

Introducing the SAS System Release 6.09 for Windows NT

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ABSTRACT

This paper discusses the SAS[®] System Release 6.09 for Microsoft Windows NT(TM). The paper presents the technical advantages of Windows NT with respect to the SAS System. These advantages include 32 bit and floating point processing, preemptive multitasking and security, symmetric multiprocessing, I/O performance, graphical user interface enhancements, and interprocess communication methods provided in Windows NT. Hardware requirements as well as the products available in Release 6.09 will be listed. Finally, we will discuss future directions of the SAS System for personal computers.

WINDOWS NT OVERVIEW WITH RESPECT TO THE SAS SYSTEM RELEASE 6.09

Microsoft Corporation began the design review of NT in early 1989. Dave Cutler, a well-known architect of minicomputer operating systems and credited with the design of the VMS[®] operating system, led the design team. From the beginning, Windows NT had five design goals:

- **Portability** Windows NT would be developed in a portable programming language, C. The operating system should be capable of being ported quickly to other CISC or RISC architectures as technology and market factors dictate. Portability is accomplished by isolating hardware dependent code or non-portable code to specific files or sub-components that are easily recognizable and replaceable. Windows NT runs on Intel 80386 and higher processors, MIPS, and DEC Alpha processors. Currently, SAS Institute has committed only to an Intel version of Windows NT. Other architectures are being researched, and market conditions evaluated.
- **Extendibility** The design must allow changes and enhancements throughout the development cycle. With the ever increasing pace of hardware and device advancements, the operating system must be flexible enough to have additional support and features added even after the initial design is complete, and coding has begun. Designing a modular operating system to allow components to be added without affecting the integrity of the system was key to this goal. Loadable device drivers that can be added while the system is running are a major improvement over previous versions of DOS, OS/2, or Windows. The designers of NT recognized that during the implementation of a state-of-the-art operating system, changes would have to be made to ensure the final product was up-to-date with support for hardware devices that weren't available when NT was first designed.
- **Reliability and Robustness** PC operating system robustness has been a topic of conversation in the last few years. Debates have centered on comparing the presumed robustness of OS/2 for mission critical applications, as compared to Windows 3.1 being portrayed as a DOS extender and an immature operating system. Windows NT enhances this debate by providing a reliable, robust, and secure operating system for the workstation platform. First of all, one must "log into" Windows NT as a user. This means that two or more people could use the same Windows NT workstation and have

access to different sets of resources. Very rarely is system integrity violated to the point that NT freezes; a welcomed advancement for all PC users. Whenever a severe application error occurs, the logging facility makes a record of the error, and the application is closed by NT. In addition, given the fact that Windows NT is a server operating system for running Microsoft's Lan Manager and SQL Server, it must require high levels of reliability for porting mission critical applications.

- **Compatibility** Another design goal of NT is to preserve the software investment of a decade of software developed for the personal computers starting way back at DOS 3.0. Windows NT allows binary compatibility of shrink wrapped software for 16 bit DOS 3.0 programs and above, 16 bit Windows 3.x programs, POSIX compliant applications, as well as the new WIN32 applications. A complaint about Windows NT is the lack of robust Novell network requestors. However, with the introduction of Novell's Netware 4.0, robust network requestors for NT should be available.
- **Performance** Performance was a major consideration when designing each component of NT. The modular design of NT allowed for components to be written and re-written many times, after regressions of performance testing were accomplished. Specialized components for local message passing, named local procedure calls, were developed to optimize the performance of message passing, which is the cornerstone of NT.

SAS MULTIVENDOR ARCHITECTURE

The SAS System utilizes a proprietary design called Multivendor architecture. This design allows all the applications of the SAS System to be developed in C and be absolutely portable to all hardware and software platforms. This architecture is visually depicted as an inverted triangle with the top layer, Applications layer, being the largest since it contains the most amount of code. The second layer is the Core layer. These two layers are developed completely in portable C code. The underlying layer of the Multivendor Architecture is the Host layer. This component allows the SAS System to exploit the features that the operating system provides, and also allows for a native user interface for each platform. Multivendor architecture allowed the SAS System to be one of the quickest, most complete, and most successful ports to NT in the industry.

The SAS System Release 6.09 for NT builds upon code designed for previous SAS System releases for OS/2 and Windows. Much of the kernel features of the SAS System such as memory management, task management, and I/O subsystems were borrowed from the production level code for the SAS System for OS/2, while the GUI and load management subsystems were primarily ported from production code developed for the SAS System for Windows.

The SAS System also provides for a modular design of components. Controlled internally in the SAS Bridge, Dynamic Link Libraries (DLL) allow software components to be added to the SAS System without affecting overall system integrity. DLLs allow for updated SAS products, procedures, and modules to be released after the initial shipment of the SAS System.

The SAS System is designed to be robust and reliable through the use of protected modular components. In addition, exception handling covering floating point overflow and underflow, divide by zero exceptions, as well as memory overwrites and general protection faults are intercepted and processed appropriately without allowing the SAS System to crash. At SAS Institute, we attempt to ensure a robust application. This is accomplished

by the automated testing of thousands of tests run each night on a variety of PCs running Windows NT. Automated testing covers all product areas. In fact, many tests exist for coverage of exception handling and critical error recovery. In addition, many hours each day are spent by testing teams validating the interactive use of the graphical user interface.

The SAS System also has compatibility goals to ensure the syntax of the SAS System's programming languages such as the Data Step and Screen Control Language (SCL) are backward compatible to previous releases. In addition, SAS data set and catalog compatibility to previous releases is important. The rich feature set of PC platform exploitation for the SAS System Release 6.08 for OS/2 and Windows has been moved forward, so that users of these releases will find the SAS System for Windows NT an easy upward step. The SAS System Release 6.09 for Windows NT is fully compatible with the SAS System Release 6.08 for Windows and OS/2.

32 Bit and Floating Point Processing

Windows NT is a 32-bit operating system and thus requires an Intel 80386 or higher processor. The processor is run in full 32-bit mode, taking full advantage of the rich feature set of the Intel 80386 processor including flat memory addressing and 32 bit instructions and operands. The memory model provided is a flat memory model where memory is presented to the program as a contiguous region without any segment limitations. This enhancement in the memory model alone is responsible for a large increase in execution performance. This is because the large code overhead associated with the segmented memory model of Windows 3.1 has been removed in the 32-bit version of the SAS System for Windows NT. Windows NT also provides for virtual memory by paging 4 kilobyte blocks or pages of memory to and from the disk. The operating system can address up to 4 gigabytes of virtual memory per process, and large amounts of physical extended memory can also be added for increased performance.

The SAS System for Windows NT assumes that a floating point processor is available, and thus the SAS System is compiled with floating point instructions. If the PC does not have a floating point processor, Windows NT emulates the instruction via software.

Preemptive multitasking and application security

Windows NT is a powerful operating system that supports preemptive, time-sliced multithreading and multitasking. For example, the operating system supports execution threads, semaphores, priorities, separate address spaces, and a task based file system. Windows NT protects applications code and data from being overwritten by other applications. To a large and sophisticated application like the SAS System, this is an important feature in the operating system. Under Windows NT, there can be several concurrent SAS sessions running, although only two or three are really practical.

Windows NT provides for a responsive user interface by implementing per task execution threads and an asynchronous input/output model. A per task message queue allows each application to respond to user's input. In Windows NT, the user is always in control. For example, print jobs or ill behaved applications no longer bring the system to a halt since the user can always switch to another application.

Each task has its own protected code and data areas. Program code cannot be overwritten, and per task data is protected from erroneous overwrites from other applications. All

process management, local procedure call activity, and thread initiation are routed through the security subsystem in Windows NT.

The design of Windows NT includes support for the U.S. Department of Defense Class C2 security level. This includes the following features:

- **Secure logon facility** - requires users to logon to the system with a user name and password before using the system.
- **Discretionary access control** - allows an owner of a resource to determine who can access a resource and what they can do with the resource. The owner grants access rights to a user or group of users.
- **Auditing** - provides the ability to detect and record important security events.
- **Memory protection** - prevents program code from being overwritten, and allows data to be accessed (written or read) only by the owner. Once memory has been returned to the operating system, the data is no longer accessible. Memory is reinitialized before it is reused.

Symmetric multiprocessing

Windows NT can deliver ever increasing performance by adding additional processors to the PC. Symmetric multiprocessing provides for per task thread scheduling on the next available processor. This allows the operating system itself to gain from the installation of multiple processors. Research has begun on restructuring much of the SAS System Host and Core layers to fully exploit symmetric multiprocessing on Windows NT.

I/O Performance: Data Set and Catalog Compatibility

The SAS System for Windows NT can directly read and write SAS Release 6.04, 6.06, and 6.08 data sets. Catalogs created in Release 6.04, 6.06, and 6.08 must be converted to Release 6.09 format by using the Procedures CPORT and CIMPORT.

Recently, the SAS System has become widely used in data collection activities on the factory floor. Through the use of the serial port on PCs, the SAS System can be interfaced to any piece of equipment supporting the RS-232 interface. The Data Step supports an array of functions to facilitate the program interface to any data collection equipment, measuring device, or robot. Features such as DDE, named pipes, and SAS functions WAKEUP, SLEEP, and DATAMYTE are provided for powerful data collection abilities.

Windows NT provides for both synchronous and asynchronous I/O. Windows NT supports four file systems at present including the File Allocation Table (FAT) file system of DOS, the High Performance File System (HPFS) of OS/2, the CD-ROM File System (CDFS), and the New Technology File System (NTFS). The latter extends the capability of the former file systems by providing 64 bit file I/O allowing extremely large files to be accessed.

GUI Exploitation

The SAS System exploits the Windows Graphical User Interface (GUI). Provided features include:

common dialogs and toolbar support
drag and drop support and REGEDIT support
ways to tailor the system
printing enhancements
clipboard support
native help support in some cases
interprocess communications support

Since the GUI of Windows 3.1 and Windows NT 3.1 is identically the same, so is the GUI between the SAS System Release 6.08 on Windows and the SAS System Release 6.09 for Windows NT. However, we have added a few new features.

Dialogs and Tools

The SAS system takes advantage of the common dialogs provided by Windows. Examples of these dialogs are the Open, Save as, Font, Find, and Replace. These are the same dialogs used by other Windows applications and help the SAS system to achieve a more native look and feel.

Additionally, the SAS system provides the Preferences and Edit Toolbox dialogs to customize your system. The Preferences dialog allows you to customize your SAS System user interface. You can choose:

- to open the Command dialog
- to use a toolbox, a toolbar or no tools
- to be prompted when exiting the SAS System
- to use a monochrome display (useful for plasma displays)
- to display menus as pop-ups, menu bars or no menus (command lines)
- to enter text in insert or type over mode
- to save your current workspace settings like font face name and point size, size and position of SAS AWS, wsave all currently displayed SAS windows, and current position of Command dialog and toolbox.

With the SAS System, you have two choices to associate icons with SAS commands - the toolbar and the toolbox. The toolbox is a floating (modeless) dialog which contains the icons.



The toolbar displays these icons in the SAS AWS menu bar.

SAS/AF programmers may find the TOOLLOAD command useful. Using the Toolbox Editor, you can create multiple toolboxes and save each to a different SAS catalog entry. Then using the TOOLLOAD command, you can load each toolbox as necessary. The syntax is "toolload <box|bar> libref.catalog.member". You can also use the TOOLCLOSE command to close a toolbox. The TOOLDEF command allows you to control the location where the toolbox is created (this option has no effect on the toolbar).

The Edit Toolbox dialog allows you to customize your toolbar/toolbox. You can specify both the icons displayed in the toolbox and the definitions for each tool. Any valid SAS command can be used as a definition. Each icon is a bitmap. The bitmap may be chosen from a provided list of more than a hundred by pressing "Browse..." and selecting a bitmap or by pasting a bitmap into the toolbox editor from the system clipboard. The bitmaps can be copied to the clipboard either from SAS applications or other OS/2 or Windows applications that create bitmaps.

Submitting Code

The SAS System supports drag and drop of files into any SAS window as a method of submitting code. Simply drag a file from the File Manager under Windows NT and drop it on any SAS window and it runs.

Also included in the Desktop object that the SAS System install program creates is an association with *.sas files. Double-clicking on a file with an extension of .sas invokes the SAS system which includes and executes that SAS program. The install program for the SAS System for Windows updates the registration database for Windows to provide the same functionality. You can review sas.reg in !sasroot\core\sasinst to view the changes that the SAS System has made to the registration database. You can extend this functionality to associate other extensions with additional behavior by using REGEDIT (an application provided by Windows).

You can control the code submitted in the program editor. Selecting "submit" from the Locals pull-down menu in the program editor will submit the entire contents of the program editor. However marking an area of text in the program editor and then selecting "submit" only submits the marked area.

You can also submit code created in another editor under Windows. Edit your text, copy it to the clipboard, then select "Submit clipboard" from the Locals pull-down menu in the program editor. This submits the code in the system clipboard directly to the SAS system. Alternatively, copy text to the clipboard and then use a function key that you have defined as "gsubmit buf=default". Another option is

```
gsubmit 'data a; x = 1; run;'
```

to submit a static string.

The SAS program editor now works more like other system editors such as Microsoft Window's Notepad. By default, there are no line numbers in the program editor. You can use Shift and the arrow keys (like ->) to mark text. After marking the text, you can use the standard accelerators or the pull-down menus to copy or cut this text to the system clipboard. Additionally, pressing the Delete key or simply typing any additional text will delete the marked text. The HOME key takes you to the beginning of the line; the END key takes you to the end of the current line; entering RETURN in the middle of existing text also works as you would expect, creating a line break. Using CTRL and the arrow keys (like ->) moves the cursor one word at a time.

Tailoring your System

The default style of menus is pop-up menus. Use the right mouse button to display your menus. There are several advantages to using pop-up menus instead of menu bars. Pop-up menus are displayed at the mouse pointer's current location, eliminating the navigation to

the menu bar. Also, no screen space is used since pop-up menus are only displayed upon demand.

The system option "-register" allows you to add applications to the File pull-down of the SAS AWS menu. Once these applications are added, you can then execute each application by selecting it from the menu. For example,

```
-register "Excel" "excel.exe" "c:\exdata"
```

will add "Excel" to the SAS AWS menu bar and when this item is selected, Excel will be invoked with a working directory of "c:\exdata".

The Run dialog provides a method to simultaneously execute another application or system command.

The Command dialog box allows you to use a floating command line. You can start this dialog in several ways. One method is to select the Command dialog check box in Preferences. Another method is to choose "Command..." on the Globals menu. A third method is to issue the SAS DM command "command window <title>" where title allows you to control the title of the command dialog. This method would probably be of most use to SAS/AF programmers. The Command dialog provides a combo box that allows you to either enter commands or select and/or modify commands that you have previously entered.

You can add your own icons to the SAS System with the -usericon command. This feature is available with SAS/AF and SAS/EIS applications. To use this feature, create a frame entry using SAS/AF. Then, make or fill a region with an icon. From the attributes screen, select the current icon button, and then select the "user-defined" radio button. If you have specified an icon resource file with USERICON, when you click on the radio button, you will see all of your icons displayed. Clicking on the "sas-supplied" radio button allows you to use any of the icons provided by the SAS System.

Another option that SAS/AF programmers may find useful is -noawsmenu. This system option will eliminate the SAS AWS menu. You can then control what commands are available to users of your application. Also provided as of Release 6.08, is the ability to close the program editor, log and output windows. You can double click on the control menu to close each window or enter "pgm off", "list off", and "log off" to close the program editor, output, and log windows respectively. SAS/AF users can also control whether application AWS windows are created. If you invoke your application with "af c=sasuser.a.a.frame aws=no", then no AWS application window will be created. You can use the "\$title titlename" option to control the title of the SAS AWS window.

Printing

The Print dialog allows you to spool output to the Windows Print Manager. This dialog allows you to choose what you wish to print:

- the text contents of the active SAS window
- a bitmap of the current active SAS window
- a bitmap of the current SAS application workplace,
- a bitmap of the entire screen including any non-SAS applications that are visible
- the text contents of the system clipboard
- or a bitmap of the system clipboard's contents

The Printer Setup dialog allows you to define your default printer and to specify printing attributes supported by that printer. For 6.09 we have added the ability to save attributes associated with each printer driver you have installed. This allows you to set up multiple printers once and then switch between them as needed without having to run setup again. In addition we have added a "Fonts..." button that allows you to choose which font you would like for the printer to use. If no font is specifically chosen, we will use the default printer font just as we have in the past. We feel these enhancements will make printing an easier task.

SAS/GRAPH software provides two types of hard copy device drivers -- the stand-alone SAS/GRAPH drivers and the WINPxxx series of drivers. The WINPxxx drivers were new for Release 6.08 and are also known as the generic printer drivers. The generic printer drivers use the operating system provided printer drivers to generate graphics data and then pass this data to the Windows Print Manager. If new printers become available that are not currently supported by the SAS/GRAPH stand-alone drivers, you can always use the generic drivers to access your new printer.

To export SAS/GRAPH output to other applications, you can use provided SAS/GRAPH stand-alone drivers to produce external files in common PC formats like CGM, TIFF and HGPL. To create a file in one of these formats, specify the appropriate driver name with the TARGET = or DEVICE = option in a GOPTIONS statement.

You can take advantage of hardware fonts, such as True Type provided by the Windows environment. You can use either CHARTYPE = or the FONT = options in SAS/GRAPH to select hardware fonts. For example, if you submit:

```
title2 font = Helv "This is hardware text" ;  
proc gslide;run;
```

Your title will be displayed using the Helvetica hardware font.

The Font utility (from the SAS AWS menu select Help and then select Utility) provides a method to easily add fonts that you have purchased to the SAS/GRAPH devices catalog. After adding the fonts to the catalog, you can use these fonts in your SAS/GRAPH applications. This utility works with the default display driver (WIN) or the generic printer drivers and should not be used with the graphics stand-alone drivers.

Clipboard Support

The Windows clipboard enables you to exchange text and graphics between applications. With the clipboard, you can move text between windows within the SAS System, between two SAS sessions, and between the SAS System and Windows applications. The SAS System supports multiple data formats. The SAS internal format is only understood by the SAS system. This format will allow you to preserve the text colors and attributes of your data when copying this data to another SAS window. Another supported format is CF_TEXT that is just a generic text format that is supported by most OS/2 and Windows applications. Several bitmap formats are supported by SAS windows like HELP, SAS/ASSIST and windows containing graphics. Both Bitmap and DIB (device independent bitmap) formats are supported. Additionally, the metafile format is supported in SAS System windows that support the GSTORE command. These windows include the Graphic Editor in SAS/GRAPH software, SAS/INSIGHT and ISHIKAWA in SAS/QC software. Text can be copied both into and out of SAS. However the bitmap formats and metafile format can only be copied out of the SAS System with this release. You can easily determine if text or graphics will be stored in the system clipboard. When you select the area (by

pressing and dragging the left mouse button), if the area is enclosed with a rectangle, bitmap and/or metafile format will be placed in the clipboard (in HELP and SAS/ASSIST both text and graphics are stored). If the selected area is displayed as reverse video (this is the default – you can override with a "color mark color attribute" command), then the data will be stored as both SAS internal text and CF_TEXT in the system clipboard.

Windows Native Help

For Release 6.09 installation instructions as well as most sample programs are provided through the native help manager in addition to the on-line or printed versions. By providing the sample programs in this format, you can now directly copy the sample program text into the SAS System via the clipboard. For install, the hypertext links make it easy and convenient to access information pertaining to particular topics about install. Research is still underway on how to provide all help screens and other important information through the standard Windows help manager.

Interprocess Communication: DDE, OLE, MCI

Windows NT supports Dynamic Data Exchange (DDE) and Object Linking and Embedding (OLE). Dynamic Data Exchange (DDE) is a client-server method of dynamically exchanging data between applications. Microsoft Windows NT provides support for DDE and using Microsoft Windows for Workgroups allows DDE between applications on a network. The SAS System supports DDE only as a client. You can request data from server applications, send data to server applications or send remote commands to server applications. You can use DDE with the Data step, the SAS macro facility, SAS/AF applications or any other portion of the SAS System that requests and generates data. You can use DDE for a one-time data transfer or dynamic data transfer. The HOTLINK option forces automatic data update. Specifying this option activates the DDE link each time the data in the specified range are modified. By default, the update is manual and updates the data only when requested by you. Missing values sometimes present problems to SAS users of DDE. The MISSEVER option prevents a SAS program from going to a new input line if it does not find values in the current line for all the INPUT statement variables. The values that are not found are set to missing. NOTAB tells the SAS System not to convert tabs into blanks so you can use the tab character as the delimiter between the data values.

The DDE triplet item, located on the SAS AWS menu, allows you to view the current DDE triplet name in the system clipboard. You can get the information that you will need to program your DDE code by starting the DDE server application. Select and copy an area from that application into the system clipboard. When you select the DDE triplet message box, the DDE triplet is displayed. You can then select this string and copy it into a SAS program that is accessing DDE. Alternatively you can use 'FILENAME foo DDE "clipboard"' to access the other application.

OLE allows objects created from one application to be embedded or linked into the display of another application. The SAS System supports OLE in SAS/AF (Application Facility) through the use of a "Frame" object. This allows objects created in other Windows applications to be embedded in a SAS/AF application through SCL programming. For example, by using OLE in SAS/AF, an application can be easily developed such that a chart from Microsoft Excel can appear in an end user's SAS/AF application. Merely clicking on the chart will allow drill down on the data by invoking Microsoft Excel to manipulate the data corresponding to the chart. Another advanced example of OLE allows multimedia, audio, or video clips using Microsoft Video for Windows to be played back inside a SAS/AF application. Thus, OLE provides a convenient method to take advantage of other Windows applications to embed objects into SAS applications. Newer technologies such as

animation, video, advanced audio, and multimedia are conveniently interfaced and accessible in the SAS System through the use of OLE technology.

Not only does Windows NT support DDE, but also pipes and named pipes as a method of accessing or sharing data between applications. Pipes are used to invoke a standard C program from the SAS System, directing input into the standard input handle of the program and retrieving the output from the standard output handle of the C program. Under Windows NT, pipes work interactively where the SAS System can control the execution of the C program. Named pipes under Windows NT are used to communicate from the SAS System to another SAS session, or to another application. (Named pipes and pipes are a supported device to which a fileref can be assigned.) In addition, named pipes can be used locally or across a network such as Lan Manager, Lan Server, Novell, or any network supporting the named pipe interface. Named pipes are used in data collection scenarios on the factory floor, collecting data and transferring the data to other workstations.

A set of SAS functions is provided to interface the SAS System to any Media Control Interface (MCI) compatible device. MCI allows access to various MCI compatible multimedia devices (like CD Player, Mixer, Videodisk Player, etc.). MCI was developed by IBM and Microsoft and provides a standard way to interface to multimedia devices through text commands. OLE can provide access to these devices but an intermediate application that provides access to each device is required. With MCI, no intermediate application is required since MCI allows direct communication with the device driver. Support for MCI is provided via the Data Step and/or SAS/AF Screen Control Language (SCL) through a user-written function.

Hardware/Software Requirements for the SAS System for Windows NT

We received the Windows NT 3.1 production version on the day this paper was due. The requirements listed below are based on running the SAS System for Windows NT on the released version:

- Intel 386 33 Mhz or above PC
- Floating point processor highly recommended
- 12 Meg memory minimum, 16 Meg recommended
- Approximately 200 Meg is required for the entire SAS System; a selective install is provided.
- CD-ROM drive; SAS will ship on a single CD
- Mouse
- VGA, XGA, XGA-2, or 8514-A (24 bit color cards will be supported in the future)

Network Support

The SAS System has been fully tested under the following networks. The SAS System uses no specific networking programming interfaces, except for access methods in the SAS/CONNECT product.

- Lan Manager 2.1
- Lan Server 3.0

SAS System Release 6.09 Products

The SAS System Release 6.09 for Windows NT contains the following SAS software products:

- | | | |
|--------------------|-----------------------------|--------------------------|
| • SAS/BASE | SAS/ASSIST | SAS/EIS |
| • SAS/AF | SAS/FSP | SAS/GRAPH |
| • SAS/STAT | SAS/IML | SAS/OR |
| • SAS/QC | SAS/ETS | |
| • SAS/INSIGHT | SAS/CBT | |
| • SAS/ACCESS | SAS/CONNECT | SAS/SHARE (EXPERIMENTAL) |
| • SAS/IMAGE (BETA) | SAS/KINETICS (EXPERIMENTAL) | |

SAS/ACCESS SOFTWARE

SAS/ACCESS software provides the following access I/O engines to read and write data in the indicated formats.

- dBase III and IV files
- DIF files
- Lotus WKS files
- Microsoft SQL Server

SAS/CONNECT Software

SAS/CONNECT software provides cooperative processing between workstations and provides support for micro-to-host communications. SAS/CONNECT software allows remote execution of SAS data sets, catalogs, and external files. The following access methods are supported under Windows NT:

- EHLLAPI 3270 Emulation
 - to be provided in the future
- NETBIOS Communications
 - Windows NT support
- TCP/IP Communications
 - Microsoft WinSoc interface

SAS/SHARE Software

SAS/SHARE software is released as an experimental product. It provides for a SAS file server allowing concurrent access to a data set or catalog by multiple users. Windows NT can operate as the server or client component. In addition, in Release 6.09, cross platform sessions are supported. Therefore, SAS /SHARE can serve SAS applications running on any SAS 6.08 or above release, on any operating system platform supported.

Future Directions of the SAS System for Personal Computers: 6.10, WIN32s, WIN32c, 486, Pentium, OLE 2.0, CAIRO, and ODBC

Currently planned for a SAS Release 6.10, is the SAS System under Windows 3.1 using either Win32s or Win32c, the SAS System under Windows NT 3.1, and the SAS System

under OS/2 2.1. The SAS System using Win32s or Win32c provides a 32 bit version of the SAS System on Windows 3.1. In the future for the Windows environment, we expect Windows NT to become a server platform, and the Windows 3.1 Win32s or Windows 4.0 Win32c to be the prevalent client platform. All three 6.10 releases will incorporate new graphical user interface enhancements, including support for the multiple document interface (MDI) model. For those unfamiliar with MDI, the changes will include a combination menu bar/toolbar across the top of the AWS window and a status bar along the bottom of the AWS window.

The Institute has internally developed a compiler to optimally support the Intel Pentium processor. By rearranging the instruction execution sequence, optimally for the Intel 80486 and the Pentium processor, a performance gain of about 15-25 % can be realized. For the SAS Release 6.10, we expect to target our development towards the Intel 80486 and Pentium processors, for maximum performance.

In addition, the Institute is currently upgrading the implementation of OLE 1.0 within the SAS System to support OLE 2.0. OLE 2.0 provides visual editing of objects as well as the merging of application toolbars and action bars. OLE 2.0 is the foundation of the next generation CAIRO object oriented user interface from Microsoft. The Institute is currently investigating CAIRO and OLE 2.0.

One more project that the Institute is working on is support for ODBC, Open Database Connectivity. An SQL Pass-Through engine (a data access method) will allow the SAS System to "talk to" ODBC so users can bring data directly into the SAS System from other database products or use the SAS System to reach into the databases and manipulate the data. After this initial phase is complete, we will investigate allowing other applications to access SAS data sets.

Notes and Trademarks

SAS, SAS/ACCESS, SAS/AF, SAS/ASSIST, SAS/FSP, SAS/GRAPH, SAS/IML, SAS/OR, SAS/SHARE, SAS/QC, SAS/STAT, Multivendor Architecture, SAS/CONNECT, and SAS/EIS are registered trademarks or trademarks of SAS Institute Inc. in the USA and other countries. OS/2 is a registered trademark or trademark of International Business Machines Corporation. Other brand or product names are registered trademarks or their respective companies. The SAS(R) System is an integrated system of software providing complete control over data access, management, analysis, and presentation. Base SAS software is the foundation of the SAS System. Products within the SAS System include SAS/ACCESS(R), SAS/AF(R), SAS/ASSIST(R), SAS/CPE(R), SAS/DMI(R), SAS/ETS(R), SAS/FSP(R), SAS/GRAPH(R), SAS/IML(R), SAS/IML-DL/I(R), SAS/OR(R), SAS/QC(R), SAS/REPLAY-CICS(R), SAS/SHARE(R), SAS/STAT(R), SAS/TOOLKIT(R), SAS/CALC(TM), SAS/CONNECT(TM), SAS/DB2(TM), SAS/EIS(TM), SAS/ENGLISH(TM), SAS/INSIGHT(TM), SAS/LAB(TM), SAS/LOOKUP(TM), SAS/NVISION(TM), SAS/PH-Clinical(TM), SAS/SQL-DS(TM), and SAS/TUTOR(TM) software. Other SAS Institute products are SYSTEM 2000(R) Data Management Software, with basic SYSTEM 2000, CREATE(TM), Multi-User(TM), QueX(TM), Screen Writer(TM), and CICS interface software; NeoVisuals(R) software; JMP(R), JMP IN(R), JMP SERVE(R), and JMP Design(TM) software; SAS/RTERM(R) software, and the SAS/C(R) Compiler and SAS/CX(R). Compiler. MultiVendor Architecture(TM), and MVA(TM) are trademarks of SAS Institute Inc.

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