

Taking advantage of the SAS® System on Windows NT™

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ABSTRACT

Windows NT is fast becoming the universal desktop client operating system as well as an important file and compute server for mission critical applications. This paper presents a discussion of the state of Windows NT and how the SAS System Release 6.12 for Windows takes advantage and integrates with the operating system. Areas such as the user interface, OLE and Web integration are presented. Data access and Microsoft BackOffice integration, and hardware considerations are also presented.

INTRODUCTION

Microsoft Windows NT sales grew dramatically in 1996, as many corporations which have been investigating Windows NT have now begun to deploy Windows NT for the client desktop. Many of these deployments were replacing Windows 3.1 and Windows 95®. Also, Windows NT Server is making major inroads for mission critical file and compute servers. Just what does Windows NT provide that is so appealing to corporations? And, how does the SAS System integrate with Windows NT? This paper presents the current state of the SAS System for Windows NT. It introduces the basic system features of Windows NT as well as some of the more advanced features of Windows NT. At each point, features and products of the SAS System that integrate well with Windows NT are presented. A brief overview of Windows NT Server is discussed within the context of SAS Institute's plan for continued support. The paper concludes with hardware considerations for the SAS System on Windows NT and a glimpse of future directions for Windows NT and the SAS System.

Note: Throughout the paper, unless otherwise specified, the term Windows NT generally refers to the code base and feature set that is represented in both product offerings, Windows NT Workstation and Windows NT Server.

Unless specified, all the SAS System products and features are provided on both Windows NT Workstation and Windows NT Server. This paper assumes the current release of Windows NT is Version 4.0. For brevity, the abbreviation NT will be used for Windows NT.

Windows Family - Single Executable Image

Windows NT is now in its full 3rd generation, with the release of Windows NT Workstation 4.0 and Windows NT Server 4.0. NT Workstation and NT Server share the same microkernel, and is portable to several RISC platforms, including DEC Alpha AXP™, and the PowerPC™ Prep Platforms. The MIPS® chip is no longer supported by Windows NT. The majority of NT installations still run on the Intel Pentium® and Pentium Pro® processor. The SAS System Release 6.12 only supports the Intel platform, and the Pentium Pro processor is highly recommended. At this writing, the market demand for the SAS System for NT on RISC platforms has not been great enough to warrant a production release. Please contact your SAS Institute sales representative if you are interested in using SAS for Windows NT on a RISC platform.

Although this paper focuses on Windows NT, it is important to note that the SAS System for Windows Release 6.12, supports the Windows family of operating systems with a single executable image. There is a single CD that supports all three Windows operating systems Windows NT (workstation and server), Windows 95, and Windows 3.1 using Win32s. However, the product has run time checks for Windows NT to take advantage of NT specific APIs (application programming interfaces). Microsoft's strategy is to have a family of Windows offering from the low end Windows 3.1, to the entry level business environment Windows 95, through the high end power user and server platforms with Windows NT. Applications should be able to run across all of

these environments unmodified. Now, this strategy is being narrowed to Windows 95 and Windows NT Workstation and Windows NT Server, with the demise of Win32s. Development at SAS Institute focuses on Windows NT. The SAS System release is later tested on Windows 95 and Windows 3.1 with Win32s for compatibility. Future releases of the SAS System will only support Windows NT and Windows 95.

User Interface - Windows 95 Explorer Shell

Windows NT 4.0 has released the Windows 95 Explorer shell as the default user interface shell. This means that the user interface between the highly popular Windows 95 and Windows NT, and the newly released Windows CE[®], is largely the same. This user interface is commonly believed to have become the defacto standard for client workstations. Also provided on NT is the Windows 95 Start menu, wizards, my computer, network neighborhood, recycle bin, interactive help, and other Windows 95 applets.

It is important for applications to follow the user interface guidelines provided by Windows, and the SAS System is no exception. The SAS System is a native Windows NT application. Developers at SAS Institute have paid special attention to Windows 95 user interface guidelines outlined in Microsoft's *Windows User Interface Handbook* in designing the SAS System user interface.

Additionally, Windows NT supports messaging through Microsoft Exchange. NT provides for an email client named the Inbox, and Microsoft Office97 provides for a Personal Information Manager named Outlook that combines email inbox, scheduling, and contacts. Through support of Microsoft Messaging API (MAPI), the SAS System integrates nicely with the Inbox and Outlook, allowing email messages containing rich text and attachments to be created and mailed by the SAS System. The SAS System uses the email user interface consistent with the mail program installed. The messaging APIs supported are MAPI and VIM.

Also provided as a new feature in Release 6.12 is the SMNP email access method. This experimental feature makes it much easier to

programmatically send a simple email message from within a Data Step or SCL program, without requiring a user interface.

Print Preview for all display manager and graph windows is a new feature provided in Release 6.12. This allows for the printed output to first be reviewed before printing.

ActiveX Support

There has been much confusion over the difference between OLE and ActiveX. Mostly the confusion has been caused by a name game and marketing push by Microsoft. ActiveX is the new generic name for OLE, and OLE is now the specific acronym for what it should be, that of Object Linking and Embedding. Much of the confusion has happened because new OLE technology is now being released named as ActiveX and there really was never a previous OLE name for the technology. For example, consider ActiveX scripting, where there was never previously an OLE scripting model. In general, ActiveX includes objects, controls, documents, and various scripting models. OLE has not fundamentally changed; it has just been renamed as ActiveX.

Support for ActiveX continues strong in Release 6.12. This includes Object Linking and Embedding support in SAS/AF and SAS/EIS. These SAS products can function as an OLE Container and host any ActiveX object. Visual editing, drag and drop, and OLE automation is supported. OLE automation server support was provided experimentally in Release 6.11 and has now been fully tested as a production feature in Release 6.12. This provides for the ability to program the SAS System and access the full functionality of the SAS System from products such as Microsoft's Visual Basic, PowerSoft's PowerBuilder, or any OLE automation controller. For example, from a Visual Basic program, any SAS procedure or Data Step statements and DM commands may be submitted to the SAS System and the results may be brought back into the Visual Basic program, including text and graphic reports. Please see "OLE and the SAS System for Windows Release 6.12" in these proceedings for a complete description of ActiveX (OLE) support in Release 6.12.

DCOM Support

ActiveX is built on top of a systems infrastructure named Component Object Model (COM). COM provides the software architecture for software components or objects to communicate with each other. COM is limited to coordinating objects all executing on the same local workstation. However, now provided in Windows NT 4.0 is production support of Distributed COM referred to as DCOM. DCOM allows for the invocation and coordination of objects across networks. With DCOM provided in Windows NT 4.0, the SAS System can now access objects that are remotable across the network. DCOM has now provided the beginning infrastructure for powerful distributed computing. SAS Release 6.12 provides support for DCOM in the SAS OLE Automation Server.

WEB Integration

As Microsoft positions Windows NT to be a premier web client and server, the SAS System also is adding features aimed at the web. The SAS toolbar now sports a new tool that provides for the invocation of the current web browser. Additionally, URLs can be typed in any command line or command bar, which will invoke the browser and load the specified URL. DM commands are provided to allow this functionality to be placed in an SCL program.

Upon installing the SAS System with the Setup application, various system registry tags are defined to allow the invocation of the SAS System from a web browser or from the Windows Explorer. For example, while in a web browser viewing a .htm (or .html) page, when clicking on a SAS file type, the SAS System is invoked with the appropriate SAS program to process the file. Also, new in Release 6.12, if the SAS System is invoked from an .htm page, the SAS System will display within the window frame of the browser, providing a more seamless user interface.

Three access methods are available in Release 6.12 that make accessing the internet easier. These fileref based access methods can be used from a Data Step or SCL program.

- The FTP access method allows for accessing remote files, directory listings, and accessing anonymous FTP sites from within the SAS System.
- The TCP/IP socket access method can be used to establish peer-to-peer connections with a remote program. In this way, a remote program can be set up to communicate with the SAS System.
- The URL access method allows a SAS program to access remote files using the universal resource locator protocol. (Of course this is a standard protocol used on the world wide web.)

Several new tools are available and can be downloaded from the SAS Institute home page under the Research and Development section. (<http://www.sas.com>)

- The HTML Output Formatter is a tool to save output from any SAS procedure to an HTML file, making the static pages of the data immediately available for users to access from their web browsers.
- The HTML Data Set Formatter is used to format the contents of a SAS Data Set into a html page.
- A JDBC driver is one of SAS Institute's open interfaces to SAS data. It is written completely in Java and conforms to the Java Database Connectivity (JDBC) API developed by Sun Microsystems. The driver enables you to write Java applets that access data through a direct connection to a SAS/SHARE*NET server.
- Finally, a Netscape plugin enables you to place a push button on a Web page that is associated with a SAS action. When a user selects the push button, the predefined action is sent to the local SAS session. If a session is running, the plugin sends the action request to that session. If a session is not running, the plugin starts one.

Security

An essential part of an industry strength client workstation or mission critical server platform is security. NT provides for per-file and per-directory security within the NTFS file system, as well as local desktop security. A user id and password is required for logging into Windows NT. Across the network, APIs are provided for a single network login, and NT prevents use of resources by unauthorized users. Finally, Windows NT is C-2 certified.

The SAS System takes advantage of the security features of Windows NT within the file system. In addition, SAS products such as SAS/CONNECT and SAS/SHARE only allow data access from authorized remote sessions.

Data Access - File Systems

The file systems supported on Windows NT include FAT, HPFS, CDROM, and NTFS. The FAT file system is provided for compatibility with MS-DOS, while the High Performance File System (HPFS) provides compatibility with OS/2. The NT File System provides for a secure file system that provides for 64-bit addressing, supporting large files greater than 2 Gigabtes. Release 6.12 of the SAS System properly supports NTFS allowing SAS Data Sets to be accessed that are larger than 2 Gigabytes. Data Sets around the size of 8 to 10 Gigabytes are common in this scenario. Windows NT and the SAS System also support long filenames up to 256 characters long.

Disk sharing services are provided for peer connections. And NT provides for file compression per file or per directory with the NTFS file system.

For large scale file server capability, Windows NT Server is a network operating system that provides for powerful and secure file server capabilities that can support many users. See the section, **Comparing Windows NT Server to NT Workstation, Release 4.0**

Data Access - ODBC Support

The SAS System provides for open data access. To provide data access to SAS Data Sets from other applications such as Microsoft's Excel or Microsoft Access, the SAS ODBC Driver provides for support for both local and remote access. Local access is supported by a local SAS ODBC Server provided in BASE SAS. Remote access to SAS Data Sets is provided through the SAS/SHARE ODBC Server. And using SAS/SHARE*NET, clients can access data on remote SAS/SHARE servers without requiring the SAS System to be executing on the local PC. The SAS ODBC Driver supports data access through TCP/IP sockets, DDE and Network DDE communication access methods.

SAS/ACCESS supports accessing any ODBC compliant data source for both 16 and 32 bit drivers, thus making available data external from SAS, to the SAS System for processing. This provides for a large array of PC and data base data sources to be accessible from the SAS System.

Data Access - Microsoft SQL Server

The SAS System can access data in Microsoft's SQL Server data base through the SAS/ACCESS for SQL Server product. This provides for the ability to read, write or update a SQL data base. The data base can reside locally or across the network.

Network Connectivity

SAS/CONNECT access methods have long supported a comprehensive array of network access methods. Windows NT also supports a large variety of network protocols including client services for Netware®, TCP/IP (DHCP, WINS, PPP, PPTP, SLIP), RAS, WinSock Sockets, NetBEUI / Netbios and IPX-SPX. SAS/CONNECT and SAS/SHARE support TCP/IP, Netbios, IPX-SPX, DecNet, and APPC.

New in Release 6.12 is the SAS Domain Server which provides protocol bridging. The SAS Domain Server works in combination with SAS/CONNECT and SAS/SHARE software.

SAS Viewer

The SAS System Viewer is a freely redistributable application for viewing and printing files that were created by the SAS System. The Viewer provides a quick and convenient way to view the contents of a SAS Data Set or catalog without invoking the entire SAS System, or even having the SAS System installed on your computer. The features of the SAS System viewer include:

- View/Print SAS Data Sets and SAS catalogs in a grid format.
- View/Create/Print and edit SAS programs, text files, LST files, LOG files, and RTF files.
- View/Print SAS files created by versions of the SAS System that run on other platforms.
- Supports ftp and http protocols
- Launch the SAS System to work with local Windows or OS/2 SAS files
- Supports sorting, subsetting the data (WHERE clause), find, filter, email, column re-sizing, and drag and drop

Multitasking and Memory Management

Windows NT provides for preemptive multitasking. Applications execute within their own address space and are prevented from corrupting other applications. Windows NT runs in full 32 bit mode, using the protected mode of the Intel architecture. All of Windows NT is 32 bit, and all of the SAS System is 32 bit code. (except the 16 bit ODBC drivers for backward compatibility) The SAS System is compiled for optimum performance on Intel Pentium and Pentium Pro microprocessors. This includes using a highly tuned floating point compiler optimizer for creating optimized floating point instruction sequences.

Memory is addressed linearly up to a limit of 2 Gigabytes of address space per process. Memory management APIs are provided for a rich set of memory including memory mapped

files, named shared memory, and dynamic loading and unloading of code libraries. Applications execute in a robust tasking environment and the memory management architecture virtually removes the out-of-memory constraints of previous Windows 3.1 releases. This includes the removal of the 64 kilobyte limitations of the USER and GDI segments. NT provides for the ability to execute multiple concurrent SAS sessions. Multiple SAS sessions do not strain the system because these concurrent sessions share all the same code in memory, and only the data and stack sections of the SAS System are allocated in memory per executing session. This is often the best way to take advantage of multiple processors.

Symmetric Multiprocessing Support

Out of the box, NT supports up to four processors in which any thread of execution could execute on any processor, at any time. Up to 32 processors can be supported but requires that the customer purchase a software component named a HAL (Hardware Abstraction Layer) directly from the PC hardware vendor. Windows NT Workstation and Server takes advantage of multiple threads even down to the kernel level. This provides a significant value to applications, because even though applications are not full multi-threaded, applications may often gain considerable performance from multiple processors because API requests tend to be multi-threaded as the API is completed down at the NT kernel level.

The SAS System uses multiple threads of execution, but SAS procedures are not fully multi-threaded. Where possible the SAS System does take advantage of multiple thread execution such as in SAS/CONNECT and SAS/SHARE. Future releases of the SAS System will utilize threads in a much smarter design.

It is recommended to install multiple processors especially in the case of using SAS/SHARE or SAS/CONNECT on a Windows NT Server. Typically there are other server processes running on the NT Server system, and can gain from multiple processors. Additionally, multiple SAS sessions running concurrently can

significantly improve if multiple processors are available.

Note: CPU usage of all processors can be monitored by using the NT Performance Monitor provided in the Administrative Tools program group, from the start menu.

Portability

From a strategic point of view, portability can be measured in two ways: 1) portability of the SAS applications, and 2) portability of the Windows operating system to be provided on a new and different processor and architecture. First, SAS applications are portable across SAS Institute's MVA[®] supported platforms. This includes SAS Data Step code, procedure code, and SCL code. Care needs to be taken not to use platform specific extensions typically found in advanced file i/o APIs and in the user interface.

Second, Windows NT itself is portable across differing hardware platforms, including Intel, DEC Alpha, and the PowerPC. Clearly, Microsoft is working on a 64 bit version of Windows NT targeted towards the Intel P7 processor, code named Merced. Expectations are that NT and the existing SAS System will port easily to this new processor. Portability was one of the design goals of Windows NT, and provides customers with hardware independence. This is accomplished with the use of a portable microkernel built on top of modules named HALs (Hardware Abstraction Layers).

It's a pretty good bet that the combination of Windows NT and the SAS System provides one of the best portable or vendor independent solutions available. Windows NT can and most likely will be ported to the most successful workstation platforms in the future, and SAS Institute has already proved the portability of the SAS System, having ported to every major operating system in the industry. Also, SAS applications remain portable even across differing platforms.

Setup

Windows NT provides a control panel applet that is responsible for installing and de-installing applications. Applications should be installed in the Program Files folder, and should keep a log of the changes made (including folders created, files copied, registry changes made). Later, the de-install applet for the application, can remove cleanly the entire application. Setup programs should not update or maintain .INI style files but instead update the system registry. The SAS System setup allows for custom installs allowing specifics parts of the SAS System to be installed, reducing the overall disk usage.

The SAS System's approach to Client Server

The Institute's MVA architecture provides for the entire SAS System functionality to be able to run on either a client (Windows NT Workstation) or server (Windows NT Server). There is not a unique SAS System release for Windows NT Server, instead the same executable system runs on both NT Workstation and NT Server. This provides for maximum flexibility in designing a client server solution. Functionality on the client side or the server side is not limited. By providing the SAS System on both client and server, total flexibility and granularity is available in creating the optimal client server application.

There are a few guidelines for creating optimized client server applications. For example:

- Attempt to minimize data traffic across a local area network, realizing the data access is usually faster on a local machine than across a network. Therefore, execute the SAS System and other related server applications on the same machine if possible.
- Determine what data is to be accessed and how. Define the application architecture that accesses the data in the best way to keep the data traffic at a minimum. Consider using subsetting WHERE clauses

to trim down the data to be transferred across the link between server and client

- Have available symmetric multiple processors on the machine that is executing the SAS System and other related server applications.
- Have available large amounts of memory on the machine that is executing the SAS System and other related server applications. Also, provide additional memory for data caching on server machines.

However, certain SAS products will tend to be better utilized on Windows NT Server. For example:

- **SAS/CONNECT applications server** - This scenario provides for executing SAS System programs (typically Data Step, procedures, or SCL code) on the NT Server machine, as the result of a request from the client machine. Multiple processors should be installed on the NT Server machine for maximum processing power.
- **SAS/SHARE data server** - Provides concurrent SAS Data Set and catalog access in read and write modes. This provides for sharing a SAS Data Set across an organization.
- **Processing data from Microsoft SQL Server with SAS/ACCESS** - In order to limit the data traffic across a LAN, its best to execute the SAS System on the same server machine where the data base is executing. Again, this will require large amounts of memory and multiple processors preferred to support concurrent executions of the SAS System and SQL Server.
- **Processing large amounts of data from ODBC compliant data bases or Lotus Notes** - This is similar to the above scenario. Attempt to reduce data traffic across the LAN.
- **Supporting data access serving through Remote Library Services** - RLS provides

for remote SAS Data Set access from client machines. A SAS/SHARE or SAS/CONNECT server would provide the data access. RLS is best suited for small amounts of data to be accessed and transmitted across the network.

- **The SAS Domain Server** - Can provide cost savings for protocol conversions. For example, suppose a SAS System running on Windows NT Workstation running only TCP/IP needs to access data on an IBM MVS Mainframe which uses the APPC protocol. The SAS Domain Server could run on the NT Server, and convert the data access request from the NT Workstations running the TCP/IP protocol to the APPC protocol. Thus, each NT workstation would not need access to the APPC protocol.

Windows NT Server Support

In the previous discussion, it was presented that the Institute does not provide a customized version of the SAS System for Windows NT Server. Regardless, the SAS System is still optimized for Windows NT Server, based upon Microsoft's NT Server application guidelines. Microsoft has created a logo certification program that creates a level of functionality for products designed to run optimally on Windows NT Server. This logo certification program is called **Designed for Microsoft BackOffice**. Microsoft BackOffice is a family of products designed to run on Windows NT Server.

The certification requirements are specified for both BackOffice client and server applications. The SAS System meets the requirements of a BackOffice client, and SAS/CONNECT and SAS/SHARE meet the requirements of the BackOffice server. The requirements of being a **BackOffice server** include:

- Run as a Windows NT Server service
- Support Windows NT unified logon
- Network independence (support both IPX/SPX and TCP/IP using RPC, OLE, Named Pipes, or WinSock)

The **SAS/CONNECT spawner** runs as a service on NT. A service is automatically invoked at boot time by the operating system and operates in a specified security context. It does not require manual intervention to start. The SAS spawner listens for SAS/CONNECT or SAS/SHARE requests, and invokes the SAS System on behalf of the requesting remote SAS Session. The spawner service allows a remote NT machine to be accessed by authorized users, without first having to invoke the SAS System on the server PC. Authorized users must have an appropriate NT login account. The spawner will compare the login request with the list of authorized sessions before letting the connection succeed. The spawner, SAS/CONNECT, and SAS/SHARE are independent of the network protocol being used. The spawner supports TCP/IP, Netbios, and SPX protocols.

- Installable using Microsoft's Systems Management Server

The SAS System can be installed from Microsoft's Systems Management Server using Program Description Files (PDF). This provides support for unattended installs. This feature will be provided to SAS customers during 1997.

The essential requirements of being a **BackOffice client** is to properly interface and support one of Microsoft's BackOffice products. The SAS System meets this requirement by supporting Microsoft's SQL Server™ within the SAS/ACCESS to SQL Server product.

Comparing NT Server to NT Workstation, Release 4.0

NT Workstation and NT Server are built upon the same code base and execute the same programs. Typically, not even special server versions of programs are required to run on NT Server. What then are the basic differences in NT Workstation and NT Server ? Simply stated, NT Workstation is optimized for the client workstation even for power users, while NT Server is optimized for system administration of NT based networks and for setting up large server applications.

Specifically, NT Server provides for a number of additional features such as:

Network Monitor - provides for the monitoring of network traffic, making it easier for administrators to trouble shoot network performance.

Windows Network Directory Server - provides for single network logon to all network resources and centralized administration for user accounts.

Internet Information Server - provides an integrated WEB server.

Microsoft Index Server - provides the ability to index for fast retrieval information in all files and HTML documents on the NT Server.

Microsoft FrontPage - WEB authoring tool.

Hardware Considerations

In general, Windows NT Workstation is the preferred environment for SAS data analysis and end user application development. It is highly recommended for advanced development with the SAS System, to have at least 16 additional megabytes of memory available for use by only the SAS System, above what is required for the operating system. Typically, this would suggest a minimum of 32 Megabytes memory on the NT Workstation. 64 Megabytes performs exceptionally well. An Intel Pentium Pro 200Mhz processor is highly recommended, but a 200 Mhz Pentium also is very acceptable. Multiple processors should be considered especially if performing concurrent SAS processing, or if substantial concurrent processing is required by other applications. (When purchasing new hardware, check to ensure the motherboard allows for additional processors to be added.)

When using Windows NT Server, the size of machine is dependent on the type of processing and serving being provided, as well as the other applications to be executed. NT Server machines can be configured at the low end (32-64 Megabytes memory and 4 Gigabytes disk storage) to the high end (512 Megabytes

memory and 64 Gigabytes of disk storage). In general, for optimal performance using the SAS System on Windows NT Server, at least dual Intel Pentium Pro 200Mhz processors and at least 64 Meg memory is recommended. Provide 16 Megabytes of memory for the SAS System and an additional 12-16 Megabytes of memory for SAS data processing.

The disk space required by the SAS System varies widely, but can range from under 100 Megabytes to 350 Megabytes for the entire system. The product can be custom installed for less disk utilization.

Care should be taken reviewing the hardware requirements for Windows NT. Windows NT is not supported across all Intel based PCs. *The Windows NT Hardware Compatibility Guide* should be consulted to determine compatibility with existing hardware

Future Directions

At a Microsoft Professional Development Conference in Los Angeles in November 1996, Microsoft laid out plans for future releases of Windows NT. Although the plans include a great deal of new technologies, five specific directions are clear and will influence the direction of the SAS System on Windows NT. For a complete listing of new Windows NT technologies, consult the Microsoft WEB page (www.microsoft.com).

DCOM - will have a major influence on Windows and the SAS System. DCOM provides an industry standard infrastructure for robust distributable objects. Expect to see applications broken down into objects or components, where the objects could run either locally or remotely. DCOM provides the infrastructure to accelerate distributed computing by making it easier to develop distributed applications.

Object based - implied in the above discussion concerning DCOM, applications will be broken down into separate executable components. Components will then be threaded together to create an application. Components will bring us to a higher level of programming productivity by

getting us closer to the holy grail of code reuse. Within the SAS System, expect to see applications and procedures broken down into components that can be accessed independent of the SAS System.

Internet Explorer 4.0 - to be released in 1997, Microsoft Internet Explorer 4.0 will merge the Windows Explorer with the Internet Explorer. The user interface differences will diminish between using the web and exploring your local or network resources. The user interface should be consistent between exploring the web or the network. The internet will become just an extension of your computer; a shared public network, just like your LAN. Also, on line documentation will be provided in HTML and viewed in browser controls. The interactivity provided in web pages will also influence the directions of the Windows user interface.

Windows User Interface - Currently, the user interface in Windows is based upon the Windows 95 model. But as the internet explodes with active content, expect to see the general user interface of Windows NT to change to be more active, like the web. This includes windows with water marks, dialogs and wizards that are much more colorful and graphical, hypertext linking, as well as using the basic controls of web browsing like the Rebar (often called the Coolbar). With the explosion of ActiveX control development which provides for reuse of specific graphical controls, tied together with scripting languages Java and VB Script, we can expect to see future Windows applications that are indistinguishable from web or Java based applications. SAS Institute is following these user interface evolutions carefully.

OLE DB - Today the most widely used data access model in Windows is ODBC. ODBC is built for data that is columnar based and can support SQL queries. OLE DB (OLE Data Base interface) will soon be provided to not only access SQL based data like ODBC, but also non-tabular data. OLE DB, designed around DCOM, has a concept of data providers. A data provider is built for each proprietary data source. The OLE DB interface and various high level APIs will provide access to all types of data sources to Windows programs. In effect, OLE DB is more inclusive of data sources than is

ODBC and will replace ODBC data access. In future releases of the SAS System, an OLE DB provider will be supported allowing third party applications to access SAS Data Sets and the SAS System will be able to access thirty party data through OLE DB.

CONCLUSION

The SAS System for Windows Release 6.12, is designed to run across the Windows family of operating systems. Specifically, Release 6.12 targets Windows NT Workstation and Windows NT Server Version 4.0. On Windows NT Workstation, the SAS System exploits the Windows 95 user interface, ActiveX (OLE), Web integration and large files. For Windows NT Server support, the SAS System supports a SAS spawner as a NT Service, and server products such as SAS/CONNECT, SAS/SHARE and the SAS Domain Server. The Institute's MVA Architecture provides for the optimal client server application to be developed, because it provides for the possibility to have specific processing or data access, placed on either the client or server.

SAS Institute will continue investing in research and development for Windows NT and can expect to further embrace ActiveX, OLE DB, and Windows NT Server development.

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