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PACKCOPY Program Now Available on User Group Support Bulletin Board System

The PACKCOPY program mentioned in Issue 2, 1989 of this publication is now available on the IBM PC User Group Support Bulletin Board System. The program that was published in Issue 2 contains errors. The program that is on the BBS has been tested and works correctly.

The phone number for the BBS is 404-988-2790.

Improving DOS 4.00 Response Time

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Users whose computers have extended memory can improve response time significantly by executing the DOS 4.00 Shell and File System from a virtual (instead of real) fixed disk, and by caching the fixed disk.

An 80286- or 80386-based computer with at least 2 MB of memory is required. (Fewer than 2 MB will work, but tests have shown that 2 MB is preferable.) You may also wish to consider expanded memory if you have an 80386-based computer and applications that support expanded memory.

To use the approach described in this article, changes are necessary to:

- CONFIG.SYS, to invoke the VDISK device driver
- AUTOEXEC.BAT, to set the environment
- DOSSHELL.BAT, to specify execution from the virtual disk

The examples below assume that:

- The computer has 2 MB of memory. (Adjust the VDISK and IBMCACHE parameters indicated below if you have more or less memory.)
- COMMAND.COM is in the root directory. (This alone improves performance compared to having it in a subdirectory.)
- All other DOS files are in subdirectory c:\dos.
- AUTOEXEC.BAT and CONFIG.SYS are in the root directory.
- There is only one fixed disk, drive C. If you have more, be sure the LASTDRIVE parameter in CONFIG.SYS is not set too low. VDISK selects the next available drive letter.

VDISK Changes

In CONFIG.SYS, add this statement:

```
device=c:\dos\vdisk.sys 768 512
64 /e
```

The parameters represent a virtual disk size of 768 KB, a sector size of 512 bytes, and a maximum of 64 directory entries (and therefore files) that the virtual disk can contain. The /e tells DOS to put the virtual disk into extended memory.

Also in CONFIG.SYS, be sure SHELL has the /p and /e:256 parameters:

```
shell=c:\command.com /p /e:256
```

/p tells DOS to make the copy of COMMAND.COM permanent in memory. /e:256 sets the environment size to 256 bytes, thus permitting a longer PATH statement; a larger or smaller number may be more appropriate. If the /e parameter is omitted, the default is 160.

In the AUTOEXEC.BAT file:

(1) At the top, add:

```
md d:dos
copy c:\command.com d:\
copy c:\dos\*.meu d:\dos
copy c:\dos\shell*.* d:\dos
copy c:\dos\dosshell.bat d:\dos
```

(2) Change or add COMSPEC:

```
set comspec=d:\command.com
```

(3) Add d:\ and d:\dos to PATH and APPEND:

```
path d:\;d:\dos;c:\;c:\dos (plus any
others you want)
append /e
append d:\;d:\dos;c:\;c:\dos (etc.)
```

In file DOSSHELL.BAT, change line 1 from @c: to @d:

IBMCACHE Changes

Installing IBMCACHE (found on the PS/2 Reference Diskette) in extended memory above 1 MB is especially effective because it improves performance of ill-behaved applications that modify the contents of memory below 1 MB. To implement IBMCACHE in extended memory:

- Copy IBMCACHE.SYS into the root directory. To do this, insert the Reference Diskette into drive A, type A:IBMCACHE, and follow the directions displayed.
- In CONFIG.SYS, *after* the VDISK statement (because of the way DOS assigns extended memory), add:

```
device=c:\ibmcache.sys 128 /e p4
```

The 128 denotes 128 KB of cache, /e specifies extended memory, and /p4 means the page size is 4 sectors.

- Change the BUFFERS= parameter to 3:

```
buffers=3
```

Execution

Simply re-boot the computer. After that, the DOS Shell and File System will execute from the virtual D disk.

Caution! When the DOS Shell runs from a virtual disk, any change made to a menu pertains only to the copy of the menu file in the virtual (D) disk. You should copy any changed file to the fixed disk (C) to make it permanent.

Extended Versus Expanded Memory

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Memory! Programs seem to keep needing more and more of it. Various options are available to increase the amount of memory available for your programs. Two options are to use extended or expanded memory.

To understand extended and expanded memory, it is helpful to understand how memory is set up on your machine. Memory is measured in kilobytes (KB) or megabytes (MB), 1024 KB. A certain amount of memory is available on the machine itself. In addition, memory cards can be added to the machine to increase the total memory size. Other cards can be added that give some programs access to more memory by using another program called an Expanded Memory Specification (EMS) device driver. The cards are called EMS hardware adapters, and the device driver is called an Expanded Memory Manager (EMM).

Memory Modes

The first IBM personal computers were based on an Intel 8088 processor. The total accessible memory was physically limited to 1 MB. The operating system and applications were given the first 640 KB, while the memory from 640 KB to 1 MB was reserved for BIOS (Basic Input / Output System), adapters, and video buffers.

On the PC AT and PS/2s that use the Intel 80286 processor, two modes are available. In the first, real mode, memory is set up the same as on the 8088 machines. A new mode, protected mode, allows access to up to 16 MB of memory. The 80386 processor also supports protected mode and provides the capability to access up to 4 gigabytes (1 GB = 1024 MB) of memory.

OS/2 runs in protected mode on 80286 and 80386 machines, and thus has access to the extra memory, but DOS and applications written in real mode can access only the traditional memory from 0 to 1 MB. Extended and expanded memory allow access to additional memory available.

Extended and expanded memory, though similar in name, refer to different types of memory. Extended memory is simply the memory that is part of the total memory of the machine, above 1 MB. Expanded memory is memory that is accessed using an EMM and an EMS card. This memory is mapped into the memory below 1 MB on the machine.

Expanded memory can help you access the memory you need.

Extended Memory

If your machine has more than 1 MB of memory, you have extended memory. All the memory above 1 MB is extended memory. This may have come with the machine, or you may have added a card with memory chips to increase the size of the memory. Figure 1 illustrates the memory of a machine with extended memory.

To take advantage of extended memory, you need to either run a program written to take advantage of extended memory, or run OS/2 in protected mode. If you have a machine with an 80386 processor (PS/2 Model 70 386 or 80 386), you can also use this memory as expanded memory with DOS 4.00 by using the XMAEM.SYS and XMA2EMS.SYS drivers.

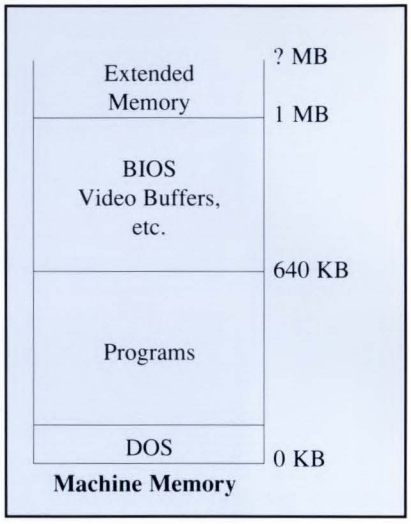

Figure 1. Extended Memory

Expanded Memory

Expanded memory is not defined by its physical location. It may be accessed from an EMS hardware adapter or it may be memory above 1 MB. What makes it unique is that it is memory that is mapped into the memory positions in the machine below 1 MB.

The architecture for expanded memory use was defined by Lotus, Intel and Microsoft and is titled the LIM Expanded Memory Specification. Two versions have been used by application developers: version 3.2

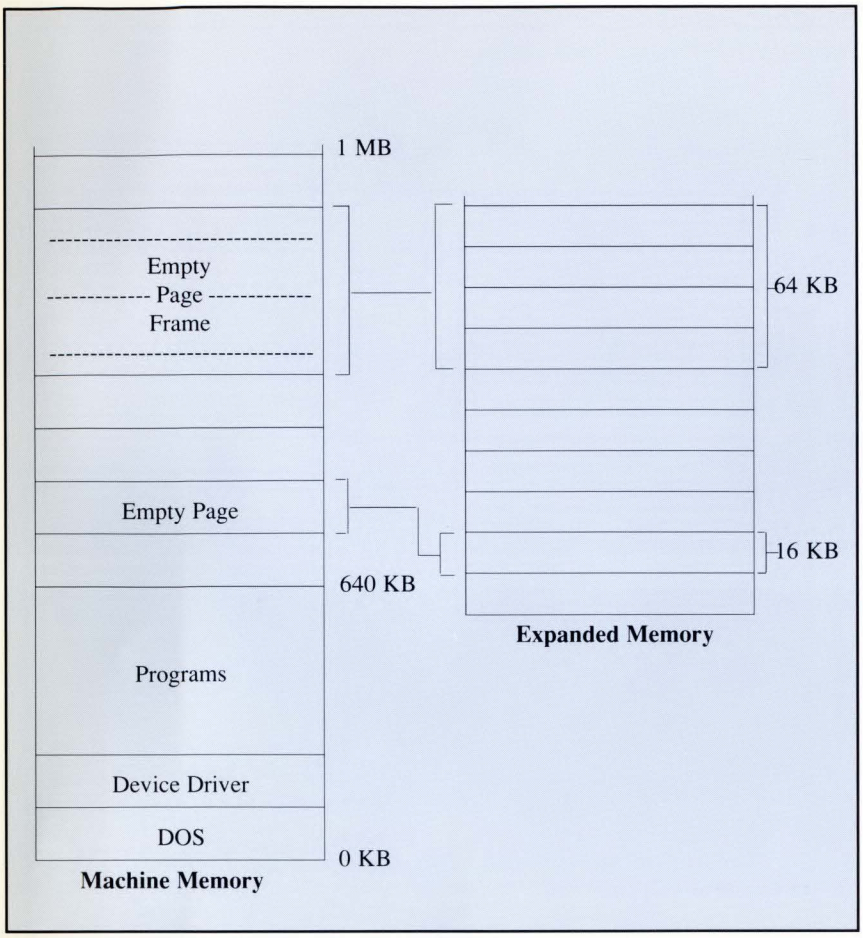

Figure 2. Expanded Memory

	Extended	Expanded	Extended Emulation
8086 / 8088	N	Y	N
80286	Y	Y	N
80386	Y	Y	Y*
* with the DOS XMAEM driver			

Figure 3. Memory Options for Different Processors

and version 4.0. The two differ in the number of blocks of memory that must be free for use in the machine below 1 MB.

The device driver, the software that allows the memory to be accessed, is loaded when the computer is started. The memory in the EMS card has unassigned addresses, so the device driver is able to specify sections of memory on the card to be mapped into empty spaces below 1 MB in the machine's memory.

After mapping takes place, the expanded memory can be used directly through the addresses in the memory below 1 MB. Because this is an accessible range on all computers, the memory can be used by applications or the operating system.

Figure 2 shows the machine memory and the mapping from the expanded memory. The expanded memory is taken in either blocks of 16 KB, a page, or 64 KB, a page frame. For LIM 3.2, four contiguous 16 KB pages (a page frame) are required. LIM 4.0 allows a program to use pages that need not be contiguous. To use expanded memory for certain IBM DOS 4.00 commands, one to three pages are needed.

To take advantage of expanded memory, you need an EMS card and an EMM. The device driver should be specified to be loaded in the CONFIG.SYS file. DOS 4.00 users can have extended memory emulate expanded memory on 80386 machines with the EMMs shipped with DOS. You can use the memory for programs written to use it and for the DOS 4.00 commands FASTOPEN, BUFFERS, and VDISK.

Figure 3 shows the options that are possible on the various machines.

Conclusion

If you use an 8086- or 8088-based machine, expanded memory can help you access the memory you need. If you use an 80286- or 80386-based machine in real mode and have memory constraints, either expanded or extended memory can help increase your memory.

A Power User's Guide to EMS

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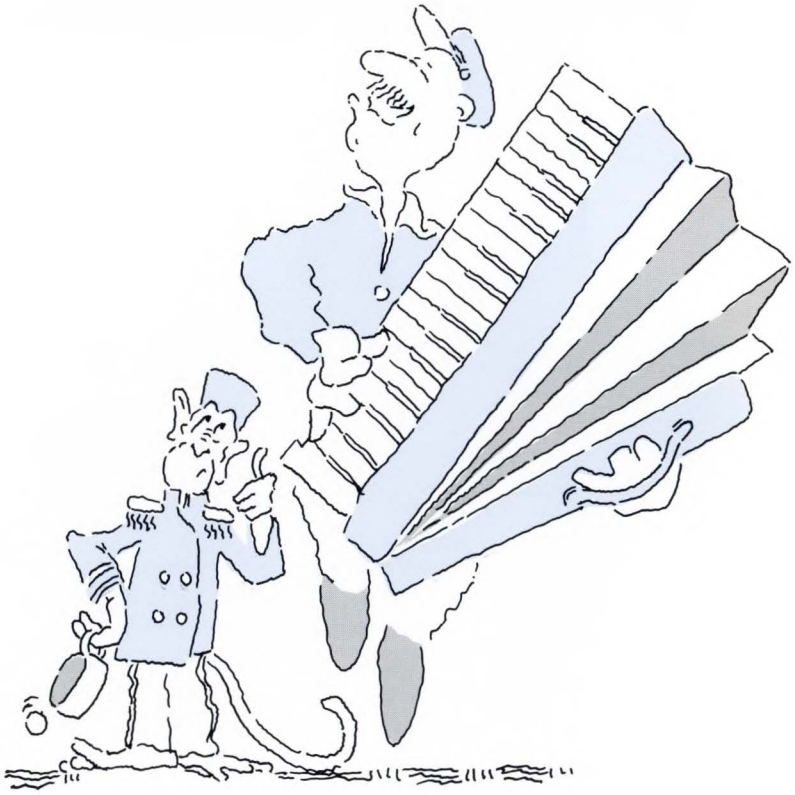
How to Use This Article

This article was meant to be as complete as possible. More than likely it contains many subjects that are initially confusing or that do not interest you. Feel free to browse through or skip those areas; you can come back later for additional information.

This article discusses the Expanded Memory Specification (EMS) from a systems perspective, which is a bottoms-up approach. You may want to read the article from front to back if you are configuring systems for EMS, or are designing EMS cards or applications. However, if you already have a computer, and possibly an EMS card, you may wish to read this article from back to front. Doing so will help you choose which applications are most appropriate for you.

Note: Several non-IBM hardware and software products are mentioned in this article. They are mentioned only as examples; there may be other products that provide the same function, or are better or worse than the ones mentioned. *Being mentioned in this article does not imply recommendation or non-recommendation.* You must choose the products that are most appropriate for your needs.



Why EMS?

PC DOS was designed around the Intel 8088 chip. The maximum

memory that this chip can address is 1 MB. At the time, this was a large address space, so IBM reserved 384 KB of that for system areas. This left us with the now famous 640 KB boundary for applications.

Many of today's applications require more memory than 640 KB. There are a couple of ways that applications have been coping with this limited amount of memory.

Many applications, such as spreadsheets and database programs, work with amounts of data that are too large to load into memory at one time. These programs manage their data by reading only a portion of it into memory at a time.

Other applications, particularly those that are easy to use, have large amounts of code. Because loading all this code into memory at once would make less memory available for data, these applications use "overlays" that are read in from disk.

Both of these methods can cause an application to run very slowly, because it has to access the disk often. Rewriting the application to use EMS instead of reading from the disk can result in significant performance increases.

Types of Memory

There are three types of memory: conventional, extended, and expanded (EMS).

Conventional memory is the normal memory that DOS applications run in. This is the memory from zero to 640 KB, and is the address space of the 8088 processor.

Extended memory is available on 80286 and 80386 machines. Extended memory begins at 1 MB, and can go up to 16 MB. This memory can be used for applications under OS/2, but DOS applications can only use this memory to store data. Using extended memory is slow and may cause interrupts to be lost when transferring data to and from extended memory.

Expanded memory can be used by any personal computer. It has no address until used. It is generally faster than extended memory, and can perform many more functions.

Figure 1 shows several differences between the three types of memory.

Expanded memory ... has no address until used.

Goals of EMS Memory

EMS was devised to satisfy several goals:

- **More conventional memory**. You can use EMS memory to place certain programs or data outside the 0 to 640 KB area. This frees up space for normal application programs to run in. SideKick Plus and the DOS programs BUFFERS and FASTOPEN are examples of programs that do this; we will discuss how to use these DOS programs later.
- **Larger data sizes**. Application programs can use EMS memory to store their data instead of reading it from the disk every time it is needed. This is the technique used by applications such as Lotus 1-2-3, Excel, and Paradox.
- **Multitasking**. Some applications are called operating system extensions (OS/E). These applications let you swap normal (non-EMS-aware) applications into and out of EMS memory. The normal applications behave as if they were running in the 0 to 640 KB DOS area. Examples of these applications are Windows, Desqview, Carousel, and DoubleDOS.

Note: These OS/E's differ in their ability to run multiple programs at

	Coventional Memory	Expanded Memory (EMS)	Extended Memory
Speed	fast	medium	slow
Size	640KB	32MB	15MB
Recode app?	no	yes	yes
Run code?	yes	yes	no

Figure 1. Different Types of Memory

the same time. When one application runs in the background and another in the foreground, this is called multitasking. When the background task is kept in memory but suspended until it is in the foreground again, this is called program swapping.

The LIM Spec

The Lotus / Intel / Microsoft Expanded Memory Specification (LIM Spec) is an interface that applications use to access EMS memory. It is similar to the Basic Input/Output System (BIOS). An application communicates with the BIOS, which then translates that call into a hardware request.

Each EMS card comes with its own EMS device driver, which implements this BIOS-like interface. The hardware is different on each card, so each card must have its own driver – you cannot use a driver from one card with another card.

Pages

Memory in EMS is made up of units of 16 KB. (This is similar to how disks are made up of units of clusters and sectors.) These 16 KB units are called pages, and a page is the smallest part of EMS memory that a LIM function operates on.

Once the memory is made available to the application, the application can read or write the individual bytes. Again, this is similar to a disk, where the operating system will find a file, open it for access, then allow you to read or write the individual bytes of the file.

Logical Pages

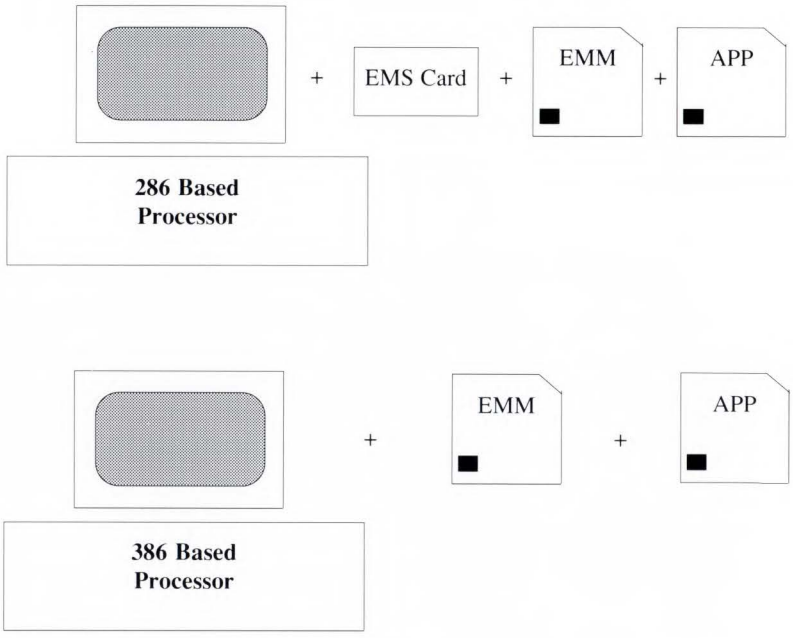
Logical pages are similar to the memory chips on the EMS card. They are not addressable by the application until "mapped." The maximum size of this area is 32 MB, which yields 2 KB as the maximum number of logical pages (32 MB total divided by the 16 KB page size).

These pages, however, are not simply numbered from 0 to 2048 – the LIM spec provides a way to keep applications from using each others' pages. This is done by giving each application a *handle*. The handle number is associated with a specific number of logical pages, so each application can request a number of pages, and is then free to use those pages until it no longer needs them.

Physical Pages

Physical pages have no memory, as such. They are created when the user boots the EMS driver. Usually they are specified on the command line of the driver, in the CONFIG.SYS file. For example, this line might look like:

```
device=c:\dos\xma2ems.sys
p0=c000 p1=c400
```



	Mem 1	Mem 2	Mem 3
PC Network Adapter II/A			
Primary	- C800-D000,	D000-D800,	D800-E000
Alternate	- CE00-D000,	D600-D800,	DE00-E000
Token-Ring Adapter			
ROM	- C000-C200, C200-C400, C400-C600, C600-C800 C800-CA00, CA00-CC00, CC00-CE00, CE00-D000 D000-D200, D200-D400, D400-D600, D600-D800 D800-DA00, DA00-DC00, DC00-DE00, DE00-E000		
RAM	- C000-C400, C400-C800, C800-CC00, CC00-D000 - D000-D400, D400-D800, D800-DC00, DC00-E000		
3270 Connection A	- CE00-D000 (fixed)		
3270 Connection B	- C000-C200, C200-C400, C400-C600, C600-C800 C800-CA00, CA00-CC00, CC00-CE00, CE00-D000 D000-D200, D200-D400, D400-D600, D600-D800 D800-DA00, DA00-DC00, DC00-DE00, DE00-E000		
8514/A Adapter			
RAM	- C680-C800, CA00-CA80		
ESDI			
ROM	- C000-C400, C400-C800, C800-CC00, CC00-D000 - D000-D400, D400-D800, D800-DC00, DC00-E000		

Figure 2. Common Adapter Cards With ROM or RAM

The EMS driver associates a physical page number with each 16 KB address that is used for EMS. These addresses are all below 1 MB to maintain compatibility with the 8088 processor. The maximum number of physical pages is 64, which results from dividing 1 MB (the size of the 8088 address space) by 16 KB.

When a logical page is "mapped" to a physical page, the memory is available to the application.

Mapping

Mapping is the process that is required before the EMS memory is addressable by the processor. The application makes a call to the EMS driver to "map" a logical page to a physical page. The memory in the logical page then "appears" at the address that is associated with the physical page number.

This "appearance" of memory is very fast, because the memory itself is not moved. The mapping is done at a hardware level that is transparent to the processor. The application and processor do not know that the memory is on an EMS card – they "see" it at the physical page address.

Once this mapping is complete, the application can read and write from the expanded memory (EMS), just as it does with conventional random-access memory (RAM).

The History of EMS

CP/M™

Although EMS for the PC was not directly imported from the Z80™ world, CP/M did have bank switching long before DOS did. This feature was originally implemented in 1979-1980, with MP/M™. MP/M was a multitasking version of CP/M, and the bank switching was included with the operating system and had language support.

In this implementation, the operating system resided in the lowest 16 KB, and each bank was 48 KB in size. Together, these two areas resulted in the 64 KB size of the Z80 processor's address space. One bank was reserved for the rest of the operating system, and then each program was placed into one of the remaining banks.

The typical configuration had four banks of 48 KB (208 KB total), while a few systems actually had eight banks (400 KB total). Even though the Z80 processor would never be able to handle all that memory, the architectural limit of the number of banks was 256 banks. Theoretically, this would have allowed 12 MB of memory in the system.

The History of LIM

LIM 3.2

Lotus, Intel, and Microsoft were the original developers of EMS. That is why it is still called the LIM Spec today. The original version had four physical 16 KB pages. These pages were numbered 0 to 3, and together formed a contiguous 64 KB area located at D000. The amount of logical EMS memory was limited to 8 MB.

Total Pages	DOS Pages	Application Pages
1	1	0
2	2	0
3	2	1
page frame	N/A	4
4	2	2
frame + 1	1	4
5	2	3
frame + 2	2	4
6	2	4

Figure 3. Allocation of Pages

Enhanced Expanded Memory Specification (EEMS)

Soon after the LIM Spec was announced, AST Research enhanced the design by developing additions to it, and called this design the "Enhanced Expanded Memory Specification" (EEMS). These additions included more EMS calls, more physical pages, and two sets of fast registers.

LIM 4.0

In 1987, the LIM group announced an upgrade of the LIM design, version 4.0. This spec incorporated almost all of the AST enhancements, and the LIM group added a few of their own. They added more EMS function calls, more physical pages, up to 32 MB of EMS memory, and up to 255 fast register sets.

One of the pitfalls of EMS lies in the LIM 4.0 Specification itself. The LIM 4.0 Spec allows for different levels of support. Each of these levels is "LIM 4.0-compatible," but because they provide different amounts of functionality, this causes confusion for users.

For example, the lowest level of support is provided by 80286 EMS emulators. They use the extended memory of the 80286 processor, which results in much slower performance and less function than that of EMS drivers that are based on hardware cards. Yet, when the application requests the LIM version number, these emulators return version 4.0.

Configuring Your System for EMS

EMS requires either three or four components. All of these components must be in place for EMS to work correctly.

For 80286 systems, you must have four components: a computer with an 80286 processor, an EMS card, an EMS device driver (called EMM, for Expanded Memory Manager), and an application that uses EMS.

For 80386 systems, you do not need an EMS card; normal extended memory is used for EMS. The EMS functionality is provided by using a feature of the 80386 processor called "paging." This feature allows any 4 KB or larger block of memory to have an address anywhere in the system. You must still have a system unit, an EMM, and an application that uses EMS.

Note: There is a category of EMS product that falls outside of this general classification. These products provide EMS support for 80286 systems that have only extended memory. They use a hardware device that fits between the 80286 processor and the system board, along with their own EMM driver. In effect, this hardware device emulates the "paging" capability of the 80386 processor, allowing memory addresses to be placed anywhere in the address space. An example of this product is the ALL ChargeCard.

EMS requires either three or four components.

System Units

There are three basic types of system units, and they implement EMS in slightly different ways. These differences involve a feature of LIM 4.0 called backfilling (largeframe).

Most EMMs have the capability of providing physical pages below 640 KB. When a system unit does not have 640 KB of conventional memory, the EMM fills it up with EMS memory. This is called backfilling.

However, it is not required that this backfilled memory be set up as EMS physical pages. When it is, these additional pages are called the largeframe. The largeframe is different from the page frame as identified in the LIM 3.2 Spec, because it

includes more physical pages and resides below 640 KB.

The first type of system is similar to the IBM Personal Computer AT and XT. To get a largeframe, you must disable some of the memory on the planar board. On AT-type systems, you do this by setting a switch or a jumper on the planar board. On the second type of system, you must also disable the memory below 640 KB; however, on this type of system, you can do it using software – you do not have to touch the hardware to do it. IBM PS/2 Models 30 286, 50, 50 Z, and 60 fall into this category.

Systems with 80386 processors fall into the third category of system types. Because of the nature of the 80386 processor, the largeframe can be implemented without disabling any of the memory. We will discuss this type further a little later.

EMS Cards

Just as there are different system types, so are there different types of EMS cards. EMS cards differ in two respects. First, they may or may not be capable of functioning as extended memory. Second, EMS cards come in two EMS "flavors" – LIM 3.2 and LIM 4.0.

Some EMS cards do not support extended memory. The advantage of this type of card is that it is easier to configure, and does not conflict with the extended memory on your system. The IBM 2 MB Expanded Memory Adapter (for the IBM Personal Computer AT) is an example of this type of card.

Other EMS cards can function as either extended or expanded, and sometimes as both at once. When installed in your system, they are extended when you first boot your system. Then, when you load the EMM device driver that comes with the card, the EMM changes the memory on the card from extended to EMS. A few EMM drivers are capable of making only a portion of the card EMS, so the other portion will remain as extended.

Some systems, such as the IBM PS/2 Models 50 and 60, have some (384 KB) extended memory that comes on the system board. This memory cannot be converted to EMS memory, and must be used as extended.

Some EMS cards do not support extended memory.

Some cards were manufactured for the LIM 3.2 Spec. These cards support only a single page frame above 640 KB. Even though they have received a software update for a LIM 4.0 driver, they still provide only a single page frame of four physical pages. An example of this type of card is the original Intel AboveBoard.

Newer cards can support more pages than the LIM 3.2 page frame. These cards typically support physical pages across the entire 1 MB address range.

Finally, some cards also support a LIM 4.0 feature called fast registers. These fast registers allow for very fast mapping of many pages in a single call. They are typically used to map pages into the largeframe area below 640 KB; the mapping is performed almost instantaneously compared to the previous method of mapping a single page at a time.

Configuring for the EMS Page Frame

Many users have a difficult time configuring their systems for EMS. The most difficult part is to find a place for the LIM 3.2 page frame, which is usually above 640 KB.

Unfortunately, it currently requires some knowledge of the details of your system in order to implement EMS. This is because the EMS page frame, as defined in the LIM 3.2 Spec, occupies part of the 384 KB reserved area.

Here, I describe the pieces of this area that are used by the various parts of the system, and how you can determine which areas can be used for EMS. Remember, each system is configured differently, so what is available for EMS will be different for each system.

The addresses I use are segment addresses in hexadecimal (for example, A000, B400, DC00). I use hexadecimal instead of decimal addresses in KB (for example, 736 KB) because most EMMs ask you to specify an address in hexadecimal format. The reserved area is located from A000 to 10000, and each of the major segments (for example, A000 to B000) is 64 KB in length. Thus you can see that there are six major segments in the 384 KB area – A000, B000, C000, D000, E000, and F000.

Video Buffer

The first two segments of the reserved area are used by the video buffer, an area of memory that the video card uses to display information on your monitor. There are four basic types of display buffers:

- Buffers for **Monochrome** adapters begin at address B000 and end at B100, making them 4 KB in size. Buffers for Hercules adapters also begin at B000.
- Buffers for **Color/Graphics Adapters (CGA)** begin at address B800 and end at BC00; they are 16 KB in length.
- Buffers for **Enhanced Graphics Adapters (EGA)** and **Video Graphics Array (VGA)** adapters, in graphics mode, use both major segments, from A000 to C000. If attached to a monochrome display, and run in mono mode, the EGA / VGA adapters use only the monochrome address space. If attached to a color display, and run in the CGA modes, the EGA / VGA adapters use only the CGA address space.

The IBM 8514/A Adapter uses the entire EGA / VGA area, plus two additional areas: C680-C800 and CA00-CA80.

ROM BIOS Area

At the other end of the reserved area lies the system BIOS. The BIOS is read-only memory (ROM) that acts as the interface from applications to the PC hardware. The size and location of this area can be different, depending on the system. On the PC XT, the BIOS was 64 KB in length and located from F000 to 10000. Most systems today, including the PC AT, PC XT 286, and most PS/2 models, reserve space for a 128 KB BIOS located from E000 to 10000. This is because the Personal Computer AT was designed with a disabled E000 segment, so that the system board does not send out those addresses to the I/O connectors.

Adapter Card Area

That leaves an area in the middle of varying size. If you have a monochrome display attached to a PC XT, then your adapter area is from B100 to F000. This is the largest available size, 252 KB. On the other hand, if you have a PS/2 system, with a VGA display, you are limited to a 128 KB area from C000 to E000.

Finding a "Hole" for EMS

You must have a "hole" available in the 384 KB reserved area for use by EMS. Unfortunately, this cannot be a completely automatic process, and sometimes requires assistance from the user. Most EMMs attempt to choose the most likely available area; however, the reserved area may then be inefficiently used, or there may be hardware that the EMM cannot detect.

There are several methods that EMMs can use to find holes.

The first method looks for ROM adapters that are extensions to the system BIOS. These ROMs have a hex 5A as the first byte, and they can begin at any 2 KB address starting at C000.

The second method is to do a memory read of the entire 16 KB page. If there is nothing at that page, then each byte of the page shows up as a hex FF. You can check this yourself by using DEBUG.COM. When you are in Debug, type:

```
d e000:0
```

You should then see the ROM BIOS displayed. You can also type

```
d a000:0
```

This area should be all FFs because this area of the video buffer is not being used.

A third method is to use a Micro Channel feature called the Card Select Feedback Loop. In any system, some cards may have ROM and/or RAM areas that cannot be found using the previous methods. This feature helps the EMM find more of these areas than the previous methods. This feature is available only on Micro Channel systems.

A fourth method is to perform a write and then a read of each byte in the 16 KB page. This method finds areas of memory that have not yet been filled by the system. This could cause problems with an adapter that has write-only memory, however.

Hole Finding by Users

Even with all these methods, some areas still cannot be determined. For example, some ROM and RAM may be enabled only by a software driver during the CONFIG.SYS boot time. If these drivers are loaded after the EMS driver, the EMM cannot find the ROM or RAM. For these unfindable areas, the user must become familiar with the hardware configuration of the system.

There are three methods that the user can use to do this. The first has already been discussed – DEBUG.COM.

The second user method can be used with any system. It involves either calling the vendor's technical assistance line, or purchasing the technical reference manual for that adapter. Either should provide the addresses used by the adapter.

The third user method employs another feature of the Micro Channel bus – the Reference Diskette. This diskette provides the means to either view or change the addresses

used by the adapters in the system. From the main menu, choose option 3, Set Configuration, and then choose either option 1, View Configuration, or option 2, Change Configuration. Either of these selections will help determine which areas of memory are being used.

Note: It is always a good idea to make a backup copy of the system Reference Diskette as well as of any Option Diskette that comes with a separately purchased option. Backing up the Reference Diskette is strongly advised before you attempt to modify the .ADF file (see below).

Configuring PS/2 Systems

Figure 2 shows a list of the most common adapter cards that have either ROM or RAM. For each adapter, a list is provided of each possible address that the ROM / RAM can be configured to.

Note: PS/2 Models 50-021, 60, 80 386-041 and 80 386-071 have a limitation – they do not allow any adapter (except the 8514/A) to be located below address C800. If you have a PS/2 Model 50 Z, 55 SX, 70, 80 386-111 or 80 386-311 (or any future system), you can place adapters below this range. However, you will have to modify the .ADF files on your system Reference Diskette.

Warning! A novice user should not attempt to modify the .ADF file, because damaging the data in the .ADF file can cause unpredictable results. The technical reference manual for the device whose .ADF file you wish to change has the information needed to complete the following steps successfully. Do not attempt to modify these files without consulting the technical reference! If you are at all uncertain, have a more experienced person do it for you.

All EMMs are device drivers.

Modifying the .ADF File

An example of an .ADF file is the file for the Enhanced Small Device Interface (ESDI) fixed disk controller. This file, @DDFF.ADF, is on the Reference Diskette. If you edit the file, you will see the following information in the middle of the file:

```
nameditem
  Prompt "Adapter Memory Location"
    Choice "Segment C800"
      pos[1]=XXXX0010b
      mem 0c8000h-0cbfffh
```

To create a new choice, you must copy the last three lines. You must also change any other information in the choice, such as the pos[1] line. For the ESDI file, these new lines would look like this:

```
    Choice "Segment C000"
      pos[1]=XXXX0000b
      mem 0c0000h-0c3fffh
    Choice "Segment C400"
      pos[1]=XXXX0001b
      mem 0c4000h-0c7fffh
```

Note: The information for modifying file @DDFF.ADF is correct at the time of this writing; however, this particular .ADF file will change in the future to eliminate the need for this modification.

The EMM Device Driver

Installing the EMM

All EMMs are device drivers. To install an EMM, insert this statement into the CONFIG.SYS file:

```
DEVICE=EMM.SYS /optional parameters
```

The file name EMM.SYS is the name of your EMM device driver. For 80286 systems, this driver comes with the EMS card, and is provided by the card's manufacturer. For 80386 systems, you must purchase a driver separately – either XMAEM.SYS that comes with DOS 4.00, or another 80386 EMM driver.

Note: A few EMS drivers for 80286 systems emulate EMS memory on extended memory. These are not the same as 80386 EMS drivers and do not provide as much function. The AboveDisc driver is an example of this kind of driver.

If you purchase an 80386 EMS driver, you do not need a separate EMS card. However, these drivers do require an 80386 system and at least 384 KB of extended memory.

EMM Types

EMM drivers provide many different levels of functionality, as do the EMS cards they support. Only a few EMMs provide LIM 3.2-level functionality (the lowest level of support) today.

The second level of support is provided by EMMs that support LIM 3.2 EMS cards. Even though these cards cannot provide more than a page frame (due to the hardware limitation), the EMM provides some of the additional function calls as well as the 4.0 version number.

Next comes the full LIM 4.0-compatible EMMs. These drivers can provide various parts of the LIM 4.0 spec: largeframe (below 640 KB), more than four pages above 640K, and fast registers.

Finally, there are the state-of-the-art EMMs. These are mostly the 80386 EMMs and 80286 hardware implementations (such as the ALL ChargeCard). These EMMs provide complete LIM 4.0 functions, and include a host of other programs. These other programs provide support for things such as:

- They can load programs and device drivers into memory above 640 KB. This creates more space in conventional memory.
- They support "forefilling." This allows the area between 640 KB and the video buffer to be used as conventional memory. If you are running in CGA mode, this allows a 736 KB DOS area.
- They can place parts of DOS (for example, buffers, files, drives) into memory between 640 KB and 1 MB (upper memory).
- They provide support for the XMS spec (HIMEM.SYS). This spec supports addressing the first 64 KB of extended memory in the 8088 real mode. Programs that are coded to this spec can place parts of themselves above the 640 KB boundary.
- They can provide precision control of the areas to use or not use for EMS. These controls are provided with optional parameters such as keywords INCLUDE=A000 and EXCLUDE=C000.
- Finally, they can copy slow ROM areas to RAM, then map the RAM to the same address as the ROM. This makes the ROM code, and therefore the entire system, execute much faster.

Applications

Different Uses of EMS

Applications also vary in their use of EMS. Some applications were designed to be compatible with LIM 3.2; these applications require the page frame, and use only the page frame. Examples of programs that use this method are Lotus 1-2-3, Symphony, and Excel.

Other applications use the page frame, but also make use of the newer LIM 4.0 function calls.

Some applications not only use the newer LIM 4.0 function calls, but can make use of pages outside the page frame. Examples of this type of application are the DOS programs BUFFERS, FASTOPEN, and VDISK, which are discussed in the next section.

Next are the multitasking or program-swapping applications, which are really operating system extensions (OS/E). They can make use of the pages in the largeframe as well as the fast register support. Windows, Desqview, Carousel, and DoubleDOS are examples of this genre'.

Finally, the newest programs on the market today are flexible enough to use EMS in any configuration they find. They can use a single 16 KB page if that is all there is, and they can use all the pages of the largeframe if that exists. Advanced Revelation 2.0 is an example of this type of application.

Different Types of Applications

Different types of programs use EMS. The first type includes utilities such as disk cache, print spoolers, and ramdisks. These programs use EMS in order to free up conventional memory for non-EMS-aware applications.

Second, some applications use EMS to increase the amount of data that they can work with. Lotus 1-2-3 and Paradox are examples of this kind of program.

Finally, OS/E applications use EMS to provide multiple DOS areas. This allows multiple non-EMS-aware applications to run at the same time. Examples are Windows, Desqview, and DoubleDOS.

How DOS Uses EMS

Three DOS 4.00 programs – BUFFERS, FASTOPEN, and VDISK – use expanded memory. Each of these programs can be invoked from the CONFIG.SYS file; you must tell each one to use EMS by placing a parameter on the command line in the CONFIG.SYS file.

Static Mode

DOS 4.00 was originally designed to take advantage of the LIM 4.0 capabilities of IBM EMS cards. The information here shows the changes made in a recent corrective service diskette (CSD) (#UR 25066). You can ask your dealer for this diskette.

In static mode, DOS can use EMS if there are any number of pages except a single LIM 3.2 page frame. This is the same function that was provided in the original DOS 4.00. However, the parameter you use to specify it has changed from /X to /XS (on the BUFFERS= line).

DOS does not use static mode if you have only a page frame, because DOS assumes that you want to use the page frame for applications. Because DOS "allocates" one or two pages when you invoke static mode, you would no longer

have a valid page frame. Therefore, if you have only a page frame, use the /X or /XD parameters, which invoke the dynamic mode.

If you use the PC Local Area Network Program, and you have only a page frame, you should not use either mode. The PC LAN Program is not compatible with dynamic mode, and the page frame is not compatible with static mode.

If you specify the /XS parameter on the BUFFERS statement, this puts DOS into static mode. DOS "allocates" one or two physical pages from the list of physical pages, and reserves them for itself. No other program either knows about or can use these pages.

Figure 3 shows how these pages are allocated, and how many physical pages remain for applications to use.

BUFFERS takes the highest page that is not part of the frame. If you specify the /XS parameter on BUFFERS, and the /X parameter on FASTOPEN and VDISK, then FASTOPEN and VDISK take the second-highest page that is not part of the page frame.

This mode works the same as the BUFFERS /X parameter in previous releases of DOS 4.00. However, the /X parameter now specifies dynamic mode. The /XS parameter must be used when running the PC Local Area Network Program.

Dynamic Mode
Dynamic mode was designed so that DOS could use EMS memory on LIM 3.2 cards with LIM 4.0 EMMs. This means you can now tell BUFFERS, FASTOPEN, and VDISK to use EMS memory if you have one of these cards. You still cannot use XMA2EMS.SYS unless you have an IBM card. These cards have only a page frame, so they cannot use static mode. Dynamic mode requires a minimum of three physical pages.

DOS uses dynamic mode if the user specifies /X or /XD on the BUFFERS= line in CONFIG.SYS. Dynamic mode is also activated if FASTOPEN /X or VDISK /X is specified without BUFFERS /XS (buffers not using EMS at all).

In dynamic mode, DOS uses the pages in the page frame, and shares these pages with other applications. DOS does not reserve the pages for its own use.

Warning! You cannot run BUFFERS in dynamic mode (/XD or /X) with the PC LAN program. Doing so could cause unpredictable results, including loss of data. If you use the PC LAN program, you must specify the /XS parameter on BUFFERS.

In dynamic mode, DOS uses the pages in the page frame.

The Future of EMS

The following comments are purely speculative on my part. These are my ideas about where the industry is moving, based on current developments in the industry and various press releases.

Forefilling
This feature increases the DOS area from 640 KB to either 704 KB (mono mode) or 736 KB (CGA mode). The EMM fills in the area from 640 KB to the video buffer. This area could be increased further if users move to new video adapters.

Future Video Adapters
In the future, display adapters may have a reduced or nonexistent display buffer. These adapters may have video processors (such as the ones from Intel and Motorola). Also, newer operating systems, such as OS/2, require that the application not write to the hardware. This means that, with the right EMS driver, the DOS box could increase in size from 640 KB up to the system BIOS area.

Windows, Desqview, etc.
These applications allow more applications to share the 640 KB DOS area, thus reducing the memory limitation. Users are also moving to Windows to take advantage of the graphical user interface. This provides an easier upgrade path from DOS to OS/2.

Loading Programs into Upper Memory
Loading programs and device drivers into upper memory (above 640 KB) increases the amount of memory available in the DOS area for application programs. This feature allows small areas between the adapter card ROMs and RAMs to be used.

Using EMS for Code Overlays
Most of yesterday's programs used EMS only for storage of data. Today, applications are taking advantage of the LIM 4.0 capability of placing code into EMS memory. The LIM spec makes it easy to execute this code in EMS memory, and this feature makes it easier to port a program from DOS to OS/2.

Fast Registers
EMS cards are beginning to provide complete implementation of the LIM 4.0 Spec. Accompanying this implementation are ever-increasing numbers of fast register sets. EMS cards are coming to market with hundreds of fast register sets. These fast register sets allow several programs to share the 640 KB DOS area, and they can be switched in and out very quickly.

Improved Hole-Finding Techniques
In the future, new techniques for identifying address locations will be found, and EMMs will be able to fully automate the hole finding and EMS implementation process. No longer will users be required to know the addresses of all adapters in their hardware.

Further Help

If you have problems with a product that uses EMS, you should attempt to obtain help from the dealer and/or the manufacturer of the product. In most cases, this will solve the problem you are having. If not, they may be able to help you obtain the information you need before contacting other sources such as IBM.

IBM Service for DOS 4.00
If you have purchased DOS 4.00, IBM provides service and support free of charge. If you think there is a problem with DOS 4.00, ask your dealer to place a call to the DOS service organization. If you are an IBM employee, you can also go through your site service coordinator. The IBM service reps can help you when you install DOS 4.00 and at any time during the first year of use. Please note that DOS components have been tested on, and are warranted for, IBM equipment only. IBM will attempt to provide help if you use DOS 4.00 on other equipment, but any differences between IBM hardware and the other equipment may cause problems. IBM does not provide support for the LIM spec, but IBM does support IBM's implementation of it (XMA2EMS and XMAEM). IBM service hours are 8 AM through 5 PM Eastern time.

Intel Corporation Service
You can get a copy of the LIM 4.0 Spec from Intel Corporation at no charge by calling them at 1-800-538-3373. They have an automated voice menu system; press the 2 key when the recording answers. An operator will then pick up, and you can ask him or her to send you the spec. You can also request help for Intel products via this number. The Intel help line is open from 7 a.m. until 5 p.m. Pacific time.

Intel has several other methods of providing technical support for EMS. They have a computer bulletin board system that you can access via modem. The phone number is 1-503-645-6275. You must have a modem that operates at 300, 1200, or 2400 baud.

If you are a Compuserve member, you can access the Intel help system by typing either GOINTEL or GOPCEO from the main menu.

Intel also has a new program called FAXBACK. If you have a fax machine, you can call 1-503-629-7576 at any time. You will reach another voice menu system (like the technical help line has); this menu will ask for your fax telephone number, and you can request any of several documents they have. The system will call your fax machine and send the information. They currently have information on the AboveBoard, Inboard 386, and the Connection Coprocessor.

Intel also provides help if you are programming to the LIM Spec. Just send them a written note (either via the BBS or mail); they will respond within five working days.

Microsoft Corporation Service
The Microsoft product support phone line is 1-206-454-2030. Microsoft also has a voice menu system; from the main menu, press the 3 key, and you will be routed to the Windows and Excel support staff. Microsoft does not support the LIM Spec; they only support their products that use EMS. They also support Windows/386, which implements the LIM 4.0 Spec.

Trademarks

The IBM Family of DOS 3270 Emulators

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IBM currently has four "native" 3270 software emulators that run in the DOS environment. Native 3270 software emulation does not require the use of a protocol converter such as a 3708 Network Conversion Unit. This article discusses each of the software emulators in sufficient detail to allow you to determine the package(s) appropriate for your requirements as well as the hardware needed for each of the software packages. The information in this article is current as of May 10, 1989.

The four packages are:

- IBM PC 3270 Emulation Program, Entry Level, Version 1.21 (Category 5871-AAA, Feature Code 0803, Program Number 75X1085)
- IBM PC 3270 Emulation Program Version 3.0 (Category 5871-AAA, Feature Code 9969, Program Number 59X9969)
- IBM 3270 Workstation Program Version 1.10 (Category 5871-AAA, Feature Code 0837, Program Number 75X1088)
- IBM PS/2 Graphics Workstation Program Version 1.0 (Category 5871-AAA, Feature Code 6242, Program Number 6242912)

Assumptions

Several assumptions will be made throughout this article:

(1) The term "PC" applies to personal computers and Personal System/2 systems unless otherwise specified.

(2) All PCs will be using DOS 3.30, 4.00, or higher.

(3) All software product information is listed for 3.5-inch media. If you are interested in the equivalent information for 5.25-inch media, please contact your IBM Marketing Representative or your place of purchase.

(4) This article covers only token-ring local area networks. The information may or may not apply to broadband or baseband local area networks.

(5) The reader should have a general understanding of Systems Network Architecture (SNA) hardware and software terminology and connectivity and a general understanding of PS/2s.

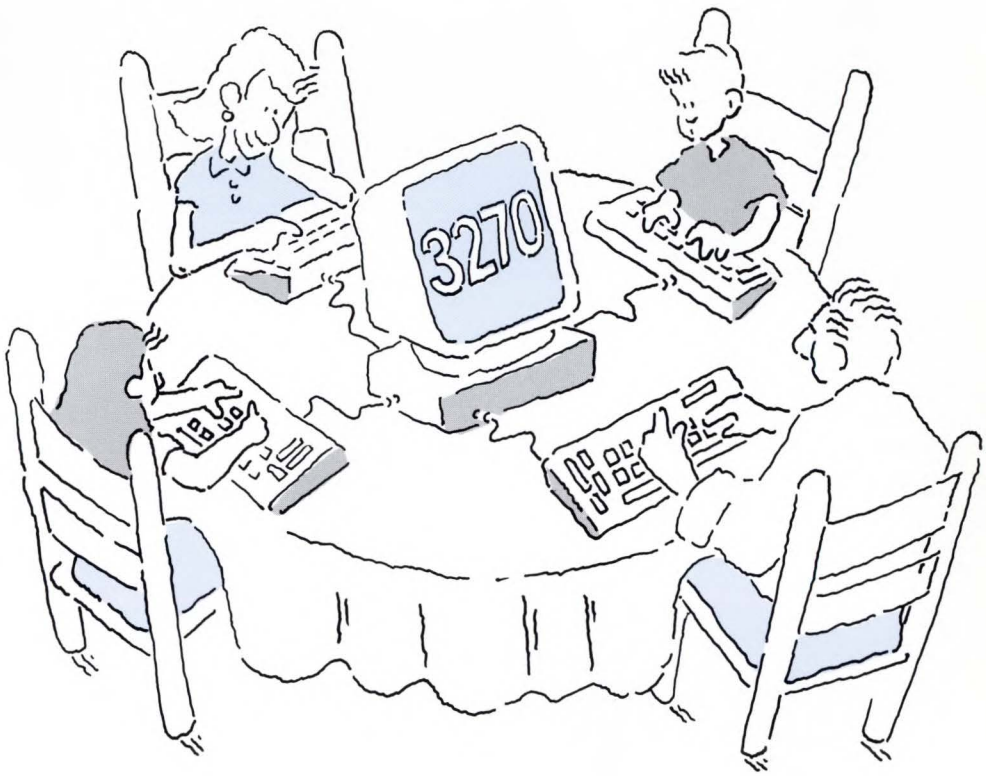
(6) The term "host" refers to an IBM mainframe of System/370 (S/370) architecture.

(7) The term "3X74" refers to 3274 and 3174 control units unless otherwise specified.

(8) The term "37XX" refers to 3720, 3725, or 3745 communications controllers unless otherwise specified.

(9) The term "ES/9370" refers to the Enterprise System/9370.

(10) Microcode for 3274 control units is assumed to be at configuration support D, level 65.1 or higher. Microcode for 3174 control units is assumed to be configuration level A or S, release 4.0 or higher.



(11) The S/370 host file transfer software installed is at the following or higher levels:

- 3270-PC File Transfer for MVS/TSO (Program Number 5665-311), Version 1.1.1
- 3270-PC File Transfer for VM (Program Number 5664-281), Version 1.1.1
- CICS/VS 3270-PC File Transfer (Program Number 5798-DQH), Version 1.0
- VSE Version 3.1.2 (Program Number 5666-345) Intelligent Workstation Support (IWS) (included in base operating system at no charge)

(12) The following items are not covered in this article:

- Host Virtual Telecommunication Access Method (VTAM) considerations.
- 37XX Network Control Program (NCP) considerations.
- Customer Information Control System (CICS) considerations.
- Hardware, software, and microcode to connect a 3174, 37XX, or an ES/9370 to a token-ring network.
- Host Graphical Data Display Manager (GDDM) software considerations.

(13) Some functions of the software packages are not discussed here.

(14) All remote communication is assumed to be using Systems Network Architecture (SNA) and Synchronous Data Link Control (SDLC) protocols.

(15) The terms "coaxial" or "coaxially connected" do not necessarily mean that coaxial cable is the only media actually used between a PC and either a 3X74 control unit or an ES/9370 Workstation Subsystem Controller. The IBM Cabling System, fiber-optic cable, telephone twisted pair, or other media may be used. From a PC perspective, the other media is transparent, and the PC "thinks" it is connected only via "real" coaxial cable.

3270 General Considerations

Several general considerations should be understood before a detailed discussion of any 3270 emulator can be made.

3270 Terminals, Printers, and Control Units

What exactly are 3270 terminals, printers, and control units? The terms may mean different things to different people.

A 3270 terminal is a terminal defined by the Logical Unit (LU) 2.0 device specifications in SNA. All software products discussed in this article emulate an LU 2.0 terminal.

One of the packages allows a directly attached PC printer to emulate a host-addressable printer. In this case, the PC software allows the PC printer to emulate a host-addressable 3287 printer supporting the Logical Unit (LU) 1.0 or 3.0 device specifications as defined in SNA.

Three of the packages allow the PC to emulate a 3274 Control Unit supporting the Physical Unit (PU) 2.0 device specifications defined in SNA. A physical unit is generally considered to be a control unit.

The different device emulations will be discussed in detail as they relate to each individual software package.

LU 2.0 Model Types

The term "3270 terminal" needs to be further defined. There are four model types as defined in the LU 2.0 specifications:

- Model 2, 24 rows x 80 columns (1920 characters)
- Model 3, 32 rows x 80 columns (2560 characters)
- Model 4, 43 rows x 80 columns (3440 characters)
- Model 5, 27 rows x 132 columns (3564 characters)

Not all the packages support all model types. Model 5 support requires further clarification between "scrolling" and "non-scrolling" support for viewing all 132 columns of information on the display. Some software / hardware configurations support model 5 but can only physically display 80 characters at a time. This configuration requires the user to scroll horizontally to view all of the 132 columns of data. Other software / hardware configurations support all 132 columns of data displayed on the screen at a time.

Control Unit Terminal (CUT) Versus Distributed Function Terminal (DFT)

All 3270 emulation packages operate in Control Unit Terminal (CUT) and/or Distributed Function Terminal (DFT) mode. A package operates in DFT mode if the software was written to support DFT-mode operation.

Initially, all 3270 terminals operated in CUT mode. In CUT mode operation, the majority of the logic supporting the terminal resides in the 3X74 control unit, not in the terminal or in the PC emulating a CUT terminal. This additional logic requires additional processing cycles

in the 3X74 control unit. An example of the additional work the 3X74 performs for CUT terminals is keystroke handling. The 3X74 control unit actually reads and interprets every key that is pressed at a CUT terminal. DFT terminals or PCs emulating DFT terminals contain enough logic to interpret their own keystrokes. As a result, this additional processing overhead for keystroke handling in the 3X74 control unit is not required for a DFT terminal or a PC emulating a DFT terminal.

DFT file transfer is faster.

CUT-mode PC file transfer is significantly slower than DFT mode PC file transfer. This is due to a phenomenon known as "nibblization." In CUT-mode file transfer, the host / PC software emulates a full-screen interactive application between a host and a terminal. For a file download, the host fills the screen (1920 characters) with data. The PC software then acknowledges the data by "pressing" the Enter key, and the process is repeated until all the data is downloaded. To accomplish file uploading, the PC software sends a screen full of data and then "presses" the Enter key; the process is repeated until all the data is uploaded. In both cases the 3X74 treats the data as if it were being sent to or received from a real 3270 terminal. Because the 3X74 reads all CUT terminal keystrokes, the host and PC file transfer software must ensure that the 3X74 "sees" only valid displayable 3270 characters, or else the 3X74 control unit will "think" that it has received or sent invalid data to the host, or it may try to interpret the data as a control character (such as End of Transmission (EOT)).

The host and PC software split each byte of data into two parts or "nibbles." Each nibble is then expanded to a full valid 3270 displayable byte of data and then moved through the 3X74 control unit. The data is then de-nibblized back to its original state. (A more complete description of the nibblization process is beyond the scope of this article.) The nibblization of the data in CUT file transfer can add significant overhead, and as a result, CUT file transfer is slower than DFT file transfer. The reason DFT file transfer is faster is that the 3X74 does not interpret all keystrokes from the PC emulating a DFT terminal, and file transfer nibblization does not occur.

Microcode in the 3174 Control Unit has been designed to assist users who choose CUT file transfer. In configuration level A or S release 4.0 or higher, question 125, File Transfer Aid (digit 6) is for CUT file transfer. By answering yes (1=yes), the 3174 will give CUT file transfer additional processing cycles and will improve CUT file transfer performance. However, the preferred solution is to use only DFT file transfer and not CUT file transfer.

3X74 control units require CUT terminals, or PCs emulating CUT terminals, to be used to configure the microcode in the 3X74. A DFT terminal or a PC emulating a DFT terminal cannot be used to configure the microcode in a 3X74 control unit.

Host File Transfer

As mentioned above, DFT file transfer is significantly faster than CUT-mode file transfer.

This article discusses only file transfer performance for coaxially attached PCs. File transfer performance over a token-ring network encompasses numerous other variables, and a complete discussion is beyond the scope of this article.

The larger the block size, the faster the file-transfer performance.

A second factor in file transfer performance is the block size used by a particular 3270 emulation package. The larger the block size, the faster the file-transfer performance.

File transfer is initiated in the DOS session via a SEND.COM (to send a file to a host) or RECEIVE.COM (to receive a file from a host) command while 3270 emulation is active. All of the software packages come with the SEND.COM and RECEIVE.COM commands. The user can choose to convert from / to ASCII / EBCDIC, or to do no conversion at all.

The host software required for file transfer is listed under assumption 11 above. All the host software is based on the same file transfer protocol known as IND$FILE. All of the host software listed supports file transfer in both CUT and DFT modes.

PC Graphics Mode Versus Host Graphics Mode

Which graphics mode is being used? A distinction should be made between running in PC graphics mode or host graphics mode.

In PC graphics mode, the user is running a PC package and displaying graphs and/or charts on the PC. An example of a PC-based graphics package is IBM DisplayGraphics Version 1.1 (Category 5871-BBB, Feature Code 0103, Program Number 75X3275).

In host graphics mode, the user has one of the 3270 emulation packages active and is running a host application that is executing on the mainframe and displaying graphs and/or charts on the PC. An example of a host-based graphics application is Application System (AS).

In order for a 3270 emulation package to display host graphics, the emulator must support Graphical Data Display Manager (GDDM) or equivalent applications.

IBM has implemented host graphics support on PCs in two ways:

(1) With GDDM-PCLK Version 1.1 (Category 5871-BBB, Feature code 2913, Program Number 6242913). GDDM-PCLK Version 1.1 is a DOS-based PC program that runs in conjunction with a 3270 emulation package. In this environment the 3270 emulation software would be active, and in the PC session GDDM-PCLK Version 1.1 would be active. By having both software packages concurrently active, the user can display host-based graphics as if he or she were using a host graphics non-programmable terminal. With GDDM-PCLK Version 1.1, the user can also print or plot host graphics to a directly attached PC printer or plotter.

If GDDM-PCLK Version 1.1 is used on a PC, then the host must be running GDDM-PCLKF. GDDM-PCLKF is a chargeable feature for the host GDDM code. The GDDM-PCLKF software at the host and the GDDM-PCLK software at the PC work together.

GDDM-PCLK Version 1.1 supports host-based graphics in only one host session.

(2) Without GDDM-PCLK Version 1.1. In this environment, the 3270 emulation package has already incorporated the GDDM-PCLK Version 1.1 function in the 3270 emulation software, and does not need GDDM-PCLK Version 1.1. Because GDDM-PCLK will not be used at the PC, the host does not have to be running the GDDM-PCLKF feature. When not using GDDM-PCLK Version 1.1, the user can have two host sessions, each supporting host graphics.

IBM has implemented host graphics support on PCs in two ways.

3270 Printing Modes

Which 3270 printing mode is being used? There are three modes of printing in a 3270 environment:

(1) **Host-directed** printing means that within a host application a user can send data to be printed. The printer can be coaxially attached to a 3X74 control unit, an SDLC link attached to a S/370 host, a channel attached to a S/370 host, or actually be a PC printer emulating a host-addressable printer. Host-directed printing is supported in all environments.

(2) **Local Copy** applies only to 3270 terminals or to PCs emulating

There are three modes of printing in a 3270 environment.

3270 terminals that are coaxially attached to a real 3X74 control unit. Local copy allows the user to print the contents of a 3270 screen to a printer which is coaxially attached to the same control unit that the terminal or PC is coaxially attached to. Local copy is a function of the microcode in the 3X74, and is configured in the Printer Authorization Matrix (PAM) in the 3X74 microcode on a 3X74 coaxial port-for-port basis.

(3) **Print Screen** allows the user to print the contents of a PC session or a 3270 session on a PC printer that is directly attached to the PC. Printscreen is supported in all environments.

3270 Application Programming Interfaces (APIs)

All software packages support 3270 APIs. The packages differ in whether they support high-level language or assembler language interfaces.

A 3270 API allows the user to write a PC program to read and interact with the 3270 datastream. This API enables a PC programmer to develop a PC program to execute as a "programmed operator" that shields the user from some of the complexity of host / PC interaction.

For example, a PC application could be written that presents the user with a menu. The user could

select options that would perform specific host functions, present the user with the information, then return to the main menu; or, the user could select options that would perform specific PC functions, present the user with the information, then return to the main menu. It is also possible to have a menu option that performs host and PC functions concurrently. It is much cheaper and easier to change PC code instead of host code, and all of the functions mentioned here could be performed without changing the host application.

3270 Emulation Hardware

There are three ways to physically connect PCs to a S/370 mainframe:

- Coaxial attachment
- SDLC link attachment
- Token-ring attachment

Coaxial and SDLC attachment hardware will be discussed in detail. A complete discussion of token-ring attachment hardware and software is beyond the scope of this article. However, the token-ring attachment for each supported 3270 emulation package is mentioned without listing the individual hardware and software items required.

3270 Coaxial Attachment

The Advanced 3278/79 Emulation Adapter (Type / Model 5150-ZZZ, Feature code 5050, Part Number 8575427) supports the IBM Personal Computer, PC XT, PC XT 286, PC AT, and PS/2 Models 25, 30, and 30 286. This adapter allows the PC to be directly coaxially attached to a 3X74 control unit or ES/9370 Workstation Subsystem Controller.

The Advanced 3278/79 Emulation Adapter is a half-slot card that fits in any non-Micro Channel half-slot including the PS/2 Model 25's half-slot.

The Advanced 3278/79 Emulation adapter is not supported if it is installed in the same system unit with a Speech Adapter (Type / Model 8530-ZZZ, Feature Code 5002, Part Number 1501216).

The 3270 Connection Adapter (Type / Model 8550-ZZZ, Feature Code 2000, Part Number 25F8448) supports the PS/2 Models 50, 50 Z, 55 SX, 60, 70 386, P70 386, and 80 386. The 3270 Connection Adapter is the Micro Channel card that allows PS/2s to be directly coaxially attached to a 3X74 control unit or ES/9370 Workstation Subsystem Controller.

There are three ways to physically connect PCs to a S/370 mainframe.

There are three versions of the 3270 Connection Adapter, listed in order of introduction:

(1) Version A (long): Adapter Description File (ADF) (@E7FF.ADF)

(2) Version B (long): Adapter Description File (ADF) (@E1FF.ADF)

(3) Version B (short): Adapter Description File (ADF) (@E1FF.ADF)

IBM was able to reduce the number of chips required on the version A card, and that card became the version B long card. The version B long card offered some functional improvements – its ADF allows the user to change the memory segments that the card uses, and it supported multiple version B cards in a single PS/2. The version B short card is exactly the same as the version B long card except that IBM was able to reduce the size of the card. The version B short card does not offer any functional improvements over the version B long card.

The version B long and short cards use the same ADF, which differs from the ADF that supports the version A long card. Because the two files differ, they cannot be interchanged. All cards come with an option diskette that contains the ADF for the card. The ADF from the option diskette has to be copied over to the system unit Reference Diskette for proper PS/2 system unit configuration.

The P70 386 supports only the short version B card. If this card is going to be concurrently used with the parallel port in the system unit, then an L-angle BNC connector is required.

3270 SDLC Link Attachment

The second way to attach PCs to a S/370 host is via an SDLC link.

The SDLC Communications Adapter (Type / Model 5150-ZZZ, Feature Code 1205, Part Number 1501205) is supported on the PC, PC XT, PC XT 286, PC AT, and PS/2 Models 25, 30, and 30 286. The SDLC Communications Adapter requires that the PC be cable-attached to a synchronous modem.

The only 3270 emulation software package that supports the SDLC Communications Adapter is 3270 Emulation Version 3.0.

The Multi-Protocol Adapter/A is the Micro Channel card that allows PS/2s to be attached via an SDLC

link to a S/370 host. The Multi-Protocol Adapter/A also requires the PS/2 to be cable-attached to a synchronous modem.

The Multi-Protocol Adapter/A comes in two versions:

- Type / Model 8550-ZZZ, Feature Code 3042, Part Number 6450348, which supports only the PS/2 Models 50, 60, 80 386 model 041, and 80 386 model 071.
- Type / Model 8550-ZZZ, Feature Code 3043, Part Number 6451003, which supports all models of the PS/2 Model 50, 50 Z, 55 SX, 60, 70 386, P70 386, and 80 386. This card was introduced to support the faster Model 70 386 and 80 386 systems. There are no other functional differences between the two cards.

Both feature codes 3042 and 3043 have the same price. Because feature code 3043 supports all models supported by feature code 3042, plus additional models, 3043 should be the card ordered. Both cards use the same ADF (@DEFF.ADF), which can be interchanged between the two cards. The ADF for these cards is shipped on the PS/2 system unit Reference Diskette. The cards are not shipped with separate option diskettes.

In addition to supporting the SDLC protocol, these adapters also support Binary Synchronous (BSC), High-Level Data Link Control (HDLC), and Asynchronous (Async) protocols if the appropriate software is used to initialize the cards for those protocols. IBM supports the cards only by using the SDLC protocol with the 3270 Emulation Program Version 3.0.

3270 Emulation Software

IBM PC 3270 Emulation Program, Entry Level, Version 1.21

The IBM PC 3270 Emulation Program, Entry Level, Version 1.21 enhances and replaces several other IBM products:

- IBM 3278/79 Emulation Control Program Version 1.0
- IBM 3278/79 Emulation Control Program Version 2.0
- IBM 3270 Emulation Program, Entry Level, Version 1.0
- IBM 3270 Emulation Program, Entry Level, Version 1.1

The major characteristics of IBM PC 3270 Emulation Program, Entry Level, Version 1.21 are:

- Supports single host session
- Single session can only be 3270 Model 2
- Emulates CUT device
- Supports CUT file transfer
- Supports host-directed, local copy, and print-screen printing
- Supports host-based graphics with GDDM-PCLK Version 1.1 software
- Supports 3270 API (EEHLLAPI) in the following languages:
  - COBOL/2 (Category 5871-AAA, Feature Code 0816, Program Number 6280207)
  - C/2 Version 1.1 (Category 5871-AAA, Feature Code 1410, Program Number 6280284)
  - Pascal/2 (Category 5871-AAA, Feature Code 0826, Program Number 6280183)
  - BASIC/2 (Category 5871-AAA, Feature Code 0822, Program Number 6280179)

The IBM PC 3270 Emulation Program, Entry Level, Version 1.21 will run on all PCs.

Because this program supports only CUT file transfer, it would not be a good choice for a user who does significant amounts of file transfers.

The 3270 API that this software uses is known as the Entry Emulator High Level Language Application Programming Interface (EEHLLAPI). The EEHLLAPI code is included with the IBM PC 3270 Emulation Program, Entry Level, Version 1.21.

This software supports only coaxial attachment to a 3X74 control unit or coaxial attachment to an ES/9370 Workstation Subsystem Controller. (See Figure 1.) The only hardware required would be the Advanced 3278/79 Emulation Adapter or the 3270 Connection Adapter.

Of all the packages discussed, IBM PC 3270 Emulation Program, Entry Level, Version 1.21 uses the least amount of PC memory.

Notes: (1) If you use IBM PC 3270 Emulation Program, Entry Level, Version 1.21 on an IBM PS/2 Model 30 286, you will need to apply program update number IR79951 (see list at end of article). (2) If you use this software package with the IBM 3270 Connection Adapter Version B (long) or Version B (short), you must leave the memory segment used by the card at the default segment of X"CE000".

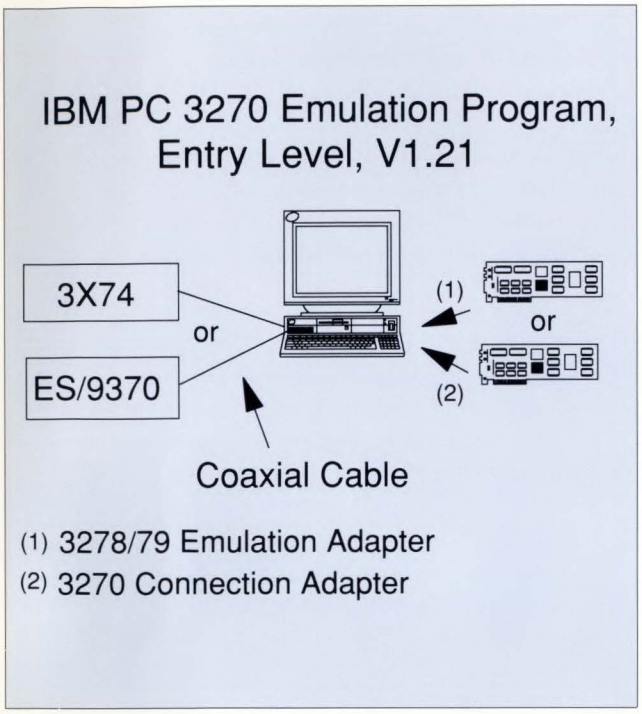


Figure 1. 3270 Emulation Program, Entry Level, Version 1.21

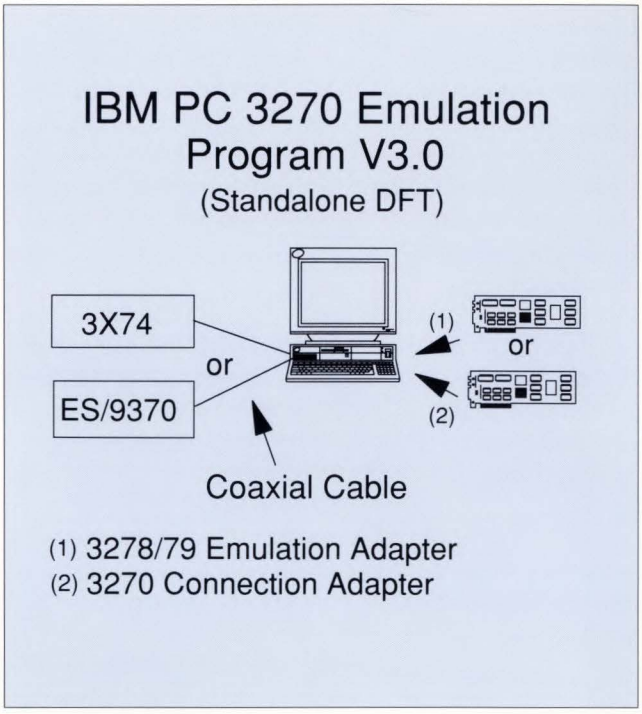


Figure 2. 3270 Emulation Program Version 3.0 (Standalone DFT)

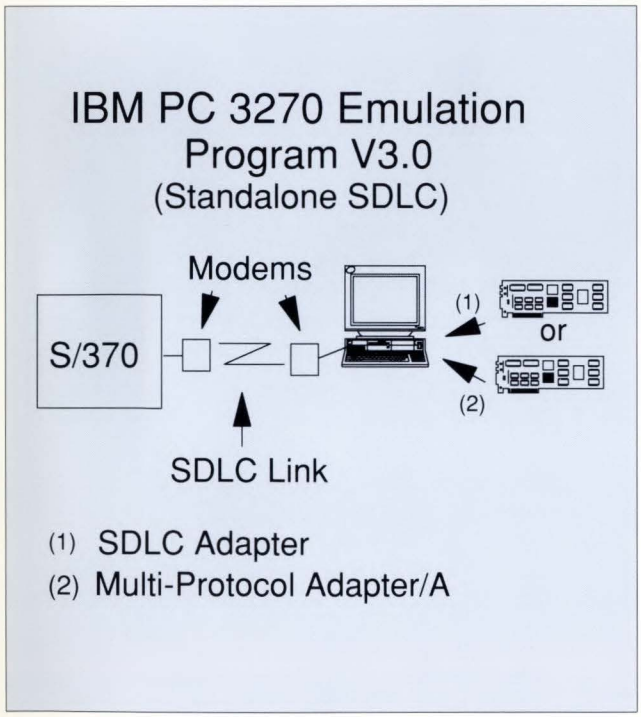


Figure 3. 3270 Emulation Program Version 3.0 (Standalone SDLC)

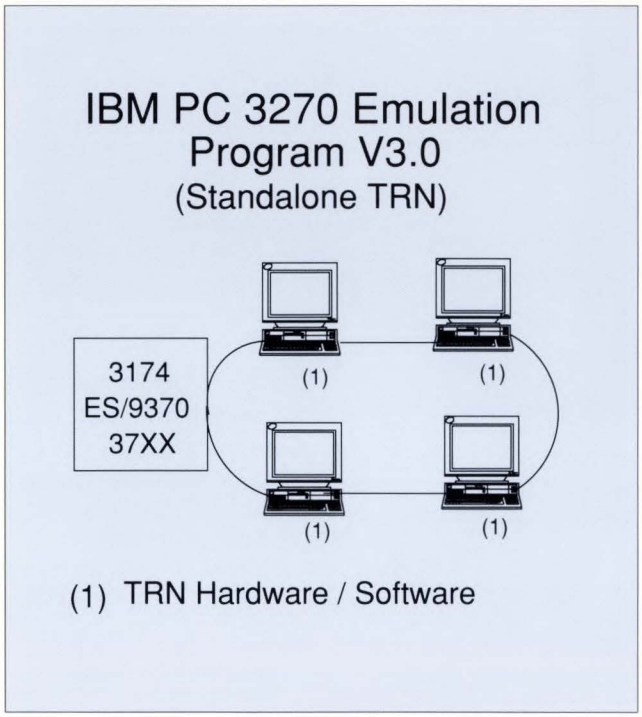


Figure 4. 3270 Emulation Program Version 3.0 (Standalone TRN)

IBM PC 3270 Emulation Program Version 3.0

The latest available version of IBM PC 3270 Emulation Program Version 3.0 is version 3.05. All users should be at this release level. This level of the product may not actually be shipped when the software is purchased. To obtain version 3.05, you can call the IBM Support Center (1-800-237-5511) and request it at no charge. If you have questions about obtaining this release level, please contact your IBM Marketing Representative or your place of purchase.

IBM PC 3270 Emulation Program Version 3.05 enhances and replaces two IBM products:

- IBM PC Network SNA 3270 Emulation Program Version 1.0
- IBM PC 3270 Emulation Program Version 2.0

The major characteristics of IBM PC 3270 Emulation Program Version 3.05 are:

- Supports single host session
- Single session can only be 3270 Model 2
- Emulates DFT device
- Supports DFT file transfer
- Supports host-directed and print-screen printing
- Supports host-addressable printer emulation
- Supports host-based graphics with GDDM-PCLK Version 1.1 software
- Supports 3270 API in Macro Assembler/2 (Category 5871-AAA, Feature Code 0820, Part Number 6280181)

IBM PC 3270 Emulation Program Version 3.05 supports 7 KB DFT file transfer blocks for the MVS, VM, and VSE file transfer software, and 2 KB blocks for the CICS file transfer software. For coaxially attached PCs in the MVS, VM, and VSE environments, this software will be the best performer for file transfer.

IBM PC 3270 Emulation Program Version 3.05 does not support local copy. However, it is possible to print the host screen to a file on your fixed disk and then print the file as a PC file. The difference is that the image of the screen is printed to a directly attached PC printer, not to a coaxially attached control unit printer.

IBM PC 3270 Emulation Program Version 3.05 is the only software package that supports host-addressable printer emulation. This means that the software has the logic to allow a directly attached PC printer to emulate a S/370 3287-type printer. The software emulation supports both LU 1.0 and 3.0 printer device types.

Once the host printer emulation is active, any user in your S/370 network can direct S/370 output to that printer. In effect, the PC printer now becomes a host network-addressable printer.

The major strengths of IBM PC 3270 Emulation Program Version 3.05 is its multiple connectivity options. The following terminology is what IBM PC 3270 Emulation Version 3.05 actually uses. This software uses the term "DFT" to mean coaxial attachment.

The same software can be configured in the following four ways:

(1) **Standalone DFT, Standalone SDLC, and Standalone Token-Ring Network (TRN).**

Standalone DFT is illustrated in Figure 2. In this configuration, the PC is coaxially attached to a 3X74 control unit or to an ES/9370 Workstation Subsystem Controller. The 3X74 control unit can be either local or remote to an S/370 host. If so desired, a directly attached PC printer could be configured to emulate a host-addressable 3287 printer. In this case, the host would see two LUs, one for the PC and one for the printer. The hardware required would be either an Advanced 3278/79 Emulation Adapter or a 3270 Connection Adapter.

Standalone SDLC is illustrated in Figure 3. In this configuration, the PC would have either an SDLC Communications Adapter or a Multi-Protocol Adapter/A and would be cable-attached to a synchronous modem. In this configuration, the PC is actually emulating a remote 3274 51C control unit with a directly attached 3270 terminal. The host sees one PU 2.0 (for the 3274) and one LU 2.0 (for the PC) on the SDLC link. Once again, the software could be configured so that a directly attached PC printer could emulate a host-addressable 3287 printer. In the latter case, the host would see an additional LU 1.0 or 3.0 for the printer.

This configuration could be used where a single remote user needs host access. This configuration does not require the use of any protocol conversion.

This particular configuration is supported only by IBM PC 3270 Emulation Program Version 3.05.

Standalone TRN is illustrated in Figure 4. In this configuration, a TRN is directly connected to a 3174, ES/9370, or 37XX. Each PC on the TRN appears to the host as a 3274 control unit (PU 2.0) with one 3270 terminal (LU 2.0). If so configured, a directly attached PC printer can act as a host-addressable printer. In the latter case, the host would see an additional LU 1.0 or 3.0 for the host-addressable printer.

(2) **Gateway DFT and Gateway SDLC**.

Gateway DFT is illustrated in Figure 5. The term "gateway" signifies the existence of a TRN; the PCs that are downstream from the gateway use the gateway to access a S/370 host.

In this configuration, one of the PCs in the TRN would also have either the Advanced 3278/79 Emulation Adapter or the 3270 Connection Adapter and would be coaxially attached to a 3X74 control unit.

The 3X74 control unit microcode would be configured so that the physical port to which the gateway is connected would have from one to five LU definitions associated with it. The IBM PC 3270 Emulation Program Version 3.05 software running on the DFT gateway would allow the downstream PCs to use the LU definitions to access the S/370 host.

To be defined only as a gateway means that the PC is only operating as a gateway and cannot emulate a 3270 terminal.

The downstream PCs would be running the same software but would be configured as "network stations" (see below). The advantage is that only the gateway machine has a 3270 coaxial card in it. The other PCs use the one physical coaxial connection in the gateway to access the host.

Gateway SDLC is illustrated in Figure 6. Once again, because a gateway is involved, there is by definition a TRN. In this configuration, one PC is a member of the TRN, but also has an SDLC Communications Adapter or a Multi-Protocol Adapter/A in it, and is cable-attached to a synchronous modem. In this example, the IBM PC 3270 Emulation Program Version 3.05 software emulates a 3274 51C remote control unit with downstream LUs. The maximum number of downstream LUs supported is 32, and can be any combination of 3270 terminal emulation (LU 2.0) or 3287 printer emulation (LU 1.0 or 3.0).

The downstream PCs are configured as "network stations," which are described next.

(3) **Network Station**. (See Figures 7 and 8.) To be configured as a "network station" by definition means that the PC is on a TRN downstream from a gateway. The Gateway DFT and Gateway SDLC both have downstream network stations.

The term "network station" is somewhat misleading in that it really means emulating a 3270 terminal over a TRN, and it is not related to accessing a file or print server. The term "network station" in this example only refers to a user on a TRN going through a TRN gateway to access a S/370 host.

The hardware / software in each PC would be what is required to be a member of a TRN; in addition, each PC would be running 3270 Emulation Program Version 3.05 configured as a network station.

(4) **Gateway with Network Station DFT and Gateway with Network Station SDLC.** (See Figures 9 and 10.) In this configuration a single PC will be configured to perform the gateway function, and the user at that PC will also be able to use IBM PC 3270 Emulation Program Version 3.05 to act as a network station to emulate a 3270 terminal.

The hardware / software required would be the same as Gateway DFT or Gateway SDLC, except that the IBM PC 3270 Emulation Program Version 3.05 would be configured as Gateway with Network Station DFT or Gateway with Network Station SDLC.

Additional information about IBM PC 3270 Emulation Program Version 3.05 is in the *PC 3270 Emulation Program Version 3.0 Application Program Interface and Host Reference* (form number SC23-0960).

IBM 3270 Workstation Program Version 1.10

The latest available version of the IBM 3270 Workstation Program Version 1.10 is version 1.12 (Program Temporary Fix (PTF) UR23217). All users should be at this level. This level of the product may not actually be shipped when the software is purchased. To obtain this PTF, you can call the IBM Support Center (1-800-237-5511) and request the PTF at no charge.

The 3270 Workstation Program Version 1.12 enhances and replaces two IBM products:

- IBM 3270-PC Control Program Versions 1.22, 2.10, and 3.0

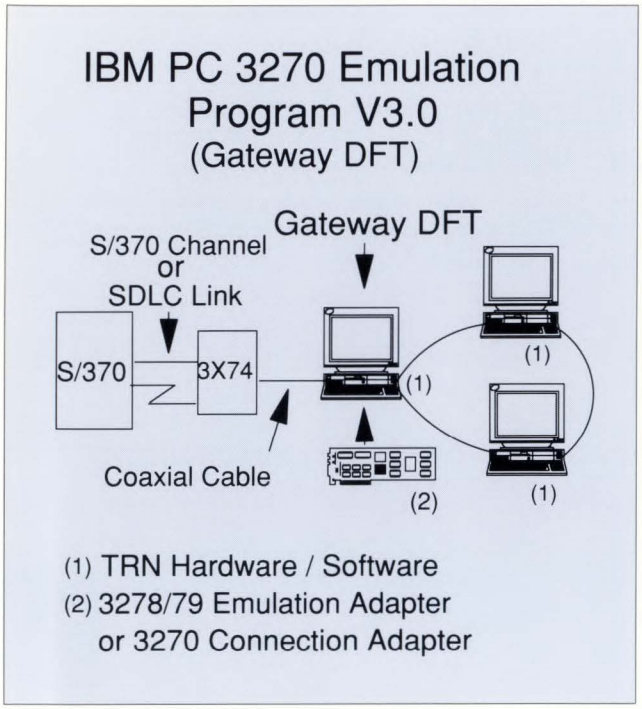


Figure 5. 3270 Emulation Program Version 3.0 (Gateway DFT)

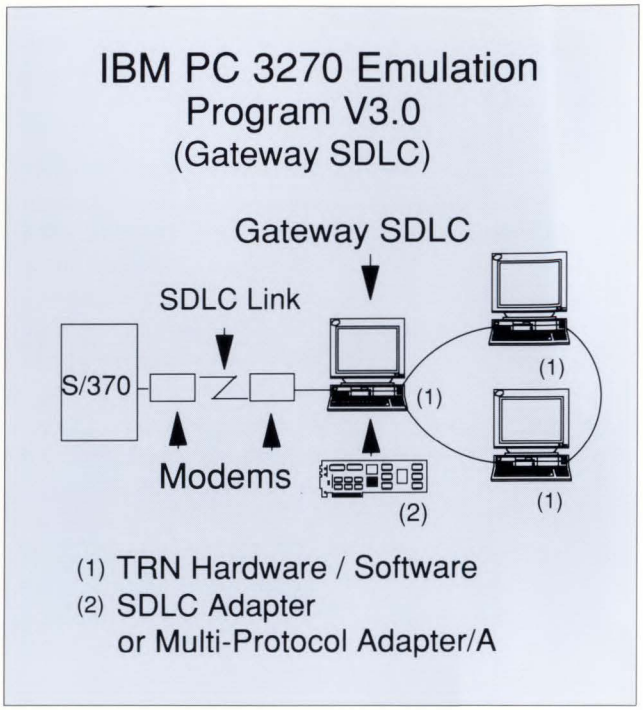


Figure 6. 3270 Emulation Program Version 3.0 (Gateway SDLC)

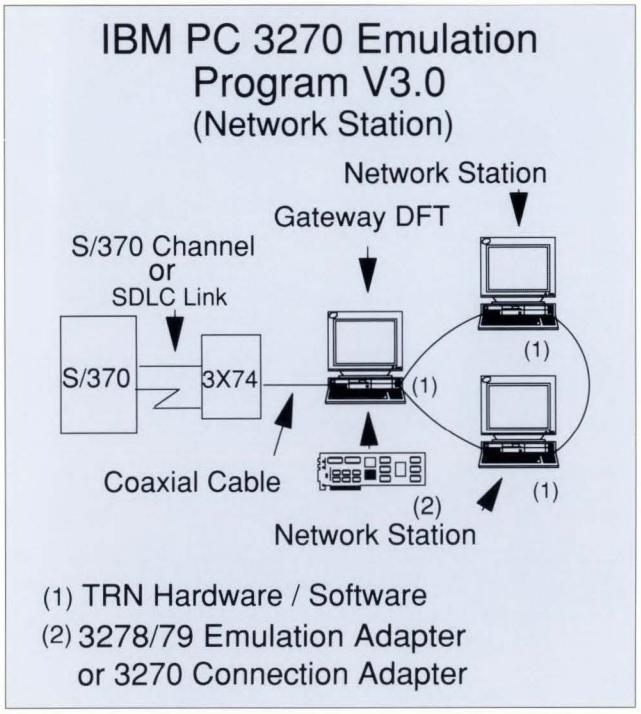


Figure 7. 3270 Emulation Program Version 3.0 (Network Station)

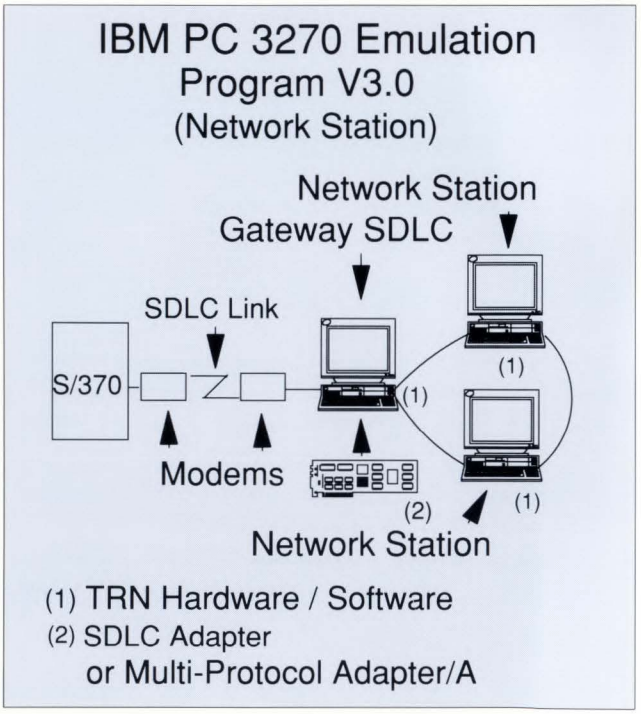


Figure 8. 3270 Emulation Program Version 3.0 (Network Station)

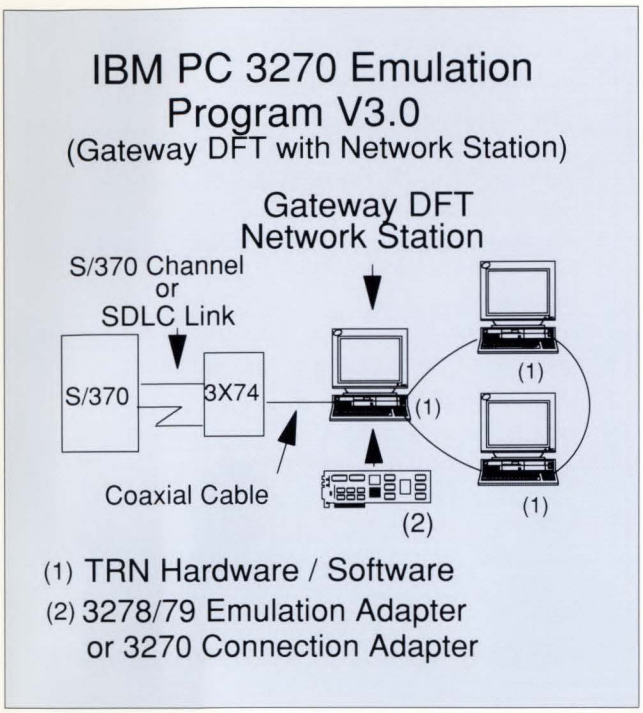


Figure 9. 3270 Emulation Program Version 3.0 (Gateway DFT with Network Station)

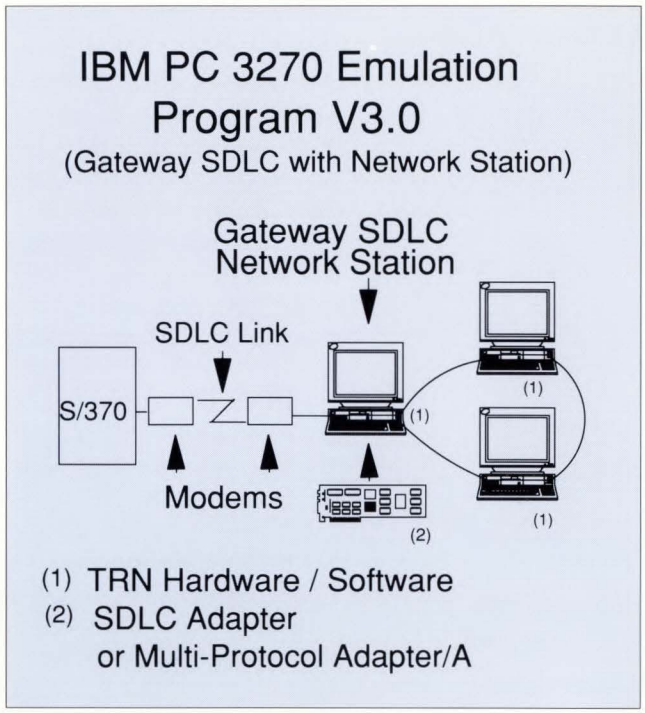


Figure 10. 3270 Emulation Program Version 3.0 (Gateway SDLC with Network Station)

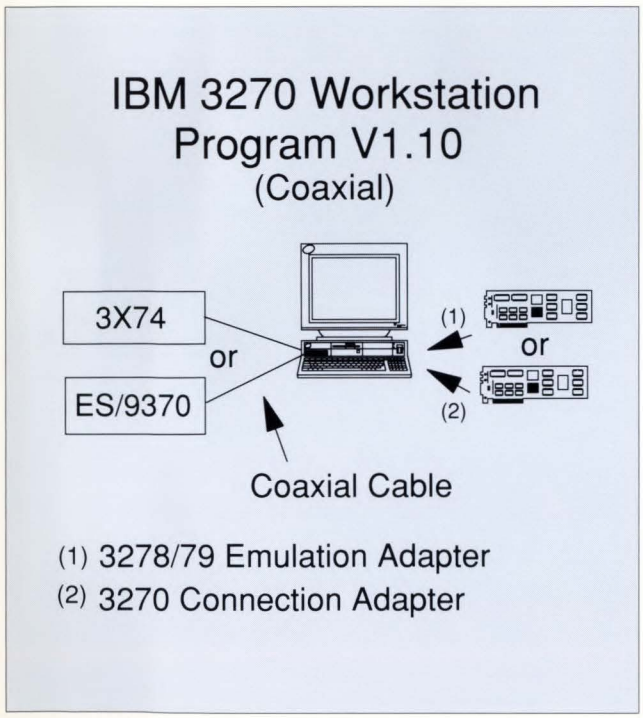


Figure 11. 3270 Workstation Program Version 1.10 (Coaxial)

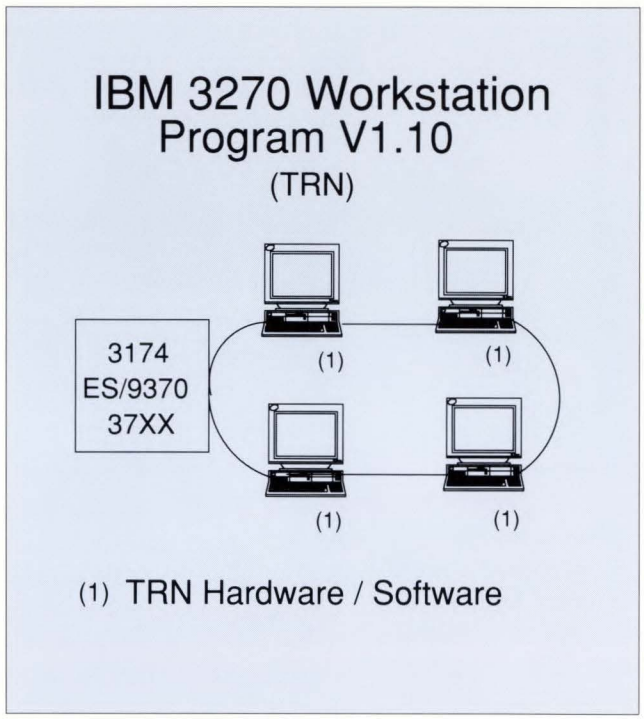


Figure 12. 3270 Workstation Program Version 1.10 (TRN)

- IBM 3270 Workstation Program Version 1.0

The 3270 Workstation Program Version 1.12 supports:

- Up to four concurrent host sessions
- 3270 Models 2, 3, 4, and 5
- CUT or DFT device emulation
- CUT or DFT file transfer
- Up to two note pads
- Up to six PC sessions
- Host-directed, local copy, and print screen printing
- Host graphics with GDDM-PCLK Version 1.1 software
- Expanded Memory adapters (XMA)
- 3270 API (HLLAPI Version 3.1, Category 5871-AAA, Feature Code 0835, Program Number 75X1087) in these languages:
  - COBOL/2 (Category 5871-AAA, Feature Code 0816, Program Number 6280207)
  - C/2 Version 1.1 (Category 5871-AAA, Feature Code 1410, Program Number 6280284)
  - Pascal/2 (Category 5871-AAA, Feature Code 0826, Program Number 6280183)
  - BASIC/2 (Category 5871-AAA, Feature Code 0822, Program Number 6280179)

The IBM 3270 Workstation Program Version 1.12 supports 3.5 KB DFT file transfer blocks for MVS, VM, and VSE file transfer software, and 2 KB blocks for CICS file transfer software. For coaxially attached PCs in the MVS, VM, and VSE environments, this software is the second-best performer for file transfer.

The IBM 3270 Workstation Program Version 1.12 supports the older 3270-PC and 3270-PC AT hardware as well as the the newer PS/2 hardware. This software is the only software package that supports the older 3270-PC hardware. This software is not supported on the IBM PC, PC XT 286, PC AT Model 239 when used in multi-DOS mode, or the PS/2 Model 30 286.

The IBM 3270 Workstation Program Version 1.12 supports up to four active host sessions, which can be any combination of 3270 Models 2, 3, 4, and 5. In order for the IBM 3270 Workstation Program Version 1.12 to support multiple concurrent host sessions, the microcode in the 3X74 control unit has to be customized to allow multiple LUs for that one physical coaxial port.

If any display other than an 8514 Color Display is used, you must scroll right and left to view the entire 132 columns for model 5 emulation. If all 132 columns are to be seen without scrolling, the following hardware is required:

- 8514 Color Display
- 8514/A Adapter (Category 8550-ZZZ, Feature Code 4054, Part Number 1887972)

Notes: (1) The 8514/A Adapter is not supported in the Model P70 386. (2) The IBM 3270 Workstation Program Version 1.12 does not support the IBM 8507 Monochrome Display.

The software comes with its own font to support 132 columns of data without scrolling, and is written to the 8514/A DOS software adapter interface (HDILOAD.EXE). The IBM 3270 Workstation Program Version 1.12 requires that HDILOAD.EXE be at version 1.01 or higher. If your version of HDILOAD.EXE is not 1.01, an update may be obtained by ordering the 8514/A Adapter Interface Migration Kit (form number G68X-2300) at no charge. The current version of HDILOAD.EXE is version 1.02. To order the update, please contact your IBM Marketing Representative or place of purchase.

The one or two note pads are electronic scratchpads that allow the user to enter and store data and, if desired, to save the data to fixed disk. It is possible to move textual data between host and PC sessions. It is also possible to configure up to six PC sessions.

Because the IBM 3270 Workstation Program Version 1.12 is such powerful software, it can use significant amounts of PC memory. That is the reason why the software will support certain IBM memory cards as expanded memory adapters (XMA). With XMA, the software will load most of itself above 640 KB, thus allowing more of the 640 KB of memory for DOS applications.

Several older XMA cards are still available; however, the preferred newer XMA adapters are:

- 2MB Expanded Memory Adapter (Type / Model 8530-ZZZ, Feature Code 3905, Part Number 2685193), which supports the PC XT, PC AT, and PS/2 Models 25 and 30. This adapter also comes standard with a parallel port. (The PS/2 Model 30 286 does not support this adapter.)
- 2-8MB 80286 Memory Expansion Option (Type / Model 8550-ZZZ, Feature Code 8286, Part Number 6450609), which supports PS/2 Models 50, 50 Z, and 60. As the name implies, this

card comes standard with 2 MB of memory. The card will accept three additional modules of memory, which can be any combination of:

- 1 MB module removed from the Model 50 Z or Model 55 SX system board
- 1 MB module (Type / Model 8550-ZZZ, Feature Code 5212, Part Number 6450603)
- 2 MB module (Type / Model 8550-ZZZ, Feature Code 5213, Part Number 6450604)

The IBM 3270 Workstation Program Version 1.12 comes with drivers that allow any memory on PS/2 Models 55 SX, 70 386, P70 386, or 80 386 to emulate XMA memory.

The 3270 API with the IBM 3270 Workstation Program Version 1.12 is referred to as High-Level Language Application Program Interface (HLLAPI). Unlike EEHLLAPI, which comes with IBM PC 3270 Emulation Program, Entry Level, Version 1.21, HLLAPI must be purchased as a separate software product.

The IBM 3270 Workstation Program Version 1.12 is supported in a coaxial connection or over a token-ring network. In a coaxial connection, the PC has either an Advanced 3278/79 Emulation Adapter or a 3270 Connection Adapter, and is coaxially connected to a 3X74 control unit or an ES/9370 Workstation Subsystem Controller. (See Figure 11.) The IBM 3270 Workstation Program Version 1.12 is also supported on a token-ring network when the network is directly attached to a 3174, ES/9370, or 37XX. In the TRN connection, the PC appears to the host as a 3274 Control Unit (PU 2.0) with up to four LU 2.0 host sessions. (See Figure 12.) Additionally, TRN hardware and software are required. Each PC runs IBM 3270 Workstation Program Version 1.12, but is configured for TRN connection instead of coaxial connection.

Local copy is supported only when the IBM 3270 Workstation Program Version 1.12 is coaxially attached to a 3X74 control unit or ES/9370 Workstation Subsystem Controller.

Additional information about the IBM 3270 Workstation Program Version 1.12 can be found in:

- "Configuring the 3270 Workstation Program Version 1.10," *IBM Personal Systems Technical Journal*, Issue 1, 1989 (form number G325-5001), page 33
- *3270 Workstation Program Programmer's Guide* (form number S01F-0217)

This software is designed for users who have a requirement for heavy host graphics use.

IBM PS/2 Graphics Workstation Program Version 1.0

The latest available version of the IBM PS/2 Graphics Workstation Program Version 1.0 software is version 1.01. If you have version 1.0, please contact your IBM Marketing Representative or place of purchase for information about how to obtain Version 1.01.

The IBM PS/2 Graphics Workstation Program Version 1.01 replaces and enhances the IBM Graphics Control Program Version 3.21.

The IBM PS/2 Graphics Workstation Program Version 1.01 runs only on PS/2 Models 50, 50 Z, 55 SX, 60, 70 386, or 80 386 with the following hardware:

- 8514 Color Display
- 8514/A Adapter (Type / Model 8550-ZZZ, Feature Code 4054, Part Number 1887972)
- 8514/A Adapter Memory Expansion Kit (Type / Model 8550-ZZZ, Feature Code 4081, Part Number 1887989)
- A minimum of 1.5 MB of memory

It supports:

- Up to four concurrent host sessions
- 3270 Models 2, 3, 4, and 5
- Up to two note pads
- One PC session
- DFT device emulation
- DFT file transfer
- Host-directed, local copy, and print-screen printing
- 3270 API in Macro Assembler/2 (Category 5871-AAA, Feature Code 0820, Part Number 6280181)
- GDDM direct plotting
- A Programming Language (APL) support

Note: Because this software requires the 8514/A Adapter, and the 8514/A Adapter is not supported on the PS/2 Model P70 386, the IBM PS/2 Graphics Workstation Program does not run on the Model P70 386.

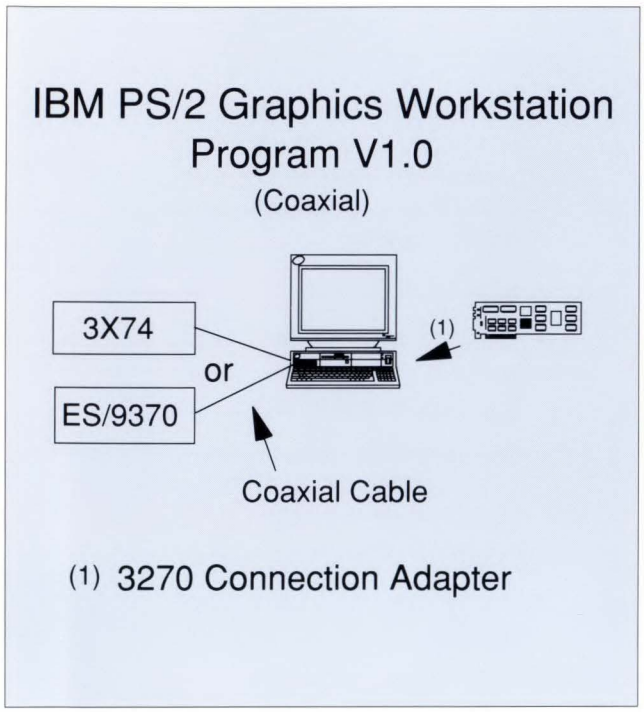


Figure 13. Graphics Workstation Program Version 1.0 (Coaxial)

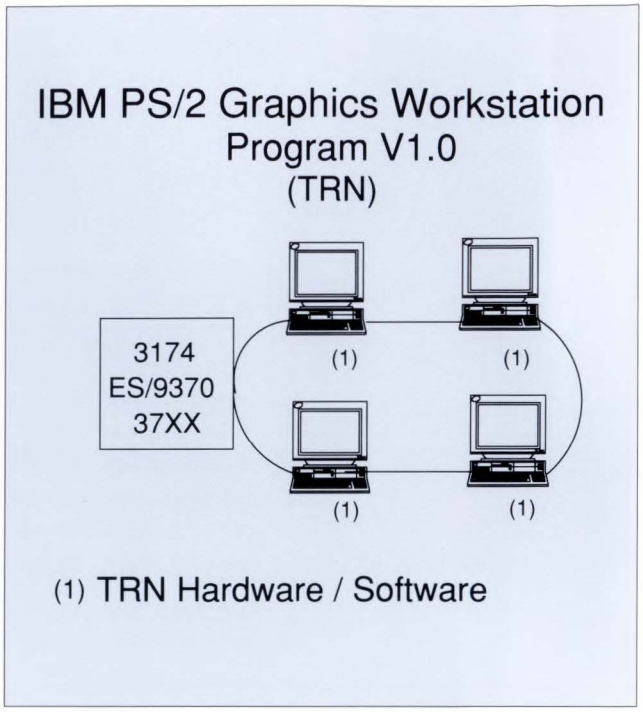


Figure 14. Graphics Workstation Program Version 1.0 (TRN)

The IBM PS/2 Graphics Workstation Program supports 2 KB DFT file transfer blocks in MVS, VM, CICS, and VSE environments. Its file transfer performance ranks behind IBM PC 3270 Emulation Program Version 3.05 and IBM 3270 Workstation Program Version 1.12. This software is designed for users who have a requirement for heavy host graphics use. It does not require the use of GDDM-PCLK Version 1.1 at the PC or GDDM-PCLKF at the host. It supports up to four host graphics sessions, compared to a single host graphics session with GDDM-PCLK Version 1.1. It also supports GDDM plotting to a directly attached PC plotter.

Although it works with a minimum of 1.5 MB of memory, more memory will yield better performance. This software loads most of itself above 640 KB, thus giving you more memory for your DOS applications.

The IBM PS/2 Graphics Workstation Program Version 1.01 supports up to four active host sessions, which can be any combination of Models 2, 3, 4, or 5. In order for the IBM PS/2 Graphics Workstation Program Version 1.01 to support multiple concurrent host sessions, the microcode in the 3X74 control unit has to be customized to allow multiple LUs for that one physical coaxial port.

It is also possible to move textual data between host and PC sessions.

The IBM PS/2 Graphics Workstation Program Version 1.01 supports model 5 emulation, 80 columns at a time. This requires scrolling left and right to view all 132 columns of data.

The one or two note pads are electronic scratchpads that allow the user to enter and store data and, if desired, save the data to fixed disk. It is also possible to move textual data between host and PC sessions.

The IBM PS/2 Graphics Workstation Program Version 1.01 is supported in a coaxial connection or over a TRN. In a coaxial connection, the PS/2 has a 3270 Connection Adapter and is coaxially connected to a 3X74 control unit or to an ES/9370 Workstation Subsystem Controller. (See Figure 13.) The IBM PS/2 Graphics Workstation Program Version 1.01 is also supported on a token-ring network when the network is connected to

3174, ES/9370, or 37XX. In the token-ring network connection, the PC appears to the host as a 3274 control unit (PU 2.0) with up to four LU 2.0 host sessions. (See Figure 14.) Additionally, TRN hardware and software are required. Each PC runs the PS/2 Graphics Workstation Program Version 1.01, but is configured for TRN connection instead of coaxial connection.

Local copy is supported only when the IBM PS/2 Graphics Workstation Program Version 1.01 is coaxially attached to a 3X74 control unit or ES/9370 Workstation Subsystem Controller.

The IBM PS/2 Graphics Workstation Program Version 1.1 will generate the APL character set for host APL programming. This is the only software package that will generate the APL character set.

Additional Information

When a PC is used to emulate a 3270 terminal, the PC keyboard is remapped to the equivalent 3270 keys, and a template is required to determine which functions the keys perform in the host session.

The PS/2 Graphics Program Version 1.01 comes with a set of replacement key tops that more closely match host functions.

IBM sells replacement key tops for the IBM PC 3270 Emulation Program, Entry Level, Version 1.21 and IBM 3270 Workstation Program Version 1.12. The key tops more closely match host functions, and can be ordered from IBM Direct (1-800-426-2468) under part number 1497258.

When a PC is used to emulate a 3270 terminal, the PC keyboard is remapped to the equivalent 3270 keys.

Program Updates

From time to time, IBM has released updates to the programs mentioned in this article. You may never require these updates; however, if you are having a problem, you may want to obtain one or more of the updates. To do this, contact the IBM Support Center (800-237-5511) or work with your IBM Account Systems Engineer or your place of purchase.

For the IBM PC 3270 Emulation Program, Entry Level, Version 1.21, these updates are available:

- For CUT file transfer: IR76457, IR79282, and IR79373.
- For GDDM-PCLK Version 1.1: IR77791, IR82709, and IR83076.

For the IBM 3270 Workstation Program Version 1.12, these updates are available:

- For users of GDDM-PCLK Version 1.1: program update numbers IR82254 and IR82641.
- For users who are connected via token-ring: program update numbers IR81492, IR82063, IR82073, IR82509, IR82712, and IR83113.
- For users who are configured for 3270 Models 3, 4, or 5: program update numbers IR81238, IR81684.

For the IBM PS/2 Graphics Workstation Program Version 1.01, this update is available:

- For users who are using host GDDM Version 2.2: program update number IR83251.

Manuals

For additional information about the subjects discussed in this article, refer to the following manuals:

- *3270 Datastream Programmer's Reference*, form number GA23-0059.
- *3174 Subsystem Control Unit Customizing Guide Configuration Level A / S Release 4.0*, GA23-0214.
- *3174 Establishment Controller: Functional Description*, GA23-0218.
- *ES/9370 Token-Ring Subsystem Description*, SA09-1739.
- *ES/9370 Information System: Customizing the Workstation Subsystem*, GA24-4044.
- *3725 Network Control Program Token-Ring Interface Planning and Implementation*, GG24-3110.
- *Installation Guidelines for Token-Ring Products*, GG24-3291.
- *Guidelines for Setting Local Area Network Support Program Parameters, for Use With Selected Products*, GG22-9430.

Writing a Presentation Manager Application

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Operating System/2's Presentation Manager (PM) plays a crucial role as the user interface portion of IBM's Systems Application Architecture (SAA), at least for machines with graphics capabilities. The goals of SAA are a common user interface and programming interface across a wide range of machines from personal computers to mainframes. Eventually an application user will be able to take a PM application and compile it to run on any SAA system, such as OS/400 or VM/XA. PM simply presents the user with a consistent view across several machine platforms.

In this article we discuss the steps that we took to write an application program under the OS/2 Presentation Manager. Our task was to write a PM application that has at least two child windows, with a menu of at least two items in each window. We decided to automate a personal telephone directory so that we could scroll the names in either ascending or descending order.

We used the IBM OS/2 Programmer's Toolkit Version 1.1 and its sample programs. Also, we used the following IBM Operating System/2 products:

- IBM Operating System/2 Standard Edition Version 1.1 (product number 6280194)
- *IBM Operating System/2 Technical Reference* Version 1.1 (6280212)
- IBM Operating System/2 Programmer's Toolkit Version 1.1 (6280211)
- IBM C/2 Version 1.1 (6280284)

We used a new IBM Personal System/2 Model 80 386 with a 70 MB fixed disk, 8 MB of memory, and an IBM 8513 Color Display.

The Concepts of Windowing

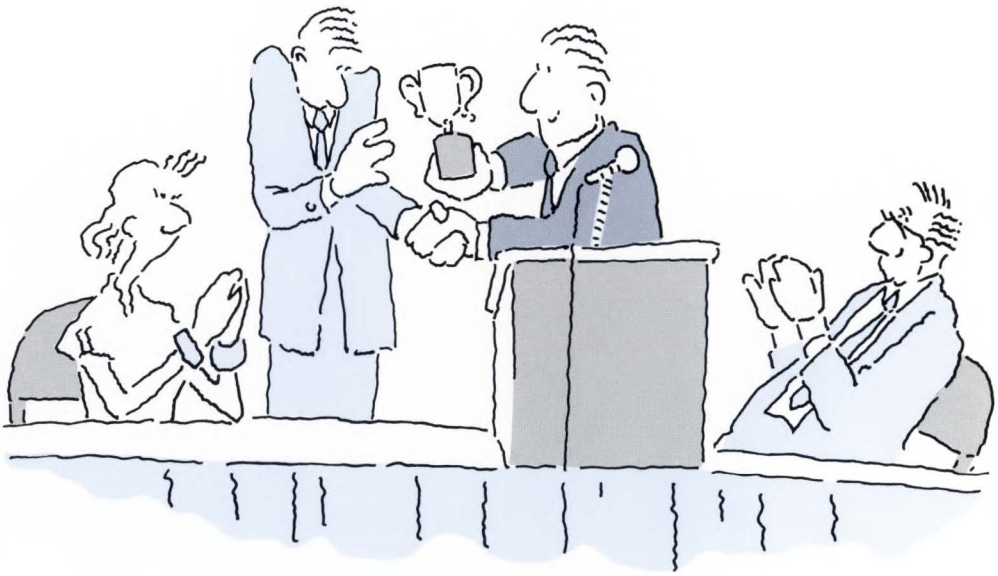
The SAMPLE application makes use of the windowing concepts of SAA Common User Access. Before getting into the SAMPLE application, we discuss the concepts of windowing.

Presentation Manager uses the concept of windows for the presentation of visual information and controls on the screen. The term "window" is used to describe a complete application window.

The complete screen is called the desk top window. Within the desk top window there can be many other windows, whose logical relationship is evident from their names:

- **Main window.** An application must first have a main window, which usually contains an identification for the program in a descriptive "title bar" and a list of the program functions in an "action bar."
- **Child window.** Separate asynchronous parts of the application running in the main window can have their own window, known as child windows. Each child window is displayed within the current limits of its parent window. A child window can itself be a parent window. Also, an application may use more than one main window.

There is a special type of child window called the **dialog box**. As its name implies, it is used mainly for



communicating with the user for a short-duration task such as:

- Requesting input from the user
- Displaying a data list that can be scrolled, and from which items can be selected.

Window Hierarchy

The Presentation Manager screen may contain many overlapping windows, representing one or more applications. It is necessary to understand the rules that PM applies, in order to determine how the various parent / child window combinations are displayed on the screen.

Windows are presented on a hierarchical parent-child basis, and each child window is presented on top of, and clipped to the borders of, its parent window.

The main or child window with which the user interacts is known as the **active window** or **input focus window**. This window, together with its parent window and any other child windows, is presented on top of all other main application windows. Thus, in Figure 1, the application in the main window "A" can be seen to have the input focus, as opposed to the application in window "B."

Child windows that have the same parent are known as "siblings," and have a specific order, so that the topmost sibling window obscures any portion of its siblings that it overlaps. This can be seen in Figure 1, where application Aa together with its child application Aa1 partially obscures its sibling application Ab.

Whereas Presentation Manager obeys these rules, there is no requirement for PM applications to generate windows with any defined parentage. The default parent window is the desk top window.

We now begin discussing our experience in writing a Presentation Manager application.

OS/2 Installation

The installation of OS/2 Standard Edition (SE) Version 1.1 and related tools went smoothly. We divided the fixed disk into three partitions named C, D, and E. We then put OS/2 SE 1.1 into partition C, the OS/2 Programmer's Toolkit into D, and the C/2 compiler into E. This technique – isolating interdependent programs (such as those used in program writing, compiling and testing) – often improves performance.

Initial Definition of Function

The IBM OS/2 Programmer's Toolkit Version 1.1 package contains three books:

- *Programming Overview*, which introduces the programming concepts that should be understood before an OS/2 application is developed
- *Programming Guide*, which gives guidance and examples to enable you to start writing source code
- *Building Programs*, which guides you through procedures to build a program that runs under OS/2 Version 1.1.

The first thing we noticed in reading the text from the Toolkit was that most of the functions in the Presentation Manager begin with either

1) Main Procedure
.. Presentation Manager initialization
(WinInitialize)
.. Create message queue for input
(WinCreateMsgQueue)
.. Create a window
... Register the window class
(WinRegisterClass)
... Create the window
(WinCreateStdWindow)
.. Main message loop
... Get and dispatch messages
(WinGetMsg and WinDispatchMsg)
... Ends when WM_QUIT message is received
.. Termination
(WinDestroyWindow, WinDestroyMsgQueue and WinTerminate)
.. (Core of application, user's responsibility)

2) Window Procedure
.. A procedure that defines the functions of the window type
.. It responds to message which are sent to it
... These are received as its input parameters
.. It must deal with all messages it is sent
... Those which it does not handle are sent to
WinDefWindowProc
.. Basically a CASE statement for the interesting message

Figure 1. The Presentation Manager Calls Used

a WIN or GPI prefix. The WIN prefix indicates the windowing and user interface functions of the Presentation Manager. The GPI prefix refers to the Graphics Programming Interface; most output functions are GPI functions.

The window is the mechanism by which the user communicates with the application program. Whenever the application user writes window procedures within a program, those procedures must be capable of processing all window messages – displaying output information and receiving input. Each window has a style that determines its appearance and behavior, such as how one window overlays another. Users can specify and control these things through window class styles that are established during execution of WinRegisterClass. There are also class styles (frame, dialog, button, and so on) that apply to all the windows of a particular class.

One of the first hurdles in approaching GPI is dealing with the concept of the Presentation Space (PS). There are three different types of Presentation Space: cached micro-PS, micro-PS and normal-PS. Which type of Presentation Space you choose for your application depends on a variety of factors, but the type of PS you choose will determine to some degree how you structure a Presentation Manager application for drawing.

The Presentation Space is basically a data structure internal to the Presentation Manager. The attributes of the PS cover the current position, the current foreground and background color, the current line style, transforms of scaling units for different output devices, and others. The relationship among the application program, the PS, and the physical output device is:

- The application draws to the Presentation Space
- The Presentation Space is associated with a virtual display context that is managed by the Presentation Manager and comprises the output device and its device driver
- The virtual display context causes output to be displayed on a physical output device that can be either a display, printer, or plotter

A PM application program can be categorized into two parts.

The problem is that different output devices have different pixel (picture element) resolutions. The application user can specify coordinate positions in terms of inches or millimeters; thereafter, GPI converts these coordinates to pixels when drawing.

General PM Concept

In general, a PM application program can be categorized into two parts: the main procedure, which sets up the window, and the window procedure, which is based on the user's application and is therefore the user's responsibility to construct.

Figure 2 shows which calls we used, and how we divided them into the two parts.

Required Files

To build our SAMPLE program, we needed the following files:

- SAMPLE.C, the PM application source code.
- SAMPLE.RC, the PM application resource file.
- SAMPLE.ICO, the PM application icon (referenced by the resource file). ICON is used to represent a minimized standard window, and the ICON editor is used to create this file.
- SAMPLE.DEF, the PM application link reference definition file.
- SAMPLE.DLG, the PM application dialog file.
- SAMPLE.H, the PM application include file.

To make the job easier by building the SAMPLE.EXE file in one step, we included:

- SAMPLE.L, the PM application link file.
- SAMPLE.CMD, the PM application batch file.

Before taking a look at the SAMPLE program, which is written in C, note that several conventions are used in C code for PM applications:

- Function calls to the system are in mixed case
- System-defined types are in upper case
- System-defined constants are in upper case
- Variables in the code are typically in mixed case

Creating SAMPLE

Next we created the program SAMPLE. SAMPLE is a simple PM application that demonstrates basic features. It consists of a main proce-

```
/********************** Start of first window procedure ************************/
/*******************************************************************************/
/*                                                                             */
/*   WinProc: fnwpClient                                                       */
/*                                                                             */
/*   Controls the Client Area: loads various dialog windows.                   */
/*                                                                             */
/*   Side Effects : None                                                       */
/*                                                                             */
/*   Modifies the values of the following globals : None                       */
/*                                                                             */
/*******************************************************************************/
MRESULT  EXPENTRY fnwpClient( HWND hwndClient, USHORT msg, MPARAM mp1, MPARAM
mp2 )
{
    POINTL     pt;                  /* Define starting point                 */
    HPS        hps;                 /* Presentation space handle             */
    RECTL      rcl;                 /* Window rectangle                      */
    SHORT      Iwidth, Idepth;      /* Define width & depth                  */
    SWP        swp;                 /* Define swp                            */
    USHORT     Command;             /* Command passed by WM_COMMAND          */

    switch(msg)
    {
/*******************************************************************************/
/* Create a child window at location 20,20 with width 40, length 20.          */
/*******************************************************************************/
     case WM_CREATE:
       hwndClientChild = WinCreateWindow(            /* Create child window   */
                         hwndClient,                 /* Client is parent      */
                         szClientChild,              /* Window Class name     */
                         "Child Window",             /* Window Text           */
                         WS_VISIBLE | WS_MINIMIZED,  /* Window Style          */
                         20, 20, 20, 40,             /* Position and size     */
                         hwndClient,                 /* Client Area is Owner  */
                         HWND_TOP,                   /* Put the window on top */
                         ID_CLIENTCHILD,             /* Window ID             */
                         0,                          /* No Control Data       */
                         0                           /* No Presentation Params*/
                         );
       break;                                        /* client window frame   */
    case WM_ERASEBACKGROUND:
       return (MRESULT)(TRUE);                       /* Erase Client Area     */
    case WM_PAINT:
/*******************************************************************************/
/* Obtain a cache PS and set color and background mix attributes.             */
/*******************************************************************************/
       hps = WinBeginPaint( hwndClient, (HPS)NULL, (PRECTL)&rcl );
       GpiSetColor( hps, CLR_RED );                  /* Set child window color*/
       GpiSetBackColor( hps, CLR_BLUE );             /* Set background color  */
       GpiSetBackMix( hps, BM_OVERPAINT );           /* Allow color overlap   */
/*******************************************************************************/
```

Figure 2. WinProc fnwpClient (Part 1 of 2)

```
/* Find out the center position of the screen for text output                */
/***************************************************************************/
      Iwidth = (SHORT)WinQuerySysValue( HWND_DESKTOP, SV_CXSCREEN );
      Idepth = (SHORT)WinQuerySysValue( HWND_DESKTOP, SV_CYSCREEN );

      WinQueryWindowPos( hwndClient, (PSWP)&swp );
      pt.x = (LONG)((Iwidth - swp.cx ) / 2);
      pt.y = (LONG)((Idepth - swp.cy ) / 2);
/***************************************************************************/
/* Put the text string in center of screen                                 */
/* szFlag functions as a boolean.  The PERSONAL TELEPHONE DIRECTORY text    */
/* will be displayed only the first time when this program is loaded.      */
/***************************************************************************/
      if (szFlag == TRUE)
      {
        strcpy(sz, "       PERSONAL TELEPHONE DIRECTORY         ");
        GpiCharStringAt (hps, &pt, (LONG)strlen( sz ), (PSZ)sz );
      }
      else
/***************************************************************************/
/* First part of strcpy makes sure we have a cleab output buffer.          */
/* Second part of strcpy forces a Hello !! string up front of each         */
/* name and phone number.  Name and phone number will be fed in            */
/* after the selected dialog window is dismissed.                          */
/***************************************************************************/
      {
        strcpy(sz, "                                                    ");
        GpiCharStringAt (hps, &pt, (LONG)strlen( sz ), (PSZ)sz );
        strcpy(sz, " Hello !!        ");
        strcat(sz, szSelection);
        GpiCharStringAt (hps, &pt, (LONG)strlen( sz ), (PSZ)sz );
      }
      WinEndPaint( hps );
      break;
    case WM_COMMAND:
/***************************************************************************/
/* Process the command, based on the submenus in the action bar.           */
/***************************************************************************/
      Command = SHORT1FROMMP( mp1 );
      ClientCommand( hwndClient, Command ); /* Process the command        */
      break;
    case WM_CLOSE:
      WinPostMsg( hwndClient, WM_QUIT, 0L, 0L );/* Cause termination      */
      break;
    default:
/***************************************************************************/
/* Pass all other messages to the default window procedure                 */
/***************************************************************************/
      return WinDefWindowProc( hwndClient, msg, mp1, mp2 );
  }
  return FALSE;
}
/*********************** End of first window procedure ***********************/
```

Figure 2. WinProc fnwpClient (Part 2 of 2)

dure and window procedures (two dialog procedures and a child window that is created under a client window). When the main window is created (using the WinCreateStdWindow system function call), the client window handle is ready to use. With this window handle, PM processes all the window messages under this client window.

The PM application can use either menus or accelerators to send commands to the window. In SAMPLE we chose menus because menus are a visual method for entering commands. But we also included the accelerator (a key stroke) in menu Exit (the F3 key) for a simple demonstration.

The menu definition is in the SAMPLE.RC file. Whenever the main window is created (by issuing the WinCreatStdWindow function call), the main menu is created at the same time. The main menu has two submenus. The first submenu, Show Names, has two pulldown items: Ascending Order and Descending Order. The second submenu, Exit, also has two pulldown items: Exit Sample and Resume.

There are two methods that a PM application can use to receive data input from the application user – via dialog boxes or the keyboard / mouse. The SAMPLE program uses the dialog box, because the data itself is visual and much of the workload is processed by the WIN function calls. A dialog box is a window that suddenly pops up on the display screen containing titles, rectangular fields for text input, scroll bars, either buttons or boxes, and a listbox. The dialog box is a child window that contains controls and must have a parent window created by the PM application.

While programming SAMPLE, we found that a dialog box procedure should never call WinDefWindowProc, but should instead call WinDefDlgProc. The dialog box processes all the window messages and addresses those messages to their respective windows. Therefore a dialog box requires a dialog procedure, which is very similar in form to a window procedure. The major difference is that window boxes call WinDefWindowProc, whereas dialog boxes call WinDefDlgProc.

PM offers a dialog box editor.

At SAMPLE.DLG, we have defined a dialog template with different window styles and different frame controls. At each control (a child window under a dialog box), we have defined a window class (button styles and miscellaneous information). Because different output devices have different resolutions, the specified coordinate positions of the listbox and the controls (Enter and Cancel) inside the dialog box will be totally dependent on the user.

Fortunately, PM offers a dialog box editor, and with its help, users can visually place the listbox and controls in a dialog box. In SAMPLE, we have two dialog boxes, one for listing the names in ascending order, the other for listing the names in descending order. They are coded almost identically. We keep two almost identical sections of code in the module because all the dialog box procedures are short-lived. Memory is allocated when the dialog box pops up, and is deallocated when the dialog box disappears.

The last step in coding the dialog box procedure is to make sure that the two dialog box procedure names are exported in the program's definition file and have forward references in the beginning of PM application programs.

Code Explained

The following is a detailed explanation of the three major parts of SAMPLE.

The largest portion of the SAMPLE program resides in the fnwpClient window procedure. A detailed description will help users to understand the PM application (see Figure 3).

Explanation:

. WM_CREATE: We create a child window that displays "CHILD WINDOW UNDER CLIENT WINDOW" at all times when the client window exists. This message will be displayed on top of the client window because parameter HWND_TOP is specified.

. WM_ERASEBACKGROUND: Whenever any dialog menu is chosen to move from point A to point B, the dialog menu's old image still exists. To make the picture more readable, the proper client window's background should be restored.

. WM_PAINT: We simply write the text string "CHILD WINDOW UNDER CLIENT WINDOW" in the child window.

. WM_COMMAND: We process the user's desired command:

```
/********************** Start of second dialog procedure **********************/
/******************************************************************************/
/*                                                                            */
/* DlgProc:  fnwpAscendBoxDlg                                                 */
/*                                                                            */
/* A dialog procedure which displays a list of names in                       */
/* ascending order.                                                           */
/*                                                                            */
/* Side effects : None                                                        */
/*                                                                            */
/* Modify : None                                                              */
/*                                                                            */
/******************************************************************************/

MRESULT EXPENTRY fnwpAscendBoxDlg( HWND hwndDlg, USHORT msg, MPARAM mp1,
                                   MPARAM mp2 )
{
    CHAR szBuffer[LEN_LISTBOXENTRY];
    INT  i;
    SHORT id;

    switch (msg)
    {
      case WM_INITDLG:
         CentreDlgBox( hwndDlg );             /* Position centrally          */

         /*************************************************************************/
         /* Initialize the listbox with a set of names loaded from a              */
         /* resource file.                                                        */
         /*************************************************************************/

         for ( i = 0; i  NUM_LISTBOXENTRIES; i++ )
    {
       /*************************************************************************/
       /* Load from stringtable into an intermediate variable                   */
       /*************************************************************************/
       WinLoadString( hab,
                      NULL,
                      LBI_1 + i,
                      LEN_LISTBOXENTRY,
                      (PSZ)szBuffer
                    );
       /*************************************************************************/
       /* Add item to the listbox in ascending order                            */
       /*************************************************************************/
       WinSendDlgItemMsg( hwndDlg,
                          ASCENDLISTBOX,
                          LM_INSERTITEM,
                          MPFROM2SHORT( LIT_SORTASCENDING, 0 ),
                          MPFROMP( szBuffer )
                         );
    }
```

Figure 3. DlgProc fnwpAscendBoxDlg (Part 1 of 3)

```
/*************************************************************************/
/* Make the first list item initially selected  This is to force the     */
/* first item to be chosen.  User can select any one that shows on the   */
/* screen in the dialog box.                                             */
/*************************************************************************/
WinSendDlgItemMsg( hwndDlg,
                   ASCENDLISTBOX,
                   LM_SELECTITEM,

                   MPFROMSHORT( 0 ),      /* First item index value       */
                   MPFROMSHORT( TRUE )
                  );
  break;
case WM_CONTROL:
  /***********************************************************************/
  /* When user double-clicks the mouse, the highlight item in the        */
  /* dialog box is chosen.                                               */
  /***********************************************************************/
  switch( SHORT2FROMMP( mp1 ) )
  {
     case LN_ENTER:                      /* Catch double-click on        */
        WinPostMsg( hwndDlg,             /* list box item, and           */
                    WM_COMMAND,          /* simulate Enter               */
                    MPFROM2SHORT( DID_OK, CMDSRC_OTHER ),
                    MPFROMLONG( 1L )     /* pushbutton selection         */
                  );
      break;
    default:
      break;
  }
  break;
case WM_COMMAND:
  switch( SHORT1FROMMP( mp1 ) )
  {
     case DID_OK:    /* Enter key or pushbutton pressed/ selected        */
        /*****************************************************************/
        /* Find out which item (if any) was selected and return.         */
        /*****************************************************************/

        szFlag = FALSE;
        id = SHORT1FROMMR( WinSendDlgItemMsg( hwndDlg,
                           ASCENDLISTBOX,
                           LM_QUERYSELECTION,
                           0L,
                           0L ) );
        if( id == LIT_NONE )
          strcpy( szSelection, "" ); /* Nothing selected               */
        else
        /*****************************************************************/
        /* Something has been selected from dialog box.                  */
        /*****************************************************************/
          WinSendDlgItemMsg( hwndDlg,
                           ASCENDLISTBOX,
```

Figure 3. DlgProc fnwpAscendBoxDlg (Part 2 of 3)

```
                LM_QUERYITEMTEXT,
                MPFROM2SHORT( id, LEN_LISTBOXENTRY ),
                MPFROMP( szSelection ) );
            case DID_CANCEL: /* Escape key or CANCEL pushbutton pressed/selected */
              WinDismissDlg( hwndDlg, TRUE ); /* Finished with dialog box       */
              return FALSE;
            default:
              break;
          }
          break;

        default:  /* Pass all other messages to the default dialog proc          */
          return WinDefDlgProc( hwndDlg, msg, mp1, mp2 );
        }
        return FALSE;
    }

    /********************* End of second dialog procedure ************************/
```

Figure 3. DlgProc fnwpAscendBoxDlg (Part 3 of 3)

.. MI_EXIT, to process the WM_QUIT window message.

.. MI_RESUME, to continue the window process.

.. MI_ASCENDLISTBOX, to process the "list name in ascending order" dialog menu (see Figure 4).

Explanation:

... WM_INITDLG: This decides where to put the dialog box in a client window. By default, the dialog box will be aligned in the upper-left corner of the client window. The user procedure CenterDlgBox simply places the dialog box in the center of the client window (see Figure 5).

Explanation:

Following the system window function calls, we want to fill in the dialog box with names in input order, where names are extracted from the resource file. *Note*: The PM resource file is a simple ASCII file similar to a source code file. It is compiled into an object form using a resource compiler, and this is linked into the executable file.

... WM_CONTROL catches a double-click on a name item. Here we simply catch the name and display the name of the client window in the child window once it returns to the dialog menu.

... WM_COMMAND processes the user's command:

.... DID_OK chooses the name (if any), and displays it at the top of the client window.

.... DID_CANCEL simply returns to the dialog menu.

.... Default, does nothing but return.

.. MI_DESCENDLISTBOX processes the "list name in descending order" dialog menu (see Figure 6).

Explanation:

... MI_DESCENDLISTBOX does the same job as MI_ASCENDLISTBOX, except that the names extracted from the resource file have been processed in descending order.

.. Default, passes all other commands to the default command procedure.

.. WinDlgBox, asks PM to build the dialog box for you with the main window frame as owner.

.. WinInvalidateRect, forces an update of the client window.

. WM_CLOSE processes the WM_QUIT window message.

. Default, passes all other messages to the default window procedure (PM internally supports this).

Presentation Space and the Graphics Programming Interface

Earlier we said there are three Presentation Spaces (PS) – cached micro-PS, micro-PS, and normal-PS. The SAMPLE program above

IBM Personal System/2 Reference Tables:

Configuration and Operating Information

Pages C1 through C16
may be detached
for future use.

IBM PS/2 Reference Tables

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Since the advent of the IBM Personal System/2 family, a wide variety of system models, memory modules, memory expansion adapters, and fixed disks have been introduced. While this broad product line offers unparalleled flexibility, it can also make the tasks of selecting, configuring, or expanding systems seem complex and sometimes daunting. This article is intended to help simplify these tasks.

To assist in the system-selection process, information is provided about base system features, expandability, and usability. Much of what distinguishes an IBM system from that of the competition is a careful attention to the details of human factors design that cannot be measured with simple numbers. Nonetheless, even comparisons of those traits that can be measured reveal the benefits of IBM's concern for every aspect of system design. Reliability, expandability, size, weight, noise output, power use, and electromagnetic radiation levels can and should be compared during the system-selection process.

In making the system-selection decision, it is also important to consider performance. Therefore, it is important to understand why benchmarks and performance comparisons are not included in this guide, and to place in context many of the performance indicators that are provided.

Benchmarks are useful only to the extent that they are clearly recognized to be a limited measure of a specific component of a complex system. Rarely can any one benchmark, data point, or set of benchmarks crystallize the essence of system performance into a single comparative number. More often, they lead to misguided decisions based upon improper interpretations of system performance characteristics. Even worse, benchmarks are often used to justify inappropriate system selection criteria and weightings far removed from the realities of daily use.

Total system throughput and application performance are comprised of many interrelated factors; a bottleneck in one system subcomponent can easily negate supposed performance benefits from another ultra-fast system subcomponent. Without a complete understanding of the interrelationships of every subcomponent of the systems, decision makers might be swayed by marketing presentations that emphasize the specifications of certain suboptimized components or carefully selected benchmarks that often demonstrate performance characteristics unrelated to actual system throughput in daily use. *No benchmark should ever replace actual use or trial as the primary microcomputer system-selection criterion.*

Another critical consideration is that benchmarks almost always single-mindedly exclude reliability comparisons from performance considerations. This rewards companies that design for performance over reliability. In general, during system design, performance can be bought at the expense of reliability. IBM designs to optimize system reliability and overall system throughput through balanced system design rather than to maximize individual component specifications. Thus, IBM systems perform very well when measured by throughput or user perception of performance, and extremely well when measured to include system integrity lapses as significant negative performance indicators.

Finally, most benchmarks published to date measure PS/2 performance under single-thread benchmarks that miss the entire design point of the multitasking, Micro Channel-based Personal System/2. It is somewhat analogous to comparing a rocket to a jet plane using maximum attainable speed as the benchmark criterion. The jet may not perform like a rocket if orbiting the earth is the objective, but it more likely outperforms a rocket for anyone whose objectives are smooth take-offs and landings and flexibility in selecting destinations.

We invite you to experience Personal System/2 ergonomics and performance first-hand before making system-selection decisions, and we hope that this article makes a valuable contribution toward helping you find the system and configuration that meets your needs.

Contents

Figure 1: IBM Personal System/2 Model Summary. Figure 1 summarizes PS/2 system model names and numbers, processor speed, number of wait states, standard and maximum system board memory, system board memory speed, maximum system memory, standard disk / diskette capacity, number of free slots, and graphics capability.

Figure 2: IBM Personal System/2 Memory Expansion Alternatives by Model. Figure 2 lists applicable

memory expansion features by PS/2 model, and gives the feature name, feature number, part number, standard and maximum memory, memory speed, and a list of applicable PS/2 systems and adapters for each system, as follows:

Figure 2-	PS/2 Model(s)
A	25-00x/-G0x/-Cxx/-Kxx
B	25-L01/-L04
C	30-001/-002/-021
D	30 286-E01/-E21
E	50-021
F	50 Z-031/-061
G	55 SX-031/-061
H	60-041/-071
I	70 386-E61/-121
J	70 386-A21
K	P70 386-061/-121
L	80 386-041
M	80 386-071
N	80 386-111/-311

Figure 3: IBM Personal System/2 Memory Expansion Feature Summary. Figure 3 contains the same information as Figure 2, but summarizes memory expansion features in feature number order.

Figure 4: IBM Personal System/2 Disk Drive Summary. Figure 4 contains information about each of the different drives included in Personal System/2 models:

- Figure 4-A. DASD by Drive:
  - — 3.5-Inch Fixed Disk Drives
  - — 5.25-Inch Fixed Disk Drives
- Figure 4-B. DASD by Model:
  - — ST-506 Based Systems
  - — ESDI-Based Systems

Figure 5: IBM Personal System/2 Ergonomic and Environmental Data. Figure 5 contains information about power, heat, and noise factors, as follows:

- Figure 5-A. System Units
- Figure 5-B. Displays
- Figure 5-C. Adapter Card Power Draw
- Figure 5-D. Fixed Disk Power Draw

Figure 6: IBM Personal System/2 and Operating System/2 Announcement Letter History. Listed are relevant announcement letters since April 2, 1987.

The information contained herein applies to all PS/2 systems, displays, memory, and disk features introduced in the US between April 2, 1987 and May 31, 1989. In all figures, prices shown are suggested retail prices.

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A Summary of IBM Personal System/2 Models

Product Number	Suggested Retail Price	CPU			System Board Memory			Maximum Total Memory	Std. Fixed Disk	Std 3.5" Diskette Drive(s)	# of Free Slots	Graphics
		Type (Intel)	Speed	# of Wait States	Std.	Max.	Speed					
8525-001[0]	$1350	8086	8MHz	0	512K	640K	150ns	640K	None	720K	2-XT[1]	MCGA-mono[2]
8525-004[0]	$1695	8086	8MHz	0	512K	640K	150ns	640K	None	720K	2-XT[1]	MCGA-color[2]
8525-C02[0]	$1898	8086	8MHz	0	512K	640K	150ns	640K	None	720K(2)	2-XT[1]	MCGA-mono[2]
8525-C05[0]	$2243	8086	8MHz	0	512K	640K	150ns	640K	None	720K(2)	2-XT[1]	MCGA-color[2]
8525-G01	$1395	8086	8MHz	0	512K	640K	150ns	640K	None	720K	2-XT[1]	MCGA-mono[2]
8525-G04	$1740	8086	8MHz	0	512K	640K	150ns	640K	None	720K	2-XT[1]	MCGA-color[2]
8525-K02	$1943	8086	8MHz	0	512K	640K	150ns	640K	None	720K(2)	2-XT[1]	MCGA-mono[2]
8525-K05	$2288	8086	8MHz	0	512K	640K	150ns	640K	None	720K(2)	2-XT[1]	MCGA-color[2]
8525-L01	$2139	8086	8MHz	0	640K	640K	150ns	640K	None	720K	1-XT[1]	MCGA-mono[2]
8525-L04	$2484	8086	8MHz	0	640K	640K	150ns	640K	None	720K	1-XT[1]	MCGA-color[2]
8530-001	$1695	8086	8MHz	0	640K	640K	150ns	2.64MB[3]	None	720K	3-XT	MCGA
8530-002†	N/A†	8086	8MHz	0	640K	640K	150ns	2.64MB[3]	None	720K(2)	3-XT	MCGA
8530-021	$2395	8086	8MHz	0	640K	640K	150ns	2.64MB[3]	20MB	720K	3-XT	MCGA
8530-E01	$1995	80286	10MHz	1	512K	4MB[3]	120ns	15MB[3]	None	1.44MB	3-AT	VGA
8530-E21	$2595	80286	10MHz	1	512K	4MB[3]	120ns	15MB[3]	20MB	1.44MB	3-AT	VGA
8550-021†	N/A†	80286	10MHz	1	1MB	1MB	120ns	16MB	20MB	1.44MB[4]	3-MC	VGA
8550-031	$3250	80286	10MHz	0[5]	1MB	2MB[6]	85ns	16MB	30MB	1.44MB	3-MC	VGA
8550-061	$3650	80286	10MHz	0[5]	1MB	2MB[6]	85ns	16MB	60MB	1.44MB	3-MC	VGA
8555-031	$3895	80386SX	16MHz	0-2[5]	2MB[7]	4MB[6]	85ns	16MB	30MB	1.44MB	3-MC	VGA
8555-061	$4295	80386SX	16MHz	0-2[5]	2MB[7]	4MB	85ns	16MB	60MB	1.44MB	3-MC	VGA
8560-041	$5295	80286	10MHz	1	1MB	1MB	120ns	16MB	44MB	1.44MB[4]	7-MC	VGA
8560-071	$5795	80286	10MHz	1	1MB	1MB	120ns	16MB	70MB	1.44MB[4]	7-MC	VGA
8570-E61	$5495	80386	16MHz	0-2	1MB[7]	6MB[6]	100ns[8]	16MB	60MB	1.44MB	3-MC	VGA
8570-121	$7995	80386	20MHz	0-2	2MB[7]	6MB	85ns	16MB	120MB	1.44MB	3-MC	VGA
8570-A21	$11295	80386	25MHz	0-5[9]	2MB[7]	8MB	80ns[9]	16MB	120MB	1.44MB	3-MC	VGA
8573-061	$7695	80386	20MHz	0-2	4MB[7]	8MB	85ns	16MB	60MB	1.44MB	2-MC[1]	VGA-plasma[2]
8573-121	$8295	80386	20MHz	0-2	4MB[7]	8MB	85ns	16MB	120MB	1.44MB	2-MC[1]	VGA-plasma[2]
8580-041	$6995	80386	16MHz	1	1MB	2MB	80ns	16MB	44MB	1.44MB[4]	7-MC	VGA
8580-071	$7995	80386	16MHz	1	2MB	2MB	80ns	16MB	70MB	1.44MB[4]	7-MC	VGA
8580-111	$8995	80386	20MHz	0-2	2MB[7]	4MB	80ns	16MB	115MB	1.44MB[4]	7-MC	VGA
8580-311	$11995	80386	20MHz	0-2	2MB[7]	4MB	80ns	16MB	314MB	1.44MB[4]	7-MC	VGA

- Systems listed as requiring a variable number of wait states use Page Memory Logic. Accessing memory outside the most recently used page (one page ≈ 2KB) requires one wait state. Writing data to memory also requires one wait state. Therefore, read access from the current page requires no wait states; read access outside the current page or a write to the current page requires one wait state; and a write request to outside the current page requires two wait states.

[0] Includes IBM Space-Saving Keyboard.

[1] One available slot is a short slot, i.e. half-slot.

[2] Includes built-in display as part of base system.

[3] Requires special consideration involving configuration and availability of conventional versus extended and/or expanded memory. You may need assistance in determining suitability to your needs.

[4] To ensure proper operation of the diskette drive, this model requires the DASDDRVR.SYS device driver when running DOS 3.30. The driver is not required when running OS/2 or DOS 4.00.

[5] Expansion adapter memory that runs at 120ns causes the processor to add one wait state for access to that memory.

[6] Requires the replacement of the standard 1MB module(s) on the system board with 2MB module(s).

[7] 128K of system memory is mapped for use by BIOS in order to improve system performance.

[8] Expansion adapter memory and system board expansion memory are rated at 80ns or 85ns.

[9] Includes 30ns 64K memory cache. Cached data is accessed with zero wait states.

† Withdrawn from marketing

Figure 1. IBM PS/2 Model Summary

Applicable Memory Expansion Features for Each Model

Memory expansion alternatives are either SIPs (Single In-line Packages) or Adapters. SIPs are modules that may be used to expand the system board (planar) or adapters or both, as noted.

On all systems with more than 640K of standard memory, the extra memory is system board memory mapped beginning at the 1MB address. On 80286-based systems, this memory can be used only as extended memory. On 80386SX- and 80386-based systems, this memory is extended memory that can also be used as expanded memory with the appropriate drivers.

Throughout all tables, x = any substitutable character, e.g., 857x-x61 = 8570-E61 and 8573-061.

Figure 2-A. IBM PS/2 Models 25-00x/-G0x/-C0x/-K0x

Feature Name (IBM PS/2 ...)	Price	Feature Number	Part Number	Memory Std.	Memory Max.	Memory Speed	Description/For Use on:
128KB Memory Expansion Kit	$51	#4105	78X8955	128K	128K	150ns	Module for planar

- This model comes with planar (system board) space for 640K of RAM, of which 512K is occupied. Addition of the 128K Feature #4105 is required to bring system memory to the full 640K.
- Only 640K of conventional memory is supported.
- There are two XT-bus compatible slots available for adapter expansion, one of which is a half-size (8-inch) slot.

Figure 2-B. IBM PS/2 Models 25-L01/-L04

Feature Name (IBM PS/2 ...)	Price	Feature Number	Part Number	Memory Std.	Memory Max.	Memory Speed	Description/For Use on:
No expansion options available							

- These models come fully configured with 640K of system board memory. Addition of the 128K Feature #4105 is therefore not required.
- Only 640K of conventional memory is supported.
- There is only one half-size (8-inch) XT-bus compatible slot available for adapter expansion, because one slot is occupied by the Token-Ring Network PC Adapter.

Figure 2-C. IBM PS/2 Models 30-001/-002†/-021

Feature Name (IBM PS/2 ...)	Price	Feature Number	Part Number	Memory Std.	Memory Max.	Memory Speed	Description/For Use on:
2MB Expanded Memory Adapter	$1355	#3905	2685193	2MB	2MB	150ns	Adapter; fully populated

- This model comes with 640K of planar (system board) memory. No additional system board memory expansion is possible.
- Using the adapter specified, an additional 2MB of memory can be added, which can be configured as expanded memory using the DOS 4.00 driver XMA2EMS.SYS.
- There are three XT-bus compatible slots available for adapter expansion, but the addition of more than one memory adapter is not supported.

† Withdrawn from marketing

Figure 2(A-N). PS/2 Memory Expansion by Model (Part 1 of 6)

Figure 2-D. IBM PS/2 Models 30 286-E01/-E21

Feature Name (IBM PS/2 ...)	Price	Feature Number	Part Number	Memory Std.	Memory Max.	Memory Speed	Description/For Use on:
0.5MB Memory Module Kit	$215	#3397	30F5348	512K	512K	120ns	Modules for planar or #8635 Cannot mix with #7833
2MB Memory Module Kit	$1295	#7833	30F5360	2MB	2MB	120ns	Modules for planar or #8635 Cannot mix with #3397
Multifunction Adapter[1]	$445	#8635	30F5364	0MB	12MB	120ns	Adapter; uses #3397/#7833

- These models come with four system board memory spaces, two of which are occupied by replaceable 256K SIPs for a total of 512K. One 0.5MB Feature #3397, consisting of two 256K modules, can be added for a total of 1MB. Alternately, the original system board SIPs can be replaced by one or two of the 2MB Feature #7833, each consisting of two 1MB modules, for a total of 2MB or 4MB of system board memory. Different size SIPs cannot be used together on the system board.
- The ability to use a non-IBM memory expansion card in the Personal System/2 Model 30/286 is dependent on the flexibility of the card in establishing its starting memory address. To operate properly in the standard Model 30 286 with 512KB, a memory expansion adapter must support a starting memory address of 512KB. To operate properly in a Model 30 286 with 1MB, 2MB, or 4MB of system board memory, a memory expansion adapter must support a starting memory address of 384KB plus the total amount of system board memory installed.
- There are three AT-bus compatible slots available for adapter expansion.

[1] The PS/2 Multifunction Adapter, Feature #8635, can only be used with the original 512KB of memory on the system board. Additional memory modules must be moved from the system board to the PS/2 Multifunction Adapter. Up to two PS/2 Multifunction Adapters may be installed, providing a maximum of 15MB of additional extended memory. This adapter does not support the IBM 3270 Workstation Program Version 1.0 or 1.1 or the DOS 4.00 expanded memory drivers, but does support LIM EMS 4.0 when used in conjunction with Above Disc (registered trademark of Teleware West Company) 2.0, which is not included with the adapter and must be purchased separately. (Order Vehicle 5871-AAA / Feature #5448 / Part #30F5448). Above Disc works under PC DOS Version 3.30 or higher. This adapter also includes one parallel and one serial port. When two Multifunction Adapters are installed in the same system, it is necessary to disable the serial port on the system board in order to achieve full operation of three parallel and two serial ports.

Figure 2-E. IBM PS/2 Model 50-021 †

Feature Name (IBM PS/2 ...)	Price	Feature Number	Part Number	Memory Std.	Memory Max.	Memory Speed	Description/For Use on:
2-8MB 80286 Memory Expansion Option	$1795	#8286	6450609	2MB	8MB	85ns	Adapter Uses #5212/#5213
1MB Memory Module Kit - 85ns	$695	#5212	6450603	1MB	1MB	85ns	Module for #8286 Mix with #5213 OK
2MB Memory Module Kit - 85ns	$1395	#5213	6450604	2MB	2MB	85ns	Module for #8286 Mix with #5213 OK
0-8MB Expanded Memory Adapter/A	$600	#7259	1497259	0MB	8MB	120ns	Adapter; uses #3397/#7833
0.5MB Memory Module Kit	$215	#3397	30F5348	512K	512K	120ns	Modules for #7259 Mix with #7833 OK
2MB Memory Module Kit	$1295	#7833	30F5360	2MB	2MB	120ns	Modules for #3920 (replacement) or #7259 Mix with #3397 OK
80286 Memory Expansion Option	$630	#3006	6450344	512K	2MB	150ns	Adapter; uses #3012
80286 Memory Expansion Kit	$215	#3012	6450345	512K	512K	150ns	Modules for #3006
2MB Expanded Memory Adapter/A †	N/A †	#3920	1497252	2MB	8MB	120ns	Adapter; fully populated with replaceable 0.5MB modules (#3397) which can be replaced by 2MB modules (#7833)

- This model comes with one system board memory space that is occupied by a non-replaceable 1MB module.
- Only 1MB of system board memory is possible; of this, 640K is conventional user memory and 384K is extended memory that cannot be used as expanded memory.
- Using the above-referenced adapters and kits, up to 15MB of additional extended memory can be added. The memory from any one adapter can be configured as expanded memory using the DOS 4.00 driver XMA2EMS.SYS.
- There are three 16-bit Micro Channel slots available for adapter expansion. One slot incorporates the video extension interface that allows the addition of an advanced video graphics board such as the IBM 8514/A in order to upgrade video function without duplicating the built-in VGA circuitry.

† Withdrawn from marketing

Figure 2(A-N). PS/2 Memory Expansion by Model (Part 2 of 6)

Figure 2-F. IBM PS/2 Models 50 Z-031/-061

Feature Name (IBM PS/2 ...)	Price	Feature Number	Part Number	Memory Std.	Memory Max.	Memory Speed	Description/For Use on:
2-8MB 80286 Memory Expansion Option	$1795	#8286	6450609	2MB	8MB	85ns	Adapter; uses #5212/#5213
1MB Memory Module Kit - 85ns	$695	#5212	6450603	1MB	1MB	85ns	Module for #8286 Mix with #5213 OK
2MB Memory Module Kit - 85ns	$1395	#5213	6450604	2MB	2MB	85ns	Module for planar (replacement) or #8286 Mix with #5212 OK on #8286
0-8MB Expanded Memory Adapter/A	$600	#7259	1497259	0MB	8MB	120ns	Adapter; uses #3397/#7833
0.5MB Memory Module Kit	$215	#3397	30F5348	512K	512K	120ns	Modules for #7259 Mix with #7833 OK
2MB Memory Module Kit	$1295	#7833	30F5360	2MB	2MB	120ns	Modules for #3920 (replacement) or #7259 Mix with #3397 OK
80286 Memory Expansion Option	$630	#3006	6450344	512K	2MB	150ns	Adapter; uses #3012
80286 Memory Expansion Kit	$215	#3012	6450345	512K	512K	150ns	Modules for #3006
2MB Expanded Memory Adapter/A †	N/A †	#3920	1497252	2MB	8MB	120ns	Adapter; fully populated with replaceable 0.5MB modules (#3397) which can be replaced by 2MB modules (#7833)

- These models come with one system board memory space that is occupied by a replaceable 1MB module. This 1MB module can be replaced by the 2MB Feature #5213 to achieve the maximum of 2MB on the system board.
- Any of the system board memory above 640K is extended memory only and cannot be used as expanded memory.
- Using the above-referenced planar replacement modules, adapters, and kits, up to 15MB of extended memory can be added. The memory from any one adapter can be configured as expanded memory using the DOS 4.00 driver XMA2EMS.SYS.
- There are three 16-bit Micro Channel slots available for adapter expansion. One slot incorporates the video extension interface that allows the addition of an advanced video graphics board such as the IBM 8514/A in order to upgrade video function without duplicating the built-in VGA circuitry.

† Withdrawn from marketing

Figure 2-G. IBM PS/2 Models 55 SX-031/-061

Feature Name (IBM PS/2 ...)	Price	Feature Number	Part Number	Memory Std.	Memory Max.	Memory Speed	Description/For Use on:
2-8 MB 80286 Memory Expansion Option	$1795	#8286	6450609	2MB	8MB	85ns	Adapter; uses #5212/#5213
1MB Memory Module Kit - 85ns	$695	#5212	6450603	1MB	1MB	85ns	Module for planar or #8286 Mix with #5213 OK
2MB Memory Module Kit - 85ns	$1395	#5213	6450604	2MB	2MB	85ns	Module for planar or #8286 Mix with #5212 OK
0-8MB Expanded Memory Adapter/A	$600	#7259	1497259	0MB	8MB	120ns	Adapter; uses #3397/#7833
0.5MB Memory Module Kit	$215	#3397	30F5348	512K	512K	120ns	Modules for #7259 Mix with #7833 OK
2MB Memory Module Kit	$1295	#7833	30F5360	2MB	2MB	120ns	Modules for #7259 Mix with #3397 OK

- The 8555-031 comes with two system board memory spaces that are occupied by replacable 1MB modules. These 1MB modules can be replaced with the 2MB modules, Feature #5213.
- The 8555-061 comes with two system board memory spaces, one of which is occupied by a 2MB module. The free system board space can be filled with either Feature #5212 or Feature #5213.
- Using the above-referenced planar expansion options, adapters, and kits, up to 14MB of additional extended memory can be configured. Any memory above 640K can be configured as expanded memory using the DOS 4.00 drivers XMAEM.SYS and XMA2EMS.SYS.
- There are three 16-bit Micro Channel slots available for adapter expansion. One slot incorporates the video extension interface that allows the addition of an advanced video graphics board such as the IBM 8514/A in order to upgrade video function without duplicating the built-in VGA circuitry.

Figure 2(A-N). PS/2 Memory Expansion by Model (Part 3 of 6)

Figure 2-H. IBM PS/2 Models 60-041/-071

Feature Name (IBM PS/2 ...)	Price	Feature Number	Part Number	Memory Std.	Memory Max.	Memory Speed	Description/For Use on:
2-8MB 80286 Memory Expansion Option	$1795	#8286	6450609	2MB	8MB	85ns	Adapter; uses #5212/#5213
1MB Memory Module Kit - 85ns	$695	#5212	6450603	1MB	1MB	85ns	Module for #8286 Mix with #5213 OK
2MB Memory Module Kit - 85ns	$1395	#5213	6450604	2MB	2MB	85ns	Module for #8286 Mix with #5212 OK
0-8MB Expanded Memory Adapter/A	$600	#7259	1497259	0MB	8MB	120ns	Adapter; uses #3397/#7833
0.5MB Memory Module Kit	$215	#3397	30F5348	512K	512K	120ns	Modules for #7259 Mix with #7833 OK
2MB Memory Module Kit	$1295	#7833	30F5360	2MB	2MB	120ns	Modules for #3920 (replacement) or #7259 Mix with #3397 OK
80286 Memory Expansion Option	$630	#3006	6450344	512K	2MB	150ns	Adapter; uses #3012
80286 Memory Expansion Kit	$215	#3012	6450345	512K	512K	150ns	Modules for #3006
2MB Expanded Memory Adapter/A †	N/A †	#3920	1497252	2MB	2MB	120ns	Adapter; fully populated with replaceable 0.5MB modules (#3397) which can be replaced by 2MB modules (#7833)

- These models come with one system board memory space that is occupied by a non-replaceable 1MB module.
- Only 1MB of system board memory is possible; of this, 640K is conventional user memory and 384K is extended memory that cannot be used as expanded memory.
- Using the above-referenced adapters and kits, up to 15MB of additional extended memory can be added. The memory from any one adapter can be configured as expanded memory using the DOS 4.00 driver XMA2EMS.SYS.
- There are seven 16-bit Micro Channel slots available for adapter expansion. One slot incorporates the video extension interface that allows the addition of an advanced video graphics board such as the IBM 8514/A in order to upgrade video function without duplicating the built-in VGA circuitry.

† Withdrawn from marketing

Figure 2-I. IBM PS/2 Models 70 386-E61/-121

Feature Name (IBM PS/2 ...)	Price	Feature Number	Part Number	Memory Std.	Memory Max.	Memory Speed	Description/For Use on:
80386 Memory Expansion Option	$1695	#3019	6450367	2MB	6MB	80ns	Adapter; uses #3064
80386 Memory Expansion Kit	$1395	#3064	6450372	2MB	2MB	80ns	Module for #3019
2-8MB 80386 Memory Expansion Option	$1695	#5211	6450605	2MB	8MB	85ns	Adapter; uses #5212/#5213
1MB Memory Module Kit - 85ns	$695	#5212	6450603	1MB	1MB	85ns	Module for planar or #5211 Mix with #5213 OK
2MB Memory Module Kit - 85ns	$1395	#5213	6450604	2MB	2MB	85ns	Module for planar or #5211 Mix with #5212 OK

- The 8570-061 comes with three system board memory spaces, one of which is occupied by a replaceable 1MB module. This module can be replaced with the 2MB Feature #5213. Free system board spaces can be filled with either #5212 or #5213 or both.
- The 8570-121 comes with three system board memory spaces, one of which is occupied by a 2MB module. The two free system board spaces can be filled with any combination of the 1MB Feature #5212 or the 2MB Feature #5213.
- Using the above-referenced planar expansion options, adapters, and kits, up to 15MB of additional extended memory can be configured for the 8570-061. Up to 14MB of additional extended memory can be configured for the 8570-121. Any memory above 640K can be configured as expanded memory using the DOS 4.00 drivers XMAEM.SYS and XMA2EMS.SYS.
- There are two 32-bit and one 16-bit Micro Channel slots available for adapter expansion. Memory adapters require a 32-bit slot. The 16-bit slot incorporates the video extension interface that allows the addition of an advanced video graphics board such as the IBM 8514/A in order to upgrade video function without duplicating the built-in VGA circuitry.

Figure 2(A-N). PS/2 Memory Expansion by Model (Part 4 of 6)

Figure 2-J. IBM PS/2 Model 70 386-A21

Feature Name (IBM PS/2 ...)	Price	Feature Number	Part Number	Memory Std.	Memory Max.	Memory Speed	Description/For Use on:
Memory Module Kit - 80ns	$1495	#5214	6450608	2MB	2MB	80ns	Module for planar
80386 Memory Expansion Option	$1695	#3019	6450367	2MB	6MB	80ns	Adapter; uses #3064
80386 Memory Expansion Kit	$1395	#3064	6450372	2MB	2MB	80ns	Module for #3019
2-8MB 80386 Memory Expansion Option	$1695	#5211	6450605	2MB	8MB	85ns	Adapter; uses #5212/#5213
1MB Memory Module Kit - 85ns	$695	#5212	6450603	1MB	1MB	85ns	Module for #5211 Mix with #5213 OK
2MB Memory Module Kit - 85ns	$1395	#5213	6450604	2MB	2MB	85ns	Module for #5211 Mix with #5212 OK

- This model comes with four system board memory spaces, one of which is occupied by a 2MB module. The free spaces can be filled with up to three of the 2MB Feature #5214.
- Using the above-referenced planar expansion options, adapters, and kits, up to 14MB of additional extended memory can be configured. Any memory above 640K can be configured as expanded memory using the DOS 4.00 drivers XMAEM.SYS and XMA2EMS.SYS.
- There are two 32-bit and one 16-bit Micro Channel slots available for adapter expansion. Memory adapters require a 32-bit slot. The 16-bit slot incorporates the video extension interface that allows the addition of an advanced video graphics board such as the IBM 8514/A in order to upgrade video function without duplicating the built-in VGA circuitry.

Figure 2-K. IBM PS/2 Models P70 386-061/121

Feature Name (IBM PS/2 ...)	Price	Feature Number	Part Number	Memory Std.	Memory Max.	Memory Speed	Description/For Use on:
80386 Memory Expansion Option	$1695	#3019	6450367	2MB	6MB	80ns	Adapter; uses #3064
80386 Memory Expansion Kit	$1395	#3064	6450372	2MB	2MB	80ns	Module for #3019
2-8MB 80386 Memory Expansion Option	$1695	#5211	6450605	2MB	8MB	85ns	Adapter; uses #5212/#5213
1MB Memory Module Kit - 85ns	$695	#5212	6450603	1MB	1MB	85ns	Module for #5211 Mix with #5213 OK
2MB Memory Module Kit - 85ns	$1395	#5213	6450604	2MB	2MB	85ns	Module for planar or #5211 Mix with #5212 OK

- These models come with four system board memory spaces, two of which are occupied by 2MB modules. The free system board spaces can be filled with up to two of the 2MB modules, Feature #5213.
- Using the above-referenced planar expansion options, adapters, and kits, up to 12MB of additional extended memory can be configured. Any memory above 640K can be configured as expanded memory using the DOS 4.00 drivers XMAEM.SYS and XMA2EMS.SYS.
- There is one full-size, 32-bit Micro Channel slot and one half-size, 16-bit slot available for adapter expansion. Memory adapters require the 32-bit slot.

Figure 2-L. IBM PS/2 Model 80 386-041

Feature Name (IBM PS/2 ...)	Price	Feature Number	Part Number	Memory Std.	Memory Max.	Memory Speed	Description/For Use on:
System Board Memory Expansion Kit	$728	#3009	6450375	1MB	1MB	80ns	Module for planar
80386 Memory Expansion Option	$1695	#3019	6450367	2MB	6MB	80ns	Adapter; uses #3064
80386 Memory Expansion Kit	$1395	#3064	6450372	2MB	2MB	80ns	Module for #3019
2-8MB 80386 Memory Expansion Option	$1695	#5211	6450605	2MB	8MB	85ns	Adapter; uses #5212/#5213
1MB Memory Module Kit - 85ns	$695	#5212	6450603	1MB	1MB	85ns	Module for #5211 Mix with #5213 OK
2MB Memory Module Kit - 85ns	$1395	#5213	6450604	2MB	2MB	85ns	Module for #5211 Mix with #5213 OK

- This model comes with two system board memory spaces, one of which is occupied by a 1MB module. The free space can be filled with 1MB Feature #3009.
- Using the above-referenced planar expansion option, adapters, and kits, up to 15MB of additional extended memory can be configured. Any memory above 640K can be configured as expanded memory using the DOS 4.00 drivers XMAEM.SYS and XMA2EMS.SYS.
- There are three 32-bit and four 16-bit Micro Channel slots available for adapter expansion. Memory adapters require a 32-bit slot. One 16-bit slot incorporates the video extension interface that allows the addition of an advanced video graphics board such as the IBM 8514/A in order to upgrade video function without duplicating the built-in VGA circuitry.

Figure 2(A-N). PS/2 Memory Expansion by Model (Part 5 of 6)

Figure 2-M. IBM PS/2 Model 80 386-071

Feature Name (IBM PS/2 ...)	Price	Feature Number	Part Number	Memory Std.	Memory Max.	Memory Speed	Description/For Use on:
80386 Memory Expansion Option	$1695	#3019	6450367	2MB	6MB	80ns	Adapter; uses #3064
80386 Memory Expansion Kit	$1395	#3064	6450372	2MB	2MB	80ns	Module for #3019
2-8MB 80386 Memory Expansion Option	$1695	#5211	6450605	2MB	8MB	85ns	Adapter; uses #5212/#5213
1MB Memory Module Kit - 85ns	$695	#5212	6450603	1MB	1MB	85ns	Module for #5211 Mix with #5213 OK
2MB Memory Module Kit - 85ns	$1395	#5213	6450604	2MB	2MB	85ns	Module for #5211 Mix with #5212 OK

- These model comes with two system board memory spaces, both of which are occupied by 1MB modules.
- Using the above-referenced planar expansion option, adapters, and kits, up to 14MB of additional extended memory can be configured. Any memory above 640K can be configured as expanded memory using the DOS 4.00 drivers XMAEM.SYS and XMA2EMS.SYS.
- There are three 32-bit and four 16-bit Micro Channel slots available for adapter expansion. Memory adapters require a 32-bit slot. One 16-bit slot incorporates the video extension interface that allows the addition of an advanced video graphics board such as the IBM 8514/A in order to upgrade video function without duplicating the built-in VGA circuitry.

Figure 2-N. IBM PS/2 Models 80 386-111/-311

Feature Name (IBM PS/2 ...)	Price	Feature Number	Part Number	Memory Std.	Memory Max.	Memory Speed	Description/For Use on:
80386 System Board Memory Expansion Kit	$1395	#8722	6450379	2MB	2MB	80ns	Module for planar
80386 Memory Expansion Option	$1695	#3019	6450367	2MB	6MB	80ns	Adapter; uses #3064
80386 Memory Expansion Kit	$1395	#3064	6450372	2MB	2MB	80ns	Module for #3019
2-8MB 80386 Memory Expansion Option	$1695	#5211	6450605	2MB	8MB	85ns	Adapter; uses #5212/#5213
1MB Memory Module Kit - 85ns	$695	#5212	6450603	1MB	1MB	85ns	Module for #5211 Mix with #5213 OK
2MB Memory Module Kit - 85ns	$1395	#5213	6450604	2MB	2MB	85ns	Module for #5211 Mix with #5213 OK

- This models come with two system board memory spaces, one of which is occupied by a 2MB module. The free space can be filled with the 2MB Feature #8722.
- Using the above-referenced planar expansion option, adapters, and kits, up to 14MB of additional extended memory can be configured. Any memory above 640K can be configured as expanded memory using the DOS 4.00 drivers XMAEM.SYS and XMA2EMS.SYS.
- There are three 32-bit and four 16-bit Micro Channel slots available for adapter expansion. Memory adapters require a 32-bit slot. One 16-bit slot incorporates the video extension interface that allows the addition of an advanced video graphics board such as the IBM 8514/A in order to upgrade video function without duplicating the built-in VGA circuitry.

Figure 2(A-N). PS/2 Memory Expansion by Model (Part 6 of 6)

A Summary of IBM Personal System/2 Memory Expansion Features

Feature Name (IBM PS/2 ...)	Price	Feature Number	Part Number	Memory Std.	Memory Max.	Memory Speed	Description/For Use on: (P) = Planar/System Board
80286 Memory Expansion Option	$630	#3006	6450344	512K	2MB	150ns	Adapter for 8550-xxx or 8560-xxx Uses #3012
System Board Memory Expansion Kit	$728	#3009	6450375	1MB	1MB	80ns	Module for 8580-041 (P)
80286 Memory Expansion Kit	$215	#3012	6450345	512K	512K	150ns	Modules for #3006
80386 Memory Expansion Option	$1695	#3019	6450367	2MB	6MB	80ns	Adapter for 857x-xxx or 8580-xxx Uses #3064
80386 Memory Expansion Kit	$1395	#3064	6450372	2MB	2MB	80ns	Module for #3019
0.5MB Memory Module Kit	$215	#3397	30F5348	512K	512K	120ns	Modules for 8530-Exx (P), #7259, or #8635
2MB Expanded Memory Adapter	$1355	#3905	2685193	2MB	2MB	150ns	Adapter for 8530-0xx Fully populated
2MB Expanded Memory Adapter/A†[1]	N/A†	#3920	1497252	2MB	8MB	120ns	Adapter for 8550-xxx or 8560-xxx Uses #3397/#7833[1]
128KB Memory Expansion Kit	$51	#4105	78X8955	128K	128K	150ns	Module for 8525-00x/-G0x-C0x/-K0x
2-8MB 80386 Memory Expansion Option	$1695	#5211	6450605	2MB	8MB	85ns	Adapter for 857x-xxx or 8580-xxx Uses #5212/#5213
1MB Memory Module Kit--85ns	$695	#5212	6450603	1MB	1MB	85ns	Module for 857x-x61 (P), 8570-121 (P), 8555-xxx (P), #8286, or #5211
2MB Memory Module Kit--85ns	$1395	#5213	6450604	2MB	2MB	85ns	Module for 8550-031/-061 (P), 8555-xxx (P), 857x-x61/-121 (P), #8286, or #5211
2MB Memory Module Kit--80ns	$1495	#5214	6450608	2MB	2MB	80ns	Module for 8570-A21 (P)
0-8MB Expanded Memory Adapter/A	$600	#7259	1497259	0MB	8MB	120ns	Adapter for 855x-xxx or 8560-xxx Uses #3397/#7833
2MB Memory Module Kit	$1295	#7833	30F5360	2MB	2MB	120ns	Modules for 8530-Exx (P), #3920[1], #7529 or #8635
2-8MB 80286 Memory Expansion Option[2]	$1795	#8286	6450609	2MB	8MB	85ns	Adapter for 855x-xxx or 8560-xxx Uses #5212/#5213
Multifunction Adapter[3]	$445	#8635	30F5364	0MB	12MB	120ns	Adapter for 8530-Exx Uses #3397/#7833
80386 System Board Memory Expansion Kit	$1395	#8722	6450379	2MB	2MB	80ns	Module for 8580-x11 (P)

- All PS/2 memory expansion alternatives listed (with the exception of 8086 and 80286 system board memory and Model 30 286 memory) offer memory that can be used as expanded memory using the drivers provided under DOS 4.00 (for applications written to Lotus / Intel / Microsoft EMS Specification 4.0).
- All PS/2 memory expansion alternatives listed (with the exception of 8086 memory) offer memory that can be used as extended memory (for OS/2, VDISK, or IBMCACHE).
- To improve performance under certain circumstances, it is generally advisable to fully populate the system board before adding adapters.
- When using the IBM Workstation Program, special considerations apply involving configuration and availability of expanded memory. You should seek additional assistance to determine the appropriate memory configuration.

[1] The IBM 2MB Expanded Memory Adapter/A†, Feature #3920, comes fully populated with four sets of modules identical to the 0.5MB Feature #3397, which consists of two 256K modules. The adapter can be expanded from the standard 2MB configuration up to 8MB by replacing any or all of the eight 256K modules on the board with the 2MB Feature #7833, which consists of two 1MB modules. Once removed, two of the 256K modules can be used as if they were the 0.5MB Feature #3397.

[2] The IBM Personal System/2 2-8MB 80286 Memory Expansion Option, Feature #8286, should be placed in a higher numbered slot than Feature #3920 or #7259 when used concurrently in the 8550-021, 8560-041, or 8560-071.

[3] The IBM Personal System/2 Multifunction Adapter, Feature #8635, includes one parallel and one serial port in addition to memory expansion spaces. This adapter supports LIM EMS 4.0 only when used in conjunction with Above Disc 2.0, which is not included with the adapter and must be purchased separately (Order Vehicle 5871-AAA / Feature #5448 / Part 30F5448). Above Disc works with DOS Version 3.30 or higher.

Figure 3. IBM PS/2 Memory Feature Summary

Summary of Personal System/2 Direct Access Storage Devices (DASD)

Figure 4-A. IBM Personal System/2 DASD by Drive

3.5" Fixed Disk Drives

Drive that is standard on:	**8530-021**		**8530-E21**	**8550-021†**		**8550-031** **8555-031**	**8550-061** **8555-061** **8573-061** **8570-E61**	**8570-121** **8573-121** **8570-A21**
Or available as Feature # **or Part #**	**#4107** **78X8958**	**#4110** **27F4130**	**#4115** **27F4969**		**#1030** **6451027**		**#6666** **6450606**	
Suggested Retail Price:	$795	$795	$765		$950		$1695	
Capacity:	20MB	20MB	20MB	20MB	30MB	30MB	60MB	120MB
Integrated Controller?	Yes	No	No	No	No	Yes	Yes	Yes
Interface:	ST-506	ST-506	ST-506	ST-506	ST-506	ST-506	ESDI	ESDI
Drive Type:	26	N/A	26	30	N/A	33	N/A	N/A
Sectors/track:	17	26	17	17	25	25	26	32
Heads:	4	4	4	4	4	4	6	8
Autopark Heads?	No	Yes	No	No	No	No	Yes	Yes
Cylinders:	610	400	610	610	615	615	762	920
Data Transfer Rate:	5.0Mbps	7.5Mbps	5.0Mbps	5.0Mbps	7.5Mbps	7.5Mbps	8.4Mbps	10 Mbps
Access (Seek) Time Average: Track-to-track:	 80ms 15ms	 38ms 15ms	 80ms 15ms	 80ms 15ms	 39ms 15ms	 39ms 15ms	 27ms 15ms	 23ms 5ms
Interleave:	3:1	3:1	2:1	1:1	3:1	1:1	1:1	1:1
Power Draw (Watts) Idle: Max:	 15.5 17.0	 15.5 17.0	 15.5 17.0	 15.5 17.0	 12.1 14.2	 12.0 14.0	 13.0 19.0	 13.0 19.0
Also works on:	8525-xxx	8525-xxx	8530-001 8530-E01		8530-001 8530-E01	8550-061	8550-021† 8550-031	

5.25" Fixed Disk Drives

Drive that is standard on:	**8560-041** **8580-041**	**8560-071** **8580-071**	**8580-011**	**8580-311**
or available as Feature #: **or Part #:**	**#3046** **6450354**	**#3051** **6450355**	**#8730** **6450377**	**#6023** **6450381**
Suggested Retail Price:	$1460	$2505	$3660	$6805
Capacity:	44MB	70MB	115MB	314MB
Integrated Controller?	No	No	No	No
Interface:	ST-506	ESDI	ESDI	ESDI
Drive Type:	31	N/A	N/A	N/A
Sectors/track:	17	36	36	34
Heads:	7	7	7	15
AutoparkHeads?	Yes	Yes	Yes	Yes
Cylinders:	733	583	915	1225
Data Transfer Rate:	5Mbps	10Mbps	10Mbps	10Mbps
Access (Seek) Time Average: Track-to-track:	 40ms 15ms	 30ms 5ms	 28ms 5ms	 23ms 5ms
Interleave:	1:1	1:1	1:1	1:1
Power Draw (Watts) Idle: Max:	 31 39	 31 39	 31 39	 35 42
Also works on:		8580-111 8580-311	8560-071 8580-071 8580-311	8580-071 8580-111

† Withdrawn from marketing

Figure 4(A-B). IBM PS/2 Disk Drive Summary (Part 1 of 2)

Figure 4-B. IBM Personal System/2 DASD by Model

ST-506-Based Systems

PS/2 Model	8525-00x 8525-G0x 8525-C0x 8525-K0x	8525-L0x	8530-x01	8530-x21	8550-021†	8550-031 8555-031	8560-041 8580-041
Standard Fixed Disk Capacity:				20MB	20MB	30MB	44MB
Maximum # of Fixed Disk Drives Supported:	1	1	1	1	1	1	2
Expansion Feature #(s):	#4107 #4110	#4107 #4110	#4115 #1030				#3046
Replacement Feature #:					#6666	#6666	
Maximum Total Fixed Disk Capacity (MB) Without Replacement: With Replacement:	20MB	20MB	30MB	20MB	20MB 60MB	30MB 60MB	88MB
3363 200MB Optical Disk Drive Models Supported:	A01 B01	A01 B01	A01 B01	A01 B01	A11 B01	A11 B01	A11 B01 #8700
Maximum Number of Optical Disk Drives per System:	2	2	2	2	6	6	8
Slots remaining for Memory or Other Expansion:	1/2	0	2	2	0	0	3
Maximum Optical Disk Capacity per System:	400MB	400MB	400MB	400MB	1200MB	1200MB	1600MB
Maximum Combined Optical and Fixed Disk Capacity Without Replacement: With Replacement:	420MB	420MB	430MB	420MB	1220MB 1260MB	1230MB 1260MB	1688MB

ESDI-Based Systems

PS/2 Model	8573-061	8573-121	8550-061 8555-061 8570-E61	8570-121 8570-A21	8580-071 8560-071	8580-111	8580-311
Standard Fixed Disk Capacity:	60MB	120MB	60MB	120MB	70MB	115MB	314MB
Maximum # of Fixed Disk Drives Supported:	1	1	1	1	2	2	2
Expansion Feature #(s):					#3051 #8730 #6023	#3051 #8730 #6023	#3051 #8730 #6023
Replacement Feature #(s):					#8730 #6023	#3051 #6023	#3051 #8730
Maximum Total Fixed Disk Capacity (MB) Without Replacement: With Replacement:	60MB	120MB	60MB	120MB	384MB 628MB	429MB 628MB	628MB 429MB
3363 200MB Optical Disk Drive Models Supported:	A11 B01	A11 B01	A11 B01	A11 B01	A11 B01 #8700	A11 B01 #8700	A11 B01 #8700
Maximum number of Optical Disk Drives per System:	2	2	6	6	8	8	8
Slots Remaining for Memory or Other Expansion:	1/2	1/2	0	0	3	3	3
Maximum Optical Disk Capacity per System:	400MB	400MB	1200MB	1200MB	1600MB	1600MB	1600MB
Maximum Combined Capacity Without Replacement: With Replacement:	460MB	520MB	1260MB	1320MB	1984MB 2228MB	2029MB 2228MB	2228MB 2029MB

Figure 4(A-B). IBM PS/2 Disk Drive Summary (Part 2 of 2)

IBM Personal System/2 Ergonomic and Environmental Data

One of the distinguishing characteristics of the Personal System/2 product line is superb ergonomic design. The PS/2 systems are smaller, use less power, generate less heat, and make less noise than previous-generation machines. These improvements can make a significant contribution to reducing operating costs and increasing user productivity and satisfaction. The following information may be used for cost and/or ergonomic or comfort comparison.

Figure 5-A. System Units

System Model	Type	Dimensions Width x Depth x Height mm	inches	Weight kg	lbs.	Heat Output (BTU/hr)	Noise Output (dB)	Power Rating (Watts)	Input Voltage (Vac)	Max. Current (Amps)[1]
Model 25	Integrated Desktop	320x375x382	12.6x14.7x15.0	14.6	32.0	683	51.0	200	90 - 137	2.0
Model 30	Desktop	406x397x102	16.0x15.6x4.0	8.0	17.5	438	37.5	70	90 - 137	1.5
Model 30 286	Desktop	406x397x102	16.0x15.6x4.0	7.8	17.2	438	37.5	90	90 - 137	2.5
Model 50/50 Z	Desktop	360x420x140	14.2x16.5x5.5	9.5	21.0	494	41.5	94	90 - 137	2.7
Model 55 SX	Desktop	406x397x102	16.0x15.6x4.0	8.6	19.0	438	43.0	90	90 - 137	2.5
Model 60	Floor-Standing	165x483x597	6.5x19.0x23.5	21.3	47.0	1240	36.5	206	90 - 137	5.3
Model 70 386	Desktop	360x420x140	14.2x16.5x5.5	9.5	21.0	751	41.5	132	90 - 137	3.2
Model P70 386	Transportable	465x126x305	18.3x5.0x12.0	9.4	20.8	480	45.0	85	90 - 137	2.4
Model 80 386	Floor-Standing	165x483x597	6.5x19.0x23.5	21.3	47.0	1245	36.5	225	90 - 137	5.3

- All systems are classified by the Federal Communications Commission as Class B, suitable for home use. However, the addition of a Class A adapter, such as the Token Ring Adapter, could make the systems unsuitable for home use.
- All systems are UL-478-approved.
- All systems except the Model P70 386 (see next note) have been tested to operate properly when the air temperature is at least 60° F (15.6° C) and not more than 90° F (32.2 ° C) with relative humidity between 8% and 80%.
- The Model P70 386 has been tested to operate properly when the air temperature is at least 50° F (10° C) and not more than 95° F (33° C) with relative humidity between 8% and 80%.

[1] Maximum current sustainable by the power supply. Actual current during operation will approximate the power rating (Watts) divided by the input voltage (Vac).

Figure 5-B. Displays

Display Model	Price	Maximum Resolution	Viewing Area: Width x Height mm	inches	Dimensions Width x Depth x Height mm	inches	Weight kg	lbs.	Heat Output (BTU/hr)	Power Rating (Watts)	Max. Current (Amps)[1]
8503	$275	720x640	207x155	8.1x6.1	321x311x312	12.6x12.2x12.3	8.5	18.8	188	55	0.80
8506[2]	$1295	848x1200	216x300	8.5x11.8	334x371x470	13.1x14.6x18.5	22.0	48.5	341	100	1.20
8507	$865	1024x768	356x267	14.0x10.5	476x432x451	18.7x17.0x17.7	23.5	51.7	290	85	1.20
8508[2]	$1295	1600x1200	356x267	14.0x10.5	476x432x451	18.7x17.0x17.7	23.5	51.7	341	100	1.20
8512[3]	$623	720x640	240x180	9.4x7.1	355x394x304[3]	14.0x15.5x12.0[3]	13.5	30.0	325	61	1.00
8513	$750	720x640	207x155	8.1x6.1	321x311x312	12.6x12.2x12.3	10.5	23.0	273	100	0.95
8514	$1620	1024x768	283x212	11.1x8.3	400x415x360	15.8x16.3x14.2	19.0	41.9	307	100	2.00

- All color displays (8512, 8513, and 8514) are capable of displaying up to 256 colors simultaneously from a palette of 262,144 colors of varying resolutions depending on the graphics adapter and the amount of graphics memory available.
- The 8503 and 8507 displays can display 64 shades of gray simultaneously at varying resolutions depending on the graphics adapter and the amount of graphics memory available. Application colors are automatically converted to grey shades via color summing.
- The 8506 and 8508 displays can display up to 16 shades of gray from a range of 256 shades of gray at varying resolutions depending upon the amount of memory on the PS/2 Image Adapter/A.
- All displays require an input voltage of 100 - 125 Volts AC with a frequency of 50 - 60 Hz.
- All displays have been tested to operate properly when the air temperature is at least 60° F (15.6° C) and not more than 90° F (32.2° C) with relative humidity between 8% and 80%.
- Both the power cord and signal cord on all displays are 6 feet (1.8 meters) in length.
- All displays are classified as Acoustic Class 1 (no fan or other noise source).

[1] Maximum current sustainable by the power supply. Acutal current during operation will approximate the power rating (Watts) divided by the input voltage (Vac).

[2] May only be attached to the PS/2 Image Adapter/A, Feature #4324.

[3] Does not include tilt / swivel pedestal. All displays except the 8512 come with a tilt / swivel pedestal which is included in the height measurements.

Figure 5-C. Adapter Card Power Draw

Micro Channel Adapter Type	Power Draw
16-bit	7-10 watts
32-bit	7-13 watts

Figure 5-D. Fixed Disk Power Draw

Fixed Disk	Power Draw
20MB 3.5"	15.5 - 17 watts
30MB 3.5"	12 - 14 watts
44MB 5.25"	31 - 39 watts
60MB 3.5"	13 - 19 watts
70MB 5.25"	31 - 39 watts
115MB 5.25"	31 - 39 watts
120MB 3.5"	13 - 19 watts
314MB 5.25"	35 - 42 watts

Figure 5(A-D). IBM PS/2 Ergonomic and Environmental Data

IBM Announcement Letter History for the Products Referenced in This Article		
Date	**Letter Number**	**Title of Announcement Letter**
04/02/87	S87-006	Announcement Summary - April 2, 1987
04/02/87	187-048	IBM Personal System/2 Model 30
04/02/87	187-049	IBM Personal System/2 Model 50
04/02/87	187-050	IBM Personal System/2 Model 60
04/02/87	187-051	IBM Personal System/2 Model 80 (8580-041/071)
04/02/87	187-052	IBM Personal System/2 Model 80 (8580-111)
04/02/87	187-053	Graphics System Overview
04/02/87	187-054	IBM Personal System/2 Display Adapter
04/02/87	187-055	IBM Personal System/2 Monochrome Display 8503
04/02/87	187-056	IBM Personal System/2 Color Display 8512
04/02/87	187-057	IBM Personal System/2 Color Display 8513
04/02/87	187-058	IBM Personal System/2 Color Display 8514
04/02/87	187-059	3.5-Inch Media Overview
04/02/87	187-061	IBM 2MB Expanded Memory Adapter and IBM Personal System/2 80286 Expanded Memory Adapter/A
04/02/87	187-064	IBM 3363 Optical Disk Drive
04/02/87	287-099	IBM Operating System/2 Standard Edition
04/02/87	287-100	IBM Operating System/2 Extended Edition Version 1.1
08/04/87	187-148	IBM Personal System/2 Model 25 (8525)
08/04/87	187-149	IBM Personal System/2 Model 25 Collegiate Kit
08/04/87	187-150	IBM Personal System/2 Model 80 (8580-311)
11/03/87	187-203	IBM 4707 Monochrome Display
11/03/87	287-498	IBM Operating System/2 Availability
11/03/87	287-499	IBM Operating System/2 Extended Edition Version 1.1 First Customer Ship Date and New Version 1.0
06/02/88	188-078	IBM Personal System/2 Model 70 386 (8570-A21)
06/02/88	188-079	IBM Personal System/2 Model 70 386 (8570 E61/121)
06/02/88	188-080	IBM Personal System/2 Model 50 Z Desktop Systems With Improved Hardfile and Memory
06/02/88	188-081	IBM Personal System/2 Model 25 LS
06/02/88	188-082	IBM Personal System/2 60MB Fixed Disk Drive
06/02/88	188-083	IBM Personal System/2 Model 25 20MB Fixed Disk Drive and Model 25 20MB Fixed Disk Drive With Adapter
06/02/88	188-084	IBM Personal System/2 0-8MB Expanded Memory Adapter/A
06/02/88	388-088	Price Changes IBM Personal System/2 Model 60 and Model 80
07/19/88	288-380	IBM Disk Operating System (DOS) Version 4.00
08/09/88	188-132	IBM Personal System/2 80286 Expanded Memory Adapter/A Withdrawal From IBM Marketing
09/13/88	188-139	IBM Personal System/2 Monochrome Display 8507
09/13/88	188-145	IBM Personal System/2 Model 30 286 (8530-E21)
09/13/88	188-146	IBM Personal System/2 Model 30 286 (8530-E01)
09/13/88	188-147	IBM Personal System/2 Multifunction Adapter
09/13/88	388-144	Price Changes IBM Personal System/2
10/25/88	288-623	IBM Operating System/2 (OS/2) Standard Edition Version 1.1 Availability
12/13/88	288-721	IBM Operating System/2 (OS/2) Standard Edition Version 1.1 and Extended Edition Version 1.1 Starter Set
01/24/89	189-013	IBM Personal System/2 Model 30 286 (8530-E21)
03/07/89	389-040	Price Changes IBM Personal System/2 System Units (85xx) and Selected I/O
03/21/89	189-037	IBM Personal System/2 Image Adapter/A and Related Features
03/21/89	189-038	IBM Personal System/2 Monochrome Display 8506 Model 001
03/21/89	189-039	IBM Personal System/2 Monochrome Display 8508 Model 001
04/04/89	189-049	IBM Personal System/2 Model 30-001
04/04/89	189-050	IBM Personal System/2 2-8MB 80286 Memory Expansion Option
04/04/89	189-051	Optional Features for the IBM Personal System/2 8530-E01 and 8530-001
04/04/89	189-052	IBM Personal System/2 Models 8530-002 and 8550-021 Withdrawal From IBM Marketing
04/04/89	389-055	IBM Personal System/2 Models 50 and 70 Price Changes and Revised Volume Procurement Amendment Exhibit
05/09/89	189-074	IBM Personal System/2 Model P70 386 (8573-061 and 8573-121)
05/09/89	189-076	IBM Personal System/2 Model 55 SX and 80387SX Math Coprocessor
05/09/89	389-072	IBM Operating System/2 Rebate Offering

Figure 6. References

```
/*****************************************************************************/
/*                                                                           */
/*  PRIVATE FUNCTION: ClientCommand                                          */
/*                                                                           */
/*  Take the appropriate action when a WM_COMMAND message is                 */
/*   received by fnwpClient window procedure.                                */
/*  Set up the appropriate dialog template id and pointer to the             */
/*   dialog procedure for the chosen dialog type, if any.                    */
/*  If exit is selected, post a quit message to end program.                 */
/*                                                                           */
/*****************************************************************************/
VOID cdecl ClientCommand( HWND hwndCliend, USHORT Command )
{
  USHORT idDlg;
  PFNWP  pfnDlgProc;

  /* Switch according to pulldown menu subitem chosen                        */
  switch( Command )
  {
    case MI_EXIT:
/*****************************************************************************/
/* Exit selected                                                             */
/*****************************************************************************/
     WinPostMsg( hwndCliend, WM_QUIT, 0L, 0L );
      return;
    case MI_RESUME:
/*****************************************************************************/
/* Resume selected                                                           */
/*****************************************************************************/
      return;
    case MI_ASCENDLISTBOX:
/*****************************************************************************/
/* Ascendlistbox dialog selected                                             */
/*****************************************************************************/
      idDlg       = DLG_ASCENDLISTBOX;
      pfnDlgProc = (PFNWP)fnwpAscendBoxDlg;
      break;
    case MI_DESCENDLISTBOX:
/*****************************************************************************/
/* Descendlistbox dialog selected                                            */
/*****************************************************************************/
      idDlg       = DLG_DESCENDLISTBOX;
      pfnDlgProc = (PFNWP)fnwpDescendBoxDlg;
      break;
    default:
/*****************************************************************************/
/* Take no action for any other selections                                   */
/*****************************************************************************/
     return;
  }
/*****************************************************************************/
/* Invoke a modal dialog with the main window frame as owner                 */
```

Figure 4. Private Function ClientCommand (Part 1 of 2)

```
/* Here the selections could be either ascending or descending                */
/* order.                                                                     */
/*****************************************************************************/
  WinDlgBox( HWND_DESKTOP,                /* Parent                          */
             hwndFrame,                   /* Owner                           */
             pfnDlgProc,                  /* Address of dialog proc          */
             NULL,                        /* Module handle                   */
             idDlg,                       /* ID of dialog in resource        */
             NULL );                      /* Initialization data             */
/*****************************************************************************/
/* Force repaint of main window                                               */
/* Here the dialog box overlays the client-area, and the                      */
/* control is in the dialog box window.                                       */
/*****************************************************************************/
  WinInvalidateRect( hwndClient, NULL, FALSE ); /* Update Client Area         */
}
/*****************************************************************************/
```

Figure 4. Private Function ClientCommand (Part 1 of 2)

demonstrates drawing using the Graphics Programming Interface (GPI) under the cached micro-PS. Now we will modify the SAMPLE.C program to use the two other PSs. (All the other database files – SAMPLE.RC, .DLG, .DEF, .H, .CMD, .ICO, .L, and .CMD – (remain the same.)

Most OS/2 Presentation Manager GPI functions are for drawing output. PM offers three drawing modes:

- Draw
- Retain
- Draw-and-Retain

Draw Mode and Cached Micro-PS
In draw mode, graphic images are immediately output to the currently associated device. In the cached micro-PS version of my SAMPLE program, the text data is painted immediately on the monitor screen (that is, the text data is not retained in a segment, so its image is short-lived). We can therefore summarize some characteristics of cached micro-PS:

- Cached micro-PS associates with the output device monitor only.
- It uses the default attributes of the PS only.
- It draws in units of pixels.
- It does not generate a permanent image, so the PM application user has to recreate the graphic image every time.

Retain Mode and Normal-PS
In retain mode, the graphic images are retained in the segment store, which is a closed-end data structure with a size limit of 64 KB. The user does not have to direct the retained segment(s) to the current device, which could be either the display, printer, or plotter. The virtual display context determines which physical output device will be used for graphic image painting. The retained segment can be reused at any time as long as it resides in memory.

The closed-end data structure renders most of the OS/2 PM GPI query functions invalid. Only normal-PS supports the retained mode. The GpiSetDrawingMode function call allows the user to select one of the drawing modes before starting to create a segment.

Some characteristics of normal-PS are:

- Normal-PS can associate with any physical output device, such as a display, printer, or plotter.
- It requires that any graphic images to be used more than once must be put inside a segment, and that the virtual device context has to be in retain mode.
- It draws in units of inches, millimeters and pixels.
- It reuses the PS by issuing the GpiSavePS, GpiRestorePS, GpiResetPS, and GpiSetPS function calls.

Draw-and-Retain Mode and Micro-PS
In draw-and-retain mode, graphic images are output as they are created, and are then stored in a segment. The graphic images retained

```
/********************** Start of third dialog procedure ************************/
/*******************************************************************************/
/*                                                                             */
/* DlgProc:  fnwpDescendBoxDlg                                                 */
/*                                                                             */
/* A dialog procedure that displays a list of names in descending              */
/* order.                                                                      */
/*                                                                             */
/* Side effects : None                                                         */
/*                                                                             */
/* Modify : None                                                               */
/*                                                                             */
/*******************************************************************************/

MRESULT EXPENTRY fnwpDescendBoxDlg( HWND hwndDlg, USHORT msg, MPARAM mp1,
                                    MPARAM mp2 )
{
  CHAR szBuffer[LEN_LISTBOXENTRY];
  INT     i;
  SHORT   id;

  switch (msg)
  {
    case WM_INITDLG:
      CenterDlgBox( hwndDlg );     /* Position centrally                    */

      /*************************************************************************/
      /* Initialize the listbox with a set of names loaded from a              */
      /* resource file.                                                        */
      /*************************************************************************/

      for ( i = 0; i   NUM_LISTBOXENTRIES; i++ )
      {
        /* Load from stringtable into an intermediate variable               */
        WinLoadString( hab,
                       NULL,
                       LBI_1 + i,
                       LEN_LISTBOXENTRY,
                       (PSZ)szBuffer
                     );
/*************************************************************************/
/* Add item to the listbox in descending order                           */
/*************************************************************************/
        WinSendDlgItemMsg( hwndDlg,
                           DESCENDLISTBOX,
                           LM_INSERTITEM,
                           MPFROM2SHORT( LIT_SORTDESCENDING, 0 ),
                           MPFROMP( szBuffer )
                         );
      }
```

Figure 5. DlgProc fnwpDescendBoxDlg (Part 1 of 3)

```
/*****************************************************************************/
/* Make the first list item initially selected                               */
/* This is to force the first item to be chosen. User can                    */
/* select any one that shows on the screen in the dialog box.                */
/*****************************************************************************/
        WinSendDlgItemMsg( hwndDlg,
                           DESCENDLISTBOX,
                           LM_SELECTITEM,
                           MPFROMSHORT( 0 ), /* First item index value       */
                           MPFROMSHORT( TRUE  )
                         );
        break;
      case WM_CONTROL:
/*****************************************************************************/
/* When user double-clicks the mouse, the highlight item                     */
/* in the dialog box is chosen.                                              */
/*****************************************************************************/
        switch( SHORT2FROMMP( mp1 ) )
        {
          case LN_ENTER:                  /* Catch double-click on   */
            WinPostMsg( hwndDlg,          /* list box item, and      */
                        WM_COMMAND,       /* simulate Enter          */
                        MPFROM2SHORT( DID_OK, CMDSRC_OTHER ),
                        MPFROMLONG( 1L ) /* pushbutton selection    */
                      );
            break;
          default:
            break;
        }
        break;
      case WM_COMMAND:
        switch( SHORT1FROMMP( mp1 ) )
        {
          case DID_OK:    /* Enter key or pushbutton pressed / selected       */
            /*************************************************************/
            /* Find out which item (if any) was selected and return.     */
            /*************************************************************/

            szFlag = FALSE;          /* flag to show program is dirty        */
            id = SHORT1FROMMR( WinSendDlgItemMsg( hwndDlg,
                                                  DESCENDLISTBOX,
                                                  LM_QUERYSELECTION,
                                                  0L,
                                                  0L ) );
            if( id == LIT_NONE )
              strcpy( szSelection, "" ); /* Nothing selected                 */
            else
            /*************************************************************/
            /* Something has been selected from dialog box.              */
            /*************************************************************/
              WinSendDlgItemMsg( hwndDlg,
                                 DESCENDLISTBOX,
```

Figure 5. DlgProc fnwpDescendBoxDlg (Part 2 of 3)

```
                                    LM_QUERYITEMTEXT,
                                    MPFROM2SHORT( id, LEN_LISTBOXENTRY ),
                                    MPFROMP( szSelection ) );
            case DID_CANCEL: /* Escape key or CANCEL button pressed / selected */
              WinDismissDlg( hwndDlg, TRUE ); /* Finished with dialog box      */
              return FALSE;
            default:
              break;
          }
          break;
        default:  /* Pass all other messages to the default dialog proc        */
          return WinDefDlgProc( hwndDlg, msg, mp1, mp2 );
      }
      return FALSE;
    }
    /******************** End of third dialog procedure ************************/
```

Figure 5. DlgProc fnwpDescendBoxDlg (Part 3 of 3)

inside a segment are reusable (in normal-PS), but any graphic image outside a segment image is drawn immediately. Only normal-PS supports draw-and-retain mode. Whereas normal-PS can handle retained graphics, micro-PS cannot. We can therefore list some characteristics of micro-PS:

- Micro-PS can associate with any physical output device, such as a display, printer, or plotter.
- It requires that any graphic images must be drawn immediately.
- It draws in units of inches, millimeters and pixels.
- It reuses the PS by issuing the GpiSavePS, GpiRestorePS, GpiResetPS, and GpiSetPS function calls.

The SAMPLE Program With Micro-PS

To demonstrate using micro-PS, we can use all of the SAMPLE.C source code except the procedure fnwpClient. During WM_CREATE time, we have to open a virtual device context and get a handle. We then associate the handle and create a micro-PS environment using pixels as the drawing unit. Once we have chosen the name item, it displays in the child window under the client window as well as back in the main menu. When the user decides to quit, the association between the virtual device context and the micro-PS is broken, and the micro-PS is destroyed. The global boolean variable szFlag has initial value TRUE, but it is reset to FALSE whenever the WM_COMMAND gets control.

Figure 8 shows the SAMPLE.C source code when executing under micro-PS.

The SAMPLE Program With Normal-PS

To demonstrate normal-PS, we can use all of the SAMPLE.C source code except the procedure fnwpClient. During WM_CREATE time, we have to open a virtual device context and get a handle. We then associate the handle and create a normal-PS environment using pixels as the drawing unit. Under normal-PS, a graphic image segment is created and retained. The major differences are located in WM_SIZE and WM_PAINT. We put identical code into WM_SIZE and WM_PAINT because the WM_SIZE message occurs only when the window changes its size (that is, a resize is required).

Figure 9 shows the SAMPLE.C source code when executing under normal-PS.

Publications Used

The SAMPLE program concept comes from reading the OS/2 Presentation Manager's *Programming Overview* and *Programming Guide*. Most of the SAMPLE source code is extracted from the IBM OS/2 Standard Edition Version 1.1 Toolkit's sample programs. If anything in the SAMPLE program is not clear, please read these materials.

We hope that this simple SAMPLE program will help guide users into the world of Presentation Manager applications.

```
/*****************************************************************************/
/*                                                                           */
/*  PRIVATE FUNCTION : CenterDlgBox                                          */
/*                                                                           */
/*  Positions the dialog box in the center of the screen                     */
/*                                                                           */
/*****************************************************************************/

 VOID cdecl CenterDlgBox( HWND hwndClient )
 {
   SHORT ix, iy;
   SHORT iwidth, idepth;
   SWP   swp;

/*****************************************************************************/
/* Query width and depth of screen device                                    */
/* Each device (display, printer, plotter) has its own PIXEL                 */
/* (picture element).  So we need to find out the width and                  */
/* depth of the output device, which the screen here.                        */
/*****************************************************************************/
   iwidth = (SHORT)WinQuerySysValue( HWND_DESKTOP, SV_CXSCREEN );
   idepth = (SHORT)WinQuerySysValue( HWND_DESKTOP, SV_CYSCREEN );

/*****************************************************************************/
/* Query width and depth of dialog box                                       */
/*****************************************************************************/
   WinQueryWindowPos( hwndClient, (PSWP)&swp );

/*****************************************************************************/
/* Center dialog box within the screen                                       */
/*****************************************************************************/
   ix = ( iwidth  - swp.cx ) / 2;
   iy = ( idepth  - swp.cy ) / 2;
   WinSetWindowPos( hwndClient, HWND_TOP, ix, iy, 0, 0, SWP_MOVE );
 }
```

Figure 6. Private Function CenterDlgBox

```
/*****************************************************************************/
/*                                                                           */
/*  WinProc: fnwpClient                                                      */
/*                                                                           */
/*  Controls the Client Area: loads various dialogs.                         */
/*                                                                           */
/*  Side Effects : None                                                      */
/*                                                                           */
/*  Modifies the values of the following globals: None                       */
/*                                                                           */
/*****************************************************************************/
```

Figure 7. SAMPLE.C Source Code Under Micro-PS (Part 1 of 3)

```
MRESULT  EXPENTRY fnwpClient( HWND hwndClient, USHORT msg, MPARAM mp1, MPARAM
mp2 )
{
   POINTL    pt;                                /* Define starting point        */
   RECTL     rcl;                               /* Define rect                  */
   SIZEL     sizel;                             /* Define sizel                 */
   SHORT     Iwidth, Idepth;                    /* Define width & depth         */
   SWP       swp;                               /* Define swp                   */
   USHORT    Command;                           /* Command passed by WM_COMMAND */

   switch(msg)
   {
     case WM_CREATE:
/*******************************************************************************/
/* This is the place to create the PS (Presentation Space) for the             */
/* Client Area.                                                                */
/*******************************************************************************/
       hdc = WinOpenWindowDC( hwndClient );  /* Open display context          */
       sizel.cx = 0L;                        /* Set initial value            */
       sizel.cy = 0L;                        /* where is relative to         */
       hps = GpiCreatePS (hab,               /* client window                */
                          hdc,               /* Create PS with proper        */
                          &sizel,            /* association                  */
                          PU_PELS | GPIF_DEFAULT | GPIT_MICRO | GPIA_ASSOC
                         );
       GpiSetColor( hps, CLR_RED );          /* Set child window color       */
       GpiSetBackColor( hps, CLR_BLUE );     /* Set background color         */
       GpiSetBackMix( hps, BM_OVERPAINT );   /* Allow color overlaps         */
       break;                                /* client window frame          */
/*******************************************************************************/
/* This is required to allow the user's dialog box to overlap the              */
/* Client Area.                                                                */
/*******************************************************************************/
     case WM_ERASEBACKGROUND:
       return (MRESULT)(TRUE);               /* Erase Client Area            */
/*******************************************************************************/
/* This is optional, depends on user.  It allows the user to control           */
/* the proper proportion between dialog window and Client Area when resized.   */
/*******************************************************************************/
     case WM_SIZE:
       break;
     case WM_PAINT:
/*******************************************************************************/
/* Find out the center position of screen for text output                      */
/*******************************************************************************/
       Iwidth = (SHORT)WinQuerySysValue( HWND_DESKTOP, SV_CXSCREEN );
       Idepth = (SHORT)WinQuerySysValue( HWND_DESKTOP, SV_CYSCREEN );
       WinQueryWindowPos( hwndClient, (PSWP)&swp );
       pt.x = (LONG)((Iwidth - swp.cx ) / 2);
       pt.y = (LONG)((Idepth - swp.cy ) / 2);
/*******************************************************************************/
/* Put the text string in center of screen                                     */
/*******************************************************************************/
```

Figure 7. SAMPLE.C Source Code Under Micro-PS (Part 2 of 3)

```
          if (szFlag == TRUE)
          {
            strcpy(sz, "       PERSONAL TELEPHONE DIRECTORY          ");
            GpiCharStringAt (hps, &pt, (LONG)strlen( sz ), (PSZ)sz );
          }
          else
          {
            strcpy(sz, " Hello !!         ");
            strcat(sz, szSelection);
            GpiCharStringAt (hps, &pt, (LONG)strlen( sz ), (PSZ)sz );
          }
          break;
        case WM_COMMAND:
          szFlag = FALSE;                       /* Reset flag                  */
          Command = SHORT1FROMMP( mp1 );
          ClientCommand( hwndClient, Command ); /* Process the command         */
          break;
        case WM_DESTROY:
          GpiAssociate( hps, NULL );      /* Break the association between     */
                                          /* micro-PS & virtual device context */
          GpiDestroyPS( hps );            /* Destroy the micro-PS              */
          break;
        case WM_CLOSE:
          WinPostMsg( hwndClient, WM_QUIT, 0L, 0L ); /* Cause termination      */
          break;
        default:
    /*************************************************************************/
    /* Pass all other messages to the default window procedure               */
    /*************************************************************************/
          return WinDefWindowProc( hwndClient, msg, mp1, mp2 );
      }
      return FALSE;
    }
```

Figure 7. SAMPLE.C Source Code Under Micro-PS (Part 3 of 3)

```
/*************************************************************************/
/*                                                                       */
/*  WinProc: fnwpClient                                                  */
/*                                                                       */
/*  Controls the Client Area: loads various dialogs.                     */
/*                                                                       */
/*  Side Effects : None                                                  */
/*                                                                       */
/*  Modifies the values of the following globals: None                   */
/*                                                                       */
/*************************************************************************/

MRESULT  EXPENTRY fnwpClient( HWND hwndClient, USHORT msg, MPARAM mp1, MPARAM
mp2 )
{
  #define  ID_ONE              1          /* Define segment ID value      */
```

Figure 8. SAMPLE.C Source Code Under Normal-PS--Part 1 of 3

```
    LONG      SegmentId = ID_ONE;           /* Set segment ID                */
    POINTL    pt;                           /* Define starting point         */
    RECTL     rcl;                          /* Define rect                   */
    SIZEL     sizel;                        /* Define sizel                  */
    SHORT     Iwidth, Idepth;               /* Define width & depth          */
    SWP       swp;                          /* Define swp                    */
    USHORT    Command;                      /* Command passed by WM_COMMAND  */

    switch(msg)
    {
      case WM_CREATE:
/*****************************************************************************/
/* Initially set up the Client Area with retained mode.                      */
/*****************************************************************************/
        hdc = WinOpenWindowDC( hwndClient );      /* Open display context    */
        sizel.cx = 0L;                            /* Set initial value       */
        sizel.cy = 0L;                            /* where is relative to    */
        hps = GpiCreatePS (hab,                   /* client window           */
                           hdc,                   /* Create PS with proper   */
                           &sizel,                /* association             */
                           PU_PELS | GPIF_LONG | GPIT_NORMAL | GPIA_ASSOC
                          );
        GpiSetDrawControl( hps, DCTL_DISPLAY | DCTL_ERASE, DCTL_ON);
        GpiSetDrawingMode( hps, DM_RETAIN );      /* Set retained mode       */
        break;

      case WM_COMMAND:
/*****************************************************************************/
/* Process the sub-menu items.                                               */
/*****************************************************************************/
          szFlag = FALSE;
          Command = SHORT1FROMMP( mp1 );
          ClientCommand( hwndClient, Command );  /*    Process the command    */
        break;

/*****************************************************************************/
/* Allows the dialog window to overlay the Client Area.                      */
/*****************************************************************************/
      case WM_ERASEBACKGROUND:
        return (MRESULT)(TRUE);                   /* Erase Client Area       */
      case WM_SIZE:
/*****************************************************************************/
/* Find out the center position of screen for text output.                   */
/* Only needed the first time.                                               */
/*****************************************************************************/
        Iwidth = (SHORT)WinQuerySysValue( HWND_DESKTOP, SV_CXSCREEN);
        Idepth = (SHORT)WinQuerySysValue( HWND_DESKTOP, SV_CYSCREEN);
        WinQueryWindowPos( hwndClient, (PSWP)&swp );
        pt.x = (LONG)((Iwidth - swp.cx ) / 2);
        pt.y = (LONG)((Idepth - swp.cy ) / 2);
        GpiDeleteSegment( hps, SegmentId );       /* Delete retained segment */
                                                  /* if any                  */
        GpiOpenSegment (hps, SegmentId );         /* Open retained segment   */
```

Figure 8. SAMPLE.C Source Code Under Normal-PS--Part 2 of 3

```
        GpiSetColor( hps, CLR_RED );              /* Set child window color    */
        GpiSetBackColor( hps, CLR_BLUE );         /* Set background color      */
        GpiSetBackMix( hps, BM_OVERPAINT );       /* Allow color overlaps      */
        strcpy(sz, " PERSONAL TELEPHONE DIRECTORY ");
        GpiCharStringAt (hps, &pt, (LONG)strlen( sz ), (PSZ)sz );
        GpiCloseSegment ( hps );                  /* Close retained segment    */
        break;

      case WM_PAINT:
        if (szFlag == FALSE)                      /* Check updated status      */
        {
/*****************************************************************************/
/* Refresh the window when this task becomes the foreground task.            */
/* Put the text string in center of screen (same place as before)            */
/*****************************************************************************/
          Iwidth = (SHORT)WinQuerySysValue( HWND_DESKTOP, SV_CXSCREEN);
          Idepth = (SHORT)WinQuerySysValue( HWND_DESKTOP, SV_CYSCREEN);
          WinQueryWindowPos( hwndClient, (PSWP)&swp );
          pt.x = (LONG)((Iwidth - swp.cx ) / 2);
          pt.y = (LONG)((Idepth - swp.cy ) / 2);
          GpiDeleteSegment( hps, SegmentId );     /* Delete the previous       */
                                                  /* detained segment          */
          GpiOpenSegment (hps, SegmentId );       /* Open retained segment     */
                                                  /* Set different color       */
                                                  /* to verify retained seg    */
          GpiSetColor( hps, CLR_BLUE );           /* Set child window color    */
          GpiSetBackColor( hps, CLR_RED );        /* Set background color      */
          GpiSetBackMix( hps, BM_OVERPAINT );     /* Allow color overlaps      */
          strcpy(sz, " Hello !!        ");
          strcat(sz, szSelection);
          GpiCharStringAt (hps, &pt, (LONG)strlen( sz ), (PSZ)sz );
          GpiCloseSegment ( hps );                /* Close retained segment    */
        }

          GpiDrawSegment( hps, SegmentId );       /* Write to child window     */
        break;

      case WM_DESTROY:
          GpiDeleteSegment( hps, SegmentId );     /* Delete retained segment   */
          GpiAssociate( hps, NULL );              /* Break the association     */
                                                  /* between PS & Virtual DC   */
          GpiDestroyPS( hps );          /* Destroy the Presentation Space      */
        break;

      case WM_CLOSE:
          WinPostMsg( hwndClient, WM_QUIT, 0L, 0L ); /* Cause termination    */
        break;

      default:
        /* Pass all other messages to the default window procedure             */
        return WinDefWindowProc( hwndClient, msg, mp1, mp2 );
    }
    return FALSE;
  }
```

Figure 8. SAMPLE.C Source Code Under Normal-PS--Part 3 of 3

Password Security for PS/2 Micro Channel Systems

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Incorporated into IBM Personal System/2 computers with Micro Channel architecture (Models 50 and above), as well as the PS/2 Model 30 286, are physical and logical ways to protect against unauthorized access to the inside of the system and to the information stored on fixed disks. This article summarizes these protection mechanisms.

Note: In this article, such terms as PS/2, computer, and system refer to the PS/2 models listed above.

Keylock

The physical protective mechanism is the keylock. The keylock prevents removal of the system's cover, and therefore prevents removal of the system's fixed disk(s) and/or diskette drives. However, the keylock does not prevent the use of the PS/2 keyboard, as was the case with some IBM Personal Computers. If you have not implemented any additional security features, you (or anyone else) can use the system.

If you feel confident that no unauthorized person is able to access your PS/2, you may choose to be satisfied with just the physical keylock. However, if unauthorized people can access your computer, you may need to install an additional security feature – a password.

Power-On Password

IBM Personal System/2 computers with Micro Channel architecture have the capability of implementing a logical password. The implementation of a password can be done in two ways: power-on password and server mode.

The power-on password is the simpler of the two. Before discussing how to implement a power-on password, let's discuss how a power-on password works.

Assume that you have already established a power-on password in a previous session, and you are now powering on the system to use it again. After you switch on the power, the system goes through its Power-On Self-Test (POST), and eventually displays a little key symbol. This symbol is telling you to type in the power-on password that you previously established, and press the Enter key. Unless you enter the correct password within three attempts, the computer will come to a halt. You will then have to switch off the computer, turn it back on, and try again to enter the correct password.

The power-on password is therefore the basic logical protection scheme. Unless you give your password to other people, they will not be able to enter the correct password, and will be unable to use your system.

You can establish your power-on password by booting your system using the Reference Diskette. On the Reference Diskette are configuration utilities. You should first select the Set Features option, then the Set Password option. You will then see a screen that asks you to type in the password you want to establish.

The password that you establish is stored in Complementary Metal

Oxide Semiconductor (CMOS) random-access memory inside the system. This CMOS is backed up by a six-volt, direct-current lithium battery. CMOS plus the backup battery make it possible to retain information when the system is turned off, and to activate that information when it is turned on again. (In addition to retaining the password, the CMOS also has a real-time clock that retains the current date and time, so you need not re-enter the date and time when you turn on the system.)

After you have established your power-on password, the only time you can change it is when you power on the system and see the little key symbol. To make the change, enter:

```
oldpassword/newpassword
```

Substitute your own old and new passwords in the line above.

This entry serves two purposes. By giving your current password, you are identifying yourself to the system, and the system then permits you to continue. Also, the new password that you enter is written directly to the CMOS at this time – the only time it can be done. The new password will be the one you will need to type in the next time you power on the computer.

The only time that the CMOS password area is accessible is when you enter your power-on password. After that, the password area within CMOS is locked.

Keyboard Controller

The keyboard controller is a logic circuit inside the system unit. Its purpose is to enable (unlock) or disable (lock) the keyboard.

When you power on your computer, the password stored in CMOS is actually copied into the keyboard controller, and the keyboard-locked bit inside the controller is set, thereby disabling the keyboard. You can still press the keyboard's keys, but nothing happens. Why? The keyboard controller matches the password you type in against the password that was copied from CMOS into its circuitry. If you enter your password incorrectly, there will be no match; the keyboard controller will keep the keyboard locked, and you will see a key symbol with an X drawn through it. The system then displays another key symbol, prompting you once again to enter your password. You will have two more chances. When you do enter your password correctly, the keyboard controller makes the match and unlocks the keyboard.

Another password option is the feature called server mode.

Disabling Your Keyboard at Any Time

If you have to leave your work area temporarily, but you don't want to power off your PS/2 in the meantime, you can make it secure by disabling your keyboard. (This presumes you have cleared the display screen and put your diskettes away.) To disable the keyboard, use the program KP.COM on your Reference Diskette. At the DOS prompt, simply enter:

```
KP
```

You will then hear a beep notifying you that the keyboard has been locked (disabled).

When you come back, you have to enter your password again. After you enter it, the system again beeps to notify you that the keyboard is unlocked (enabled). You can then proceed to use the system.

Remember that when you saw the key symbol, you had to enter your power-on password. If you entered anything else, the computer disallowed it and prompted you once again to enter your password. The computer behaves differently after you have used KP.COM to lock your keyboard. Here, to unlock your keyboard, you still have to enter a password, but this time the computer will be patient with you – it will let you enter any sequence of characters, and as many as you want. However, all this is for naught, because the keyboard will not be unlocked until you enter the characters that constitute your password.

Server Mode

Another password option is the feature called server mode. Server mode was implemented to accommodate PS/2s that act as servers on a network (although a PS/2 that is not on a network can still use server mode).

The intent of server mode is to permit the network to come up and to permit users of remote systems to access their data files on the server, while at the same time preventing anyone from using the server's keyboard. In server mode, no one can use the server to access the data files of other users on the network, and no one can press Ctrl-Alt-Del to reboot the server.

An interesting corollary of server mode is that it permits a properly configured network to come back up by itself after power is restored following a power failure.

You can implement server mode by using the Configuration Utilities that come with the Reference Diskette, specifying the Set Features option, selecting Set Server Mode, and proceeding through the menus.

Server mode behaves differently from power-on password mode. Both modes lock the keyboard immediately, but whereas power-on password mode requires that you enter your password before you can proceed, server mode continues on with some processing. Specifically, server mode executes the CONFIG.SYS and AUTOEXEC.BAT files. If the AUTOEXEC.BAT file calls other programs, server mode will permit those programs to execute. Therefore, if AUTOEXEC.BAT invokes the network program, the network will come up. AUTOEXEC.BAT might also invoke a program that executes without operator intervention.

While all of this is happening, the keyboard remains locked. In server mode, you will not see the key symbol, so you are not required to enter your power-on password.

However, if you ever want to use the server's keyboard, you will have to enter your power-on password before you can use it. The process is the same as for a power-on password – the password in CMOS was transferred to the keyboard controller, so the password you enter must match the password stored in the keyboard controller. Once the match is made, the keyboard controller unlocks the keyboard, and you can proceed to use it.

Rebooting Your Computer

Suppose you decide to reboot your computer by pressing Ctrl-Alt-Del. When you do this, the password stored in the keyboard controller is erased. Because it is a reboot and not a power-on, the system does not access CMOS again, so the password in CMOS is not transferred anew to the keyboard controller.

Having rebooted, you can proceed with using your computer. However, if you later decide to lock the keyboard by using the program KP.COM, the program will find no password in the keyboard controller, so it will display a screen that asks you to enter a password. The password you enter at this time will be a temporary password; for sanity's sake it should probably be the same as your original power-on password that is stored in CMOS, but it doesn't have to be the same.

The temporary password you type in is placed into the keyboard controller, and it becomes the password for the remainder of the session, until you switch off your computer. The temporary password is never written to CMOS. Therefore, when you power on your computer again, your original password, which is still in CMOS, is the one you need to use.

Changing Your Password in Server Mode

The only time you can change your power-on password in CMOS is when you see the key symbol after you switch on the computer. If your system is configured for server mode, you will never see the key symbol. Therefore, before you can change your password, you must get out of server mode and back to power-on password mode. After you change your password, you must once again specify server mode.

Forget Your Password?

If you forget your power-on password, your only recourse is to make the system believe you have no password. The way to do this is to remove the battery so that the CMOS password area drains away. This takes anywhere from 10 minutes to a few hours. (See the Hardware Maintenance manual for the specific procedure.)

To remove the battery, you must first power off the system, and then remove the system's cover. This means you have to have the physical key. Therefore you should keep the key secure so that no one else can get into your system and remove the battery.

After the password in CMOS is drained away, your system has no password. If you want to establish another password, you have to reinstall the battery, switch on the system, boot from your Reference Diskette in drive A, and use the configuration utilities to establish a new password.

You Are the Main Source of Security

The protective mechanisms discussed above will work only if you, the user, practice common sense. The power-on password will prevent unauthorized people from accessing your computer, but if you tell someone else your password, that person can access your system. That person can also change your password without your knowledge. Clearly it is to your advantage not to reveal your password.

Magnetic Media Security Exposures

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A recent article in a trade magazine reported that a purchaser of a used personal computer was able to recover most of the data on the computer's erased fixed disk. Included in this recovered data were automated design files and company memos. Was this accomplished using sophisticated and expensive hardware and software by a expert in the field of fixed disk technology? No – all that was required was a low-cost, user-friendly file recovery program available to anyone. Was the original user careless and negligent? Probably not, just uninformed like most everyday users of personal computers.

Confidential, sensitive and personal data, presumed to be erased, can be easily recovered from a disk or diskette unless the user takes special precautions.

The DOS and OS/2 ERASE Functions

Contrary to what their names imply, the DOS and OS/2 ERASE functions do not actually erase the data in the specified file. Instead, DOS or OS/2 simply overwrites the first character of the file's name in the disk(ette)'s directory, and deallocates the file's clusters in the File Allocation Table (FAT). To the layman, the directory can be thought of as a table of contents of all the files on the disk(ette), and the FAT can be thought of as an index used to keep track of the locations on the disk(ette) where all files' data is stored.

Although all of the data in the erased file still exists, DOS and OS/2 no longer consider the file to be present. For most purposes, this system of erasure makes sense because it greatly speeds up the time it takes to erase a file, and the erased files' sectors are simply overwritten when the user writes other files to the disk(ette). Until the file is overwritten, however, the entire erased file may be recovered using one of the many disk recovery utilities available from software vendors. This is a blessing if the file was accidentally erased, but a curse if the user actually wanted the file's data to be destroyed.

The DOS and OS/2 FORMAT Functions

If a diskette has sensitive data on it, a user could effectively destroy the data by using the DOS or OS/2 FORMAT command to reformat the diskette. On a diskette, the FORMAT command clears the Directory and File Allocation Tables, and overwrites all existing data.

When formatting fixed disks, however, the DOS or OS/2 FORMAT commands do *not* overwrite the data sectors of most files on fixed disks. FORMAT merely clears the existing File Allocation Tables and root directory information. This is all that DOS and OS/2 require for a "high-level" format, and it saves a great deal of time.

However, most files which were stored on the disk still exist in superb condition, although DOS or OS/2 will no longer recognize them. This situation is transparent to the casual user and could constitute a security risk if the user believes all data on the fixed disk was de-

stroyed during the format procedure. Not only is the data not destroyed, but it can be recovered relatively easily by any of several programs designed to rebuild accidentally reformatted disks.

This is probably what happened to the fixed disk mentioned in the trade magazine. The original owner probably formatted the disk just prior to its sale, believing all sensitive data would be destroyed. The curious new owner then proceeded to recover most of the files using a disk recovery utility.

Contrary to what their names imply, the DOS and OS/2 ERASE functions do not actually erase the data in the specified file.

Security Options

Now that these potential security exposures have been discussed, we can examine several options that offer some solutions.

It should be clearly noted that there is no 100 percent effective method of erasure, short of utterly destroying the disk. Sensitive and sophisticated equipment can read disks that have been thoroughly erased, overwritten, or damaged. Such equipment is usually used to recover important data that was accidentally lost, but it can be used for clandestine purposes as well. Some disks used by the military have to be physically destroyed in the presence of security officers. Fortunately, for most users this is unnecessary – simply overwriting the existing data will foil most attempts at data recovery.

The key to magnetic media security is common sense and an understanding of the limitations of file- and disk-erasure methods. For instance, if you must send data on a diskette to someone outside your company, it is obviously best to use a new diskette that has never contained any data. If you must send a previously used diskette, first format the diskette several times to thoroughly overwrite any existing data. Remember, the IBM DOS and OS/2 format programs only overwrite data on diskettes, not fixed disks, and although overwritten several times, the old data on the diskette could conceivably still be recovered.

Another way to effectively erase a diskette is to use bulk-erasure hardware designed for such purposes. This hardware is usually reasonably priced, readily available, and much faster than using software utilities. Bulk-erasure hardware uses a powerful electromagnetic field to erase the diskette. Do not try to do the same with a simple permanent magnet. This method is very unreliable and may not destroy all data. In addition, the diskette may be damaged if the magnet contacts the delicate surface coating.

Data security for fixed disks is more difficult than for diskettes, because fixed disks can store more data, are repeatedly used more often, are not conveniently bulk-erased, and cannot be erased using the DOS or OS/2 FORMAT utility. Unlike diskettes, fixed disks generally remain stationary. Thus, the first level of defense to protect the data it contains is to provide a secure environment. A secure room is an obvious solution, but not always practical. Older PC systems can be locked with a device that simply fits over the power switch, requiring a key to switch on the system or open the unit's case. IBM PS/2s help prevent unauthorized use by using passwords to access the system and by providing hardware to lock the system unit's case. These locks are at best a deterrent because determined thieves can usually defeat them. Also, locks work only if the user controls access to the key.

The key to magnetic media security is common sense and an understanding of the limitations of file- and disk-erasure methods.

What if the computer or disk is to be sold or transferred? In this case, all sensitive data on the disk should be destroyed. To destroy all data on a fixed disk requires a special "low-level" format program. Most low-level format utilities overwrite all existing data on the disk. This type of format program is not included with DOS or OS/2, but may be found on some IBM diagnostic diskettes, PS/2 Reference diskettes, or in software provided with add-on fixed disk drives.

Several third-party vendor programs that destroy all data stored on the disk may be a better solution. They are usually easier to find and simple to use. These utilities were written with disk security in mind, and will overwrite the entire disk. Running such programs multiple times may offer even greater security. It should be noted that these utilities will only work on disks in good op-

erating condition. If your fixed disk no longer functions properly, these utilities may be ineffective.

If a fixed disk needs to be replaced and it contains sensitive data, you must either arrange to have it physically destroyed according to company policy, or lock it up in a manner consistent with the level of confidential data it contains. Never hand over defective fixed disks containing sensitive information to customer engineers or other computer service personnel unless they are authorized to handle the data contained on the disk. Inform authorized service personnel that the disk contains sensitive data and needs to be destroyed according to company policy.

For day-to-day use, destroying all data on the fixed disk is obviously impractical every time you simply want to erase a file containing sensitive information. Again, there are several vendors offering programs to handle this task. Unlike the DOS or OS/2 ERASE commands, these utilities overwrite the data located in the specified file's sectors. The security they provide is much higher than that provided by DOS or OS/2 ERASE because they prevent the file's data from being recovered by conventional disk-recovery utilities. However, these erase utilities do not provide as high a degree of security as the low-level format programs.

Due to the way DOS and OS/2 manage data on the fixed disk, deallocated clusters may still contain sensitive information. If the file was edited or copied, the operating system may have, for various reasons, selected different clusters on the disk in which to store the file, while freeing up the old clusters in the File Allocation Table and leaving the old data intact. The secure erase programs would not overwrite these sectors because they rely on the File Allocation Table to tell them where the specified program was last stored. What can be done about this? Also, what if you have been using your fixed disk for years, and you don't know whether data you once thought was erased still exists on the disk?

Unlike diskettes, fixed disks generally remain stationary.

A program available from Central Point Software Inc. can help. This program, called Compress, is available in a collection of useful and inexpensive utilities called PC Tools Deluxe Version 5.0 (trademark of Central Point Software, Inc.). Compress defragments your disk or diskette and, with the clear option set, overwrites all deallocated clusters. This leaves the user with a potentially better-performing disk with all erased file data in deallocated locations overwritten.

Unfortunately, even with this degree of protection, some sensitive information may still escape erasure. It is possible that bits and pieces of some erased files still exist on clusters allocated for use by other files. When the operating system reused these clusters, only some of the previously existing data on them may have been overwritten. The end of the new data was recorded, potentially leaving some of the old information intact in whatever space remained in the cluster. Because this cluster is allocated to a currently active file, none of its data will be erased. This problem is difficult to avoid, but can be reasonably managed by using secure erasure utilities and programs such as Compress as often as practical.

In addition to the methods of disk security already discussed, it may be necessary to take additional steps to ensure a greater level of protection for highly sensitive data. Data on a disk or diskette may be encrypted using hardware or software. With today's best methods of encryption, sensitive data stored on the disk will be safe from all but the most sophisticated thieves.

PC Tools Deluxe Version 5.0 also contains a utility called PC Secure. This utility uses the powerful Data Encryption Standards system to perform an admirable job of encrypting data on ordinary fixed disk and diskette equipment. With proper data encryption, the user can worry less about methods of file erasure, because the data cannot be read as it appears on the disk. When encrypting data, be sure to take the necessary steps to thoroughly erase the original file.

Conclusion

Security of sensitive, confidential, and personal information on magnetic media is ultimately the responsibility of the user. OS/2 and DOS do not provide convenient methods of effective disk security. Worse, the uninformed user may expose sensitive information unwittingly. However, with a general knowledge of disk hardware, an understanding of the operation and limitations of OS/2, DOS, and vendor disk software, and a little diligence, you can ensure that your magnetic media is as secure as you require.

New Products

Hardware

IBM Personal System/2 Model P70 386 (8573-061 and 8573-121)

The IBM Personal System/2 Model P70 386 (8573-061 and 8573-121) are high-function, high-performance portable systems that complement the PS/2 Model 70 386 desktop family of products. The PS/2 Model P70 386 is a 20 MHz version in both models, one with a 60 MB fixed disk and the other with a 120 MB fixed disk. These models include Micro Channel Architecture, a VGA 16-grayscale plasma display, and a fully compatible PS/2 Enhanced Keyboard, all neatly integrated into a single package.

Additional features are the 80386 32-bit microprocessor, high-density memory technology, and a wide range of integrated features. These portable systems support up to 16 MB of high-speed real memory, 60 or 120 MB of disk storage, full VGA graphics, and an optional 80387 Math Coprocessor, and have significant performance for portable computer operations. All models maintain compatibility with most existing software products for IBM personal computer systems.

The 8573-121 provides 20 MHz 80386 performance with 4 MB of high-speed (85 ns) memory and a 120 MB fixed disk.

The 8573-061 provides 20 MHz 80386 performance with 4 MB of high-speed (85 ns) memory and a 60 MB fixed disk.

An external storage device cable is available for attaching external backup devices and diskette drives. Two carrying cases are available as accessories.

Statement of Direction: The Model P70 386 (8573-061 and 8573-121) will be supported by a future release of the Advanced Interactive Executive (AIX) PS/2 operating system. The availability date of this release will be announced in the third quarter of 1989.

Highlights:

- 60 MB and 120 MB portable versions of 20 MHz 8570 with 4 MB of memory standard
- High-quality, 16-grayscale integrated gas plasma display
- 80386 20MHz 32-bit microprocessor and optional coprocessor
- System board memory expandable to 8 MB
- 60 MB and 120 MB fixed disks with integrated controllers
- Micro Channel Architecture with a 16- and 32-bit bus
- One full-length and one half-length expansion slot
- Ergonomic briefcase portable design
- External storage device cable

IBM Personal System/2 Model 55 SX and 80387SX Math Coprocessor

The Model 55 SX enhances the Personal System/2 family of systems by offering 32-bit microprocessor compatibility at a price range previously assigned to 16-bit 80286 systems. The desktop system has Micro Channel Architecture with a 16 MHz 80386SX 32-bit microprocessor, high-density memory technology, and a wide range of integrated features. With the capability of supporting up to 16 MB of high-speed real memory, 30 MB or 60 MB of disk storage, advanced graphics, and an optional 80387SX Math Coprocessor, this system provides significant performance improvements for 80286 users. The systems maintain compatibility with most existing 8- and 16-bit software for IBM Personal Computer systems such as DOS and OS/2.

Statement of Direction: The Model 55 SX (8555-061 only) will be supported by a future release of Advanced Interactive Executive (AIX) PS/2. The availability date of this release will be announced in the third quarter of 1989.

IBM Personal System/2 Model 55 SX (8555-R31 and -R61)

The IBM Personal System/2 Model 55 SX (8555-R31 and -R61) is identical to the previously announced IBM 8555-031 and -061, except that the R31 and R61 provide a unique 50-key function keyboard instead of the Enhanced Personal Computer Keyboard. This model is intended for use in bank teller locations.

IBM Personal System/2 Model 30 286 (8530-E01)

The IBM Personal System/2 Model 30 286 (8530-E01) is a single diskette drive version of the Model 30 286 (with an optional fixed disk drive). The Model 30 286 combines existing Model 30 functions along with improved processor performance, 1.44 MB diskette drive capacity, and VGA graphics. The Model 30 286 utilizes the Intel 80286 processor and operates at 10 MHz with one wait state to system memory. An optional 3.5-inch 20 MB fixed disk drive feature is available for this model.

Highlights:

- Optional second 3.5-inch device for configuration flexibility

IBM Personal System/2 Model 30 286 (8530-E0R)

The IBM 8530-E0R is identical to the IBM 8530-E01, except that the Model E0R provides a unique 50-key function keyboard instead of the Enhanced Personal Computer Keyboard. This model is intended for use in bank teller locations.

IBM Personal System/2 Model 30-001

The IBM Personal System/2 Model 30-001 enhances the Model 30 product line with a single diskette configuration. The Model 30-001 is a desktop system that provides an 8 MHz 8086 processor,

640 KB of memory, a 3.5-inch 720 KB diskette drive, Multi-Color Graphics Array (MCGA) graphics, and IBM PC XT compatibility. The system provides expansion flexibility with support for a second diskette drive or a fixed disk drive. The system maintains compatibility with most existing IBM Disk Operating System (DOS) software.

The PS/2 720 KB One-Inch-High Diskette Drive is a 3.5-inch diskette drive that can be installed as a second diskette drive in the 8530-001. This feature comes complete with diskette drive, bezel, and installation instructions.

The PS/2 5.25-Inch External Diskette Drive Adapter Cable is required to install the IBM PS/2 5.25-Inch External Diskette Drive and Adapter on an 8530-001 or 8530-021 with serial numbers from 2500000 to 2999999.

Note: The 720 KB One-Inch-High Diskette Drive and the 5.25-Inch External Diskette Drive cannot be installed in the same system unit.

Highlights:

- Expansion flexibility (720 KB diskette drive or fixed disk drive)
- Optional 8 MHz 8087 Coprocessor

Optional Features for the IBM Personal System/2 8530-E01 and 8530-001

IBM Personal System/2 30 MB Fixed Disk Drive I: Has access speed of 39 ms, and contains the fixed disk drive, cable, disk drive bezel, and installation instructions.

IBM Personal System/2 1.44 MB One-Inch-High Diskette Drive: Can be installed as the second diskette drive on the PS/2 8530-E01 (with the first diskette drive indicator light **below** the media insertion slot).

IBM Personal System/2 1.44 MB One-Inch-High Diskette Drive Kit A: Required for the 1.44 MB One-Inch-High Diskette Drive, and contains the diskette drive cable, diskette drive bezel, and installation instructions.

IBM Personal System/2 1.44 MB Diskette Drive Kit A: Contains the diskette drive cable, diskette drive bezel, and installation instructions, and provides the capability to install the IBM PS/2 1.44 MB Diskette Drive as the second diskette drive on the PS/2 8530-E01 (with the first diskette drive indicator light **above** the media insertion slot).

IBM 7541 and 7542 Industrial Computers

The IBM 7541 and 7542 Industrial Computers are designed to function in an industrial plant floor environment where harsh physical conditions may exist. The system is highlighted by Micro Channel Architecture with a 10 MHz 80286 16-bit microprocessor with a capability of supporting up to 2 MB of real memory on the system board, 30 MB of disk storage, a 1.44 MB diskette drive, and VGA graphics. Total memory is expandable to 16 MB by adding 16-bit I/O slot memory expansion feature cards.

The 7541 and the 7542 are identical in function and feature capacity; however, they differ in form. The 7541 is a benchtop system; the 7542 is designed to be installed in an industrial 19-inch rack.

Highlights:

- Micro Channel Architecture with a 16-bit bus structure
- Processing speed of 80286 at 10 MHz
- 1 MB of memory standard on the system board, upgradeable to 2 MB
- VGA graphics on planar board, three available I/O expansion slots
- 30 MB fixed disk drive; 3.5-inch, 1.44 MB diskette drive
- Optional 10 MHz 80287 coprocessor
- Universal, automatic voltage-sensing power supply
- Operating systems supported: IBM DOS Versions 3.30 and 4.00, and IBM Operating System/2 Standard and Extended Editions Version 1.1

IBM 7561 and 7562 Industrial Computers

The IBM 7561 and 7562 Industrial Computers are designed to function in an industrial plant floor environment where harsh physical conditions may exist. The system is highlighted by Micro Channel Architecture with a 20 MHz 80386 32-bit microprocessor with a capability of supporting up to 16 MB of real memory (8 MB on planar), 60 MB of disk storage, a 1.44 MB diskette drive, and VGA graphics.

The 7561 and 7562 are identical in function and feature capacity; however, they differ in form. The 7561 is a benchtop system; the 7562 is designed to be installed in an industrial 19-inch rack.

Highlights:

- Micro Channel Architecture with a 32-bit bus structure
- Processing speed of 80386 / 80387 20 MHz
- 85-nanosecond memory, 2 MB standard, upgradeable to 8 MB
- VGA graphics on planar board, four available I/O expansion slots
- 60 MB fixed disk drive; 3.5-inch, 1.44 MB diskette drive
- Optional 20 MHz 80387 coprocessor
- Universal, automatic voltage-sensing power supply
- Operating systems supported: IBM DOS Versions 3.30 and 4.00, and IBM Operating System/2 Standard and Extended Editions Version 1.1

IBM 2-8 MB 80286 Memory Expansion Option

The IBM Personal System/2 2-8 MB 80286 Memory Expansion Option is a new memory adapter expandable up to 8 MB for all models of the IBM Personal System/2 Models 50, 50 Z, and 60. This new adapter provides memory expansion up to 8 MB by using existing memory kits: 1 MB Memory Module Kit – (85ns) and 2 MB Memory Module Kit – (85ns).

The Personal System/2 2-8 MB 80286 Memory Expansion Option can be used with Operating System/2 (OS/2) as extended memory or as expanded memory. An expanded memory device driver compatible with the Lotus (TM) / Intel (TM) / Microsoft (TM) Expanded Memory Specification (LIM EMS) Version 4.0 is included. This adapter is also compatible with the IBM 3270 Workstation Program Version 1.1. For extended memory, the IBM Personal System/2 2-8MB 80286 Memory Expansion Option provides up to 8 MB of contiguous memory for use with IBM OS/2 Standard and Extended Editions, Versions 1.0 and 1.1.

Lotus is a trademark of Lotus Development Corporation; Intel is a trademark of Intel Corporation; Microsoft is a trademark of Microsoft Corporation.

Highlights:

- Supports both expanded and extended memory applications
- Uses existing 1 MB and 2 MB 85ns Memory Module Kits
- Memory increments from 2 MB to 8 MB by mixing both kits on a single adapter
- Supports IBM OS/2 Standard and Extended Versions 1.0 and 1.1
- LIM EMS Version 4.0 device drivers included with adapter shipment group
- Supports the IBM 3270 Workstation Program Version 1.1
- Supports IBM DOS Versions 3.30 and 4.00
- Operates at 0-1 wait state (read / write)

IBM PS/2 Monochrome Display 8506

The IBM PS/2 Monochrome Display 8506 is a vertically-oriented, 17-inch, analog, multimode, white phosphor, raster display capable of displaying up to 848 x 1200 pixels at 100 pels / inch in a viewable area of 8.5 inches by 11.8 inches. The large 17-inch screen permits display of full page size 8.5 x 11 inches, or the European A4, 8.25 x 11.7 inches (210 mm x 296 mm). The analog technology provides increased capability for selection of gray shades. Up to 16 of 256 shades of gray for image and text documents are available when attached to the IBM PS/2 Image Adapter/A. By attachment of the 8506 to the PS/2 Image Adapter/A, programmable selection of screen resolution is supported. The display contains a self-regulating power supply accommodating voltage (120 / 240 nominal) and frequency (50 / 60 Hz) ranges. An anti-reflective screen to reduce glare, front-accessible operator controls, and a tilt / swivel pedestal to accommodate operator comfort and convenience are standard.

The display has been verified for compliance with the FCC Rules as an FCC Class A device for use only in industrial, commercial, or business environments.

Highlights:

- Four selectable screen resolutions
- White phosphor for black-on-white or white-on-black display
- Large screen viewing area permits sharp, clear, full-page document display
- Up to 16 of 256 gray shades give sharp, clear images when attached to the PS/2 Image Adapter/A
- Self-regulated universal power supply for voltage / frequency
- Tilt / swivel pedestal and anti-reflective screen
- Front-accessible brightness and contrast controls

IBM PS/2 Monochrome Display 8508

The IBM PS/2 Monochrome Display 8508 is a horizontally oriented, 19-inch, analog, multimode, white phosphor, raster display capable of displaying up to 1600 x 1200 pixels at 114 pels / inch in a viewable area of 14 x 10.5 inches. The large 19-inch screen permits display of either coded or non-coded data in image and text applications. (See IBM PS/2 Monochrome Display 8506 description for additional information.)

IBM Personal System/2 300/1200/2400 Internal Modem/A

The IBM Personal System/2 300/1200/2400 Internal Modem/A offers high-function, internal-modem support for the new Model P70 386 portable PS/2 systems. The new modem is Hayes-compatible (see note), and provides standards compatibility via CCITT V.22 bis, Bell 212A, and Bell 103 full duplex operation. Most functions of the new modem are also compatible with the IBM 5853 External Modem. Functions include automatic dial / auto answer function, and the ability to connect directly into US public or private switched network telephone lines. A half-length, 16-bit PS/2 Micro Channel adapter, the modem includes NS16550A FIFO asynchronous support, eight programmable port assignments, and a system speaker for telephone line monitoring.

Note: Certain unique functions are not supported; see the Technical Reference manual for details.

IBM Personal System/2 Image Adapter/A

The IBM PS/2 Image Adapter/A is a high-performance Micro Channel Architecture display adapter designed for use in the IBM ImagePlus workstation. It is capable of driving resolutions up to 1600 x 1200 pixels at a maximum of 16 shades of gray with the Memory Expansion Kit installed, and four shades of gray without the Memory Expansion Kit installed. An optional Printer / Scanner feature card attachment, together with a selection of appropriate cables, enables support of specific printers and scanners directly to this adapter.

The IBM PS/2 Image Adapter/A has been verified for compliance with the FCC Rules as an FCC Class A device for use only in industrial, commercial, or business environments.

Highlights:

- Adapter for IBM ImagePlus workstation
- Supports IBM PS/2 Monochrome Display 8508 (1600 x 1200 pels) and IBM PS/2 Monochrome Display 8506 (848 x 1200 pels)
- On-board memory for video, program, and data buffering
- Additional daughter card option together with appropriate cables for printer and scanner attachment
- Memory Expansion Kit option for additional data memory or improved performance

IBM Realtime Interface Coprocessor Multiport/2 Interface Boards

The IBM Realtime Interface Coprocessor Multiport/2 Interface Boards provide additional electrical interfaces for the Realtime Interface Coprocessor Multiport/2 Adapter.

The interface boards provide the hardware facilities for the Realtime Interface Coprocessor Multiport/2 adapter to support:

- Eight RS-422A serial input / output ports
- Six RS-232C synchronous serial input / output ports

IBM 3816 Page Printer

The IBM 3816 Page Printer is a multifunction, nonimpact page printer of table-top design. It provides letter-quality text and all-points-addressable graphics at a maximum speed of 24 pages per minute, and is designed to produce an average of 40,000 pages per month. The IBM 3816 Page Printer may be attached to the IBM 3174 Subsystem Control Unit, 3274 Control Unit, 9370 Information System, System/36, System/38, Application System/400 (AS/400), 5394 Remote Control Unit, Personal System/2, Personal Computer AT, Personal Computer XT, or RT system. A high-capacity paper input feature is available, and a variety of xerographic and non-xerographic papers may be used for printing.

IBM intends to provide at a later date a duplex model in addition to optional features for both the simplex and duplex models for high-capacity paper output. The simplex model will not have field upgrade capability to duplex. However, announcement of any products will be based upon IBM's business and technical judgment.

Highlights:

- Up to 24 pages per minute
- Attachment flexibility
- Advanced Function Printing (AFP) family printer
- High-capacity paper input
- Printing on xerographic and non-xerographic papers
- Average use of 40,000 pages per month
- Quiet operation (53 dBa)

Software

IBM OfficeVision/2 LAN Series

The IBM OfficeVision/2 LAN Series is the OS/2 member of the IBM OfficeVision Family of office applications. IBM OfficeVision/2 introduces a new generation of Systems Application Architecture (SAA) application software, offering a comprehensive set of office functions for OS/2 Extended Edition and IBM DOS workstations. IBM OfficeVision/2 provides a common user access (CUA) graphical model with workplace extension that is implemented on OS/2 Extended Edition for use in each of the SAA environments of MVS, VM, OS/400, and OS/2.

The IBM OfficeVision/2 LAN Series provides office functions to interconnected OS/2 Extended Edition and IBM DOS workstations on a local area network (LAN). Support is introduced in IBM OfficeVision/2 Release 1 for mail, correspondence processing, address book, file system, and telephony. In addition to enhancing portions of IBM OfficeVision/2 Release 1, IBM OfficeVision/2 Release 2 adds the functions of calendar, decision support, file cabinet, library, extensive online help and tutorials, as well as an application platform. IBM OfficeVision/2 provides the OS/2 user with a new level of user interaction through a CUA graphical model with workplace extension and the general exploitation of OS/2 Extended Edition capabilities. IBM DOS users are presented with a user interface that is similar in appearance to that of the OS/2 user interface.

IBM OfficeVision/2 provides the facilities necessary to tie together other host and OS/2-based applications. IBM OfficeVision/2 can distribute mail to and receive mail from VM, MVS, OS/400, VSE and IBM LAN systems. In addition, the application platform greatly assists in the integration of in-house and vendor OS/2-based applications. These and other features of the IBM OfficeVision/2 LAN Series provide the extendability necessary for the support of enterprises from small autonomous businesses to large multinationals.

General availability of the U.S. English version is planned as follows:

- Release 1 of the IBM OfficeVision/2 LAN Series – September 1989
- Release 2 of the IBM OfficeVision/2 LAN Series – March 1990

Highlights:

- Based on the powerful OS/2 Extended Edition, the IBM OfficeVision/2 LAN Series introduces an SAA application that is a new generation of application software, providing business solutions initially for mail, address book, correspondence processing, file system, and telephony, and evolving to include calendar, file cabinet, library, decision support, extensive online help and tutorials, as well as an application platform.
- The IBM OfficeVision/2 LAN Series enables users on a LAN to exchange information with each other, IBM

OfficeVision/2 users on another IBM LAN, and users of VM, MVS, OS/400, and VSE office systems.

- IBM OfficeVision/2 presents an intuitive, CUA graphical model with workplace extension in which everyday office objects are represented pictorially. In the OS/2 environment, the IBM OfficeVision/2 office objects behave as would the everyday objects they represent, thus promoting ease of learning and use.
- IBM OfficeVision/2 helps reduce the overhead of system administration. All installation of IBM OfficeVision/2 occurs directly onto the IBM OfficeVision/2 server(s) rather than onto individual requesters, thus minimizing the work necessary to set up a group of users and reducing problems associated with program maintenance.
- IBM OfficeVision/2 Release 2 features an application platform with published programming interfaces to allow customers and vendors to write applications that use the IBM OfficeVision/2 office functions. This application platform makes IBM OfficeVision/2 extendable to meet the needs of most establishments.
- The IBM OfficeVision/2 LAN Series is available in many languages to support multinational and multilingual customers.

Description:

Business Solutions: The IBM OfficeVision/2 LAN Series consists of OS/2 Office server(s), supporting combinations of OS/2-based or IBM DOS-based OS/2 Office requesters on an IBM LAN. The IBM OfficeVision/2 LAN Series provides a range of tools needed in the business environment beginning in Release 1 with mail, address book, correspondence processing, file system, and telephony support and evolving in Release 2 to include calendar, file cabinet, library, decision support, and extensive online help and tutorials in IBM OfficeVision/2. To supplement these facilities, IBM OfficeVision/2 Release 2 includes an application platform allowing the integration of in-house, vendor, or other IBM applications.

Protection of Investment: The IBM OfficeVision/2 LAN Series protects investments in a wide range of current applications. The OS/2 Office DOS Requester Feature preserves investments in IBM DOS and DOS applications which remain important to businesses. From a host perspective, the IBM OfficeVision/2 LAN Series ties into existing networks of current IBM host office products – PROFS (VM), DISOSS (MVS, VSE), and AS/400 Office – as well as networks of the new IBM OfficeVision Family of products.

The IBM OfficeVision/2 LAN Series also preserves investments of time taken to learn a new product. Because IBM OfficeVision/2 is based upon IBM's System Application Architecture, IBM OfficeVision/2 LAN Series skills will be directly applicable to other SAA products.

End-User Productivity: IBM OfficeVision/2 Release 2 implements the CUA graphical model with workplace extension, providing an intuitive style of interaction with the computer. Release 1 is a significant step in this direction. Consequently, users can become productive very quickly. If a source of information is necessary IBM OfficeVision/2 Release 2 includes extensive online help and tutorials to satisfy the needs of the novice as well as the expert user.

The IBM OfficeVision/2 Release 2 main office window can be customized by a designated user before distributing to end users. Thus, IBM OfficeVision/2 can be made to satisfy particular needs that arise in most businesses. End users may also further tailor their main office windows to satisfy individual preferences, thus enabling users to work with IBM OfficeVision/2 in the most productive fashion for their individual work style.

Growth-Enabling: The IBM OfficeVision/2 LAN Series is easily expandable to meet the growing needs of a company. As additional applications become necessary to the operation of a business, they may be integrated with IBM OfficeVision/2 through the IBM OfficeVision/2 application platform. The IBM OfficeVision/2 LAN Series also provides full support of IBM networking facilities. As business needs require larger computing power, the IBM OfficeVision/2 LAN Series provides office functions that can tie into host systems.

System Management: The task of supplying installation aid to all personnel in a company is reduced by distributing the IBM OfficeVision/2 LAN Series on a LAN from a central IBM OfficeVision/2 server. This method of distribution facilitates updating the IBM OfficeVision/2 LAN Series throughout a company.

IBM OfficeVision/2 Release 1

OS/2 Office Feature

Mail: The mail facilities of IBM OfficeVision/2 Release 1 provide the ability to send information such as documents, notes, and data files to other users on the same LAN, a connected IBM LAN, VM, MVS, VSE, or OS/400 system.

Among the other mail features are the following:

- Send / reply / forward of documents, notes, and data files
- Carbon copy
- Mail log facilities
- Delivery status
- Opened / unopened mail indication
- Acknowledgment facility

Address Book: IBM OfficeVision/2 provides a two-tiered address book – personal address book and public address book. IBM OfficeVision/2 users have a personal address book in which they can store personal entries such as their doctors' or stockbrokers' names. At set-up time, the personal address book format can be tailored by a designated user to meet the information needs of the work group. A designated IBM OfficeVision/2 user also maintains the public address book, which contains an entry for each enrolled IBM OfficeVision/2

user and other entries as required by the group. These two address books can be used in tandem to create distribution lists and nicknames as required by the individual user. The address books can be interactively used while addressing a note or in conjunction with the telephony facility.

The address book search facility, working from both the public and personal address book entries, can be used to define a search list that is based on search values for one or more fields of either address book. At the time the search list is requested, the list is dynamically regenerated, ensuring the results are always up to date. When a user wants to send a note to all those in a given department, for example, a search list can be used to address the note and the note will be sent to all personnel currently listed as a member of the department.

Correspondence Processor: Correspondence processing facilities to support the business or technical professional are provided. The IBM OfficeVision/2 Release 1 correspondence processor supports the creation and revision of notes and basic documents for mailing, viewing, or printing. The user interacts with the correspondence processor in a "What-You-See-Is-What-You-Get" style. In addition to basic text processing functions (such as block operations, headers / footers, and search / replace), spell check, spell aid, and synonym search are also included for many languages.

The correspondence processor and the current DisplayWrite products have interchange capability.

File System: Data management of user files is provided by the File System. The facilities of the file system simplify access to files in OS/2 subdirectories.

Telephony: Through interaction with the IBM OfficeVision/2 Release 1 telephony function, the user can automatically dial any number specified in an address book or entered at the time of request.

Print Support: All printer support is provided by OS/2 so that all OS/2-based applications, including IBM OfficeVision/2, will benefit from consistent printer support.

SAA: IBM OfficeVision/2 Release 1 is an SAA application in the following ways:

- Executes in the IBM OS/2 Extended Edition environment, and across all four of the SAA environments
- Is structured for cooperative processing spanning SAA environments
- Conforms to IBM Common User Access (CUA)
- Uses the following SAA Common Communication Support elements:
  - Document Interchange Architecture (DIA)
  - Revisable Format Text: Document Content Architecture (RFT:DCA)
  - System Network Architecture (SNA)
  - Synchronous Data Link Control (SDLC)
  - Token-Ring Network
  - LU 6.2
  - Low-Entry Networking Nodes (Type 2.1 Nodes)
- Uses the following SAA Common Programming Interfaces:
  - C Language Interface
  - Database Interface
  - Presentation Interface

OS/2 Office DOS Requester Feature

In an interface similar in appearance to the OS/2 Office Feature, the OS/2 Office DOS Requester Feature provides mail, address book, correspondence processor, file system, and telephony support compatible with that in IBM OfficeVision/2 Release 1. In addition to these functions, the OS/2 Office DOS Requester Feature also includes a monitor mode function. This is a function which monitors the incoming mail while allowing the rest of the OS/2 Office DOS Requester Feature to be ended, thereby freeing all but 10 KB of the memory required by the OS/2 Office DOS Requester Feature. The user is then free to run other IBM DOS applications. When the monitor function detects incoming mail, the user is notified while still running the other IBM DOS application.

IBM OfficeVision/2 Release 2

OS/2 Office Feature

IBM OfficeVision/2 Release 2 significantly enhances the IBM OfficeVision/2 Release 1 function set by improving many existing functions and adding additional functions.

Mail: Users now have the capability of granting access to their mail to other users. For example, a secretary or assistant can screen incoming mail for a manager, or a co-worker can screen incoming mail while another co-worker is on vacation. This capability can also be used to set up a shared incoming mail basket for a group of users. In addition, the system can be configured to call an appropriate application to handle specific file types received as incoming mail. For example, users could set up their systems so that when they open a particular type of spreadsheet file, a particular spreadsheet application is invoked to handle the spreadsheet.

Composite Correspondence Processor: The OS/2 Office Feature composite correspondence processor is significantly enhanced to provide programming capabilities for Line of Business Integration. Additional functions are the inclusion of image and graphics which can be viewed and printed along with the text. Further enhancements include:

- Import and export of RFT:DCA (IS1 level)
- Easy-to-customize standard style templates
- Text entry aided by system interpretation of users' style intent
- Access to multiple language dictionaries
- Typographic fonts
- Automatic dynamic pagination

- Tailorable user interface

As with the correspondence processor, the composite correspondence processor and the current DisplayWrite products have interchange capability.

Calendar: The calendar facility in IBM OfficeVision/2 Release 2 will support the needs of most businesses. Not only can users work with their own calendar, they may also view and work with the calendars of others if they have been granted access by the owner. The owner of a calendar can grant and revoke read and write access to the calendar and further restrict access by assigning security classifications to individual calendar entries. This ability to work with other IBM OfficeVision/2 calendars extends beyond the bounds of the immediate LAN to other connected LANs.

Calendars can be viewed in a variety of time formats including daily, weekly, monthly, and six-month views. In addition to calendar viewing, essential functions such as create, discard, move, copy, recur, and change are provided to assist users with maintaining their calendars.

File Cabinet: Data management of user files is provided by the File Cabinet. Data files are stored within two types of drawers, designating either the library or disk space on either the user's workstation or the LAN file server. The facilities of the File Cabinet simplify access to the data in either type of drawer. Data stored in a LAN file server drawer may be shared with other users on the same LAN.

Library: IBM OfficeVision/2 library support is based on the Document Interchange Architecture (DIA) element of SAA. Functions provided include:

- File documents, including parametric search terms and other descriptive information
- Grant or revoke various forms of access authority to documents filed in the library
- Specify search criteria and use them in parametric searches for documents
- Save the search criteria as a document in the library for future use
- Add or delete parametric search terms associated with a document in the library
- Retrieve, delete, update or copy documents filed in the library

The separately ordered IBM SearchVision/2 optional product may be used to add contextual search capabilities to the library.

Decision Support: The decision support component of IBM OfficeVision/2 Release 2 provides the following functions:

- Reports
- Business charts
- Data entry and validation
- Data combination
- Data import / export

In addition to the decision support base, four optional products – Statistics, Development, Business Planning, and Project Management – may also be ordered to augment IBM OfficeVision/2 decision support capabilities. See the Personal AS Version 2.0 announcement for further details.

Online Help and Tutorials: IBM OfficeVision/2 Release 2 provides extensive online help to satisfy the needs of the novice as well as the expert user. Users requiring assistance in navigating through IBM OfficeVision/2 will find a special tutorial available from the Office Window.

Users can view help in one window while working with the product in another window. They can also request help in one area, then look at information about another function referenced in the help. Users can also search for help on a specific function through an index facility that can be accessed from anywhere in the product.

In addition, two levels of tutorials are available within OfficeVision/2: short contextual tutorials help the user with a specific task, while longer extended tutorials give the user a broader look at the functions in OfficeVision/2 and how to use the rich functions available to perform complex tasks.

Application Platform: IBM OfficeVision/2 Release 2 offers a flexible and extensive set of programming interfaces to help integrate new or existing OS/2 applications. Extensive use of these programming interfaces in new applications will greatly enhance the productivity of application developers and help achieve a high level of integration and consistency with IBM OfficeVision/2 applications. Selective use in existing applications will provide an attractive balance between the level of integration and consistency achieved and the rework effort required. The services accessed through the programming interfaces provide:

- Functions and protocols to help implement an advanced end-user interface which can comply with the SAA-CUA standards
- High-level access to frequently used office application functions
- Easier management of system resources in the OS/2 multitasking environment
- Application building blocks for the management of internal data structures and the support of multiple national languages

End-User Interface Implementation: A registration process allows OS/2 application objects to be represented as icons and invoked within IBM OfficeVision/2 windows, whether the underlying applications are Presentation Manager-based or not. Depending on how much information an existing application can accept on invocation, the registration process may allow the application to recognize a limited set of graphical CUA menu manipulation and direct manipulation actions by the end user with little or no application reprogramming. Beyond this, through the availability of generic

window procedures, the application platform facilitates the development of highly integrated applications with very consistent appearance and direct manipulation characteristics. More specifically, the IBM OfficeVision/2 application platform functions and protocols help C application programs to:

- Create and modify a window with title bar icon, application action bar with its associated pulldown menus, heading and dynamic information line
- Display and access objects as text lines, icons or mini icons within a fully scrollable list window
- Recognize and process direct manipulation actions performed by the end-user
- Build, dynamically tailor and display informational and error messages to the end-user

Office Application Invocation: High-level, string-oriented requests can be issued from an OS/2 command line or .CMD file, an OS/2 REXX Procedure Language procedure, or a C program to perform the following functions:

- Send an object as an OS/2 file to one or more other users in the network
- Retrieve the list of items in a mail in-basket
- Receive one of the items from a mail in-basket
- Resolve a nickname or a distribution list into a set of one or more user network addresses
- Add, change or delete an address book entry
- Schedule an event into a calendar
- Invoke the correspondence processor

Composite Correspondence Processor Procedures: The composite correspondence processor supports tailoring through the use of OS/2 REXX Procedure Language procedures, and the invocation mechanism allows such procedures to be identified via a CALL interface, or defaulted via the object type being opened. Through this mechanism, many application requirements can be addressed with one or more OS/2 REXX Procedure Language procedures, and capabilities of the composite correspondence processor can be utilized for presentation to the user and entry of data.

System Resources Management: The IBM OfficeVision/2 application platform includes a set of programming interfaces that help C application programs to:

- Allocate, subset, and manipulate shared and non-shared memory
- Manage the invocation of application code across OS/2 processes and threads
- Trigger the invocation of application code at a future time or at given intervals
- Control the execution of task termination routines
- Manipulate queues, files and file directories
- Exploit the OS/2 tracing facilities

Application Building Blocks: C application programs can access IBM OfficeVision/2 application platform functions that will help them to:

- Manage the conversations between the OS/2 Office requester and the OS/2 Office server parts of an application in the same manner whether the requester and server are on the same or different systems
- Convert data arriving from or destined to host systems
- Manage and display date and time values according to the standards of many different national languages
- Sequence, search and insert text elements in the culturally expected manner for many different national languages
- Manage variable pools
- Perform row and column manipulation in tables of variables
- Arrange items as elements of a balanced binary tree

IBM will provide preliminary information about the definition of these programming interfaces for planning purposes prior to the availability of IBM OfficeVision/2 Release 2, and will update this information when Release 2 is available. A variety of programs to provide information and guidance on the use of the application platform to customers, other software vendors, and the industry in general will begin in third quarter, 1989.

SAA: In addition to the SAA elements of IBM OfficeVision/2 Release 1, IBM OfficeVision/2 Release 2 is an SAA application in the following ways:

- Conforms to IBM CUA graphical model with workplace extension
- Uses the OS/2 REXX Procedure Language Interface

OS/2 Office DOS Requester Feature

The features of the OS/2 Office DOS Requester Feature are identical to those in Release 1.

Optional OS/2 Products

The following products may be used to augment IBM OfficeVision/2 LAN.

Note that the application platform facilities allow any OS/2 application to be configured with IBM OfficeVision/2 Release 2 and accessed from the office window.

DisplayWrite 5/2 and IBM DisplayWrite 5/2 Composer

IBM DisplayWrite 5/2, an IBM OS/2-based application, contains all the function provided by the IBM Personal Computer DisplayWrite 4/2 Licensed Program while adding significant new text functions and user interface enhancements, including a user-specified option to select between two different user levels and the ability to view and print text, images, and graphics. In addition, a command line function gives an expert user the ability to bypass menus while in text.

IBM DisplayWrite 5/2 Composer includes a document composition feature providing WYSIWYG (What-You-See-Is-What-You-Get) function of advanced layout, text, image and graphics composition and typographic font printing.

IBM DisplayWrite Dictionaries

IBM DisplayWrite Dictionaries are additional dictionaries to be used with IBM DisplayWrite 5/2, IBM DisplayWrite 5/2 Composer, and IBM DisplayWrite 4 Version 2. When invoked, an active dictionary is used in providing linguistics functions such as spell aid, spell check, and hyphenation. Synonyms are supported for seven of the language dictionaries. The dictionaries are offered in 18 individual packages. There are 17 language dictionaries plus package that contains a U. S. English legal and medical dictionary.

SearchVision/2

IBM SearchVision/2 provides full-text search functions for users of IBM OfficeVision/2 Release 2. The facility extends the scope of search terms to the entire textual content of documents stored in the document library. Users do not depend on special keywords stored in the document profile or document identifiers, but may use as search criteria any word or combination of words appearing in the text body. Even word fragments (masking at front, middle, or end) can be used to find a document. The search also covers synonyms and linguistics inflections, i.e., plural or conjugation. Users can combine parametric and contextual searches in one single query.

OS/2 Image Support Version 1.0

OS/2 Image Support enables office professionals to create and manipulate bilevel images for inclusion in documents. Color and gray image handling functions are also supported.

Personal Application System Version 2.0 Optional Applications

The decision support capabilities of IBM OfficeVision/2 Release 2 can be extended by the addition of the Personal AS Optional Applications – Statistics, Development, Business Planning, and Project Management.

Optional DOS Products

The following products may be used to augment IBM OfficeVision/2.

IBM DisplayWrite 4 Version 2

IBM DisplayWrite 4 Version 2 is a full-function text editor for IBM DOS supporting document interchange via Revisable Form Text-Document Content Architecture (RFT:DCA). Many extra program features and print options provide a high degree of flexibility in document design. The menu-driven user interface features a menu design with multiple selection techniques and enhanced online contextual helps based on cursor position and function in use. Multicolumn text support allows text to flow from the bottom of one column to the top of the next. In addition, groups of related items can be kept together across columns. Justification, bold, underscore and color printing can be used in the columns.

IBM DisplayWrite Dictionaries

See "IBM DisplayWrite Dictionaries" in the "Optional OS/2 Products" section.

National Language Support

The OfficeVision/2 LAN Series provides National Language Support for multinational and multilingual customers. National Language Support includes the character sets, code pages and keyboards for customers who require support for non-U.S. English data creation and communications. National Language Dependent Function, which includes date and time conventions, will be provided by OfficeVision/2. Linguistics functions provide a collection of facilities that help authors, secretaries and other users who handle text communications. This support will be available in most language versions of IBM OfficeVision/2.

Statement of Direction

Among the planned enhancements to IBM OfficeVision/2 is the capability to collect objects, such as notes, documents, and data files, in folders. Folders give the user the ability to work with a group of objects as if the group were a single entity, thus the name 'folder'. Folders can be printed, mailed, stored, and shredded as a single entity.

IBM intends to provide support for Japanese, Korean, and Traditional Chinese translated versions of the OS/2 Office DOS Requester for the 5550 family of workstations, based on the appropriate equivalents to IBM DOS for those languages.

IBM intends to provide a migration aid for users of the Network Courier (TM). The function will assist such users in the conversion of mail log and address book formats in a token-ring configuration.

In addition, IBM intends to provide support for the following connectivity options for IBM OfficeVision/2 LAN:

- The capability for a remote DOS requester workstation to dial in to an OS/2 Office server, for mail to be transferred to the remote workstation for processing either while the connection is maintained or while disconnected, and for mail to be transferred back to the OS/2 Office server upon reconnection.
- The capability for gateway interchange between an IBM OfficeVision/2 LAN environment and other LANs supported by the Network Courier, such that files and other mail can be exchanged among the users.

The general availability dates for these functions will be announced at or before the availability date for IBM OfficeVision/2 Release 2.

Network Courier is a trademark of Consumer Software, Inc.

Introductory Price Discount

IBM offers an introductory price discount of 50 percent off of the one-time charge for the Operating System/2 Office Feature of IBM OfficeVision/2. This offering will be available for three months from the date of availability of the OS/2 Office Feature of Office-

Vision/2. Customers are eligible for this special introductory discount or their VPA / Special Bid discount, but not both.

OS/2 Office Feature Memory Rebate

IBM is offering a rebate on selected IBM memory to Operating System/2 Extended Edition customers who acquire the OS/2 Office Feature of OfficeVision/2 Release 1. The rebate is available on PS/2 80286 and 80386 IBM memory purchased between May 16, 1989 and December 31, 1989 inclusive. The rebate is $200 per MB for eligible IBM memory, up to a maximum of 4 MB. This offering expires after December 31, 1989, but may be modified or withdrawn by IBM at any time upon notice.

IBM Operating System/2 Standard Edition Version 1.2

Operating System/2 (OS/2) has been enhanced with a Dialog Manager that conforms to IBM's Systems Application Architecture (SAA).

Application developers, using the Dialog Manager contained in the OS/2 Programming Tools and Information Version 1.2, can efficiently implement application dialogs that take advantage of Presentation Manager facilities, including the capability of being windowed.

OS/2 Standard Edition Version 1.2 also includes new hardware support and enhancements to function, usability and RAS.

The OS/2 Programming Tools and Information Version 1.2, a single product, has been enhanced to support the new features and functions provided in OS/2 Standard Edition Version 1.2, and contains material previously supplied in the OS/2 Programmer's Toolkit and the OS/2 Technical Reference.

Highlights:

- Availability of an SAA Dialog Manager
- User interface enhancements through the Desktop Manager using iconic representation and direct manipulation for files and programs
- IBM COBOL/2 and IBM FORTRAN/2 language interfaces for Presentation Manager
- High Performance File System
- Windowable System Editor
- RAS enhancements
- New hardware support including a PostScript (TM) device driver for the IBM 4216-030
- Programmer's Toolkit and Technical Reference combined into the single product, Programming Tools and Information
- Programming Tools and Information additions for Dialog Manager
- Dialog Tag Language Compiler in the Programming Tools and Information

PostScript is a registered trademark of Adobe Systems, Inc.

Description:

OS/2 Standard Edition Version 1.2

The many enhancements announced for OS/2 Standard Edition are an advance for the implementation of SAA on programmable workstations. The availability of an SAA Dialog Manager in the OS/2 Programming Tools and Information Version 1.2, and the enhancements to the already available Presentation Manager, emphasize IBM's commitment to SAA. Also included in this announcement are many other improvements such as a new High Performance File System that makes OS/2 a durable and high-function platform for the workstation applications of today and tomorrow. Enhancements to OS/2 Standard Edition Version 1.2 are also available in OS/2 Extended Edition Version 1.2.

Dialog Manager

The OS/2 Dialog Manager is a productivity aid to assist application developers in managing input and output between their applications and the end user. The Dialog Manager is contained in the OS/2 Programming Tools and Information Version 1.2.

The OS/2 Dialog Manager provides significant elements of the interface for the SAA Dialog Manager described in the SAA publication, *Common Programming Interface Dialog Reference* (SC26-4356).

Using the Dialog Manager, application developers can efficiently implement application dialogs that take advantage of Presentation Manager facilities. The Dialog Manager provides application programming interfaces (APIs) for the Dialog elements dealing with display-related services, Dialog variable handling function pools and create / end Dialog session control.

Architected to support a dialog interface for interactive text-oriented applications, the Dialog Manager also provides an interface for the application developer to the Presentation Manager, allowing for special purpose dialog customization. An example of customization would be to incorporate special purpose graphics and icons into the dialog displays.

The Dialog Tag Language (DTL), also described in the CPI Dialog Reference, is the means to define dialog elements other than application program logic: application panels, application command tables and messages. The compiler to process panels written in the DTL is contained in the OS/2 Programming Tools and Information Version 1.2.

The Dialog Manager and the DTL help the application conform to SAA / CUA as described in the publication *Systems Application Architecture Common User Access Advanced Interface Design Guide* (SC26-4582). Applications developed using Dialog Manager service calls, together with the dialog elements defined with the DTL, take advantage of the windowing facilities of OS/2.

The Dialog Manager provides significant support to implement CUA conven-

tions allowing application developers to focus on CUA concepts. CUA consistency assistance is provided in both the run-time facilities and the DTL Compiler.

The general structure of the OS/2 Dialog Manager may be recognized by current dialog developers (EZ-VU or ISPF), facilitating the migration of current dialogs to the OS/2 environment.

Dialog Manager programs may be written in IBM C/2 1.1, IBM FORTRAN/2, IBM Macro Assembler/2, IBM Pascal/2 and IBM COBOL/2.

Presentation Manager Enhancements

The Presentation Manager has further enhanced its SAA / CUA enabling by providing more function and greater usability for both application developers and end users. Some of the CUA enhancements may be enabled automatically; others will require that the application be changed.

Several additions or modifications have been made to the Presentation Manager, particularly for the application developer. The following are intended to assist the application developer in writing high-performing, full-function applications that can be tailored to a specific user or environment:

- Applications can check which windows are visible to avoid repainting windows that don't show.
- A user may mark an area of a VIO window using a system menu option. The contents of the marked area are copied to a clipboard in text format. The contents may then be moved to a Presentation Manager window or application, provided the application allows.
- Presentation Manager calls are now available to the programmer to control the program groups a user sees and can access, allowing for personalization of the system to a specific user or group of users.
- Programs that emulate different terminals can use appropriate font sizes.

Three new Presentation Manager utilities for the printing / plotting, display and interchange of picture files are:

- The PICPRINT utility, which allows the user to print metafiles and picture interchange format (PIF) files
- The PICSHOW utility, which displays picture files on the workstation screen
- The PICICHG utility, which allows picture files to be interchanged by converting a PIF file to a Presentation Manager metafile.

Presentation Manager programs may be written in IBM FORTRAN/2 and COBOL/2 as well as C/2 1.1 and Macro Assembler/2.

Other OS/2 Standard Edition Enhancements

Default User Interface Enhancements: The OS/2 default user interface has been modified to more closely conform to the most current SAA / CUA definition and significantly enhanced to provide increased usability and overall appearance.

The most noticeable enhancements are:

- An enhanced user interface, called the Desktop Manager, for adding and starting programs
  - Icons are used to represent programs or groups displayed on the screen.
  - Programs may be started using direct manipulation to pass input files to the program.
  - Enhanced group manipulation functions allow programs to be copied or moved to different groups more easily.
  - DOS programs may now be added to and started from the Desktop Manager window.
- An enhanced user interface, called the File Manager, for displaying and manipulating files
  - Icons are used (optionally) to represent files.
  - Files displayed by the File Manager may be printed, copied, moved or passed to a program using direct manipulation.
  - The font used by the File Manager may now be selected from any installed fonts, allowing more information to be displayed on the screen when a smaller font is used.
  - File lists resulting from searches may be used to manipulate files in the same manner as directory lists are used.
  - Users may select one or more files and then be prompted for a program to execute and pass the file list to.

System Editor Enhancements: The system editor in OS/2 now executes as a windowed Presentation Manager application. Files created with the Version 1.1 system editor are compatible with Version 1.2. The appearance and operational characteristics of the Version 1.2 system editor are designed to the SAA / CUA definition.

High Performance File System: The High Performance File System manages large disk media in a fast and consistent manner. The High Performance File System is an attractive alternative to the file allocation table or FAT-based file system because it supports DASD with as many as 16 partitions and can handle partitions as large as 2 gigabytes. The High Performance File System maintains compatibility with the FAT file system at the API level and is less performance sensitive as file sizes and / or directories get very large. The system installation procedure is used to optionally install the High Performance File System.

If a partition is formatted for use by the High Performance File System, the contents of that partition will be lost. Copies of existing files should be made before that partition is formatted. After the partition is formatted, the copied files may then be placed in the newly formatted partition and accessed using the High Performance File System.

Files created using the High Performance File System may be accessed by programs running in the DOS environment of OS/2. Files created using the

High Performance File System may not be accessed by either DOS 3.30 or 4.00.

The High Performance File System is implemented to be booted as the C drive.

Reliability, Availability and Serviceability (RAS): The RAS capabilities of OS/2 Standard Edition have been enhanced with several new or modified functions. Improvements have been made for the collection, logging and reporting of detailed information if a system error occurs. These improvements permit a problem to be isolated faster and more accurately.

Consistency between the Standard and Extended versions of OS/2 has been improved by making the application of corrective service appear more nearly the same on both products.

Additional Version 1.2 Enhancements

Additional enhancements have been made to improve data integrity, performance and usability.

- The system can now accommodate 64,000 file handles, 32,000 per process.
- A descriptive name, such as the name and location, may now be associated with a printer.

Hardware-Related Enhancements

Device Independence: The display and mouse device support have been rewritten for OS/2 Standard Edition Version 1.2 to facilitate the attachment of other displays and mice that may normally not have been supported by OS/2 Standard Edition.

Note: See the section listing supported hardware for specific part numbers and other pertinent information.

IBM DOS Compatibility

The DOS environment of OS/2 Standard Edition Version 1.2 protects a user's investment in current software by providing the capability to run existing DOS programs, subject to certain limitations described in the OS/2 documentation. Generally, the DOS environment is compatible to a subset of DOS 4.00 function. Support for disk files greater than 32 MB was included in OS/2 Standard Edition Version 1.1, and is available in DOS compatibility mode. The DOS 4.00 support for greater than 25 lines of text mode display and support for additional video modes for Personal System/2 displays are also available in DOS compatibility mode. The remaining new DOS 4.00 functions, such as the DOS Shell or LIM EMS, are not supported. The interface for the DOS compatibility environment resembles the DOS 3.30 command line as it did in Version 1.1. The family API provided with OS/2 allows programs to be written that will run on DOS 3.30, DOS 4.00, OS/2 Standard Edition Version 1.1 or OS/2 Standard Edition Version 1.2.

Device Support

All device drivers delivered with Version 1.1 either with the product or with its device support supplement will be packaged as separate media and shipped with the Version 1.2 base operating system.

A PostScript driver is included with OS/2 Standard Edition Version 1.2 to allow applications to output PostScript to the IBM Personal Page Printer II (4216-030).

OS/2 Standard Edition has the capability to separately install device drivers if needed. For example, this capability can be used if a customer acquires new hardware in the future that requires installation of a different device driver.

National Language Support

OS/2 has National Language Support for thirteen languages: Canadian French, Danish, Dutch, Finnish, French, German, Italian, Norwegian, Portuguese, Spanish, Swedish, U.K. English, and U.S. / Universal English.

IBM OS/2 Programming Tools and Information Version 1.2

IBM OS/2 Programming Tools and Information Version 1.2 has been updated with the following changes:

- The OS/2 Programmer's Toolkit and OS/2 Technical Reference, separately available in the past, have now been combined to consolidate required technical information in one product.
- The Dialog Manager and its documentation, as well as associated language bindings, have been included.
- A compiler for panels written in DTL, along with its documentation, has been included.
- Existing information for the Presentation Manager has been updated and new material has been added to correspond with the Version 1.2 enhancements.
- New language-specific information and bindings have been added for the use of COBOL/2 and IBM FORTRAN/2 with Presentation Manager.
- Presentation Manager examples have been enhanced to assist application developers with practical applications of existing and new Presentation Manager capabilities.
- C/2 and Macro Assembler/2 external function bindings are included for use with the Procedures Language.
- A sample printer device driver has been included. This sample is written in C/2 and is intended to show basic coding techniques for Presentation Manager device drivers.

Schedule:
The planned availability date is September 29, 1989.

IBM Operating System/2 Extended Edition Version 1.2

Operating System/2 Extended Edition Version 1.2 uses the functions of OS/2 Standard Edition Version 1.2 as its base operating system. OS/2 has been enhanced with a Dialog Manager that conforms to IBM's Systems Application Architecture (SAA). In addition, OS/2 Extended Edition Version 1.2 includes an SAA Procedures Language, a flexible language that allows programmers to write command procedures in a clear, structured way. OS/2 Extended Edition

continues as a primary participant in IBM Systems Application Architecture.

New functions supported by the Communications Manager are SNA gateway, Ethernet (trademark of Xerox Corporation) DIX Version 2.0 and IEEE 802.3, X.25, asynchronous and 3270 terminal emulator enhancements, with modifications to allow them to run as Presentation Manager applications. Support also includes COBOL/2 language support and expanded support for AS/400 including 5250 Work Station Feature and twinaxial attachment.

The LAN Requester component of OS/2 Extended Edition enables workstation access to the shared resources on the OS/2 LAN Server Version 1.0. The LAN Requester supports the IBM OS/2 LAN application programming interfaces (APIs) and takes advantage of the performance improvements and large disk media management characteristics provided by the new High Performance File System option of OS/2 Standard Edition Version 1.2.

Database Manager enhancements include local area network (LAN) support (remote data services), a DOS Database Requester, referential integrity, SAA Procedures Language support, precompiler support for COBOL/2, Pascal/2, IBM FORTRAN/2 languages, a Query Manager callable interface, and a business graphics interface. Also included are enhancements to error log support, additional security functions (SQL GRANT / REVOKE support), and new levels of data isolation. The Query Manager has been modified to run as a Presentation Manager application.

Highlights:

- SAA participant
- SNA extensions including gateway, X.25, and Ethernet DIX Version 2.0, and IEEE 802.3 LAN support
- AS/400 twinaxial connectivity and 5250 Work Station Feature
- 3270 and asynchronous enhancements including use of the Presentation Manager, 3270 host directed print, and 3270 host graphics enabling
- X.25 non-SNA API, selective support of COBOL/2, and RAS extensions to the common services API
- LAN Requester support for the IBM OS/2 LAN APIs and the new High Performance File System
- Database Manager Enhancements
  - — Remote Data Services and DOS Database Requester
  - — Referential integrity and additional levels of data isolation
  - — COBOL, Pascal, FORTRAN and Procedures Language support
  - — Query Manager callable interface and a business graphics interface
  - — Query Manager operation as a Presentation Manager application
  - — User Profile Management and SQL GRANT / REVOKE

Description:

OS/2 Extended Edition Version 1.2 is upwardly compatible with OS/2 Extended Edition Version 1.1, but adds significant new functions, services, and usability enhancements to allow users to migrate existing DOS applications, develop new Protect Mode applications, and install and use the system more productively than ever before.

OS/2 Extended Edition continues to participate in SAA as the platform for the development of portable applications and the interconnection of cooperative SAA systems. The OS/2 workstation is the window to the customer enterprise-wide information system under SAA. Applications written to SAA specifications will have a consistent screen design and user interface, making it easier for customers to learn and use new applications. SAA is the framework for development of consistent applications and cooperative processing across the major IBM computing environments of System/370, AS/400, and the Personal System/2. SAA consists of four related elements: common user access, common programming interface, common communications support, and common applications.

The integrated SAA Procedures Language is similar to Virtual Machine / System Product (VM/SP) System Product Interpreter and is based on REstructured eXtended eXecutor (REXX). It combines the structured logic, general variables, and subroutine calls of a traditional programming language with the ability to execute character strings as system commands. External functions may be written in the Procedures Language itself, IBM C/2 1.1, IBM Pascal/2 or IBM Macro Assembler/2.

OS/2 Standard Edition Enhancements

OS/2 Extended Edition Version 1.2 uses the functions of OS/2 Standard Edition Version 1.2 as its base operating system. It contains all the enhancements of OS/2 Standard Edition Version 1.2. The High Performance File System manages large disk media in a fast and consistent manner. The High Performance File System is an attractive alternative to the file allocation table or FAT-based file system because it supports DASD with capacities up to 2 terabytes and can handle files as large as 2 gigabytes. The High Performance File System maintains compatibility with the FAT file system at the API level, and is less performance-sensitive as file sizes and / or directories get very large. The system installation procedure is used to install the High Performance File System.

The integration of an SAA Dialog Manager in OS/2 Standard Edition along with the enhancements to the presently available Presentation Manager emphasize IBM's commitment to SAA.

The OS/2 Dialog Manager provides significant elements of the interface for the Systems Application Architecture Dialog Manager. The OS/2 Dialog Manager is a productivity aid to assist application developers in managing input and output between their applications and the end user. The Dialog Manager is contained in the OS/2 Programming Tools and Information Version 1.2. It provides APIs for many of the defined SAA dialog elements. The Dialog Tag Language (DTL), also described in the CPI Dialog Reference, is the means to define dialog elements

other than application program logic: application panels, application command tables, messages and function key lists. A compiler to process panels written in the Dialog Tag Language is contained in the OS/2 Programming Tools and Information Version 1.2. Dialog Manager programs may be written in IBM C/2 1.1, IBM FORTRAN/2, IBM Macro Assembler/2, IBM Pascal/2 and IBM COBOL/2.

The Presentation Manager has further enhanced SAA / CUA compliance, providing more function and usability for both application developers and end users. Presentation Manager enhancements are intended to assist the application developer in writing high-performing, full-function applications that can be tailored to a specific user or environment. Presentation Manager calls are available to control the program groups a user sees and can access, allowing personalization of the system to a specific user or group of users. The Presentation Manager has three new utilities for the printing / plotting, display and interchange of picture files. Presentation Manager programs may be written in IBM FORTRAN/2, IBM COBOL/2, IBM C/2 1.1, and IBM Macro Assembler/2.

Communications Manager Enhancements

SNA gateway support allows access to an IBM System/370 host by multiple users attached to the gateway via an IBM Token-Ring, IBM PC Network LAN, SDLC switched link, or an X.25 network. The link between the gateway and the host may be SDLC, X.25, or an IBM Token-Ring. The supported line speeds for these links are the same as for any personal computer using OS/2 Extended Edition Version 1.2. The gateway personal computer, which does not have to be dedicated to this task, appears to the host as a single physical unit (PU2.0) with up to 254 LUs, which may be shared between the workstations. Up to 256 workstations may be configured on the LAN, with 64 active at one time, each with multiple LUs. The workstation appears to the user as if it were directly attached to the host. LUs may be dedicated, or they may be pooled in order to allow greater efficiency in their allocation between workstations, and to reduce the configuration and startup requirements in the host. The protocols supported by the gateway between the workstation and the host are LU1, 2, 3, and 6.2. In most environments, workstations may use the same gateway when operating with:

- OS/2 Extended Edition Version 1.1
- OS/2 Extended Edition Version 1.2
- IBM Personal Communications / 3270
- 3270 Emulation Program Version 3.0
- 3270 Workstation Program Version 1.1
- APPC/PC Version 1.11

Communications to the AS/400 have been expanded to allow IBM Token-Ring, X.25, twinaxial, and remote connection via the IBM 5394 Remote Control Unit links, in addition to existing SDLC links. All these use LU6.2 protocols. X.25 has been added to System/36 support in addition to the existing SDLC and IBM Token-Ring support. The 5250 Work Station Feature can provide the functions of up to five display / printer sessions. The five sessions may be any combination of display sessions and printer sessions concurrently active on one or more local or remote AS/400 or System/36 units. The Emulator High Level Language Application Programming Interface (EHLLAPI) supported with 3270 emulation is also supported for the enhancement of 5250 applications.

3270 Emulation has been enhanced with the addition of 3270 host-directed print, 3270 graphics support enabling, and presentation space print (3270 local copy). 3270 host-directed print allows LU1, LU3 and non-SNA printer data streams to be printed at the workstation printer. Multiple printer sessions are supported and the workstation may be standalone or gateway-attached. 3270 Graphics support works with the GDDM - OS/2 Link program, which adds graphics support to the 3270 emulator. This allows the workstation to function as a GDDM mainframe graphics terminal. In addition, GDDM pictures may be printed and plotted, or saved to a Presentation Manager metafile. Presentation space print may be either host or user initiated. The entire presentation space or a user selected portion may be printed.

The ASCII terminal emulators add support for 8-bit, no parity, asynchronous character data streams. The modem command strings provided for the explicitly supported modems, or their equivalents, may now be edited by the user, which allows support for a variety of modems with different command requirements. Applications written to the Asynchronous Communications Device Interface may initialize ACDI with their own modem command strings. It is possible through the use of a single key to have a snapshot copy of the display screen contents saved on a logfile. A Version 24 (RS-232C) ABC switch can be connected to any asynchronous communications port to provide user switching between a modem supported by the ACDI asynchronous device drivers and other serial I/O devices (such as printers and plotters) supported by the base operating system device drivers. The ACDI and base device drivers will share this port on a sequential use basis.

The 3270 and ASCII terminal emulators now use the Presentation Manager and its windowing facilities to allow user interaction with the system and to take advantage of the enhanced font support available. Each logical terminal will appear in a separate window that can be individually started, stopped, moved and sized by the user. Additional emulator facilities include:

- The remapping of keyboard function and accelerator keys
- Cursor join (to the mouse position)
- Online choice of fonts for the EGA, VGA, and the IBM 8514/A displays
- The saving and restoring of window characteristics

Additional support is provided for the 3270 emulator with the clipboard functions of Mark, Cut, Copy, Paste, and

Undo. The ASCII emulator has support for Mark and Copy. The user can transfer information between the Communications Manager windows and other application windows that support clipboard. Formats supported for Cut and Copy are: Simple Text, Text with Attributes, and Bit Image. Simple Text is supported for Paste.

X.25 is a Systems Application Architecture Common Communications Support protocol. OS/2 Extended Edition Version 1.2 X.25 Packet Switched Data Network (PSDN) support allows an IBM Personal System/2 Model 50 Z or higher, equipped with one or more IBM X.25 Interface Co-Processor/2 adapters, to attach to one or more X.25 PSDNs and communicate with other systems or hosts having appropriate X.25 support. Connection to public and private networks conforming to CCITT 1980 or 1984 X.25 recommendations is supported. Multiple IBM X.25 Interface Co-Processor/2 adapters are supported, depending on the available slots in the system unit. The software enables each adapter to offer either an X.21, an X.21bis/V.24, or an X.21bis/V.35 interface, and support speeds up to 64K bps. The software can support a mixture of up to 128 switched virtual circuits (SVC) and permanent virtual circuits (PVC). SNA Communications is supported by the qualified logical link control (QLLC). There is also an API that enables X.25 support for non-SNA communications (an enhanced version of the API available on IBM DOS products in some non-US countries). This API can support multiple applications concurrently. Both SNA and non-SNA applications may concurrently share the same adapters. Connection (in France only) to the Transpac network via the public switched telephone network is supported via the PTT supplied MOCAM VX32 adapter. Autodial and autoreceive facilities are supported.

Ethernet DIX Version 2.0 and IEEE 802.3 LANs are supported. The Communications Manager utilizes the Network Driver Interface Specification (NDIS) for these two additional LAN protocols. This support provides the ability for the upper layer Netbios, SNA LU2, SNA LU6.2 functions to be used across Ethernet DIX Version 2.0 and IEEE 802.3 LANs. Applications written to the IEEE 802.2, Netbios, and APPC interfaces can be used across an Ethernet DIX Version 2.0 and IEEE 802.3 LAN. The SNA functions of APPC and 3270 emulation (with EHLLAPI and SRPI) may be used through the Communications Manager SNA gateway to SDLC, IBM Token-Ring and X.25-based hosts for Ethernet DIX Version 2.0 and IEEE 802.3 LANs. A list of LAN adapters supported in this environment will be provided at product availability.

An extension to the common services API allows all Communications Manager RAS functions (trace, dump, errors and messages) to be performed under program control, and no longer require an operator to perform these tasks. A user-written program can monitor errors and messages selectively, and take appropriate action. Message pop-ups on the screen can be suppressed.

The COBOL/2 language has been added to Pascal/2, C/2 and the Macro Assembler/2 for the support of the APPC and SRPI programming interfaces.

Double Byte Character Set (DBCS) enabling has been extended to cover 3270 Emulation and 5250 Work Station Feature. IBM implementation of DBCS versions of OS/2 Extended Edition are only available as announced in the IBM Asia/Pacific Group.

LAN Requester Enhancements

The OS/2 Extended Edition Version 1.2 LAN Requester will attach to the IBM OS/2 LAN Server Version 1.0 and will take advantage of the new OS/2 Standard Edition Version 1.2 High Performance File System. In addition to performance improvements, this optional replacement for the FAT-based file system will manage large disk media.

In addition to Named Pipes APIs already announced, IBM OS/2 LAN API support has been extended to the following categories:

- ALERT – notification of network events
- SERIAL SERVICE – control shared serial devices and their associated queues
- CONNECTIONS – list of all connections made to a server by a requester client or all connections made to a server's shared resources
- FILES – monitoring which file, device, and pipe resources are opened on a server, and closing one of the resources if necessary
- MESSAGES – send, receive, read, log, and forward messages
- REMOTE UTILITIES – copy and move remote files, remotely execute a program, and access the time-of-day information on a remote server
- SERVER – enable remote administration tasks to be performed on a local or remote server
- SERVICE – start and control network service programs
- SESSIONS – control network sessions established between requester and servers
- SHARES – control shared resources
- USE – examine or control connections (uses) between requesters and servers
- REQUESTERS – control the operation of requesters
- PRINT – control the print jobs in a spooler queue or the spooler queue manager and spooler queue processor
- MAILSLOTS – one-way interprocess communication

Database Manager Enhancements

Remote Data Services (Operating System/2 Extended Edition to Operating System/2 Extended Edition via the Communications Manager's APPC) provides support to allow the data base management system to be used in an IBM Token-Ring, IBM PC Network LAN, or Ethernet DIX Version 2.0 and IEEE

802.3 environment. A supported Personal System/2 or personal computer on the LAN is able to function as a data base requester and / or data base server workstation. This capability allows multiple workstations to access a common data base, or a single workstation to access geographically distributed data bases. The location of the data base (server) is transparent to the requesting application or end user (requester). Multiple application programs can access a single data base concurrently. An application is also able to access multiple data bases serially. Each requester / server workstation utilizes the APPC Programming Interface in the Communications Manager. The Remote Data Services component uses the OS/2 Extended Edition Communications Manager APPC sessions to connect Database Manager requesters and servers. APPC sessions can be configured on a variety of communications links. The Remote Data Services APPC sessions can be supported by IBM Token-Ring, IBM PC Network or Ethernet DIX Version 2.0 and IEEE 802.3 links in a LAN environment. The Database Manager will support a single SDLC connection between an OS/2 Extended Edition Database Manager Requester and an OS/2 Extended Edition Database Server.

The OS/2 Extended Edition Database Manager provides a DOS Database Requester allowing access from a DOS workstation to an OS/2 Extended Edition Database Manager data base. The DOS Requester supports the SQL API in the DOS environment, and also a subset of the Database Services Environment Utility API. Applications intended for use with the DOS Database Requester must be precompiled on an OS/2 Extended Edition Database Manager workstation and then compiled as a DOS application. The application can then be transferred to the DOS workstation for execution. A user interface is not provided and, if required, must be obtained from an alternative source. The DOS Database Requester Workstation requires the installation of the IBM LAN Support Program Version 1.0 and DOS 3.30 or later to support the Netbios session used to communicate with the OS/2 Extended Edition Database Manager server. The DOS Database Requester supports both IBM Token Ring and IBM PC Network LAN environments.

Referential integrity ensures the consistency of data values between related columns of different tables. The Database Manager in OS/2 Extended Edition Version 1.2 provides this key relational support that can be applied to new or existing tables. Programmer productivity can be increased by allowing this function to be moved out of application programs and into the Database Manager. For example, a user may define an EMPLOYEE table that contains employee and department numbers and a DEPARTMENT table that contains department numbers. In addition, the user may want to ensure that for every department number in the EMPLOYEE table there must be an equal and unique department number in the DEPARTMENT table. Such a constraint defined on the EMPLOYEE table is called a referential constraint. The department number in the DEPARTMENT table is called the primary key, and the department number in the EMPLOYEE table is called the foreign key in this constraint. Enforcement of this constraint provides referential integrity. The Database Manager records and enforces this data relationship, and enforcement by application logic is not necessary. Referential integrity constraints can be defined for tables through the SQL interface and through a prompted interface within the Query Manager.

The OS/2 Extended Edition Version 1.2 Database Manager will support the Procedures Language to give application developers direct access to features of the Database Manager that are currently available to programmers using C/2. The Procedures Language is also supported by the Query Manager Callable Interface.

The Database Application Remote Interface capability allows an application developer to develop an application program where the processing can be split between the data base requester and the data base server in a local area network. When the application is run, some of the processing load can be transferred from the requester to the server, resulting in a reduction of traffic on the communication facility.

Precompiler support has been added to allow embedded SQL statements to be included in programs written in COBOL/2, Pascal/2 and IBM FORTRAN/2. SQL statements may be embedded into application programs allowing the programs to interface with the Database Manager and access the data in the data base.

Cursor Stability is an alternative level of data isolation that allows greater concurrent data access than the Repeatable Read data isolation level presently provided by the Database Manager. An application developer specifies the desired level of data isolation to the Database Manager. The Cursor Stability data isolation level allows another application to read or to change rows of table data, which the application with cursor stability has previously read.

Uncommitted Read is a new level of data isolation offered in the OS/2 Database Manager. A Database Manager application using Uncommitted Read will read and return all rows of data even if they contain uncommitted changes made by other applications. The Uncommitted Read function results in improved performance because an application that is reading does not have to wait on other applications to Commit or Rollback. The application programmer makes the decision as to which data isolation level to use when the application is bound to the data base.

Database Manager Error Log Support in OS/2 Extended Edition Version 1.2 will provide information to the Common OS/2 Extended Edition Error Log, one of the diagnostic tools being provided in the base operating system. In the case of a problem with an Extended Edition system, the Common Error Log will contain a record of any system level error messages generated by the Database Manager. The diagnostic tools are accessed from the OS/2 command line.

Upon invocation, a full screen interface to diagnosing errors is provided.

The Presentation Manager, introduced in OS/2 Standard Edition Version 1.1 for applications, will now be used by the Query Manager, allowing the Query Manager to utilize Presentation Manager controls, graphics, icons, and windowing capabilities.

OS/2 Extended Edition Version 1.2 Database Manager supports a Business Graphics Interface that provides the user with the capability to install and use a vendor business graphics program that has been written to this interface. This permits graphic presentation of report data that was accessed by the Query Manager's Prompted or SQL Query capability and displayed by the Report function. The Query Manager is enhanced to include a GRAPH option on the Report ACTIONS pull-down menu. Examples of Report data that a vendor supplied application program could graph includes bar, pie and line charts. The method of passing data from the Query Manager to a vendor-developed business graphics application program could change in subsequent releases of OS/2 Extended Edition. This may require applications using the business graphics interface to be changed in order to migrate to a subsequent release of OS/2 Extended Edition. Information about the Business Graphics Interface will not be included in the OS/2 Extended Edition Version 1.2 library, but will be available upon request from IBM.

The Operational Status tool of the OS/2 Extended Edition Version 1.2 Database Manager provides a snapshot of information about current data base activity. This administrative tool provides information about where the data bases are located, alias names, the time and date a data base was last backed up, and how many applications are currently connected to a specific data base. The Operational Status Tool also includes user detail information on each user connected to the data base, including:

- ID
- Authority level
- Number of SQL calls that have been made to the Database Manager since the beginning of the current transaction
- Total number of requests since the data base was started
- Number of completed units of work since connecting to the data base
- Elapsed time since the last Commit or Rollback

The total connect time, lock wait status (yes or no), and the state of a transaction are also provided. The Operational Status tool is beneficial in providing user and data base information while performing problem determination. If desired, this Operational Status information can be printed.

Query Manager now includes the Query Manager Callable Interface. This common programming interface (CPI) will enable an application program to call Query Manager functions. For example, you may want to design an end-user application that includes query, data entry / edit and report functions. Instead of designing all the screens to perform these functions inside the application, the user can call the Query Manager's functions from inside the application. As appropriate, control is returned to the calling application following the completion of the requested Query Manager function. The external application program can invoke the interactive facilities of the Query Manager to create queries, reports, menus, and panels, as well as the commands to manipulate such objects; for example, export table, run query, etc. The Query Manager Callable Interface support can be used in application programs written in C/2, COBOL/2, Pascal/2, IBM FORTRAN/2 or the Procedures Language. The Query Manager Callable Interface adheres to the SAA Query CPI definitions.

User Profile Management and SQL GRANT / REVOKE statements help control user access to a data base and the tables within the data base. Database Manager prevents unauthorized access by coordinating its security functions through a component called User Profile Management and through the SQL GRANT / REVOKE Authorization statements. User Profile Management establishes access levels used by the Database Manager. Before using objects in the Database Manager, the user must be identified to User Profile Management and be validated by a password on the first use of the Database Manager. The user is then associated with a valid USERID. Access to a specific data base and the objects within it (for example, tables, views, access plans) is controlled by SQL GRANT / REVOKE statements. A creator, or other specifically authorized user of a data base object (such as a systems administrator or data base administrator) may protect the object by only granting access rights to specific users and / or groups. Another user must be specifically authorized to access and update a data base object. These rights can also be revoked as required. A creator also has the option to allow public access to all data base objects. SQL GRANT / REVOKE statements can be defined through the SQL interface or through a prompted interface within the Query Manager.

Overall Ease-of-Use Enhancements for OS/2 Extended Edition

Features have been added to improve ease of use. The new OS/2 Extended Edition install procedures allow more flexibility in the choice of functions to be installed, the ability to remove unwanted functions, and the ability to tailor the install process for other users. The Communications Manager, the Database Manager and the LAN Requester may be installed on any logical fixed disk drive (for example, C, D or E); however, the base operating system must be installed on fixed disk drive C.

Network Asset Management is supported by responding to host queries for Product Vital Data. This information is useful to a central network administrator in performing inventory management for an entire network. Product information returned on the reply includes the operator recorded hardware model and serial number, as well as software names and version levels as maintained

by the OS/2 Extended Edition components.

Schedule:
Availability is planned for November, 1989.

IBM Operating System/2 Rebate Offering

IBM announces the availability of rebates on selected IBM memory, fixed disk upgrades, communications options, and software applications to customers who acquire OS/2 Standard Edition (SE) Version 1.1 or 1.2 or OS/2 Extended Edition (EE) Version 1.1 or 1.2 between May 9, 1989 and December 31, 1989 inclusive. Rebates are available on PS/2 80286 and 80386 IBM memory, a 60 MB fixed disk upgrade option, and a variety of personal productivity applications when acquired with OS/2 SE Version 1.1. Rebates are also available on PS/2 80286 and 80386 IBM memory, selected communications adapters, a modem, an IBM OS/2 LAN Server Version 1.0, a 60 MB fixed disk upgrade option, and a variety of personal productivity applications when acquired with OS/2 EE Version 1.1. These rebates are available through IBM US Marketing and Services – Marketing Operations as well as through eligible IBM Authorized Remarketers. This offering expires after December 31, 1989, and may be modified or withdrawn by IBM at any time upon notice.

The following rebates are available with OS/2 SE Version 1.1:

- $100 per megabyte of IBM memory, up to 4 MB
- $250 on the 60 MB fixed disk upgrade option
- IBM and selected non-IBM approved personal productivity applications that run under OS/2 protect mode

The following rebates are available with OS/2 EE Version 1.1:

- $200 per megabyte of IBM memory, up to 4 MB, or
- $200 per MB of IBM memory, up to 8 MB, when purchased with the acquisition of IBM OS/2 LAN Server Version 1.0
- $50 per communication / modem adapter
- $250 on the 60 MB fixed disk upgrade option
- IBM and selected non-IBM personal productivity applications that run under OS/2 protect mode

Easel (R) for OS/2 Extended Edition

Easel for OS/2 EE consists of two IBM licensed programs that produce a highly productive programming facility and an operating environment to assist customers in migrating to programmable workstations from terminals. These products are Easel for OS/2 EE Development system and Easel for OS/2 EE Runtime facility.

The Easel OS/2 EE Development system runs on an IBM OS/2 Extended Edition programmable workstation. Programmers use the Easel OS/2 EE Development system to write new graphical front end applications for existing terminal-based host applications. An interactive common user access (CUA) screen layout facility based on the OS/2 Presentation Manager is provided to assist programmers in developing application screens. The Easel OS/2 EE Development system also provides language statements to access host screen contents via the terminal emulation facilities of the OS/2 Communications Manager. Additional application logic can be provided in the front-end application, while the host applications can continue to run unchanged. These facilities assist programmers in developing applications that can conform with the Common User Access (CUA) guidelines of System Application Architecture (SAA).

The Easel OS/2 EE Runtime facility provides the capability to execute these new front-end applications on an IBM OS/2 EE programmable workstation. Users at these workstations can benefit from consistent CUA graphics and cooperative processing, while users at terminals can operate without change.

Easel OS/2 EE is developed by Interactive Images, Inc., Woburn, Massachusetts. Easel is a registered trademark of Interactive Images, Inc.

Highlights:

- Provides a highly productive programming facility to assist customers in migrating the user interface of host applications from terminals to programmable workstations. Includes:
  - — Interactive CUA screen layout facility based on Presentation Manager in IBM OS/2 Extended Edition that guides towards conformance with CUA guidelines
  - — High level language that is event driven, yet easy to learn. Language statements support graphics and communications as well as application logic
- Supports Communications Manager in IBM OS/2 Extended Edition:
  - — 3270 datastream connection using EHLLAPI
  - — Asynchronous connection using Asynchronous Communications Device Interface (ACDI)
- Provides business graphics routines with 14 types of charts
- Provides National Language Support, single byte character sets

IBM Application System/400 PC Support Extended with OS/2 Support

IBM Application System/400 (AS/400) PC Support is enhanced to operate with IBM Operating System/2 Extended Edition Version 1.2. PC Support provides similar function to OS/2 and IBM DOS-based systems. PC Support provides a link for two of the participants in Systems Application Architecture (SAA) – OS/400 and OS/2 Extended Edition. AS/400 supports the APPC connections provided by OS/2 Extended Edition Communications Manager (IBM Token-Ring Network, SDLC, X.25 and twinaxial for local and 5394 Remote Controller).

CICS OS/2 Version 1.1 Available

CICS OS/2 Version 1.1 is now available. In addition to previously announced function, CICS OS/2 has been enhanced by the addition of the capability for CICS transaction routing from the workstation to a host CICS system using LU 6.2 protocols.

IBM AIX PS/2 Operating System Version 1.1 and Related Programs Available

IBM announces the availability of the IBM AIX PS/2 Operating System and related licensed programs. In addition to previously announced enhancements, IBM AIX PS/2 Operating System includes support for additional devices.

IBM AIX PS/2 VS FORTRAN now includes error flagging for Systems Application Architecture (SAA) level 1 support. IBM AIX PS/2 Workstation Host Interface Program supports communication with an IBM MVS/XA host. IBM AIX Access for IBM Disk Operating System (DOS) Users and IBM X-Windows for IBM DOS support additional IBM personal computers.

The availability date for asynchronous communication support in the AIX PS/2 Operating System using the IBM Realtime Interface Coprocessor Multiport/2 with the Eight-Port RS-232 Interface Board is delayed to fourth quarter 1989.

A reduced price option of the IBM AIX PS/2 Operating System is announced for customers who require a maximum of two concurrently logged-on users of the AIX PS/2 system.

Highlights:

- Expanded support for IBM ASCII displays, IBM printers, and other devices
- Support in Graphical Support Library (GSL) for IBM 8514 Color Display
- Additional models of IBM Personal Computer and IBM Personal System/2 supported by IBM AIX Access for DOS Users and IBM X-Windows for IBM DOS
- IBM AIX PS/2 VS FORTRAN includes error flagging for SAA Level 1 support

IBM AIX PS/2 VS COBOL Compiler and IBM AIX PS/2 VS COBOL Run Time Environment

The AIX PS/2 VS COBOL Compiler and the IBM AIX PS/2 VS COBOL Run Time Environment are designed to provide a complete COBOL development system and COBOL application support environment for the IBM Personal System/2. These products provide support for the commercial programming language, COBOL, at the ANSI 85 High Level and ANSI 74 High Level. AIX PS/2 VS COBOL implements the IBM SAA COBOL Common Programming Interface (CPI) language definition without DBCS support.

Highlights:

The AIX PS/2 VS COBOL Compiler:

- is a development tools package consisting of a compiler, data screen entry utility, and debugger
- can produce both intermediate and native code
- is designed to comply with the ANSI X3.23-1985 COBOL Standard at the High Level and the ANSI X3.23-1974 COBOL Standard at the High Level

JSB – MultiView (TM) for IBM AIX PS/2

JSB – MultiView for IBM AIX PS/2 provides a multitasking windowing environment that operates from either the IBM PS/2 console display or from attached ASCII terminals. With MultiView, up to 16 users can use this program simultaneously, when used with the AIX PS/2 Operating System 1-16 User Option.

MultiView is a trademark of JSB Computer Systems Limited.

Highlights:

- Window interface with desktop accessories
- Mirrors the working environment by offering multiple active windows
- Works on ASCII terminals (up to 16 simultaneously) without graphics hardware
- Customized user configurations
- Hot key between windows
- Provides cut-and-paste facility between applications

SAMNA PLUS IV for IBM AIX PS/2

SAMNA PLUS IV for AIX PS/2 is a word processing program plus an integrated spreadsheet and text retrieval system. SAMNA PLUS IV contains significant enhancements to the SAMNA PLUS product.

SAMNA PLUS IV can be run from either the IBM PS/2 console display or from attached ASCII terminals. With the multi-user version of SAMNA PLUS IV and the AIX PS/2 Operating System 1-16 user option, 16 users can use programs simultaneously.

Highlights:

- Significant functional enhancements to SAMNA PLUS
- Enhanced document exchange
- Spreadsheets integrated into text documents
- Additional terminals and printers supported
- Compatibility with SAMNA products for IBM DOS and AIX/RT

IBM Personal Communications / 3270

IBM Personal Communications / 3270 replaces IBM PC 3270 Emulation Program Version 3 and provides enhanced workstation functions and expanded gateway services. Workstation functions include multiple 3270 display and

/ or print sessions, Emulator High-Level Language Application Program Interface (EHLLAPI), and the capability for concurrent connection to one or more IBM System/370 host systems as a 3270 terminal and / or workstation printer. Expanded gateway services provide System/370 host connection to users of IBM OS/2 Extended Edition Version 1.1, PC 3270 Emulation Program Version 3.0, 3270 Workstation Program Version 1.1 and Personal Communications / 3270 via the Personal Communications / 3270 LAN gateway. This program also replaces the IBM Information Network Personal Connectivity Services (INPCS) Version 1.1 and provides to the end-user a single program for local / remote intercompany connections as well as an asynchronous connection to an IBM Information Network Series/1 gateway for obtaining Information Network services.

Highlights:

- Provides multiple host display and / or host directed print sessions
- Provides concurrent connections to one or more IBM System/370 hosts via SDLC, Distributed Function Terminal (DFT), 802.2, NETBIOS through an IBM PC 3270 Emulation Program, Version 3.0 gateway, or Asynchronous to an IBM Information Network Series/1 gateway
- Provides Emulator HLLAPI and SRPI
- Provides improved performance for file transfer, screen updating, and Enhanced Connectivity Facilities services
- Provides expanded local area network gateway services to users of Personal Communications / 3270, OS/2 Extended Edition Version 1.1, PC 3270 Emulation Program Version 3.0 and 3270 Workstation Program Version 1.1.
- Provides host-directed print enhancements
- Allows the concurrent execution of a PC DOS application
- Supports concurrent use of two attached displays
- Provides keyboard layouts, character sets, and host code page support for 17 languages

IBM LAN Manager Entry Version 1.0 Available

The IBM LAN Manager Entry Version 1.0, a network management program, enhances LAN management capability by allowing single-segment networks (IBM Token-Ring Networks or IBM PC Networks, baseband or broadband) to be managed by NetView Release 3. Using IBM Operating System/2 Extended Edition Version 1.1 (OS/2 EE 1.1) Communications Manager function, LAN Manager Entry Version 1.0 exchanges alert and command information with NetView, facilitating centralized management of remote LANs.

An upgrade to LAN Manager Entry Version 1.0 is available to IBM PC 3270 Emulation LAN Management Version 1.0 licensees for a charge of $250.00. The program upgrade is available through December 31, 1989. The upgrade is available through IBM Authorized Personal Computer Dealers and Industry Remarketers – Personal Computer certified to market IBM Authorized Advanced Products, and through IBM branch offices.

IBM LAN Manager Version 2.0 Available

IBM LAN Manager Version 2.0, a network management program, enhances LAN management capability by allowing management of mixed networks (IBM Token-Ring Networks and broadband IBM PC Networks interconnected by IBM local area network bridge programs) from a single LAN management station.

LAN Manager Version 2.0 uses IBM Operating System/2 Extended Edition (EE) Version 1.1 Communications Manager function to exchange alert and command information with NetView Release 3. In a multiple network management environment where NetView/PC is required, LAN Manager Version 2.0 can use NetView PC Version 1.2.

An upgrade to LAN Manager Version 2.0 is available to LAN Manager Version 1.0 licensees for a charge of $1,250.00. The program upgrade is available through December 31, 1989. The upgrade is available through IBM Authorized Personal Computer Dealers and Industry Remarketers – Personal Computer certified to market IBM Authorized Advanced Products, and through IBM branch offices.

IBM PC Network Bridge Program

The IBM PC Network Bridge Program provides connectivity between multiple segments of broadband IBM PC Network or between broadband IBM PC Network and the 16 Mbps or 4 Mbps IBM Token-Ring Network. IBM PC Network Bridge Program also provides network management support by forwarding Local Area Network (LAN) segment and bridge error information to the IBM LAN Manager Version 2.0.

IBM expEDIte Family

IBM expands its role in the Electronic Data Interchange environment by announcing the IBM expEDIte family of products, which includes:

- IBM expEDIte DataInterchange Series, a new set of translators that convert business documents from an internal format into an EDI standard format
- IBM expEDIte Communicator Series, a set of communication products that allow customers to communicate with the IBM Information Network
- IBM expEDIte Integrated Series, a set of turnkey installation offerings that:
  - — allow customers to more easily get started with EDI
  - — provide traditional systems integration / consulting services to help customers integrate the IBM expEDIte DataInterchange products into existing applications

In addition, through IBM's Information Network, customers can expand their EDI applications beyond the standard

electronic exchange of computer-readable information. This expansion includes IBM's electronic mail, which gives EDI users the capability to exchange free-format messages using the same electronic mailbox on the IBM Information Network. Customers may offer their trading partners other support services, such as access to online applications and data bases on the customer's host or on the IBM Information Network.

Highlights:

- Full range of offerings and support for EDI
- Service offerings to assist with EDI implementation
- EDI implementation across a range of IBM computer systems
- Systems Application Architecture (SAA) EDI translators
- Translators provide interactive tailoring and customization
- Translators operate in interactive or batch mode, or are callable from an application

IBM DataInterchange/2

IBM DataInterchange/2 provides translation and business document management facilities for Electronic Data Interchange (EDI) in all Systems Application Architecture (SAA) operating system environments. The translation facility includes a utility for converting application data formats into or from national EDI standards (ANSI/X12) and international EDI standards (UN/EDIFACT). Standard updates are provided and maintained as a part of the product.

DataInterchange/2 can be tailored for different application data formats, standards, trading partners, and network parameters via online customization. It can be integrated with existing or new applications, or can be operated as a standalone application.

DataInterchange/2 provides the capability to read application data from a file or write to a file that can be uploaded to or downloaded from other systems. The product also includes facilities for logging, error recovery, and security.

The products provide National Language Support, including Double Byte Character Set (DBCS), and will be translated into German, Swiss-German, Swedish, Spanish, and Japanese.

Availability is planned for February, 1990.

Highlights:

- SAA application
- Support of EDI standards from different standard releases
- Integration with business applications
- Auditing, security, and logging facilities
- Multiple network and point-to-point interfaces
- Online customization
- Published communications interface for value-added or other networks

IBM PS/2 Image Workstation Program

The IBM PS/2 Image Workstation Program Version 1.0 is designed to capture, view, print, and manipulate image documents on an IBM PS/2 Micro Channel Architecture computer in an IBM DOS Version 4.00 environment. This program is a component of the IBM ImagePlus System, which allows the conversion of paper-intensive applications to computer-based electronic systems. Paper documents are scanned and manipulated at the workstation and then transmitted to the host application for storage and on-line retrieval. The IBM PS/2 Image Workstation Program is designed for the high-volume image handling environment, enabling savings in processing cycles and reduced paper handling costs.

Highlights:

- Designed as the workstation software component for IBM ImagePlus System solutions
- Sends and receives architected image data streams in compressed format
- Controls movement of various pages in a document, including moving to the next, first, previous, or last page
- Provides viewing functions including scrolling, rotating, and magnifying images
- Allows concurrent display of alphanumeric coded data and image documents
- Provides document modification such as adding a new page to a document
- Supports direct attachment of a scanner and / or printer to the image workstation for high-speed, high-volume processing

IBM OS/2 Image Support

IBM OS/2 Image Support enables office professionals to create color, gray, or bilevel images for inclusion in documents, in an OS/2 environment. The product uses either of the OS/2 Standard Edition Version 1.2 or the OS/2 Extended Edition Version 1.2 operating stages.

Images can be created using a scanner or video camera. IBM OS/2 Image Support's extensive online help and easy-to-use interface allow customers to create, modify, print, change format, display and manipulate images without specialized computer skills. IBM OS/2 Image Support's advanced CUA interface is consistent with OfficeVision/2 Release 2. IBM OS/2 Image Support also extends image capability to software application developers, who can use its programming interface to build OS/2 image applications without extensive training in image technology.

Highlights:

- Create color, grey, or bilevel images; crop, size, rotate or flip them; adjust brightness and contrast; then save in many popular formats. Use a scanner or video camera for image creation.
- The OfficeVision Release 2 correspondence processor, Storyboard

Plus, Interleaf, and image-capable DisplayWrite products are just a few of the programs able to use images created by IBM OS/2 Image Support.

- Intuitive CUA end-user interface consistent with OfficeVision/2 Release 2. The help, tutorials and messages conform to the OfficeVision/2 Release 2 interface standard.
- Simple programming interface offers image capability to developers unskilled in image technology. Extensibility allows addition of new datastreams, scanners and printers without programming changes to the product.
- Prints on all-points-addressable printers supported by OS/2 Standard Edition Version 1.2 or OS/2 Extended Edition Version 1.2 as well as the Mitsubishi G650, and the Shinko CHC-345 color printers.
- You can invoke IBM OS/2 Image Support from the main OfficeVision window via an image icon representing the product, or automatically by opening or printing image objects from an OfficeVision window.
- The communication links provided by OfficeVision can allow you to store images at and retrieve them from the AS/400, MVS, or VM host, or the LAN server, as well as the programmable workstation. IBM OS/2 Image Support code must be installed on the user's workstation, not on a LAN server or host machine.
- Utilizes the speed and storage available in an OS/2 environment. IBM OS/2 Image Support uses the Presentation Manager environment of OS/2 Standard Edition Version 1.2 and OS/2 Extended Edition Version 1.2.

GDDM-OS/2 Link

GDDM-OS/2 Link provides host graphics support for the GDDM Series under OS/2 Extended Edition. The user can run typical GDDM applications in the OS/2 Presentation Manager windowing environment, save a picture locally, and print and plot via the OS/2 Presentation Manager. GDDM-OS/2 Link is dependent on GDDM Version 2.2 and OS/2 Extended Edition Version 1.2.

Highlights:

- Adds graphics support to OS/2 Extended Edition 3270 terminal emulation
- SAA operating environment
- Operates with the OS/2 Presentation Manager function of OS/2 Extended Edition Version 1.2
- Multiple windowed host sessions supported
- Supports creation of interchange files, picture interchange format (PIF) and OS/2 Presentation Manager metafiles
- Supports retained graphics and GDDM control functions
- Context-sensitive help is available
- Central host delivery and service

IBM DisplayWrite 5/2 and IBM DisplayWrite 5/2 Composer Available

IBM DisplayWrite 5/2 and IBM DisplayWrite 5/2 Composer are available with previously unannounced function including Line Numbering and Erase to End of Line in the DisplayWrite 5/2 text processor. Additional printer support is available for both DisplayWrite 5/2 and DisplayWrite 5/2 Composer. Scanner support has been added to the composer feature.

IBM DisplayWrite 5/2 and IBM DisplayWrite 5/2 Composer now provide the following previously unannounced items:

- Line Numbering
- Erase to End of Line
- Sort Multiple Lines
- Block Align
- Column Number Indicator
- Enhanced Keyboard Extensions
- Support for five new IBM printers
- Scanner support in the composer feature

Application Foundation Version 1.1

Application Foundation Version 1.1 includes numerous enhancements that add to the usability and flexibility of Application Foundation Version 1.0. The enhancements allow for additional application program memory, increase the usability of the Data Model (service for sharing data among PC applications), add to the security functions, and provide for interfaces to PC application programs to facilitate word processing and spreadsheet tasks.

Highlights:

- Expanded Memory support to provide for additional application program memory
- Provides a complete demonstration of the combined use of DisplayWrite 4 and Application Foundation services
- Support for add-in software to integrate Lotus 1-2-3 (R) spreadsheets with Application Foundation services
- Additional security functions
- New communications functions to increase the usability of the interactive customization process

Lotus 1-2-3 is a registered trademark of Lotus Corporation.

IBM Personal Application System Version 2.0

Personal Application System (Personal AS) Version 2.0 is the second version of the IBM Decision Support software product for the OS/2 environment. Personal AS is a member of the Application System (AS) family of Decision Support software products. It provides most of the facilities of the mainframe AS product, with additional function in some areas, and is specifically designed for the personal computing environment, with emphasis on ease of use for the end user.

Personal AS Version 2.0 is offered as a base product and four optional products: Personal AS (Development), Personal AS (Statistics), Personal AS (Business Planning), and Personal AS (Project Management). The base product is a prerequisite for the optional products. The four Personal AS optional products can be ordered and installed as fully compatible options for the OfficeVision family.

Personal AS (Base) Version 2.0 will be available in English in June, 1990; Personal AS (Development) Version 2.0, Personal AS (Statistics) Version 2.0 will be available in English in July, 1990. Personal AS (Business Planning) and Personal AS (Project Management) will be available in English in September, 1990. Availability dates for Personal AS Version 2.0 products in languages other than English will be announced in the Personal AS Version 2 Availability Letter.

Highlights:

- Integrated Decision Support system for the OS/2 environment
- SAA application with graphical end-user interface, via OS/2 Presentation Manager
- Access to data managed by the OS/2 Extended Edition Database Manager
- Import / Export of data tables, report specifications, and chart specifications between AS and Personal AS via OS/2 Extended Edition Communications Manager
- Application System Language (ASL) to C interface allows applications to be written in a combination of the ASL and C programming languages
- Enhancements to base product, including extended query facilities and enhanced procedures
- Enhancements to optional Statistics and Development products
- New optional Business Planning and Project Management products

SEDF/2

Self Education Facility on the IBM Personal System/2, the successor to Self Education Facility on the IBM PC Version 1.0,, provides the following main advantages:

- Full support for developing courses that run on the IBM Personal Computer, IBM Personal System/2, and IBM Application System/400, including simulation of AS/400 terminals
- Support for IBM Operating System/2
- New productivity aids including a debugger and a built-in editor (no need to leave the presentation mode for changes)
- Extensive on-line help functions
- Installation on fixed disk
- Totally new documentation including authoring guidelines
- Support of additional presentation devices via SEDF/2 PDS Version 1
- Support of course translation via SEDF/2 TS Version 1

Numerical Control PostProcessor Generator for the Workstation

Numerical Control PostProcessor Generator for the Workstation (NCPGWS) is a licensed program that provides a full-function postprocessor solution on the IBM Personal System/2, and also complements the current NCPG family of program products. NCPGWS uses the Presentation Manager and System Editor functions of IBM Operating System/2 Version 1.1.

Highlights:

- Postprocessor generation and execution on a PS/2 workstation
- Postprocessor created can be executed on a host or RT PC
- Contains all host NCPG functions
- Interactive questionnaire using OS/2 Presentation Manager windows
- Reads CLFILE from APT-AC, CATIA (TM), CADAM (TM) and CAEDS
- Reads CAD APT source input from IBM CAD/CAM systems

CATIA is a registered trademark of Dassault Systems. In Canada, IBM is a registered user under RU81167.

CADAM is a registered trademark of CADAM, Inc.

Service and Support

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- IBM United States Marketing and Services – Market Operations
- IBM Authorized Industry Remarketers – Personal Computers
- IBM Authorized Personal Computer Dealers

"**IBM currently has four "native" 3270 software emulators that run in the DOS environment.** (page 15)

"**The one or two notepads are electronic scratchpads.** (page 27)

"**Memory is allocated when the dialog box pops up.** (page 35)

"**EMS was devised to satisfy several goals.** (page 5)

"**The implementation of a password can be done in two ways: power-on password and server mode.** (page 49)

"**Data security for fixed disks is more difficult than for diskettes.** (page 53)

"**There are three different types of Presentation Space.** (page 32)

"**Most EMMs have the capability of providing physical pages below 640 KB.** (page 8)

"**In retain mode, the graphic images are retained in the segment store.** (page 40)

"**Most OS/2 Presentation Manager GPI functions are for drawing output.** (page 38)

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