printers. Your options are to attach a "real" IPDS printer[1] or to use the IPDS emulation functions found in OS/2 Server products. The P/390 device emulation functions do not include IPDS.

Q: What indication do I receive when the hot spare disk drive is used?

A: There is one spare 18 GB drive in each frame (the primary Multiprise 3000 box and each of two optional expansion boxes). The spare drive is automatically used if the RAID processor determines that a drive in one of the RAID arrays has failed. You will receive a single notice in Hardware Messages and a Call Home function will be initiated. The system will incorporate the spare into the RAID array that had the bad drive, and will build the data areas on the disk.

Q: How can I check whether my hot spare has been used to replace a failed drive?

---

[1] These include the IBM 38xx and 3900 series of printers, and also include the newer, lower-cost network printers with an IPDS adapter.

A: Follow this path in the SE application: **Internal Disk Subsystem** --> double click on the **HDD Enclosure** icon --> double-click on the **CPC box** --> in the white space around the small disk icons, click the right mouse button (RMB) --> select **View Details**. This should provide a listing for each of the drives. The Owner column indicates which drive (if any) is the hot spare.

Q: Can I change the 9 GB drives used for emulated disks to 18 GB units? Can I add more drives?

A: Using 18 GB drives for the OS/2 emulated I/O, at the time of writing, is not a supported configuration and might cause problems if hardware service is required.

Adding more drives for OS/2 is not a supported configuration. This would require cabling changes for the SSA drives and some changes in the RAID array definitions.

Q: Can I add another 9 GB drive to provide a spare for the emulated disks?

A: There is no support for this. It would require SSA cabling changes and RAID definition changes.

Q: Can I attach multiple SCSI tape drives through the emulation functions? Are these as good as "real" mainframe tape drives?

A: You may attach multiple (differential) SCSI tape drives. As distributed, the system provides for two drives (in addition to the 4mm drive). We have observed that some mechanical functions, such as tape load times, are slower on some of the SCSI drives than on large mainframe tape drives. Other than this, you will need to make your own evaluation of the relative merits of the various types of drives.

Q: Can I attach a full string of control units to a Multiprise 3000 channel? I could not do this on my P/390.

A: We assume you mean up to eight control units on a parallel channel. As far as we know, any parallel channel configuration within general S370 and S/390 guidelines should work.

Q: Can I run Multiprise 3000 ESCON channels through my ESCON Directors? Will it present the same appearance as any other processor or LPAR?

A: Yes.

Q: I plan to use the ADSolution preloaded system. Will I still need an MVS systems programmer?

A. There is no single, simple answer to this question. In the most general case, you will need access to systems programming skills. However, you are unlikely to need a full-time systems programmer. There are many ways to address this requirement, but this discussion is beyond the scope of this redbook.

Q: I heard about OS/390 packages on CD-ROM. OS/390 does not support CD-ROM devices as far as I know. How does this work?

A: The most common method is to process the CD-ROM under OS/2. OS/2 is contained in the Service Element portion of a Multiprise 3000. OS/390 does not directly see the CD-ROM reader. This process may sound indirect and complicated, but is actually quite simple and has worked well for many P/390 systems.

Q: Is all OS/390 software available on CD-ROM?

A: No. There are several CD-ROM packages available. Each was built with different needs in mind. Each package contains OS/390 and a selection of priced OS/390 software features and additional program products. You must be licensed for all the features and products on the CD-ROM in order to receive it.

Q. Can I add additional products to the CD-ROM?

A: Yes, you can add additional software products to your system after installing the CD-ROM system. (You cannot literally add anything to the CD-ROM itself, of course.)

Q: Should I install Corrective Service Diskettes (CSDs) for OS/2?

A: No. Any required OS/2 service will be released as "MCLs" or as Licensed Internal Code "patches".

Q: Should I back up the OS/2 system?

A: You should certainly have some form of backup. Multiprise 3000 comes with a CD-ROM containing all the OS/2 programs. You could reload from this, but you would lose your customized data, such as your IOCDSs and the Configurator data. You could back up these to diskette[2], but finding exactly which files to back up this way may be a challenge. The XTAPE utility, furnished for use with SCSI tape units, can completely back up the OS/2 system to any SCSI drive.

A: I have heard that this system runs Java much faster than my P/390--faster than the relative MIPS ratios would indicate. Is there a reason for this?

Q: This may well be the case, depending on the exact nature of the Java program. The Multiprise 3000 has the binary (IEEE) floating point instructions, while the P/390 does not have these instructions and must depend on OS/390 simulation of these instructions. Java demands the use of IEEE floating point, and any significant use of it will result in poorer performance on machines without the hardware.

Q: How can I move my source code from my P/390 to my Multiprise 3000?

A: You have several choices. Perhaps the easiest is to use the 4mm drive. It should be upward compatible between the systems. You can use ADRDSSU to perform selective dumps, or organize your data sets onto a single volume and dump the whole volume. If the data sets are small, you could use AWSTAPE devices and copy the OS/2 file to diskette. A common technique is to place both systems on a LAN and use ftp. XTAPE could be used to copy an emulated volume on your P/390 and restore it on the Multiprise 3000.

Q: Does the Multiprise 3000 have the relative and immediate instructions?

---

[2] You can also use the Backup Critical Data function of the SE application to do this, but the restore function for this method is drastic and will lose all the data on all the OS/2 emulated disk volumes.

A: Yes.

Q: The 18 GB disk drives in my Multiprise 2000 look the same as the primary drives in the Multiprise 3000. Can I move them to my 3000?

A: No. The Multiprise 2000 drives are SCSI; the Multiprise 3000 drives are SSA.

Q: 18 GB drives are available from many PC sources. Can I use these?

A: In principle, maybe; in practice, not likely. You need drives with these characteristics:

- IBM-qualified for use with the Multiprise 3000
- SSA
- Formatted in 524-byte sectors
- Internal microcode compatible with the IBM drives
- In the correct mechanical carriers, with the correct connectors

You are unlikely to find these through traditional PC sources. If you use unqualified drives, you run a number of service and operational risks.

Q: Could I use the 390ADS system on a P/390?

A: Yes, ignoring licensing issues, provided you have enough disk space. However, you need to investigate the licensing requirements first.

Q: Why don't you distribute a more complete IOCDS, to match the Multiprise 3000 primary disk drives and common external devices? Why not make it match the IODF?

A: The primary disk drives and any external I/O can be configured in too many different ways. We attempted to partly work around this by creating a large IODF for OS/390, covering many devices and providing sample IOCDS definitions for small subsets (but proper subsets) of the devices defined in the IODF.

Q: Are the emulated LAN interfaces as fast as OSA-2 adapters?

A: In general, no, especially if you are comparing the total effective bandwidth of multiple OSA-2 adapters and multiple emulated LAN adapters. Exact comparisons are difficult, because the effective performance of both depend on the number of bytes transferred per CCW and the amount of data that must be moved between internal buffers. The emulated LAN functions are more sensitive to these factors than are the OSA-2 adapters and associated support. (OSA-2 adapters are not available for the Multiprise 3000.) IBM is providing more detailed performance data through the business partners that market the Multiprise 3000.

Q: Can I run both the AD system and the 390ADS system?

A: Ignoring license issues, yes. You cannot fit both on your emulated disks. (There is not enough room.) You will need to move one (or both) to the primary disks and adjust your IOCDS accordingly. With a little work, you should be able to make a single IOCDS and DEVMAP that work with both systems. In basic mode, you can run only one at a time, of course. In LPAR mode, you could run both at the same time since there are no DASD volume conflicts.

Q: You mention editing IOCDS source. What editor should I use?

A: If you export (from an SE function) an IOCDS source file, it is a simple ASCII text file that can be processed by many PC editors. Do not use a *word processor*; use a simple line editor. An editor is included in the IOCDS functions of the SE application, but this one may not be to your taste. Two editors are included with OS/2: **e** and **tedit**. Either of these can be used; **e** is probably more intuitive, and is typically used for editing CONFIG.SYS.

Q: Can I unzip volumes (CD-ROM to emulated disk) while OS/390 is running?

A: In general, this did not work with P390-based systems; the unzip process (using OS/2) monopolized the disks to the extent that OS/390 thought they were having errors and started error recovery procedures. We tried the same thing with the Multiprise 3000 and had no problems, although our OS/390 was almost idle at the time. Remember that you will need to update your DEVMAP to reflect your new volume (and maybe update your IOCDS), and then perform a POR to make the new DEVMAP effective.

Q: With my P/390, I needed to ensure that the P/390 entries in the OS/2 CONFIG.SYS were always at the end of the file. Do I need to do the same for my Multiprise 3000?

A: No. (We did the reordering anyway, with our early system. The developers told us this was not necessary.)

Q: What is the SVC/Normal switch on the power supplies?

A: In the service position, the power supply (correctly known as an OCA) will not report errors through its RS422 interface. You would normally have no reason to use this switch.

Q: Can I attach the system to a room Emergency Power Off (EPO) system?

A: Yes, see the planning manual for details. The controlling switch is the unit emergency power off (UEPO) toggle switch behind the front panel, near the main power switch. Do not toggle the small red switch unless you are connected to an external EPO switch.

Q: I sometimes forget to start the 3270 emulator sessions before IPLing, but I never get an 007 wait state. Why?

A: If OS/390 cannot find its master console, it will use the Operating System Messages console. This is a special function built into OS/390 and the SE application. (This function is not present in P/390-based systems). When this happens, you should see the Operating System Messages icon blinking (in the SE window). Clicking the icon will display a window for this function. The function is similar to a 3215 typewriter-type console used long ago for S/360 and S/370 machines. You need to click the Send Command button before entering an MVS command.

If you observe OS/390 using this Operating System Messages console, you would normally enter the command `V CN(*),ACTIVATE` to further enable the console. You can then use the console. However, you probably want to switch to the 3270 session you normally use for the master console. After starting the

appropriate emulator session, issue the MVS command `V 700,CONSOLE` (using whatever address is appropriate to your system). After verifying that the 3270 session is now receiving console messages, issue the command V `CN(*),DEACTIVATE` on the SE console.

Q: Sometimes when I POR again and try to re-IPL, I see that the master console 3270 session (the session with address 70 for the AD system) is gone, and a new 3270 session with a higher address is present. This means that OS/390 will not find the master console if it corresponds to the missing address. What now?

A: We had this happen several times. Our recovery was to end all emulator sessions (double-click on the top left of each) and then restart the emulator sessions (using the OS/2 desktop icon). This restored the original subchannel addresses.

Q: Can I copy the Multiprise 3000 device managers to my P/390?

A: In general, No. Many of the device managers contain slightly altered code for the Multiprise 3000. In addition, these are considered Licensed Internal Code and such copying would clearly violate license agreements.

Q: Can I copy XTAPE to my P/390?

A: No, this would violate your license agreement. (However, you should visit the P/390 Web site for more information about availability of XTAPE for other P/390 systems.)

Q: If one of the RAID-5 drives is replaced, how long does the resync function take?

A: We replaced several of our 9 GB drives (as part of a planned update) and found that each needed 35 minutes to resync. (The replacment worked correctly; we did not lose any data on the OS/2 and emulated I/O drives.) No other activity was in progress; if we had been running OS/390 (with a workload) we assume the resync would have taken longer.

Q: Can I define new logical volumes on the primary internal disks while OS/390 is running? Can OS/390 immediately use them?

A: Yes, new logical volumes can be defined while OS/390 is running. Yes, you can access them immediately if they are already correctly defined in the active IOCDS and IODF. (Your first job for the new drive would probably be to initialize the VTOC.)

Q: Can I use one of the serial ports on the SBC as a dial-in port for SLIP connections? I did this with my P/390.

A: We did not try it, nor did we check whether the SLIP functions of OS/2 TCP/IP are present. The SBC has two serial ports. The first port is normally dedicated to the Call Home modem supplied with the system. The second serial port is disabled in the SBC BIOS, but we assume it could be enabled. There may be an IRQ conflict between the second serial port (if enabled) and one of the Multiprotocol or WAC adapters on the ISA bus. If you are not using these adapters, there should be no conflicts. Again, we have not tried this (yet) and there is no formal support for it.

Q: Should I set more secure passwords for the various SE userids?

A: Most installations do not change the default passwords. However, if you elect to use the OS/2 Web Browser to permit remote access to the SE application, you should certainly change the default passwords.

Q: How do I display the PSW?

A: In the SE application, select **Groups**. Double-click on the **CPC** icon; this should display a processor icon. Click the processor icon with the right mouse button. This should produce a menu with the choice of CPs and CHPIDS; select **CPs**. This should produce an icon of a chip, with the word Operating below it. Drag this icon to the **Alter or Display** icon (in the CP Toolbox panel).

In the following display, double-click **Register**. In the following display, double-click **PSW**. Click the **Stop** button. (You may have to repeat the PSW selection again.) This should display the PSW. Remember to click the Start button before you exit.

Q: How can I restart an emulator device manager without doing a POR?

A: The `AWSSTART managername n` command can be used (from an OS/2 window) to restart some device managers. (At the time of writing, LCS3172 could not be started this way.) This is not a supported interface, although it may be familiar to P/390 owners. The `AWSSTAT /L` command can be used to display the active device managers, and the `AWSSTAT managername` command can be used to force a specified device manager to end. Again, these are not supported interfaces and you use them at your own risk.

Q: Should I install P/390 fixpacks? Will there be Multiprise 3000 fixpacks?

A: No, do not install P/390 fixpacks. The equivalent Multiprise fixes can be installed via modem, update 4mm tapes, or diskettes. These will be provided by the normal IBM maintenance process.

Q: Can I use the channel adapters ("Parca" and "Escimo" adapters) from my Integrated Server?

A: No.

Q: Can I use the 18 GB SSA disk drives from my Integrated Server? They are SSA and the carrier appears to be the same.

A: No.

Q: Is the AWSPROF command still available?

A: No. (It may be in the P390 directory, but do not use it.)

Q: Can I change DMA and IRQ assignments?

A: Although you may be able to do this by working with PC BIOS functions, you may make your system unserviceable by IBM.

Q: Can I attach a CD Writer (via OS/2)?

A: There is no support for this. Remember that the only external SCSI interface is differential SCSI. You are unlikely to find a differential SCSI CD writer.

Q: Should I purchase ISITAPE to improve emulated tape functions?

A: No. Equivalent functionality is included in the standard system.

Q: Is there an optical disk drive on the SE (such as is available on HMC and SE consoles for larger S/390 machines)?

A: No.

Q: Is the P/390 trace function available?

A: Partly; its use is intended for IBM diagnostic purposes only.

Q: Can I use the /T option in CONFIG.SYS to determine my tape drive SCSI address?

A: Yes

Q: You discuss standalone IOCDS builds extensively. Can I build everything under HCD?

A: Yes. However, HCD will force you to define individual CNTLUNIT and IODEVICE statements for every device on chpid FC.

Our lengthy discussions about IOCDS modifications are primarily for those using prebuilt OS/390 packages that have a large number of devices predefined (via HCD) in their IODF and a much smaller number of devices in their distributed IOCDS and DEVMAP files.

Q: Can I use a different PC display with the Multiprise 3000? The large unit supplied with it does not fit well in our available space.

A: Maybe. We tried several other PC displays that appeared to work well. We also tried PC flat panel displays, and these did not work. (Perhaps we did not spend enough time adjusting the synchronization controls for the flat panel units.)

Q: When will IBM provide official MIPS numbers for these systems?

A: Probably never. MIPS numbers were useful when machines were simpler. Complex internal interactions on current machines make MIPS numbers much less meaningful. As a trivial example, a new instruction might replace 20 "standard" instructions and run twice as fast; however the MIPS rating would be one tenth as fast. MIPS numbers are often badly misused for marketing and comparison purposes, causing IBM to shift to other metrics. (Nevertheless, *when properly used*, MIPS numbers may help position a new system.)

Q: What are the version codes for the different models?

A: The H30 is X'15', the H50 is X'17', and the H70 is X'19'.

Appendix A. IOCDS and DEVMAP Listings

The administrator of a Multiprise 3000 system can establish any device configuration and device addresses that are appropriate for his system. This appendix lists several sample IOCDSs and DEVMAPs that are discussed in the main text of this redbook.

A.1 AD IOCDSs and DEVMAP

A.1.0.1 Initial A3 IOCDS For the AD System

This IOCDS (or an appropriate update of it) is referenced as the ITSOA3 IOCDS. It contains only emulated device definitions and is intended for use while initially running a Multiprise 3000 from a few emulated volumes.

```
ID    MSG1='ITSO A3',                                          *
      MSG2='SYS1.IODF00',SYSTEM=(7060,1)
CHPID PATH=(FC),TYPE=EIO
CNTLUNIT CUNUMBR=FC0C,PATH=FC,UNITADD=((0C,001)),UNIT=2821
CNTLUNIT CUNUMBR=FC0E,PATH=FC,UNITADD=((0E,001)),UNIT=2821
CNTLUNIT CUNUMBR=FC0F,PATH=FC,UNITADD=((0F,001)),UNIT=2821
CNTLUNIT CUNUMBR=FC10,PATH=FC,UNITADD=((10,001)),UNIT=CTC
CNTLUNIT CUNUMBR=FC11,PATH=FC,UNITADD=((11,001)),UNIT=CTC
CNTLUNIT CUNUMBR=FC12,PATH=FC,UNITADD=((12,001)),UNIT=CTC
CNTLUNIT CUNUMBR=FC20,PATH=FC,UNITADD=((20,001)),              *
      UNIT=3480
CNTLUNIT CUNUMBR=FC21,PATH=FC,UNITADD=((21,001)),UNIT=3803
CNTLUNIT CUNUMBR=FC22,PATH=FC,UNITADD=((22,001)),UNIT=3803
CNTLUNIT CUNUMBR=FC30,PATH=FC,UNITADD=((30,001)),UNIT=3990-2
CNTLUNIT CUNUMBR=FC31,PATH=FC,UNITADD=((31,001)),UNIT=3990-2
CNTLUNIT CUNUMBR=FC32,PATH=FC,UNITADD=((32,001)),UNIT=3990-2
CNTLUNIT CUNUMBR=FC33,PATH=FC,UNITADD=((33,001)),UNIT=3990-2
CNTLUNIT CUNUMBR=FC34,PATH=FC,UNITADD=((34,001)),UNIT=3990-2
CNTLUNIT CUNUMBR=FC35,PATH=FC,UNITADD=((35,001)),UNIT=3990-2
CNTLUNIT CUNUMBR=FC36,PATH=FC,UNITADD=((36,001)),UNIT=3990-2
CNTLUNIT CUNUMBR=FC37,PATH=FC,UNITADD=((37,001)),UNIT=3990-2
CNTLUNIT CUNUMBR=FC38,PATH=FC,UNITADD=((38,001)),UNIT=3990-2
CNTLUNIT CUNUMBR=FC39,PATH=FC,UNITADD=((39,001)),UNIT=3990-2
CNTLUNIT CUNUMBR=FC40,PATH=FC,UNITADD=((40,001)),UNIT=3990-2
CNTLUNIT CUNUMBR=FC41,PATH=FC,UNITADD=((41,001)),UNIT=3990-2
CNTLUNIT CUNUMBR=FC42,PATH=FC,UNITADD=((42,001)),UNIT=3990-2
CNTLUNIT CUNUMBR=FC43,PATH=FC,UNITADD=((43,001)),UNIT=3990-2
CNTLUNIT CUNUMBR=FC44,PATH=FC,UNITADD=((44,001)),UNIT=3990-2
CNTLUNIT CUNUMBR=FC45,PATH=FC,UNITADD=((45,001)),UNIT=3990-2
CNTLUNIT CUNUMBR=FC46,PATH=FC,UNITADD=((46,001)),UNIT=3990-2
CNTLUNIT CUNUMBR=FC47,PATH=FC,UNITADD=((47,001)),UNIT=3990-2
CNTLUNIT CUNUMBR=FC48,PATH=FC,UNITADD=((48,001)),UNIT=3990-2
CNTLUNIT CUNUMBR=FC49,PATH=FC,UNITADD=((49,001)),UNIT=3990-2
CNTLUNIT CUNUMBR=FC70,PATH=(FC),UNITADD=((70,001)),UNIT=3174
CNTLUNIT CUNUMBR=FC71,PATH=(FC),UNITADD=((71,001)),UNIT=3174
CNTLUNIT CUNUMBR=FC72,PATH=(FC),UNITADD=((72,001)),UNIT=3174
CNTLUNIT CUNUMBR=FC73,PATH=(FC),UNITADD=((73,001)),UNIT=3174
CNTLUNIT CUNUMBR=FC74,PATH=(FC),UNITADD=((74,001)),UNIT=3174
CNTLUNIT CUNUMBR=FC75,PATH=(FC),UNITADD=((75,001)),UNIT=3174
CNTLUNIT CUNUMBR=FC76,PATH=(FC),UNITADD=((76,001)),UNIT=3174
CNTLUNIT CUNUMBR=FC77,PATH=(FC),UNITADD=((77,001)),UNIT=3174
CNTLUNIT CUNUMBR=FC78,PATH=(FC),UNITADD=((78,001)),UNIT=3174
```

```
                    CNTLUNIT CUNUMBR=FC79,PATH=(FC),UNITADD=((79,001)),UNIT=3174
                    CNTLUNIT CUNUMBR=FC7A,PATH=(FC),UNITADD=((7A,001)),UNIT=3174
                    CNTLUNIT CUNUMBR=FC7B,PATH=(FC),UNITADD=((7B,001)),UNIT=3174
                    CNTLUNIT CUNUMBR=FC7C,PATH=(FC),UNITADD=((7C,001)),UNIT=3174
                    CNTLUNIT CUNUMBR=FC7D,PATH=(FC),UNITADD=((7D,001)),UNIT=3174
                    CNTLUNIT CUNUMBR=FC7E,PATH=(FC),UNITADD=((7E,001)),UNIT=3174
                    CNTLUNIT CUNUMBR=FC7F,PATH=(FC),UNITADD=((7F,001)),UNIT=3174
                    CNTLUNIT CUNUMBR=FC80,PATH=(FC),UNITADD=((80,001)),UNIT=3174
                    CNTLUNIT CUNUMBR=FC81,PATH=(FC),UNITADD=((81,001)),UNIT=3174
                    CNTLUNIT CUNUMBR=FC82,PATH=(FC),UNITADD=((82,001)),UNIT=3174
                    CNTLUNIT CUNUMBR=FC83,PATH=(FC),UNITADD=((83,001)),UNIT=3174
                    CNTLUNIT CUNUMBR=FC84,PATH=(FC),UNITADD=((84,001)),UNIT=3174
                    CNTLUNIT CUNUMBR=FC85,PATH=(FC),UNITADD=((85,001)),UNIT=3174
                    CNTLUNIT CUNUMBR=FC86,PATH=(FC),UNITADD=((86,001)),UNIT=3174
                    CNTLUNIT CUNUMBR=FC87,PATH=(FC),UNITADD=((87,001)),UNIT=3174
                    IODEVICE ADDRESS=00C,MODEL=1,CUNUMBR=FC0C,UNIT=2540R
                    IODEVICE ADDRESS=00E,MODEL=N1,CUNUMBR=FC0E,UNIT=1403
                    IODEVICE ADDRESS=00F,MODEL=N1,CUNUMBR=FC0F,UNIT=1403
                    IODEVICE ADDRESS=E20,CUNUMBR=FC10,UNIT=CTC,UNITADD=10
                    IODEVICE ADDRESS=E21,CUNUMBR=FC11,UNIT=CTC,UNITADD=11
                    IODEVICE ADDRESS=E40,CUNUMBR=FC12,UNIT=CTC,UNITADD=12
                    IODEVICE ADDRESS=560,CUNUMBR=FC20,UNIT=3480,UNITADD=20
                    IODEVICE ADDRESS=550,MODEL=8,CUNUMBR=(FC21),UNIT=3420,          *
                          UNITADD=21
                    IODEVICE ADDRESS=551,MODEL=8,CUNUMBR=(FC22),UNIT=3420,          *
                          UNITADD=22
                    IODEVICE ADDRESS=120,CUNUMBR=FC30,UNIT=3380,UNITADD=30
                    IODEVICE ADDRESS=121,CUNUMBR=FC31,UNIT=3380,UNITADD=31
                    IODEVICE ADDRESS=122,CUNUMBR=FC32,UNIT=3380,UNITADD=32
                    IODEVICE ADDRESS=123,CUNUMBR=FC33,UNIT=3380,UNITADD=33
                    IODEVICE ADDRESS=124,CUNUMBR=FC34,UNIT=3380,UNITADD=34
                    IODEVICE ADDRESS=125,CUNUMBR=FC35,UNIT=3380,UNITADD=35
                    IODEVICE ADDRESS=126,CUNUMBR=FC36,UNIT=3380,UNITADD=36
                    IODEVICE ADDRESS=127,CUNUMBR=FC37,UNIT=3380,UNITADD=37
                    IODEVICE ADDRESS=128,CUNUMBR=FC38,UNIT=3380,UNITADD=38
                    IODEVICE ADDRESS=129,CUNUMBR=FC39,UNIT=3380,UNITADD=39
                    IODEVICE ADDRESS=A80,CUNUMBR=FC40,UNIT=3390,UNITADD=40
                    IODEVICE ADDRESS=A81,CUNUMBR=FC41,UNIT=3390,UNITADD=41
                    IODEVICE ADDRESS=A82,CUNUMBR=FC42,UNIT=3390,UNITADD=42
                    IODEVICE ADDRESS=A83,CUNUMBR=FC43,UNIT=3390,UNITADD=43
                    IODEVICE ADDRESS=A84,CUNUMBR=FC44,UNIT=3390,UNITADD=44
                    IODEVICE ADDRESS=A85,CUNUMBR=FC45,UNIT=3390,UNITADD=45
                    IODEVICE ADDRESS=A86,CUNUMBR=FC46,UNIT=3390,UNITADD=46
                    IODEVICE ADDRESS=A87,CUNUMBR=FC47,UNIT=3390,UNITADD=47
                    IODEVICE ADDRESS=A88,CUNUMBR=FC48,UNIT=3390,UNITADD=48
                    IODEVICE ADDRESS=A89,CUNUMBR=FC49,UNIT=3390,UNITADD=49
                    IODEVICE ADDRESS=700,MODEL=X,UNITADD=70,CUNUMBR=(FC70),         *
                          UNIT=3270
                    IODEVICE ADDRESS=701,MODEL=X,UNITADD=71,CUNUMBR=(FC71),         *
                          UNIT=3270
                    IODEVICE ADDRESS=702,MODEL=X,UNITADD=72,CUNUMBR=(FC72),         *
                          UNIT=3270
                    IODEVICE ADDRESS=900,MODEL=X,UNITADD=73,CUNUMBR=(FC73),         *
                          UNIT=3270
                    IODEVICE ADDRESS=901,MODEL=X,UNITADD=74,CUNUMBR=(FC74),         *
                          UNIT=3270
                    IODEVICE ADDRESS=902,MODEL=X,UNITADD=75,CUNUMBR=(FC75),         *
                          UNIT=3270
```

```
              IODEVICE ADDRESS=903,MODEL=X,UNITADD=76,CUNUMBR=(FC76),        *
                 UNIT=3270
              IODEVICE ADDRESS=904,MODEL=X,UNITADD=77,CUNUMBR=(FC77),        *
                 UNIT=3270
              IODEVICE ADDRESS=905,MODEL=X,UNITADD=78,CUNUMBR=(FC78),        *
                 UNIT=3270
              IODEVICE ADDRESS=906,MODEL=X,UNITADD=79,CUNUMBR=(FC79),        *
                 UNIT=3270
              IODEVICE ADDRESS=907,MODEL=X,UNITADD=7A,CUNUMBR=(FC7A),        *
                 UNIT=3270
              IODEVICE ADDRESS=908,MODEL=X,UNITADD=7B,CUNUMBR=(FC7B),        *
                 UNIT=3270
              IODEVICE ADDRESS=909,MODEL=X,UNITADD=7C,CUNUMBR=(FC7C),        *
                 UNIT=3270
              IODEVICE ADDRESS=90A,MODEL=X,UNITADD=7D,CUNUMBR=(FC7D),        *
                 UNIT=3270
              IODEVICE ADDRESS=90B,MODEL=X,UNITADD=7E,CUNUMBR=(FC7E),        *
                 UNIT=3270
              IODEVICE ADDRESS=90C,MODEL=X,UNITADD=7F,CUNUMBR=(FC7F),        *
                 UNIT=3270
              IODEVICE ADDRESS=90D,MODEL=X,UNITADD=80,CUNUMBR=(FC80),        *
                 UNIT=3270
              IODEVICE ADDRESS=90E,MODEL=X,UNITADD=81,CUNUMBR=(FC81),        *
                 UNIT=3270
              IODEVICE ADDRESS=90F,MODEL=X,UNITADD=82,CUNUMBR=(FC82),        *
                 UNIT=3270
              IODEVICE ADDRESS=910,MODEL=X,UNITADD=83,CUNUMBR=(FC83),        *
                 UNIT=3270
              IODEVICE ADDRESS=911,MODEL=X,UNITADD=84,CUNUMBR=(FC84),        *
                 UNIT=3270
              IODEVICE ADDRESS=912,MODEL=X,UNITADD=85,CUNUMBR=(FC85),        *
                 UNIT=3270
              IODEVICE ADDRESS=913,MODEL=X,UNITADD=86,CUNUMBR=(FC86),        *
                 UNIT=3270
              IODEVICE ADDRESS=914,MODEL=X,UNITADD=87,CUNUMBR=(FC87),        *
                 UNIT=3270
```

A.1.0.2 Initial DEVMAP for AD System (A3 and A0)

This DEVMAP matches both the A3 IOCDS (which is listed above) and the A0
IOCDS (which is listed below). Notice that the addresses seen by OS/390 are
established by the IOCDS and do not match the DEVMAP addresses specified in
the Addr field. The unit addresses in this devmap have been organized as follows:

```
  Unit Addresses                 Usage
     00-0F                       Unit record devices
     10-1F                       Channel-to-channel devices
     20-2F                       Tape devices
     30-3F                       3380 drives
     40-5F                       3390 drives
     60-6F                       Any other devices that do not fit elsewhere
     70-FF                       3270 terminals
```

There are no requirements to use this organization. However, we found that a
simple design for unit addresses made our administration much easier. Note that
any unit address can be mapped to any "UCB address" by appropriate IOCDS
statements.

We used the following DEVMAP for both the A0 and A3 IOCDS. That is, this DEVMAP was stored in both D:\IOCP\AWSMAPA0.DVM and D:\IOCP\AWSMAPA3.DVM.

```
Addr Device  Label  Atype   Size   Mgr  FN/P
 0C   2540                          7    G:\RDR\*.JCL    (AWS2540)
 0E   1403                          6                    (AWS2821)
 0F   1403                          6
 10   3088                          9                    (LCS3172)
 11   3088                          9
*12   3088                          8                    (LAN3172)
 20   3480                          E                    (AWS34X0)
 21   3420                          D                    (AWSTAPE)
 22   3420                          D
 40   3390   OS39R8  CKD    3339C   2    G:\OS39R8_1.A80 (AWSCKD)
 41   3390   OS3R8A  CKD    3339C   2    G:\OS3R8A.A81
 42   3390   OS39M1  CKD    3339C   2    G:\OS39M1_1.A82
 43   3390   OS39P8  CKD    2226C   2    G:\OS39P8.A83
 44   3390   OS3P8A  CKD    2226C   2    G:\OS3P8A.A84
 45   3390   OS39D8  CKD    2226C   2    G:\OS39D8.A85
 46   3390   OS3D8A  CKD    2226C   2    G:\OS3D8A.A86
 47   3390   OS39H8  CKD    2226C   2    G:\OS39H8.A87
 48   3390   OS3HUS  CKD    2226C   2    G:\OS3HUS.A88
 70   3278                          3    /R=OP           (AWS3274)
 71   3278                          3
 72   3278                          3
 73   3278                          4                    (LAN3274)
 74   3278                          4
 75   3278                          4
 76   3278                          4
 77   3278                          4
 78   3278                          4
 79   3278                          4
 7A   3278                          4
```

The release 8 AD system was not ready when this was written. In the final system, some of the volume sizes will be smaller (fewer cylinders) than shown here. When the emulated I/O subsystem is started (by POR), the files named in the DEVMAP entries are inspected and the actual number of cylinders found in the file will be displayed in the configurator panels.

A.1.0.3 Initial A0 IOCDS for the AD System

This is an extension of the A3 IOCDS shown above. It uses the same emulated I/O addresses (and same DEVMAP) but adds a number of primary disk drives. You may need to edit and rebuild this IOCDS before you use it, depending on the Unit Addresses of the volumes you define on your primary disks. The statements here assume the first thirty-two unit addresses for the primary disks (PATH=FD,UNITADD=00) are for 3390 drives, and these are mapped to addresses starting at AA0. (The AD system has 3390 devices defined in the range A80-ADF.)

This listing also shows chpid definitions for two ESCON channels and additional definitions for 3390s at addresses 300-33F. These lines are commented out, but you could use them or modify them as required. The two chpid definitions might be used to define external control units. The additional logical volumes (starting at OS/390 address 300) might be used for the 390ADS system. Note that these

definitions start at UNITADD=10 (hex). This assumes that the first sixteen logical volume unit addresses (00-0F) are used for the IODEVICEs defined for OS/390 addresses AA0-AAF. You must coordinate unit addresses of logical volumes (that you define via SE panels) with the IOCDS definitions that use them. You could, for example, define less than 16 addresses for the first set of logical volumes (targeted for OS/390 addresses AAx) and start the set set (targeted for OS/390 address 3xx) at a lower unit address.

```
          ID    MSG1='ITSO A0',                                  *
                MSG2='SYS1.IODF00',SYSTEM=(7060,1)
          CHPID PATH=(FC),TYPE=EIO
          CHPID PATH=(FD),TYPE=DSD
*         CHPID PATH=(04),SWITCH=D1,TYPE=CNC
*         CHPID PATH=(05),SWITCH=D2,TYPE=CNC
        CNTLUNIT CUNUMBR=FD00,PATH=(FD),CUADD=00,UNITADD=((00,16)),   *
                UNIT=3990-2
         IODEVICE ADDRESS=(AA0,16),CUNUMBR=FD00,UNIT=3390,UNITADD=00
*        CNTLUNIT CUNUMBR=FD00,PATH=(FD),CUADD=00,UNITADD=((10,64)),   *
                UNIT=3990-2
*         IODEVICE ADDRESS=(300,64),CUNUMBR=FD00,UNIT=3390,UNITADD=10
          CNTLUNIT CUNUMBR=FC0C,PATH=FC,UNITADD=((0C,001)),UNIT=2821
          CNTLUNIT CUNUMBR=FC0E,PATH=FC,UNITADD=((0E,001)),UNIT=2821
          CNTLUNIT CUNUMBR=FC0F,PATH=FC,UNITADD=((0F,001)),UNIT=2821
          CNTLUNIT CUNUMBR=FC10,PATH=FC,UNITADD=((10,001)),UNIT=CTC
          CNTLUNIT CUNUMBR=FC11,PATH=FC,UNITADD=((11,001)),UNIT=CTC
          CNTLUNIT CUNUMBR=FC12,PATH=FC,UNITADD=((12,001)),UNIT=CTC
          CNTLUNIT CUNUMBR=FC20,PATH=FC,UNITADD=((20,001)),              *
                UNIT=3480
          CNTLUNIT CUNUMBR=FC21,PATH=FC,UNITADD=((21,001)),UNIT=3803
          CNTLUNIT CUNUMBR=FC22,PATH=FC,UNITADD=((22,001)),UNIT=3803
          CNTLUNIT CUNUMBR=FC30,PATH=FC,UNITADD=((30,001)),UNIT=3990-2
          CNTLUNIT CUNUMBR=FC31,PATH=FC,UNITADD=((31,001)),UNIT=3990-2
          CNTLUNIT CUNUMBR=FC32,PATH=FC,UNITADD=((32,001)),UNIT=3990-2
          CNTLUNIT CUNUMBR=FC33,PATH=FC,UNITADD=((33,001)),UNIT=3990-2
          CNTLUNIT CUNUMBR=FC34,PATH=FC,UNITADD=((34,001)),UNIT=3990-2
          CNTLUNIT CUNUMBR=FC35,PATH=FC,UNITADD=((35,001)),UNIT=3990-2
          CNTLUNIT CUNUMBR=FC36,PATH=FC,UNITADD=((36,001)),UNIT=3990-2
          CNTLUNIT CUNUMBR=FC37,PATH=FC,UNITADD=((37,001)),UNIT=3990-2
          CNTLUNIT CUNUMBR=FC38,PATH=FC,UNITADD=((38,001)),UNIT=3990-2
          CNTLUNIT CUNUMBR=FC39,PATH=FC,UNITADD=((39,001)),UNIT=3990-2
          CNTLUNIT CUNUMBR=FC40,PATH=FC,UNITADD=((40,001)),UNIT=3990-2
          CNTLUNIT CUNUMBR=FC41,PATH=FC,UNITADD=((41,001)),UNIT=3990-2
          CNTLUNIT CUNUMBR=FC42,PATH=FC,UNITADD=((42,001)),UNIT=3990-2
          CNTLUNIT CUNUMBR=FC43,PATH=FC,UNITADD=((43,001)),UNIT=3990-2
          CNTLUNIT CUNUMBR=FC44,PATH=FC,UNITADD=((44,001)),UNIT=3990-2
          CNTLUNIT CUNUMBR=FC45,PATH=FC,UNITADD=((45,001)),UNIT=3990-2
          CNTLUNIT CUNUMBR=FC46,PATH=FC,UNITADD=((46,001)),UNIT=3990-2
          CNTLUNIT CUNUMBR=FC47,PATH=FC,UNITADD=((47,001)),UNIT=3990-2
          CNTLUNIT CUNUMBR=FC48,PATH=FC,UNITADD=((48,001)),UNIT=3990-2
          CNTLUNIT CUNUMBR=FC49,PATH=FC,UNITADD=((49,001)),UNIT=3990-2
          CNTLUNIT CUNUMBR=FC70,PATH=(FC),UNITADD=((70,001)),UNIT=3174
          CNTLUNIT CUNUMBR=FC71,PATH=(FC),UNITADD=((71,001)),UNIT=3174
          CNTLUNIT CUNUMBR=FC72,PATH=(FC),UNITADD=((72,001)),UNIT=3174
          CNTLUNIT CUNUMBR=FC73,PATH=(FC),UNITADD=((73,001)),UNIT=3174
          CNTLUNIT CUNUMBR=FC74,PATH=(FC),UNITADD=((74,001)),UNIT=3174
          CNTLUNIT CUNUMBR=FC75,PATH=(FC),UNITADD=((75,001)),UNIT=3174
          CNTLUNIT CUNUMBR=FC76,PATH=(FC),UNITADD=((76,001)),UNIT=3174
          CNTLUNIT CUNUMBR=FC77,PATH=(FC),UNITADD=((77,001)),UNIT=3174
```

```
              CNTLUNIT CUNUMBR=FC78,PATH=(FC),UNITADD=((78,001)),UNIT=3174
              CNTLUNIT CUNUMBR=FC79,PATH=(FC),UNITADD=((79,001)),UNIT=3174
              CNTLUNIT CUNUMBR=FC7A,PATH=(FC),UNITADD=((7A,001)),UNIT=3174
              CNTLUNIT CUNUMBR=FC7B,PATH=(FC),UNITADD=((7B,001)),UNIT=3174
              CNTLUNIT CUNUMBR=FC7C,PATH=(FC),UNITADD=((7C,001)),UNIT=3174
              CNTLUNIT CUNUMBR=FC7D,PATH=(FC),UNITADD=((7D,001)),UNIT=3174
              CNTLUNIT CUNUMBR=FC7E,PATH=(FC),UNITADD=((7E,001)),UNIT=3174
              CNTLUNIT CUNUMBR=FC7F,PATH=(FC),UNITADD=((7F,001)),UNIT=3174
              CNTLUNIT CUNUMBR=FC80,PATH=(FC),UNITADD=((80,001)),UNIT=3174
              CNTLUNIT CUNUMBR=FC81,PATH=(FC),UNITADD=((81,001)),UNIT=3174
              CNTLUNIT CUNUMBR=FC82,PATH=(FC),UNITADD=((82,001)),UNIT=3174
              CNTLUNIT CUNUMBR=FC83,PATH=(FC),UNITADD=((83,001)),UNIT=3174
              CNTLUNIT CUNUMBR=FC84,PATH=(FC),UNITADD=((84,001)),UNIT=3174
              CNTLUNIT CUNUMBR=FC85,PATH=(FC),UNITADD=((85,001)),UNIT=3174
              CNTLUNIT CUNUMBR=FC86,PATH=(FC),UNITADD=((86,001)),UNIT=3174
              CNTLUNIT CUNUMBR=FC87,PATH=(FC),UNITADD=((87,001)),UNIT=3174
               IODEVICE ADDRESS=00C,MODEL=1,CUNUMBR=FC0C,UNIT=2540R
               IODEVICE ADDRESS=00E,MODEL=N1,CUNUMBR=FC0E,UNIT=1403
               IODEVICE ADDRESS=00F,MODEL=N1,CUNUMBR=FC0F,UNIT=1403
               IODEVICE ADDRESS=E20,CUNUMBR=FC10,UNIT=CTC,UNITADD=10
               IODEVICE ADDRESS=E21,CUNUMBR=FC11,UNIT=CTC,UNITADD=11
               IODEVICE ADDRESS=E40,CUNUMBR=FC12,UNIT=CTC,UNITADD=12
               IODEVICE ADDRESS=560,CUNUMBR=FC20,UNIT=3480,UNITADD=20
               IODEVICE ADDRESS=550,MODEL=8,CUNUMBR=(FC21),UNIT=3420,        *
                     UNITADD=21
               IODEVICE ADDRESS=551,MODEL=8,CUNUMBR=(FC22),UNIT=3420,        *
                     UNITADD=22
               IODEVICE ADDRESS=120,CUNUMBR=FC30,UNIT=3380,UNITADD=30
               IODEVICE ADDRESS=121,CUNUMBR=FC31,UNIT=3380,UNITADD=31
               IODEVICE ADDRESS=122,CUNUMBR=FC32,UNIT=3380,UNITADD=32
               IODEVICE ADDRESS=123,CUNUMBR=FC33,UNIT=3380,UNITADD=33
               IODEVICE ADDRESS=124,CUNUMBR=FC34,UNIT=3380,UNITADD=34
               IODEVICE ADDRESS=125,CUNUMBR=FC35,UNIT=3380,UNITADD=35
               IODEVICE ADDRESS=126,CUNUMBR=FC36,UNIT=3380,UNITADD=36
               IODEVICE ADDRESS=127,CUNUMBR=FC37,UNIT=3380,UNITADD=37
               IODEVICE ADDRESS=128,CUNUMBR=FC38,UNIT=3380,UNITADD=38
               IODEVICE ADDRESS=129,CUNUMBR=FC39,UNIT=3380,UNITADD=39
               IODEVICE ADDRESS=A80,CUNUMBR=FC40,UNIT=3390,UNITADD=40
               IODEVICE ADDRESS=A81,CUNUMBR=FC41,UNIT=3390,UNITADD=41
               IODEVICE ADDRESS=A82,CUNUMBR=FC42,UNIT=3390,UNITADD=42
               IODEVICE ADDRESS=A83,CUNUMBR=FC43,UNIT=3390,UNITADD=43
               IODEVICE ADDRESS=A84,CUNUMBR=FC44,UNIT=3390,UNITADD=44
               IODEVICE ADDRESS=A85,CUNUMBR=FC45,UNIT=3390,UNITADD=45
               IODEVICE ADDRESS=A86,CUNUMBR=FC46,UNIT=3390,UNITADD=46
               IODEVICE ADDRESS=A87,CUNUMBR=FC47,UNIT=3390,UNITADD=47
               IODEVICE ADDRESS=A88,CUNUMBR=FC48,UNIT=3390,UNITADD=48
               IODEVICE ADDRESS=A89,CUNUMBR=FC49,UNIT=3390,UNITADD=49
               IODEVICE ADDRESS=700,MODEL=X,UNITADD=70,CUNUMBR=(FC70),       *
                     UNIT=3270
               IODEVICE ADDRESS=701,MODEL=X,UNITADD=71,CUNUMBR=(FC71),       *
                     UNIT=3270
               IODEVICE ADDRESS=702,MODEL=X,UNITADD=72,CUNUMBR=(FC72),       *
                     UNIT=3270
               IODEVICE ADDRESS=900,MODEL=X,UNITADD=73,CUNUMBR=(FC73),       *
                     UNIT=3270
               IODEVICE ADDRESS=901,MODEL=X,UNITADD=74,CUNUMBR=(FC74),       *
                     UNIT=3270
               IODEVICE ADDRESS=902,MODEL=X,UNITADD=75,CUNUMBR=(FC75),       *
```

```
                    UNIT=3270
          IODEVICE ADDRESS=903,MODEL=X,UNITADD=76,CUNUMBR=(FC76),      *
                    UNIT=3270
          IODEVICE ADDRESS=904,MODEL=X,UNITADD=77,CUNUMBR=(FC77),      *
                    UNIT=3270
          IODEVICE ADDRESS=905,MODEL=X,UNITADD=78,CUNUMBR=(FC78),      *
                    UNIT=3270
          IODEVICE ADDRESS=906,MODEL=X,UNITADD=79,CUNUMBR=(FC79),      *
                    UNIT=3270
          IODEVICE ADDRESS=907,MODEL=X,UNITADD=7A,CUNUMBR=(FC7A),      *
                    UNIT=3270
          IODEVICE ADDRESS=908,MODEL=X,UNITADD=7B,CUNUMBR=(FC7B),      *
                    UNIT=3270
          IODEVICE ADDRESS=909,MODEL=X,UNITADD=7C,CUNUMBR=(FC7C),      *
                    UNIT=3270
          IODEVICE ADDRESS=90A,MODEL=X,UNITADD=7D,CUNUMBR=(FC7D),      *
                    UNIT=3270
          IODEVICE ADDRESS=90B,MODEL=X,UNITADD=7E,CUNUMBR=(FC7E),      *
                    UNIT=3270
          IODEVICE ADDRESS=90C,MODEL=X,UNITADD=7F,CUNUMBR=(FC7F),      *
                    UNIT=3270
          IODEVICE ADDRESS=90D,MODEL=X,UNITADD=80,CUNUMBR=(FC80),      *
                    UNIT=3270
          IODEVICE ADDRESS=90E,MODEL=X,UNITADD=81,CUNUMBR=(FC81),      *
                    UNIT=3270
          IODEVICE ADDRESS=90F,MODEL=X,UNITADD=82,CUNUMBR=(FC82),      *
                    UNIT=3270
          IODEVICE ADDRESS=910,MODEL=X,UNITADD=83,CUNUMBR=(FC83),      *
                    UNIT=3270
          IODEVICE ADDRESS=911,MODEL=X,UNITADD=84,CUNUMBR=(FC84),      *
                    UNIT=3270
          IODEVICE ADDRESS=912,MODEL=X,UNITADD=85,CUNUMBR=(FC85),      *
                    UNIT=3270
          IODEVICE ADDRESS=913,MODEL=X,UNITADD=86,CUNUMBR=(FC86),      *
                    UNIT=3270
          IODEVICE ADDRESS=914,MODEL=X,UNITADD=87,CUNUMBR=(FC87),      *
                    UNIT=3270
   *IZP  IZP061I **CAUTION** CONTROL UNITS ATTACHING TO TYPE=CNC CHPIDS
   *IZP        EXIST WITH UNIT ADDRESS RANGES THAT DO NOT BEGIN WITH 00
   *IZP        HEX
   *IZP  IZP067I ERRORS=NO,  MESSAGES=YES, REPORTS PRINTED=NO,
   *IZP        IOCDS WRITTEN=YES, IOCS WRITTEN=YES
```

Appendix B. Maintenance Modem

The base Multiprise 3000 system includes a modem that is intended for system maintenance use. It can be used for automatic reporting of detected problems, in a *call home* function, and for downloading of Licensed Internal Code (LIC) updates.

The specific modem provided will depend on the country of installation. For North America, it is the IBM 7852-400 modem. This is an external unit that would normally sit on top of the system frame. It has an external power "brick" that needs to be plugged into a conventional wall outlet. The modem cable connects to serial port 1 on the SBC.

This modem has 16 bit switches to control various configuration functions. For use as a *call home* modem, the bit switch settings (from 1 to 16) are:

```
U U D D U U U D D U D D U U U U
```

where U or D means Up or Down for the switch settings. This corresponds to the following options:

1. (U) DTR interface control
2. (U) Hardware flow control
3. (D) Enable Command Responses
4. (D) reserved
5. (U) Enable automatic answer
6. (U) Maximum throughput ON
7. (U) RTS dependent on interface
8. (D) Enable command mode
9. (D) Remote digital loopback
10. (U) Dial-up operation
11. (D) Extended responses
12. (D) Asynchronous operation
13. (U) Speed setting (28.8 kbps)
14. (U) Speed setting (28.8 kbps)
15. (U) CD, DSR function
16. (U) 2-wire operation

These correspond to the default settings on the modem, except for bit 12. This bit switch needed to be changed from synchronous (U) to asynchronous (D).

Appendix C. Staging Jobs

The following job can be used to initialize logical volumes on the primary disk.
You should ensure that the unit addresses are correct for your system.

```
//ICKDSF JOB 1,OGDEN,MSGCLASS=X
//     EXEC PGM=ICKDSF
//SYSPRINT  DD  SYSOUT=*
//SYSIN  DD  *
 INIT UNIT(0AA0) NVFY NOVALIDATE VOLID(VOLAA0) -
   VTOC(0,2,13)
 INIT UNIT(0AA1) NVFY NOVALIDATE VOLID(VOLAA1) -
   VTOC(0,2,13)

/*
```

The following job can be used to copy one or several volumes. It copies the
original volser, and the target volume is forced offline when the copy is complete
(because it now has a dumlicate volser). This job can be used to move system
volumes from emulated disks to logical volumes on the primary disks.

```
//COPYVOL JOB 1,OGDEN,MSGCLASS=X,REGION=50M
//     EXEC PGM=ADRDSSU
//SYSPRINT DD SYSOUT=*
//D1 DD UNIT=3390,DISP=OLD,VOL=SER=OS39R8
//T1 DD UNIT=3390,DISP=OLD,VOL=SER=VOLAA0
//D2 DD UNIT=3390,DISP=OLD,VOL=SER=OS3R8A
//T2 DD UNIT=3390,DISP=OLD,VOL=SER=VOLAA1

//SYSIN DD *
 COPY INDD(D1) OUTDD(T1) ALLDATA(*) ALLEXCP COPYVOLID ADMINISTRATOR
 COPY INDD(D2) OUTDD(T2) ALLDATA(*) ALLEXCP COPYVOLID ADMINISTRATOR

/*
```

Appendix D. AWS34XX Device Manager

The following text is from the AWS34X0.DOC file that is distributed with the system. This describes the customization of the AWS34XX device manager; this device manager works with SCSI-attached tape drives. We list the text here because SCSI tape setup and usage may be important for a subset of Multiprise 3000 users and the following details may be useful for planning purposes. The complete DOC file is not listed here. Sections about more detailed error messages and specific device setup are not listed. These sections appear in the complete file distributed with the system.

AWS34XX is an OS/2 device driver which provides access to SCSI-attached IBM 3490-F01 and 4mm DAT tape drives by the S/390 Operating System.

D.0.1 Installation Steps

These steps are for adding an external SCSI tape drive to your system. The internal 4mm DAT tape drive is already configured for device manager AWS34X0.

The objective is to uniquely associate the tape drive with the device driver (AWS34XX.SYS) which will control it for EMIO tape processing.

D.0.1.1 Set the SCSI ID of the external tape drive.

The SCSI ID for a sequential device may be a value from 0 to 15 (excluding 7). For instructions about setting the SCSI ID, refer to your tape drive user manual, or other documentation that came with your tape drive.

Uncomment the following line:

```
DEVICE=d:\P390\AWS34XX.SYS   id,ai /ID=AWS34X1
```

where *id* is the 2-digit hexadecimal SCSI ID of the tape drive (00 to 15) and *ai* is the adapter index (relative to origin 0) of the SCSI adapter to which the tape drive is attached. 00 is the "first" adapter, 01 is the "second" adapter, and so on.

The best way to determine what parameters to place on the AWS34XX.SYS device driver is to use the /T option.   (See Device Driver Options, below).

If you omit the *id,ai* parameters, the device driver will try to allocate the highest numbered sequential device available on the lowest slot SCSI adapter card (usually the 4mm drive). Whenever you have more than one active tape drive, you are encouraged to supply the *id,ai* parameters.

Use "REM" or "rem" to comment out the DEVICE statement (in CONFIG.SYS) for a device driver which you do not want active.

D.0.1.2 Update the EMIO system devices.

Bring up the EMIO Configurator and select F2 *Update System Devices*.   Enter the unit address used by the S/390 Operating System in the *Addr* field.   Enter the device type (3480 or 3490) in the *Device* field.   Select the MGR code for AWS34X1 in the *Mgr* field. The MGR code is found in the Mgr Codes list at the bottom of the screen. If you are configuring the third physical tape drive, you would select the MGR code for AWS34X2, instead.

For example:

```
 Addr  Device                          Mgr    FN/P
 ---------------------------------------------------------------
 >590   >3480                          >F     >
```

After performing these steps, perform a Power-On Reset.

Only one physical tape drive can be supported by each instance of AWS34XX.SYS. The /ID= parameter distinguishes between multiple invocations for additional drives. There are three statements in the distributed CONFIG.SYS:

```
DEVICE=d:\P390\AWS34XX.SYS  /ID=AWS34X0
DEVICE=d:\P390\AWS34XX.SYS  /ID=AWS34X1
DEVICE=d:\P390\AWS34XX.SYS  /ID=AWS34X2
```

The first is usually assigned to the internal 4mm DDS-3 DAT Tape drive. The second and third are available for external SCSI tape drives.

If you wish to use AWS34X1 or AWS34X2, substitute this name everywhere that *AWS34X0* is mentioned in this DOC file.

D.0.1.3 Configuring the 4mm DAT tape drive.

The device type you select will determine the personality of the tape drive (for example, how it responds to the S/390 operating system). Specify the device type in the *Device* field of DEVMAP.

In general, the 4mm DAT tape drive should be configured as a 3480 device type (in DEVMAP) and as a 3480 with COMPACT option (in the S/390 operating system hardware definition). Under special circumstances you may want to define it as a 3422 device type.

When accessing a 4mm device as a 3422, a Mode Select for 6250 bpi will invoke data compression, while requesting density 800 or 1600 bpi will result in no data compression. When accessing a 4mm device as a 3480, a Mode Select for a 3480-XF will perform compression, while a Mode Select for 3480 will do no data compression.

D.0.1.4 Configuring the IBM 3490-F01 tape drive.

The device type you select will determine the personality of the tape drive (e.g, how it responds to the S/390 operating system). Specify the device type in the Device field of DEVMAP.

The 3490-F01 tape drive can be configured as 3480 or 3490 or both:

- When defined as a 3480, compression can be turned on by the S/390 operating system because the 3490-F01 tape unit supports IDRC. To use IDRC, do the following:
  - For OS/390, define a 3480 device with the COMPACT option
  - For VM/ESA, define a 3480 device and use the "XF" parameter on the TAPE and VMFPLC2 commands, and the "MODE XF" option on the DDR command. Do NOT specify both MODE XF (hardware compression and COMPACT (software compression) at the same time!

- For VSE/ESA, define a 3490 device with an "08" mode parameter, e.g. ADD 590,3490,08 in IPLPROC, or select "3480-DC" in the Hardware Configuration menu.

Note that in this configuration, the 3490-F01 will ONLY write in 18-track mode. It will read both 18-track AND 36-track tapes even though it is only defined as an 18-track device to S/390.   The tape drive automatically does the format adjustment transparent to the software.

- If you want to use the 3490-F01 to WRITE in 36-track mode, you must define the device in DEVMAP as device type 3490 and also define the device as 3490 or 3490E in the S/390 operating system hardware definition.

 It will also continue to automatically adjust to read both 18-track and 36-track formats.

- If you want to select either mode (18 vs 36 track) from your S/390 operating system, define TWO devices in DEVMAP, one as a 3480 and another as a 3490, and assign both to the same device manager, e.g.

```
     Addr  Device                                Mgr   FN/P
     ----------------------------------------------------------------
     >590   >3480                                 >F    >
     >591   >3490                                 >F    >
```

The S/390 operating system can use address 590 to write 18-track 3480 cartridges, and address 591 to write 36-track 3490E cartridges. Both 18-track and 36-track cartridges can be read from either address. Only one device can be varied online at a time! If you try to vary on both 590 and 591, the second device will get the message:

```
     IEE791I 0591 VARY REJECTED - ASSIGNED TO ANOTHER SYSTEM.
```

D.0.1.5 Device Driver Options

Device driver options are activated by placing parameters at the end of the device driver line in CONFIG.SYS. Each of these options begin with a forward slash (/) and must be separated from other options by a blank.

 /ID=cccccc assigns the device manager name, used in the EMIO Configurator and DEVMAP file. The three supported values are AWS34X0, AWS34X1, and AWS34X2.

 /T displays diagnostic tape device information during start-up, showing which tape devices are available and confirming which device was requested and allocated by AWS34XX.SYS. CONFIG.SYS processing will be paused until you press Enter.

The /T is a very useful option that should be used if you add an additional SCSI adapter or tape device. It will help you figure out what devices the AWS34XX device driver detects, and which parameters to put in CONFIG.SYS. After you have figured out what values of id,ai to place on the AWS34XX line, then you should delete the /T so the system doesn't pause and wait for Enter every time it is rebooted.

When the device driver is started with the /T option, the OS/2 start-up display will pause so that you can view messages similar to those in the following example:

```
AWS34X0: P/390 SCSI Tape Device Driver 2.26 Copyright (c) Interprocess
Systems, Inc.
Total sequential devices detected = 02.
Available tape unit = 03,00
Available tape unit = 05,01
Requested tape unit = 03,00
Allocated tape unit = 03,00
>>AWS34XX: Press ENTER to continue ...
```

In the example above, a total of two tape drives are present (according to OS/2). Two drives are available: SCSI ID 03 on the first adapter, and SCSI ID 05 on the second adapter. The unit with SCSI ID 03 on the first adapter was requested and successfully allocated.

D.0.1.6 Messages
The tape information messages which you receive from AWS34XX during OS/2 boot can be interpreted as follows:

No tape devices presented: OS/2 detected no sequential tape devices physically present. Is the tape powered on? Is the SCSI cable attached? Check the SCSI cable for bent or pushed-in pins.

Total sequential devices detected = nn: "nn" is the total number of tape units physically present on the system according to OS/2. This number includes both allocated and available units.

Available tape unit = id,ai: One line of this form will appear for each tape unit which has not already been claimed by another OS/2 device driver. *id,ai* indicates the SCSI ID and Adapter Index of the unit.

>>>> No tape units available <<<<<   There are no tape units available for allocation.

Requested tape unit = id,ai: The DEVICE statement specified SCSI ID *id* on Adapter Index *ai*.

Requested tape unit = blank: The DEVICE statement did not include the *id,ai* parameters.

Allocated tape unit = id,ai: The device driver successfully allocated (claimed) this tape unit.   *id,ai* indicates the SCSI ID and Adapter Index of the unit. *NONE* means that no tape drive was allocated.

D.0.1.7 Data Compression
Any SCSI-attached 3480 tape (either real 3480 cartridge or emulated 3480 such as 4mm DAT) that supports hardware compression can be used in IDRC mode (Improved Data Recording Capability feature) by the S/390 operating system. You don't have to do anything from the EMIO side to enable this. Some tape drives may have a switch to enable compression; consult the tape drive's manual to make sure it is set on.

To use IDRC under VM/ESA, you must specify the XF parameter on the TAPE and VMFPLC2 commands. For DDR, specify MODE XF. The COMPACT option of DDR will enable software compression. You cannot use both hardware and software compression at the same time.

To use IDRC under non-ESA VM (e.g. VM/ESA 370 feature or VM/SP), the 3480 device statement in DMKRIO must have FEATURE=XF coded before you can use the XF options described in the preceding paragraph.

To use IDRC under VSE/ESA, you must specify the 08 mode parameter in the IPLPROC entry for the device address AND define it as a 3490; for example, `ADD 590,3490,08`. Or you can select 3480-DC in the Hardware Configuration menu.

If you are running MVS/ESA or OS/390, you must specify the COMPACT feature on the 3480 definition in HCD in order to enable compression. COMPACT is required for SCSI tape drives like the IBM 3490-F01 and the 4mm DAT which alway report that they have compression.

D.0.1.8 Trouble-Shooting Tips

Here are some suggestions to help you investigate why a specific tape drive is not being properly activated.

Examine which SCSI IDs are configured to the SCSI adapters.
Press Ctrl+A while the system is booting to access the Adaptec SCSI configuration menus. Look for the banner: *Adaptec AIC-7880 SCSI BIOS vx.xx (c) 199x Adaptec, Inc. <<< Press <Ctrl><A> for SCSISelect Utility >>>*

If your system has a second SCSI adapter (the Adaptec AHA2944UW Differential SCSI adapter for attaching the IBM 3490-F01 tape drive) then each adapter must be examined separately for SCSI IDs. The second adapter will have a slightly different banner: *Adaptec AHA-2940 Ultra/Ultra W BIOS vx.xx (c) 199x Adaptec, Inc. <<< Press <Ctrl><A> for SCSISelect Utility >>>*

Unfortunately, the second Adaptec SCSISelect banner sometimes does not appear, even though the adapter is working fine. Whether it appears depends on the number of LAN cards installed. Try the /T option first (as described below), , and if the tape drive you are adding doesn't show up in AWS34XX's list, then you have a hardware problem with the SCSI adapter or cable.

Check which tape devices are detected by OS/2 at start-up.
Edit CONFIG.SYS and add the /T parameter at the end of the statements for AWS34XX.SYS. The resulting display will report the actual SCSI ID and Adapter Index (in *id,ai* format) for each sequential device on the system. After you have discovered the true SCSI ID and Adapter Index for your drive(s), modify the *id,ai* parameters on the DEVICE statements to match (and remove the /T).

On a RAID system, don't be surprised if the Adapter Index of a tape drive is not what you expect. More than one adapter may be reported as Adapter Index 00, or the Adapter Index values may not be consecutive. This is why it is helpful to choose unique SCSI IDs for the sequential devices on your system.

Overlapping Device Drivers.
Does another OS/2 device driver (e.g. a tape backup utility) have the SCSI tape device claimed? Check your CONFIG.SYS to see if an OS/2 tape backup utility program (such as SYTOS, NOVABACK, BackupWiz, etc.) is claiming the SCSI tape device. You cannot share the tape between the EMIO and any other OS/2 program.

Check for current copies of device drivers

Are the correct copies of the IBM2SCSI.ADD, OS2SCSI.DMD, AIC7870.ADD, and AWS34XX.SYS files being accessed at start-up? Do you have non-current copies or multiple copies floating around in different directories?   Issue the OS/2 command `DIR d:\name.ext /S` on each drive to find them all. These files must be located in C:\OS2\BOOT\ only!

Other Checks

To find out which EMIO device drivers are active and which devices they currently control, type the following at an OS/2 prompt: `AWSSTAT /L`

Under VM/ESA, a 3422 will come on-line automatically, but a 3420 device will not. To vary a 3420 on-line, type the following from the VM/ESA system OPERATOR userid: - `SET RDEVICE 580 TYPE 3420 MODEL 8`   - `VARY ONLINE 580`

6.0.1 Error Messages

If you receive the following message from OS/390 (similar messages appear in VM and VSE) and the tape drive unit address does not vary online:

```
IEA435I PHYSICAL DEVICE INCONSISTANT WITH LOGICAL DEFINITION.
```

This is because the physical tape drive (both 4mm DAT and IBM 3490-F01) supports IDRC (hardware data compression) but the S/390 unit address you have assigned to the tape drive does NOT support IDRC.

If you receive the following message from OS/390 (similar messages appear in VM and VSE) and the tape drive unit address does not vary online:

```
IEE791I uuuu VARY REJECTED - ASSIGNED TO ANOTHER SYSTEM.
```

This could occur because either:

- You defined two addresses for the same physical tape drive, and tried to vary both on at the same time.

- The physical tape drive is in use by XTAPE.EXE out in OS/2.

- If you receive the following "pop-up" message:

```
+------------------------------------------+
|                 EMIO Error               |
+------------------------------------------+
| AWSDEV908E CU=AWS34X0: RC=006E           |
| opening device driver, DD=AWS34XX        |
+------------------------------------------+
```

This means that you need to activate the AWS34XX.SYS device driver in CONFIG.SYS. This device entry is in the default DEVMAP, representing the 4mm DAT cartridge tape drive emulating a 3480:

```
    Addr Device              Mgr
    590 3480                 F          (AWS34X0)
```

If this entry is active but the device driver is not, then you get the above error message. Since every system has a 4mm DAT tape drive, you should edit CONFIG.SYS and make sure the "rem" characters are deleted from this line:

```
    rem DEVICE=d:\P390\AWS34XX.SYS /ID=AWS34X0
```

Reboot OS/2 and look for the AWS34XX message during boot. If the AWS34XX.SYS device driver is already in CONFIG.SYS with the correct parameters, add the /T parameter, reboot OS/2, and look for other error messages. For example,

```
DEVICE=d:\P390\AWS34XX.SYS /ID=AWS34X0 /T
```

Another way to get rid of the pop-up error message, if you are not using the DAT tape as a 3480, is to "exclude" the device 590 line from DEVMAP.   Go to the EMIO Configurator "F2 Update System Devices" menu and place the cursor under address 590. Press Alt+F3 to exclude the device. See the online Configurator help (F1) or the "Emulated Input/Output Subsystem User's Guide" chapter on *Configurator Tasks* for details and examples.

```
SYS1201: The device driver D:\P390\AWS34XX.SYS specified on line
nn of CONFIG.SYS was not installed. Line nn ignored.
```

This message is issued by OS/2 whenever there is no tape device detected at the *id,ai* parameters as specified on the AWS34XX.SYS statement in CONFIG.SYS.

If this OS/2 error was preceded by the message:

```
** AWS34XX OS2SCSI No tape devices presented
```

Then check for the following problems: Tape drive is powered off, or Tape drive SCSI cable is disconnected or damaged (look at the pins).

 If this OS/2 error was preceded by the message:

```
** AWS34XX OS2SCSI Open Interface error
```

Then check to see if CONFIG.SYS contains the following lines:

```
BASEDEV=AIC7870.ADD
BASEDEV=OS2SCSI.DMD
```

Otherwise, check the tape drive's SCSI ID and try Ctrl+A while the Adaptec SCSI-Select banner displays during system boot.

In any case, try adding the /T parameter at the end of the line in CONFIG.SYS. This will cause additional diagnostic information to be displayed when you reboot OS/2.

Glossary

This redbook is intended for experienced users of S/390 and OS/390 systems. Such readers are expected to recognize the various acronyms and terms associated with these products. However, this book does contain a considerable number of such terms and acronyms, and perhaps uses a few new ones. This small glossary may be helpful.

Computer manufacturers (and other organizations developing products) often assign development names while creating future products. Development names are intended as temporary names, to be used only until the product has an "official" name. Development names have no defined public meaning, however they sometimes are used for years after their associated product(s) become available. A classic example is the Winchester series of disk drives.

A few of the IBM internal development names associated with the Multiprise 3000 are listed here because, at the time of writing, these names are already being used outside the actual development groups. Again, these names have no implied meanings of any kind.

390ADS is a prepackaged OS/390 system combined with a Multiprise 300, intended primarily for COBOL, CICS, and e-business development organizations. It is similar to the AD System, but with a somewhat different set of tools included.

AD System Application Development System. This is a prepackaged OS/390 system, normally on CD-ROM, that contains a number of development products (compilers, for example) and is customized and ready for immediate use. It is intended as a convenience packaging, and is available only to S/390 PID members.

BiDi Bi-Directional. An interface used within the S/390 channel structure. For Multiprise 3000, it refers to a type of bus interface used to connect a circuit card that produces two channel interfaces, ESCON or parallel.

IBF Integrated Battery Feature. This is an optional feature that provides batteries to operate the system for a few minutes without external power. Two IBF features may be included in a Multiprise 3000.

Carrier or **Disk Carrier** is typically used with PC-style disks. The carrier usually contains fixed connectors and is designed to fit into a matching disk bay. The disk carriers used with the Multiprise 3000 are not compatible with common PC disk carriers.

CFCC Coupling Facility Control Code. This is, in effect, the combined operating system and application code in a Coupling Facility.

CF Coupling Facility. This is a separate processor (which may have multiple CPUs) that has channel links to the S/390 systems in a Parallel Sysplex. The CF

provides the communications functions and the scratchpad functions that are used to create a Parallel Sysplex.

CHPID Channel Processor Identifier. This identifier is often synonymous with the channel it identifies, making a chpid mean both a channel (ESCON or parallel for the Multiprise 3000) and the address of the channel.

CKD Count Key Data. This describes the disk record formats required by OS/390. OS/390 can operate only with disks that present this format. **ECKD** is an extended version of CDK. OS/390 cannot operate with FBA format disks.

Cryptographic Processor. A hardware component dedicated to cryptographic processing. Sometimes termed a "chip." In modern S/390 machines, this hardware optional is accessed by (undocumented) instructions in the S/390.

DASD Direct Access Storage Device. This is a traditional descriptive name for all the disks used with S/390. Conceptually, it includes non-disk devices such as drums and other "direct access" devices no longer in general use.

DAT Digital Audio Tape. The 4mm drive is similar to a DAT drive. The tape cartridges are compatible in shape, but should not be interchanged because they have different magnetic recording characteristics.

Device Manager, as used when discussing P/390-type systems, denotes an OS/2 application program that emulates a S/390 device.

Development names are used before a final product name is assigned. They are intended for internal IBM use, and have no intrinsic or hidden meanings. For various reasons, these development names are sometimes used externally. "Winchester" disk technology is perhaps the best example of an IBM development name used externally.

DEVMAP or device map. This is an OS/2 file used by emulated I/O functions to describe the exact parameters of the devices being emulated.

Driver, as used when discussing P/390-type systems, denotes an OS/2 program that (usually) runs in ring 0 of the PC. Drivers are normally specified in CONFIG.SYS.

Emulated Device. Use programs to make one type of device (a PC-type disk drive, for example) appear as a different type of device (a 3390 disk drive, for example).

ESCON Enterprise Systems Connection channel. These are the "fiber" or "optical" or "serial" channels used by most current S/390 systems and control units. Other types of channels are parallel and FICON.

FBA Fixed Block Architecture. This describes disks with fixed sector sizes, typically 512 bytes (although other sizes are sometimes used). PC-types of disks are FBA drives. OS/390 cannot use FBA disks; it uses only CKD (or ECKD) disks.

FIBB Fast Internal Bus Buffer. This is an internal component of several S/390 machines, including the Multiprise 3000. The name has no external significance and is used to conceptually describe these systems.

FRU Field Replaceable Unit. This is the smallest unit that can be replaced by field service personnel.

HDD Hard Disk Drive. This term is normally reserved for "PC-type" disks. These have fixed sectors (typically 512 bytes, but 524 bytes on the Multiprise 3000) and are ISA, SCSI, or SAA controlled.

HMC Hardware Management Console. This is an *optional* PC-based system (with the HMC application program) that can control several systems (via their SE console functions) from a central point. It is a typical central point of control for a Parallel Sysplex, but can be used with non-sysplex and/or multiple sysplex configurations.

IBB Internal Bus Buffer. This is an internal component of several S/390 systems and has no external significance, other than for conceptual descriptions of the internal design of these systems.

ICF Integrated Coupling Facility. This is a Coupling Facility function that, in effect, is provided in an LPAR of a S/390. This is more economical than using an external CF, although the performance characteristics are not the same as an external CF.

ICMF Integrated Coupling Migration Facility.

IOCDS Input Output Configuration Data Set. A file used by the S/390 "hardware" (SAP-level) to define the I/O devices (and their addresses) for a S/390.

IPDS Intelligent Printer Data Stream. This is the data format typically used by IBM's large page printers, starting with the IBM 3800 printer.

Logical Volume, in the context of a Multiprise 3000 system, means a 3380 or 3390 volume defined on a primary disk array.

ISV Independent Software Vendor. *As used here*, these are independent companies producing applications or system software for OS/390. They are often members of the S/390 PartnerWorld for Developers organization. The term Solution Developers is also used.

LIC Licensed Internal Code. This is software that is considered part of a hardware product. It is sometimes known as microcode, although it may not be microcode in the engineering sense of the word. The CFCC is an example of LIC.

LPAR Logical Partitioning. In its normal context, an LPAR is one of the partitions created within a larger S/390. Each LPAR can run an operating system (and its applications) independently from what is happening in other LPARs.

MBA Memory Bus Adapter. This is in internal component of several S/390 processors. It is used in this document as part of conceptual descriptions of the design of a S/390.

MPM2 Multiport Model 2. This is a PC-type adapter card that provides up to 8 SDLC modem connections. The Multiprise 3000 can have two of these adapters.

OCA Offline Converter Assembly. This is an internal IBM name for the primary power supply element in the Multiprise 3000 and several other systems.

OSA Open Systems Adapter. This is a family of adapters that are combined channel, control unit, and LAN communication functions. The OSA-2 adapter, for example, contains two LAN interfaces, each of which can be token ring or Ethernet. OSA adapters are available for many current S/390 processors, and have replaced older devices used for LAN connections.

PCI Peripheral Component Interconnect. This is a type of signal/data bus found on larger Personal Computers, and, increasingly, in secondary functions for larger processors.

Phoenix is an IBM development name for processes (hardware and software) that use sectorized disks ("PC-style" disks) to emulate S/390 CKD disks. The primary disks in the Multiprise 3000 are an example of a Phoenix subsystem.

PID Partners in Development. IBM's S/390 Partners in Development organization offers a variety of benefits to ISV members.

Planter99 was the IBM development name for the Multiprise 3000 system.

POR Power-on Reset. This is a function triggered from an icon in the SE application. It loads a new IOCDS and associated DEVMAP.

Preloaded means an operating system (and other software) that was installed on a system's disks before the system was shipped.

Primary Disks, as used in this redbook, means the internal disks (of a Multiprise 3000) that are not managed by OS/2 and emulated I/O. These are sometimes known as Phoenix disks.

PTF Program Temporary Fix. This term is often used to describe a software fix for OS/390 or a program product.

PU Processor Unit. PU is typically used to describe one of the S/390 engines in a multiprocessor system. It is a shortened form of **CPU** (Central Processing Unit). However, CPU can mean either a single S/390 processing engine or the whole S/390 "box" which is

likely to have multiple engines. PU narrows the meaning to a single engine; the engine might be used as a CPU, or as a SAP, or as a spare.

RAID Redundant Array of Independent Disks. There are various types of RAID usage. RAID-5, used in the Multiprise 3000, creates a large logical disk from an array of smaller disk drives. Additional parity information, equal in volume to one of the drives in the array but spread over all the disks, can be used to completely reconstruct data if any one of the drives is lost.

RAS Reliability, Availability, Serviceability. This is a common IBM term that collectively addresses all the various aspects and issues in this area.

SAP System Assist Processor. This is a processor (generally a S/390 processor) that is used internally by the system to manage I/O operations. If does not run OS/390 and cannot be seen by the operating system or applications.

Santa Cruz is the IBM development name for the SSA adapters used in the Multiprise 3000.

SBC Single Board Computer. This is a generic term for a Personal Computer built on a single adapter-type card.

SDLC Synchronous Data Link Control. This is a protocol normally used with SNA connections over modems. It applies to synchronous modems. PC modems are normally asynchronous, and do not use SDLC.

SE Support Element. This is a PC-type function that may be internal or external to the current generations of S/390 systems. It provides a GUI interface for controlling power, hardware online/offline commands, IPL functions, and so forth. It is not seen by the operating system or S/390 applications. A somewhat similar function was provided by **Service Processors** on earlier systems, and the terms Service Processor and Support Element are sometimes used as synonyms.

Sparing, such as CPU sparing or memory sparing. As used with S/390, this means building extra components into the system and providing system capability to transparently replace a failing component with a spare.

SPE Small Programming Enhancement. This describes a small upgrade (not a *fix*) for a software product that is installed in the same manner as a PTF.

SSA Serial Storage Architecture. An interface design typically used with multiple disk drives and their adapters. It permits multiple devices on a "loop." The interface contains cables for two loops, running opposite directions around the ring. If the loop is open, devices on both sides can still be accessed, using the "reverse" direction of the ring for some of them. The command set is similar to SCSI, the ring topology is slightly similar to token ring.

STI Self-Timed Interface. This describes a high-speed bus-type connection used internally in current S/390 processors.

SUF Service Update Facility. This is a process for delivering PTFs through the Web.

WAC Wide Area Connector. This is a PC-type adapter card that permits up to two modem connections. A Multiprise 3000 can have up to three of these adapters, but they are mutually exclusive with MPM2 adapters.

Appendix E. Special Notices

This publication is intended to help customers and IBM personnel better understand the Multiprise 3000 product, including several of the specially packaged software offerings available for it. The information in this publication is not intended as the specification of any programming interfaces that are provided by OS/390, OS/2, or any software mentioned in this redbook.

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Appendix F. Related Publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this redbook.

F.1 IBM Redbooks Publications

For information on ordering these ITSO publications see "How to Get IBM Redbooks" on page 127.

- *P/390, R/390, S/390 Integrated Server: OS/390 New Yser's Cookbook,* SG24-4757-01 (the -00 version is obsolete)

- *P390plex: A Technology Demonstration,* SG24-5632

F.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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IBM Enterprise Storage and Systems Management Solutions	SK3T-3694

F.3 Other Resources

These publications are also relevant as further information sources:

- *S/390 Multiprise 3000 System Overview,* GA22-1029

- *S/390 Multiprise 3000 Enterprise Server Emulated Input/Output Subsystem User's Guide and Reference,* GC38-0610

- *S/390 Stand-Alone Input/Output Configuration Program User's Guide*, GC38-0458

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