Taking Advantage of the Power and the Flexibility of the SAS System for OS/2 and Microsoft Windows
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ABSTRACT
The two preeminent operating systems for personal computers, OS/2 Version 2.0 and Microsoft Windows 3.1, are rolling out new releases, upgrading their power and flexibility. The two operating systems provide a solid platform for SAS users on workstations. However, the two systems present radically different architectures to the SAS System. The operating systems differ in the following features: memory architecture, flat versus segmented; multitasking, preemptive versus cooperative; processing power, 32-bit versus 16-bit; file I/O performance, HPFS versus the FAT; DOS compatibility, and user interface. Both operating systems provide an array of interprocess communications methods allowing dynamic sharing of data between applications. Examples are Dynamic Data Exchange, Object Linking and Embedding, and named pipes. Today corporations large and small are deciding which operating system they should use for which applications in their organizations. The operating system for more powerful and mission-critical applications continues to be OS/2. However, with the release of Windows 3.1, a maintenance release that enhances the robustness of the Windows environment, SAS users can now enjoy reliability of their SAS applications running on this extremely popular workstation platform. The SAS System, Release 6.07, supports both the OS/2 and Windows operating systems.

INTRODUCTION
This paper discusses OS/2 Version 2.0 and Microsoft Windows 3.1, with respect to the SAS System. The paper presents the advantages and disadvantages of the operating systems. The paper concentrates on the power and flexibility of the SAS System on these workstation platforms and shows how the SAS System takes full advantage of the operating system features. Issues such as memory architecture, multitasking, processing power, interprocess communications, I/O performance, and the user interface with respect to the SAS System are described in detail. Configuration issues and future directions of the SAS System for personal computers are also discussed.

COMPARING OS/2 AND WINDOWS WITH RESPECT TO THE SAS SYSTEM
Memory Management
OS/2 Version 1.3 supports the architectural functions of the Intel 80286 processor, which include accessing up to 16 megabytes of physical extended memory and up to 512 megabytes of virtual memory used for segment swapping. OS/2 Version 1.3 executes faster on an 80386 or 80486 processor because of the increased processing power but does not take advantage of 32-bit processing or the advanced memory management facilities of the 80386 processor. OS/2 is supported on an 80286 machine, but SAS performance on this processor is obviously marginal. For OS/2 Version 1.3, Release 6.07 of the SAS System recommends a minimum of 6 megabytes of memory and 8 megabytes for optimum performance of large applications like SAS/ASSIST and SAS/GRAPH software. It is important to note that problems are only limited by the amount of disk swap space and that adding additional extended memory normally increases the limits of the system. Unlike PC DOS versions of SAS software using Expanded Memory (EMS), the SAS System may take advantage of all additional extended memory for both executable code and program data. A substantial benefit of OS/2 is the increased memory available to applications. Compared to PC DOS execution, the SAS System executes faster under OS/2. Although this result is contrary to some reports concerning performance comparisons between PC DOS and OS/2, it holds true for the SAS System because of the performance loss SAS software suffers under PC DOS. Under OS/2, the SAS System does not have to resort to disk-intensive code overlays and costly unloading and loading of executable images. Additionally, the SAS System's code generator that is used to execute DATA step and procedure code has been improved and optimized for the OS/2 environment.

OS/2 Version 2.0 is a 32-bit operating system and thus requires an Intel 80386 or 80486 processor. The processor is run in full 32-bit mode, taking full advantage of the rich features of the Intel 80386 processor. The memory model provided is a flat memory model where memory is presented to the program as a contiguous region without any 64-kilobyte segmentation limits. This enhancement in the memory model alone is responsible for a large increase in execution performance of the SAS System under OS/2 Version 2.0. This is because the large code overhead associated with the segmented memory model in Release 6.06 of the SAS System has been removed for Release 6.07 and has been optimized for the 32-bit environment. OS/2 Version 2.0 provides for virtual memory by paging 4-kilobyte blocks of memory to and from the disk. The operating system can address up to 512 megabytes of memory per application. For Release 6.07 of the SAS System, a minimum of 6 megabytes of memory and 8 megabytes for optimum performance of large applications like SAS/ASSIST and SAS/GRAPH software is recommended.

Windows 3.1 runs in two operating modes, Standard mode and Enhanced mode, depending on your PC's configuration. Windows requires at least an Intel 80286 processor with at least 1 megabyte of memory, or an 80386 processor with fewer than 2 megabytes of memory. In Standard mode, Windows runs in protected mode, which means the processor can address up to a maximum of 16 megabytes of extended memory if available. Standard mode is, however, limited to the available physical memory. Once applications use this memory, Windows memory management moves and discards program segments to attempt to manage the memory. However, Standard mode does not perform swapping of segments to disk to obtain virtual memory. Therefore, adding more extended memory up to a maximum of 16 megabytes is necessary to increase performance and to overcome memory limitations. Standard mode allows an application to execute faster than Enhanced mode because Standard mode does not rely on the slower virtual device drivers that Windows uses in Enhanced mode. Enhanced mode requires an Intel 80386 or 80486 processor and at least 2 megabytes of extended memory. This is the optimal mode for Windows and for power users. In this mode, the processor can once again access up to a maximum of 16 megabytes of extended memory. However, Windows memory management takes advantage of the 80386 memory management paging features in order to "page" in and out 4-kilobyte blocks, similarly to OS/2 Version 2.0. When physical memory has been filled, the paging process begins. Only when all the virtual address space on disk has been used does Windows discard program segments. (Descended program segments must be reloaded and relocated; thus, discarding is slower than paging.) Enhanced mode can be misleading, especially to power users. A little published fact about Windows Enhanced mode is that the virtual paged memory is limited to approximately four times the amount of physical memory. This is a system limit, not a per task limit. For example, on a machine with 4 megabytes of memory, Windows Enhanced mode provides...
the entire system, including all applications running, with an address space up to 16 megabytes (4 x 4) of memory, assuming that this amount of disk space is available in either the temporary or permanent swap file. This fact can easily dispel the belief that Windows virtual memory provides the same functions and benefits that OS/2 does, just because both run in protected mode. The reason Windows limits the paging to four times physical memory is to prevent a large portion of the physical memory from being used by in-memory page tables. Another advantage of Enhanced mode is that Windows uses the virtual 66 mode of the 80386 processor to allow multiple DOS sessions to run in windows concurrently.

The SAS System, Release 6.07, will support both Standard and Enhanced modes in a single release. Both modes will require at least 6 megabytes of memory, and additional memory would increase performance. The system will run with less memory in Enhanced mode, with a performance degradation.

Multitasking and the Security of Applications

Perhaps the most important distinction between OS/2 and Windows is the method by which multitasking is accomplished. OS/2 is a powerful operating system that supports preemptive, time-sliced multitreading and multitasking. For example, there are features in the operating system to support multitasking such as threads, semaphores, signals, priority, separate address space, and a task-based file system. In addition, OS/2 provides a robust environment for an application like the SAS System. OS/2 protects applications code and data from being overwritten by other applications. To a large and sophisticated application such as the SAS System, this is a very important feature of an operating system.

OS/2 Version 2.0 executes applications that support different operating systems. DOS, Windows 3.0, OS/2 Version 1.3, and OS/2 Version 2.0 applications can run concurrently and can be invoked seamlessly from the workplace shell.

Windows, on the other hand, was designed to be compatible with the original Windows programming model of earlier releases. Real mode Windows 2.x: Multitasking is not preemptive, but it is cooperative. Applications must be very well-behaved and must yield execution of the application at designated points in order for the system to achieve the appearance of multitasking. In effect, applications can run as long as they have work to do, and they relinquish the CPU only when out of work. This means that some large applications may monopolize the CPU to the detriment of other applications. In addition, although code segments are protected against overwriting from other applications, data and allocated memory are shared between applications. This sharing allows erroneous applications to corrupt other applications easily. Applications are not protected from unintentionally writing to another application’s data areas. For these reasons, OS/2 is a much better operating system for network servers, mission-critical applications, and SAS power users.

The performance of multitasking is obviously better under OS/2 than under Windows. Under OS/2, there can be up to 16 SAS sessions running concurrently, although only 2 or 3 are really practical. However, in Release 6.07 of the SAS System under Windows, only a single SAS session will be able to execute on a given PC. Windows simply does not provide the robustness and performance to multitask multiple SAS sessions. If multiple concurrent SAS sessions on a single PC is important to your application, OS/2 is a better platform than Windows.

Processing Power

OS/2 Version 2.0 requires an Intel 80386 or higher processor. It takes full advantage of the 32-bit mode features of the processor, including flat memory addressing and 32-bit instructions and operands. Nearly all mathematical operations are faster in 32-bit mode than in 16-bit mode. In addition, the SAS System is even more robust because the use of 32-bit operands reduces the chances of program errors that are associated with the limits of 64-kilobyte segments and 16-bit integers. Performance of text manipulation is significantly enhanced. A 32-bit architecture will provide the benefit of an easy 30% increase in performance over the same version of the SAS System running in 16-bit mode. The OS/2 operating system, redesigned for 32-bit operation, could provide an additional 10%-15% performance increase.

Windows 3.1 is still a 16-bit operating system. The limitations of 16-bit operands and 64-kilobyte segments require more system overhead, which degrades SAS System performance. However, the SAS System does use 32-bit instructions for move, compare, and fill operations when executing on a 32-bit processor.

Numerical intensive applications will run more quickly under OS/2 than Windows on the same machine configuration. The reasons for this are that under OS/2 the scheduler will balance the allocation of the processor to tasks that need it most, whereas Windows has no real scheduler, and multitasking is accomplished by yielding the processor. The process of cooperatively yielding the processor will cause an inefficiency in numerical calculation performance.

Numerical accuracy and precision will be exactly the same under both operating systems. Both SAS releases for OS/2 and Windows take full advantage of an Intel 80387 floating-point coprocessor if one is installed.

Interprocess Communication, DDE, and OLE

Under OS/2, the SAS System supports three types of interprocess communications: pipes, named pipes, and Dynamic Data Exchange. 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 OS/2, pipes work interactively where the SAS System can control the execution of the C program. Under Windows, pipes are much more limited; they serve only to relieve the user from having to create an intermediate file. This is a small difference and is a result of the multitasking limitations of Windows. Given this limitation, the SAS System for Windows does not support pipes.

Named pipes under OS/2 are used to communicate from the SAS System to itself or from the SAS System to another application. (Named 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, or Novell, or any network supporting the named pipe interface. Named pipes are used extensively in data collection and factory floor applications under OS/2 but could also be used in any application that needs to share or distribute data or results across applications. Named pipes are not supported under Windows 3.0 and 3.1 and will not be provided in Windows until a later release.

Dynamic Data Exchange (DDE) is supported under both OS/2 and Windows. DDE allows the SAS System to exchange data with any application that supports DDE such as Microsoft Excel, Lotus 1-2-3, O+ E, and others. DDE allows the SAS System to gather or broadcast data or information for a one-time transfer to another application, or it can be used to create a hot link for continuous dynamic updates of the data.

Starting with Release 3.1, Windows supports Object Linking and Embedding (OLE). OLE allows objects created from one application to be embedded into the display of another application. The SAS System supports OLE in the SAS/AF (Application’s Facility) software product, which allows objects created from other Windows applications to be embedded in a SAS/AF software application and an SCL program. For example, using SAS/AF and SCL (Screen Control Language), you could display and embed a chart representing data from Lotus or Excel in a SAS/AF program window. OLE also provides for permanent DDE links. The
spreadsheet Excel or Lotus, in this case, would control the object by continuously updating the chart in the program window as the spreadsheet data dynamically changed. That is, once the link is established between the SAS System and another OLE-supported application, the link is maintained even if both applications end and the PC is powered off. OLE allows the connection to be dynamically re-established when one of the applications is invoked again. OLE provides a foundation for truly interrelated and cooperative applications in this decade on the PC. OLE is an integral part of Microsoft's "Information at your fingertips" vision and is currently only available under Windows.

I/O Performance: Installable File Systems versus File Allocation Table

As stated earlier, multitasking is the most important distinction between OS/2 and Windows, and it is the distinction that most affects the SAS System. The second most important difference between the environments is the file system. One of the advanced features of OS/2 Version 1.2 was the creation of Installable File Systems (IFS). IFS allow for the installation of additional file systems that provide increased performance to the operating system. Through IFS, the file system was separated from the operating system so that new and better file systems could be implemented without requiring a new operating system. The first of these IFS was the High Performance File System (HPFS). The HPFS creates a file system that is optimized for multitasking and for I/O throughput. Tests with the SAS System indicate at least a 25% to 50% increase in performance of accessing SAS data sets and catalogs. To achieve this performance, HPFS uses lazy writes to write data to the disk at opportune times. Windows, which is based on the DOS operating system, uses the DOS file system called the File Allocation Table (FAT). The FAT is an old-style file system mainly designed for floppy disks and is not an efficient system for advanced hard disks. Therefore, I/O under Windows is generally slow, as is consistent with DOS file I/O. This distinction generally demonstrates a performance penalty for the SAS System running I/O-intensive applications under Windows, whereas the application running under OS/2 generally runs much faster.

Further advances in HPFS and other IFS are promised and probable given the architecture of OS/2. However, since Windows is based on DOS, an improved file I/O system will require a new DOS operating system. Although a new I/O system for DOS is rumored, it is still years away from production. As far as SAS data set limits are concerned, the limits are identical for both OS/2 and Windows in the 16-bit implementation. The size of a data set and the number of variables within a data set are constrained only by your disk partition size and by the limitation of a 64-kilobyte segment inherent in the processor. A data set is not limited by the number of observations, and the number of variables per observation is a maximum of 30,700 for variables of 2 bytes. The formula to calculate the maximum number of variables per observation is:

\[ \text{variables} = 31,400 / \text{length of variable} \]

For the SAS System, Release 6.07 under OS/2 Version 2.0, the above limitation has been removed.

Recently, the SAS System has become widely used in data collection activities on the factory floor. SAS Institute allocated considerable development effort to ensuring that the SAS System has the power for sophisticated data collection in Release 6.07. Through 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 or robot. Measurement equipment, data collection terminals, and even robots can be interfaced and programmed from within the SAS System. The SAS System provides such features as named pipes, DDE, and functions such as WAKEUP, SLEEP, and DATAMYTE to facilitate data collection.

Both Windows and OS/2 generally support the communications ports in the same way so that the features for interfacing to these devices are portable between OS/2 and Windows. Each platform serves as an acceptable data collection machine. However, there are two important distinctions that indicate that OS/2 is the better operating system for data collection activities. First, as discussed previously, OS2 provides for robust multitasking for mission-critical activities, whereas Windows provides a much less robust environment. (See the earlier discussion on memory management and multitasking.) Additionally, many data collection applications use named pipe interfaces within the SAS System. Named pipes are supported only under OS/2.

User Interface

OS/2 Version 1.3 and Windows 3.1 look nearly identical with respect to the user interface and the array of user controls available. For this reason, corporations can consider Windows as an interim step to OS/2 because much of the retraining necessary for a new environment is due to the user interface. Generally speaking, by looking at a snapshot of a SAS window, the differences between OS/2 and Windows appearance are so slight that the underlying environment cannot be distinguished. Both environments have adopted the IBM Common User Access (CUA) specification for designing the user interface. Therefore, SAS users moving from Windows to OS/2 or vice versa will have no problems adapting.

However, OS/2 Version 2.0 introduces a new user interface shell named the workplace shell. The workplace metaphor attempts to provide the user with an object-oriented system instead of the traditional action-oriented system. For example, users will work more with files and documents that are associated with programs, instead of the current method of working with a program and then selecting the data. Action bars or menus are replaced with pop-up menus in the OS/2 shell. Drag and drop operations will be as common as mouse clicking is today. The Institute is currently working on enhancements to SAS software to allow it to fit the new OS/2 workplace shell.

A new feature in Release 6.07 of the SAS System for both OS/2 and Windows is the tool palette. The tool palette is a ribbon of icons. You can assign each icon a SAS command or macro. By clicking on the icon in the tool palette, you can execute the command or macro. The tool palette is fully user configurable. Up to eight icons can be in the tool palette, and you can paste icons from the clipboard. You can even create icons in the SAS graphics editor. You can display the ribbon of tools in any vertical or horizontal configuration of tools, and you can place the tool palette anywhere on the display. Tool palette commands are provided for SAS programming. By using the SAS DM statement, you can load a tool palette and close a tool palette during the execution of your application.

The SAS System also provides a floating command window to allow for quick execution of SAS commands. The command window can float anywhere on the display. The command window enables you to enter and execute SAS commands in the active window. Again,
this feature is user configurable and can be invoked through a DM command.

A preferences dialog enables you to select the layout and user interface specifics of the SAS session. For example, you can select a tool palette and command dialog to be active in the session. You can select between the menus being displayed on the action bar, popup menus, or even the traditional command line. Other options are provided to customize your SAS session.

SAS SOFTWARE UNDER OS/2 AND WINDOWS

As stated earlier, the SAS System under OS/2 and Windows will contain the same software products for Release 6.07 because of the SAS System's MultiVendor Architecture that allows the software products to be ported to multiple architectures and operating systems concurrently. The SAS System also provides additional features such as DDE, OLE, and named pipes to optimize the operating system features. In addition, in a few product areas, there are differences between the SAS System releases that are discussed in the following sections.

SAS/ACCESS Software

SAS/ACCESS software will provide engines to read and write data in the following formats. These engines are supported under both OS/2 and Windows:

- Lotus WKS files
- dBASE III and IV files
- DIF files

The OS/2 release also provides an engine for the OS/2 database manager for Extended Edition and the OS/400 database that runs on the AS/400. The Institute is investigating support for Microsoft Corporation's SQL Server on both platforms.

SAS/CONNECT Software

SAS/CONNECT software provides cooperative processing between PC workstations and will provide support for micro-to-host communications. SAS/CONNECT software allows remote execution of SAS programs on a host, and facilitates file transfer of SAS data sets, catalogs, and external files. The following access methods are supported under OS/2 Version 1.3:

- 3270 EHLAPI interface utilizing Communications Manager
- APPC (LU 6.2) interface utilizing Communications Manager
- Asynchronous communications (RS-232)
- DECnet task-to-task interface
- The IBM TCP/IP for OS/2

Access methods APPC, DECnet, and TCP/IP also allow remote execution on the OS/2 machine from another PC or host.

The following access methods are supported for local processing only under Windows 3.0 and 3.1:

- 3270 EHLAPI interface for the DCA IRMA Workstation for Windows, Attachmate's Extra for Windows, IBM Personal Communications/3270, and Walldata's Rumba. Others are being investigated.
- The DECnet task-to-task interface.
- The Novell TCP/IP for DOS.

SAS/SHARE Software

SAS/SHARE software is being developed to provide a SAS file server for allowing concurrent access to a data set or catalog by multiple users. SAS/SHARE software utilizes OS/2 as the server platform. This SAS server is planned as an experimental release in Release 6.07, initially under OS/2 Version 1.3, then as a 32-bit version under OS/2 Version 2.0. The underlying communication interface will use Netbios.

SAS/SHARE software will not be supported under Windows. The lack of true multitasking, the lack of threads, and the lack of protection for applications are the reasons for not developing a SAS server under Windows. However, the SAS System running under Windows may be a client to a SAS/SHARE server running under OS/2 in 16-bit mode.

HARDWARE

The following minimum requirements are recommended for the SAS System, Release 6.07, on both platforms:

- 80386 processor
- 6 megabytes memory, 8 megabytes for large applications
- math coprocessor (80387)
- 110 megabytes hard disk
- EGA, VGA, 8514/A, or XGA
- mouse

You can obtain complete hardware and software requirements for both systems by calling Software Sales at SAS Institute. A selective install program is provided to help install the SAS System with a minimum disk storage configuration.

NETWORK SUPPORT

Network support is a requirement before moving to a new operating system. Network vendors have provided an entire array of networks and servers in the PC/DOS market. Windows builds on this support by providing many requesters from popular networks in the Windows Setup installation program. Additionally, Windows allows installation on the network of much of the operating system, loading only necessary pieces to the local hard disk. Windows 3.1 has addressed many of the problems associated with reliable network performance. Under OS/2, vendors other than IBM, Microsoft, and Novell have been slow to provide support. Other network vendors have taken a cautious approach to supporting OS/2.

The SAS System uses no network specific Application Programming Interfaces (APIs), and thus it interfaces with the various networks through the OS/2 and Windows APIs. For SAS/SHARE software, the Netbios API will be used to interface with networks.

RELEASE STATUS

Release 6.06 of the SAS System is available for OS/2 Versions 1.2 and 1.3 Standard and Extended Edition, as well as Microsoft Corporation's OEM versions.

Release 6.07 under OS/2 and Windows will be released in stages. The SAS System will be released for the 16-bit operating systems Windows 3.0 and 3.1 and OS/2 Version 1.3. Later, the SAS System for OS/2 Version 2.0, the first 32-bit PC version, will be released.

Many customers have indicated the desire to use OS/2 Version 2.0 for the execution of their 16-bit OS/2 or Windows version of the SAS System, until the full 32-bit version of the SAS System is available.
The Institute is testing the 16-bit versions of the SAS System under OS/2 Version 2.0 in order to meet these goals.

FUTURE DIRECTIONS

The Institute believes that both OS/2 and Windows are strategic to corporations, and thus the Institute will provide support for them with future SAS releases. The products released for each environment will be the same. The feature set of the procedures will be identical; the only difference in the releases will be advanced features that one environment may support that the other does not.

Microsoft Corporation is developing a new version of Windows named Windows NT (New Technology). Windows NT will provide 32-bit processing, preemptive multitasking, separate address spaces, symmetric multiprocessing, interprocess communications features, and an enhanced Graphics Device Interface (GDI). The features of this new operating system are similar to OS/2 Version 2.0. Windows NT will run on two platforms, Intel 386 and 486 PCs, as well as on new PCs based on the RISC platforms that are based on MIPS. These PCs are based on the Advanced Computing Environment (ACE) consortium, which defines a standard RISC architecture. Windows NT will run DOS applications and Windows 3.0 and 3.1 applications, as well as Windows 32-bit Windows applications. A driver to support OS/2 Version 1.3 and OS/2 Version 2.0 applications may be added at a later date by Microsoft Corporation. Microsoft Corporation is beginning to demonstrate Windows NT around the country, and SAS Institute has begun investigating this new platform, with hopes of delivering a release in 1993.

With the introduction of OS/2 Version 2.0 and the coming release of Windows NT, 32-bit processing has finally made its way to the PC workstation. 32-bit processing is a significant boost to SAS software. The focus of future development will be on 32-bit architectures.

CONCLUSIONS

This paper compares the differences between the OS/2 and Windows operating systems and how the differences relate to Release 6.07 of the SAS System. SAS Institute does not recommend one of the environments over the other. The choice of operating system depends on the use of the application. OS/2 provides a more robust, multitasking environment. Windows provides nearly the same user interface but in a more fragile environment. However, as software giant Microsoft Corporation concentrates on enhancing Windows in the future, we can expect future improvements, innovation, and new products to appear. SAS Institute will support both operating systems in the future. SAS software will be identical under both operating systems. Any feature of OS/2 or Windows that provides the SAS System with more power and flexibility will be supported under that operating system.

Clearly, each operating system has its advantages. However, technically, there are fewer limitations and fewer disadvantages of using OS/2, while there are many advantages. The only disadvantages of using OS/2 include limited network support from many network vendors, lack of applications, and lack of development tools. The clear advantages are that OS/2 is by far a superior operating system to Windows: it is robust, and it provides true multitasking, extensible memory management, and protection of application address spaces. This makes OS/2 the preferred environment for mission-critical SAS applications and applications that are so large that extensive virtual memory is required. OS/2 is also the choice for power users performing extensive numerical computations and running server applications such as SAS/SHARE software.

However, the SAS release for Windows is functionally equivalent to the OS/2 release, and the performance for most applications will be very similar. Windows provides the SAS System with a less stable environment, and the FAT disk I/O is substantially slower. Larger problems may occur from the limited support of virtual paged memory, and the SAS System will most likely run slightly more slowly.

OS/2 Version 2.0, promised by IBM Corporation in March 1992, has the potential to propel OS/2 to the status once expected. By providing "a better DOS than DOS, a better Windows than Windows, and a better OS/2 than OS/2", IBM Corporation will be delivering to each PC user exactly what each user wants and needs. The SAS System for 32-bit OS/2 Version 2.0 promises to be an ideal platform for SAS users.

NOTES AND TRADEMARKS

The release dates for products to be delivered from IBM Corporation, Microsoft Corporation, and other corporations mentioned in this paper are dates as reported in the (public) press. These dates may not reflect official announced dates from these corporations. The dates were used in this paper merely to reflect upcoming releases of operating system software and what plans SAS Institute has to support these new releases.

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