

The SAS® System on the Windows® and Microsoft.NET Platforms: Time for a change?

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ABSTRACT

The Windows operating system is increasingly the key environment for a majority of SAS users with about 2/3 of SAS licenses being deployed on Windows. As Microsoft continues down the path towards its' .NET vision, some subtle and some not so subtle changes to the Windows operating systems are being made and SAS is working even more closely to understand these changes and identify ways to take advantage of them for SAS' Windows users.

At SUGI 26, we discussed the impending introduction of the "Whistler" releases of Windows. In October of 2001, Microsoft introduced the desktop versions of this operating system release known as Windows XP Home and Professional editions. Currently, Microsoft is continuing to promote the Windows 2000 server family including Windows 2000 Server, Advanced Server and Datacenter Server. Last year, Microsoft did release Windows Advanced Server Limited Edition, in essence a pre-release version of the .Net server code base for 64-bit computing on the Intel Itanium processor family. For 64 bit desktop systems Windows XP Professional 64 bit edition is a viable option.

In the past year, SAS has increased its support for Windows Datacenter and Advanced Server by recently receiving the "Certified for Windows 2000 Datacenter" and "Certified for Windows 2000 Advanced Server" operating systems for the SAS system 8.2. SAS has been working closely with Windows Datacenter OEMs, including Unisys, to optimize scalability of SAS version 8.2 on the Datacenter platform demonstrating that SAS scales beyond 8 CPUs on Windows-based systems. Windows-based systems are now delivering previously unattainable levels of scalability and reliability.

Most of Microsoft's efforts this past year have focused on preparation for Microsoft .NET. This included the release of the Visual Studio .NET software development environment as well as updates to some of the .NET servers including BizTalk 2002.

This paper presents a discussion of the state of the Windows platform and future direction including operating system updates and new features and how the SAS system inter-operates with these new features. It also discusses Microsoft .NET and XML web services and some work SAS is doing with the .NET server family. Also, new SAS features that take advantage of new Intel hardware advances are reviewed.

INTRODUCTION

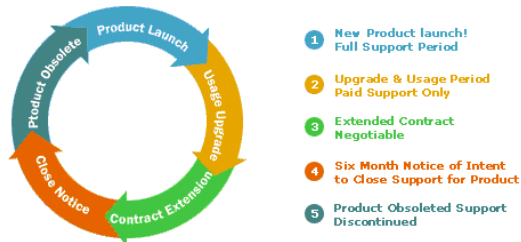
Since SUGI 26 in Long Beach, Microsoft began the introduction of the "Whistler" release with the launch of Windows XP. Many SAS users rely on the Windows desktop operating systems for developing and deploying their SAS applications.

Aside from Windows XP, the most significant Microsoft product release in the past year was Visual Studio .NET, a complete Integrated Development Environment (IDE) for developing XML web services using XML, Simple Object Access Protocol (SOAP), Web Services Description Language (WSDL) and UDDI (Universal Discovery Description & Integration). For those SAS users that are planning on deploying .NET-based solutions, Visual Studio .NET represents a significant milestone.

As before, SAS is continuing to find new ways to take advantage of new Microsoft server technologies and high-end Intel-based hardware capabilities. These exploitations center on the most effective use of the SAS System on large Windows 2000 server systems in applications such as data warehousing and several SAS solutions. In one respect taking advantage of the SAS System on the Windows platform is easy since SAS has included much of the basic support in the software itself, ready for use. However, the task of integration to the operating system has become more complex than ever because server-based

features can be technically more difficult to understand as they relate to the operation of a specific use of SAS software.

THE MICROSOFT PRODUCT SUPPORT LIFECYCLE



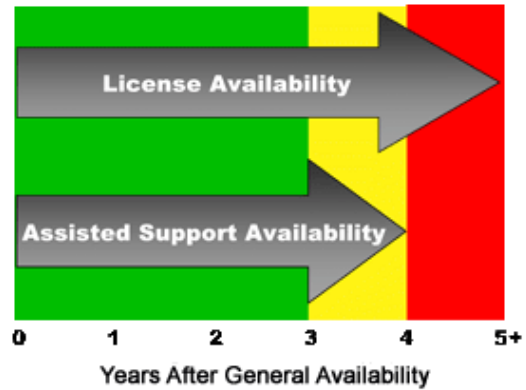
Each Microsoft product follows its own "Product Support Lifecycle", which begins when the product becomes available, and ends when the product records low or zero support questions for a significant period of time. By the time product support ends, most of our customers are using newer versions. For customers still using legacy products, Microsoft normally provides a six-month notice before ending support. Microsoft continues to make Self Service Support Options available after support concludes. Below is URL for further information.

<http://support.microsoft.com/default.aspx?scid=%2Fsupport%2Fsupportnet%2Fsuppobsolence%2Easp>

Table 1. End-of-Life for Windows OS

Product Version	Effective Date	Suggested Microsoft Replacement Product	Date
Windows 95	31-Dec-2001	Windows XP Home	04-Aug-2000
Windows 98	30-Jun-2004	Windows XP Home	01-Feb-2001
Windows 98 Second Edition	30-Jun-2004	Windows XP Home	01-Feb-2001
Windows NT 4.0 Workstation	30-Jun-2003	Windows XP Professional	01-Feb-2001

Windows Desktop Product Lifecycle Guidelines - Support and Availability Guidelines for Businesses



Microsoft® Windows® Desktop Product Lifecycle Guidelines provide advanced notification of planned changes in Windows desktop operating system availability and support. This information will assist customers and partners with product planning and information technology decisions. Under the Product Lifecycle Guidelines, Microsoft plans to make Windows desktop operating system licenses available for purchase for a minimum of five years and assisted support offerings available for four years. However, during these periods, Windows desktop product availability and assisted support will move through the Product Lifecycle Phases identified below.

Product Lifecycle Phases

Mainstream Phase: Three years after general availability.

- Licenses available in all standard product distribution channels (e.g. direct OEM, authorized OEM distributors, retail, and Volume Licensing programs via licenses or via downgrade rights*).
- Standard support offerings available (e.g. Premier Support, incident support (per warranty), hotfix support**, online support information, etc.).

Extended Phase: Between three and four years after general availability.

- Licenses only available in the authorized OEM distribution channel and through downgrade rights available in Volume Licensing programs*.
- In addition to Premier Support, paid incident support, paid hotfix support**, and online support information will be available.

Non-Supported Phase: After four years of general availability.

- Licenses will continue to be available in the authorized OEM distribution channel and through downgrade rights available in Volume Licensing programs*.
- Online support information will continue to be available.
- Microsoft may terminate this phase after providing 12 months advanced notice.

Product Lifecycle Roadmap:

- Applying the Product Lifecycle Guidelines to our current Windows desktop operating systems, the following products are scheduled to transition between December 31, 2000 and December 31, 2002.

Desktop operating systems entering Extended phase (effective date):

- Windows 95 (December 31, 2000)*
- Windows 98 / 98 SE (June 30, 2002)*
- Windows NT 4.xx (June 30, 2002) (<http://www.microsoft.com/ntserver/Default.asp>)
- Windows 2000 (March 31, 2003)
- Windows Me (December 31, 2003)

Desktop operating systems entering Non-Supported phase (effective date):

- MS DOS x.xx (December 31, 2001)
- Windows 3.xx (December 31, 2001)
- Windows 95 (November 30, 2001)

- Windows NT 3.5x (December 31, 2001)
- Windows 98/98 SE (June 30, 2003)*
- Windows NT 4.xx (June 30, 2003)

(For further information, please reference <http://www.microsoft.com/windows/lifecycle.asp>)

It is highly recommended that SAS users relying on these operating systems consider moving to Windows 2000 or Windows XP Professional Editions. With the introduction of Windows XP, Microsoft has successfully merged the Windows family to the “Windows NT” code base and is retiring the legacy DOS-based Windows systems. This should offer desktop users higher levels of reliability.

As previously mentioned, SAS users using Windows 95, Windows 98 or Windows Me, should be planning the migration to Windows 2000 Professional or Windows XP on the desktop. Microsoft has a support policy of (n-1). Microsoft will provide “quick fix engineering support” (QFE) for the current release of an operating system and the one previous version only. As an example, when Windows XP was released, Microsoft stopped QFE support for Windows 98 since Windows 2000 became the (n-1) operating system. Additionally, SAS version 9 will not be supported on Windows 95, Windows 98 or Windows Me versions.

THE STATE OF WINDOWS

Unlike the previous year, Microsoft did not introduce a staggering number of new products and technologies. This year, however, there are several new offerings of operating systems, 32/64 editions, new .NET application servers, XML web services, and the entire Microsoft .NET vision.

In the past year, .NET has become more than just a statement of vision. While .NET won't be fully implemented until at least 2004 or later, the impact of the .NET vision has the potential to affect all users of PC-based systems and applications. The introduction of Visual Studio .NET marks the beginning of actual .NET products.

In addition, systems based on new processors like Intel's Pentium 4 and the 64-bit Intel Itanium processors will dramatically impact the benefits and costs of PC-based computing.

The Windows Family 2002

The current Windows line-up includes:

- Windows XP Home Edition: upgrade path for consumers (home market) from Windows Me.
- Windows XP Professional Edition: upgrade path for business users from Windows 2000 Professional
- Windows 2000 Server
- Windows 2000 Advanced Server
- Windows 2000 Advanced Server Limited Edition: preliminary release of the 64-bit version of .NET Servers.
- Windows 2000 Datacenter Server

Table 2. Comparison of Windows XP (desktop) and Windows 2000 (server) capabilities

Edition	Win XP Pro	Win2000 Server	Win2000 Advanced Server	Win2000 Data-center Server
# CPU limit	2	4	8	32
Physical Memory Supported	4GB	4GB	8 GB (PAE)	64 GB (PAE)
Concurrent Client Network connections	10	Unlimited	Unlimited	Unlimited
Clustering (failover)	N/A	N/A	Two-node	Four-node
Other Features	N/A	N/A	N/A	Process Control Manager tool
Additional Layered Services	N/A	Server domain controller Active Directory service Software-based RAID DHCP server DNS server DFS server Certificate Services Remote install and Terminal Services		

Together, these versions of Windows provide a broad and comprehensive line of products for most all business use. The Windows 2000 Datacenter Server edition offers a product that competes with high-end UNIX and mainframe systems. In addition to feature enhancements, Datacenter Server is available only through computer vendors as part of a certified package.

One of the greatest challenges continuing to face an enterprise administrator is the management of computer networks as they become larger and more complex. For many corporations the migration from a Windows NT 4 domain structure to the Windows 2000 peer domain structure continues to be a major infrastructure change, often requiring several months to a year for implementation and training.

According to many industry analysts, 2002 is to be the year of Active Directory – the point where a majority of customers make the switch to an Active Directory environment. Active Directory, based on the standard of Lightweight Directory Access Protocol (LDAP), was one of the biggest features of the Windows 2000 server platforms. Active Directory provides location, policy, and organizational information on the enterprise-wide level. Information regarding using SAS

with Active Directory is available from the authors.

Other complementary additions to Windows 2000 included the Microsoft Management Console (MMC) and Windows Scripting Host (WSH). The Microsoft Management Console is the presentation framework for writing management applications. Windows Scripting Host allows administrators to automate complex tasks via a script language.

A Look Ahead at the .NET Servers

The .NET servers, to be named Windows .NET are currently expected to be released in very late 2002 or early 2003. At this point, this release is being considered a “dot release” with limited new features. (Note: the most significant aspect of the .NET release was the consolidation of the desktop products onto the Windows NT code base as previously described.) One important feature of the Windows .NET servers will be the support for Itanium (64 bit) processors. With 64 bit support applications can now address 512 TB of memory instead of 2 GB limit in the 32 bit world. The SAS System will fully support the Windows .NET 64-bit operating systems with version 9. As the operating systems have grown, so have the systems requirements. Please see the following table of system requirements for the new line of .Net servers.

Table 3. .Net Server (Beta 3) System Requirements

Beta 3 System Requirements. ²				
Requirement	Web Server	Standard Server	Enterprise Server	Datacenter Server
Minimum CPU Speed	133 MHz	133 MHz	133 MHz for x86-based computers 733 MHz for Itanium-based computers	400 MHz for x86-based computers 733 MHz for Itanium-based computers
Recommend CPU Speed	550 MHz	550 MHz	733 MHz	733 MHz
Minimum RAM	128 MB	128 MB	128 MB	512 MB
Recommend Minimum RAM	256 MB	256 MB	256 MB	1 GB
Maximum RAM	2 GB	4 GB	32 GB for x86-based computers 64 GB for Itanium-based computers	64 GB for x86-based computers 128 GB for Itanium-based computers
Multi-Processor Support	1 or 2	1 or 2	Up to 8	Minimum 8 required Maximum 32
Disk Space for Setup	1.5 GB	1.5 GB	1.5 GB for x86-based computers 2.0 GB for Itanium-based computers	1.5 GB for x86-based computers 2.0 GB for Itanium-based computers

²System requirements are shown for Beta 3 only. Final system requirements are subject to change.

There will be some other notable changes in how the operating systems are packaged.

- Windows .NET Web Server: A new version of Windows for web serving and hosting, providing a platform for rapidly developing and deploying web services and applications.
- Windows .NET Standard Server (32-bit only): This edition is targeted for the everyday needs of businesses of all sizes, providing a solution for file and printer sharing, secure Internet connectivity, centralized desktop application deployment and rich collaboration between employees, partners and customers.
- Windows .NET Enterprise Server: (32-bit and 64-bit editions) Enterprise Server is the platform of choice for applications, web services, and infrastructure, delivering high availability, performance, and superior business value. Enterprise Server replaces the former Advanced Server in nomenclature.
- Windows .NET Datacenter Server Edition (32-bit and 64-bit editions): Datacenter Server is meant for business-critical and mission-critical applications demanding the highest levels of scalability and availability.

(NOTE: Microsoft has also announced a Windows version for “blades”. For more information, please contact the authors.)

In the past year, Microsoft announced that there would be a new “next release” of Windows (post Windows XP/Windows .NET) code-named “Longhorn” that is sandwiched between Windows .Net and the previously announced “Blackcomb” release. Most major new server features will be deferred to the “Longhorn” release. (Reference Table 4: Windows Roadmap)




Table 4: Windows 2003 Roadmap













Edition	2002	2003	2004
Consumer	Windows XP Home	Windows XP Home	Longhorn
Work-station	Windows XP Professional	Windows XP Professional	
Servers	Win2000 Server	32-bit Windows.NET Server Standard Edition	Longhorn
		32-bit Windows.NET Server: Web Edition	Longhorn
	Win2000 Advanced Server	32-bit Windows.NET Enterprise Edition	Longhorn
		64-bit Windows.NET Enterprise Edition	Longhorn
	Win2000 Datacenter Server	32-bit Windows.NET Datacenter Server	Longhorn
		64-bit Windows.NET Datacenter Server	Longhorn

New Feature in Windows .NET Servers

Windows XP and the Windows.NET servers (when launched) provide some new features. The tables below compare major features and system requirements for each version. Please reference Table 5.

Table 5. Windows .Net Features

Key:  = Feature included  = Feature partially supported  = Feature not included

Feature	Web Server	Standard Server	Enterprise Server	Datacenter Server
.NET Application Services				
.NET Framework 1				
Internet Information Services (IIS) 6.0				
ASP.NET 1				

Enterprise UDDI Services	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Clustering Technologies				
Network Load Balancing	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Cluster Service	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Communications & Networking Services				
Virtual Private Network (VPN) Support	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Session Initiation Protocol Service (SIP)	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Internet Authentication Service (IAS)	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Network Bridge	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Internet Connection Sharing (ICS)	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
IPv6	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Directory Services				
Active Directory™	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Metadirectory Services (MMS) Support	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
File & Print Services				
Distributed File System (DFS)	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Encrypting File System (EFS)	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Shadow	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>

Copy Restore	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
SharePoint™ Team Services	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Removable and Remote Storage	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Fax Service	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Services for Macintosh	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Management Services				
IntelliMirror	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Resultant Set of Policy (RSOP)	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Windows Management Instrumentation (WMI) Command Line	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Remote OS Installation	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Remote Installation Services (RIS)	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Multimedia Services				
Windows Media™ Services	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Scalability				
64-bit Support for Intel® Itanium™-Based Computers	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Hot add memory ²	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Non-Uniform Memory Access (NUMA) ²	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
Datacenter	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

Program				
Security Services				
Internet Connection Firewall				
Public Key Infrastructure, Certificate Services, and Smart Cards				
Terminal Services				
Remote Desktop for Administration				
Terminal Server				
Terminal Server Session Directory				

¹ Not supported in Windows .NET Server, 64-bit edition operating system.

² May be limited by lack of support by OEM hardware.

Product Activation

Microsoft Product Activation is an anti-piracy technology designed to verify that the product is legitimately licensed. The upcoming Windows .NET Server Family uses Product Activation, including beta 3 and future pre-release versions of the Windows .NET Server Family. Customers who purchase retail packaged products or a new server from an original equipment manufacturer (OEM) will be required to activate the software. The software may be activated in the factory on a new server from an OEM. Product activation will not be required for licenses acquired by a customer through one of Microsoft's volume licensing programs such as Open License or Select License.

MICROSOFT .NET AND .NET SERVERS

Microsoft continues to focus heavily on Microsoft .NET: its vision for web services and the future of computing.

Benefits of the Windows .NET Server Family

This section summarizes the most important benefits of the Windows .NET Server Family. Windows .NET Server is a comprehensive platform for building, deploying, and running XML Web services and applications. By providing a highly productive, standards-based, multiple-language environment for integrating existing investments with next-generation applications and services, it allows users to build better enterprise applications faster. Easy application development encourages business process innovation and increases business opportunities both internally and externally. Windows .NET Server provides the following benefits for developers.

Build better applications with:

- Native support for XML Web services through standards such as SOAP, WSDL, and UDDI for better interoperability.
- A rich set of integrated distributed application services optimized for performance and scalability, with revolutionary enhancements for deployment, management, and security.
- Built-in robustness with support for loosely and tightly coupled architecture.
- Tight integration with Microsoft .NET Enterprise Servers.

Reduce development time with:

- An integrated set of services—most of what is needed is already in the box.
- Native support for XML Web services (SOAP, WSDL, UDDI).

- Managed code and other Microsoft Visual Studio® .NET features mean less coding for developers.
- Integration with Visual Studio .NET.
- Unified Programming Language.
- Ability to take advantage of existing investments with language independence.

Improve Employee Communication and Collaboration Across a Business

The Windows .NET Server Family improves employee communication and collaboration by providing facilitated team collaboration tools and secure real-time communications. It also offers secure mobile data and streaming media for a wide range of connected devices. Because the server is continuously available, employees can access information any time, any place, and on any device, improving productivity across the business.

Windows Media Services

Windows Media Services in the Windows .NET Server family meets the needs of Enterprise customers looking to deliver richer and more immediate communications with employees, partners and customers, while at the same time reducing overall company expenditure. Using Windows Media Services, enterprises can deliver live broadcasts from company executives directly to the employee desktop, aligning the entire organization to the corporate strategy at the same time. Rich digital media, delivered over the corporate intranet, can also help ensure that employees receive high quality training without having to travel, thereby maximizing employee productivity and reducing expenses.

Communication and Collaboration

.NET is Microsoft's vision for the future of computing focuses on three main goals:

- Enabling information access that addresses the wide variety of

computing devices via connectivity to the Internet, providing access to information any time, any place from any device.

- Providing a platform for creating applications that work in the .NET environment.
- Delivering the ability to support application-hosting to deliver services over the Internet.

Microsoft's .NET extends the concept of collaborative, on-line computing across the entire Microsoft product line. .NET heavily leverages XML, SOAP (Simple Object Access Protocol), WSDL (Web Services Description Language) and UDDI (Universal Discovery Description & Integration) to modularize computing via http-based technology so that it takes full advantage of the web. .NET redefines software as a *service*.

Microsoft is not alone in this effort. In the past year, other key vendors (Sun, BEA, IBM) have announced their vision of web services. All of these are based on the same building blocks of XML, SOAP, WSDL and UDDI.

.Net Framework

In order for Microsoft to be successful in the web services endeavor, they have built an infrastructure to host web services tuned to the Microsoft Operating Systems named .NET Framework. The .NET framework, which includes the Common Language Runtime (CLR), a software component for running and loading applications; and new class libraries, hierarchically organized collections of code that developers can use in their applications to present graphical user interfaces, access databases and files, and communicate over the web. The CLR platform, loosely analogous in some ways to the Java Virtual Machine, enables developers to write their application in the language of their choice or the language best suited to for the programming task at hand. There are currently over 20 languages that are hosted via the CLR.

A .Net-based application is compiled into an intermediate binary called MSIL (Microsoft

Intermediate Language) regardless of language. At runtime the CLR compiles the MSIL binary code into a native format that is optimized for the system that the code is being executed. Applications written in C# (described below), VB.Net, Cobol and others are supported in this fashion. The CLR and MSIL only work on Windows platforms – thus far. However, the specifications are public via European Computer Manufacturers Association (ECMA) so that any ISV could support the Common Language Interface (CLI) on their platform.

All Microsoft products are now being “.NET enabled”. At the same time, Microsoft is heavily promoting the *vision* of .NET to the marketplace. The first tool in the .NET family -Visual Studio .NET- was launched in February 2002.

VISUAL STUDIO .NET

Visual Studio .NET delivers an interactive development environment (IDE) that provides a rich set of features and productivity tools that allow developers to rapidly create enterprise-scale applications for the Web Services Platform. Visual Basic .Net, and a new language, C# (pronounced “C sharp”) are all supported via the same IDE and can now be used interchangeably. C# provides many of the same benefits of Java such as memory management and garbage collection along with the power of compatibility with C++ and Visual Basic.

The focus of Visual Studio.NET is to empower developers with the tools to continue to develop with their existing sets of skills (i.e. Win32, MFC, and COM) along with web-enabled technologies such as SOAP, XML, and web services. As the web is evolving and technologies for universal data exchange such as XML are beginning to proliferate, a new development paradigm has emerged where software is seen as a collection of readily available web services that can be distributed and accessed via standard Internet protocols. Web Services provide middle-tier business functionality exposed via standard Web protocols. XML is used to invoke and return data from these Web Services and allows programs written in any language, using any component object model, and running on any operating

system to access this functionality. In Visual Studio.NET any function can be exposed as a web service and as an added benefit, Visual Studio.NET will automatically generate an XML file that describes the function and, when it is called, the function will automatically send and receive XML packets. Visual Studio.NET provides the tools for support service delivery, service integration, and long running operations.

.NET SERVERS

Microsoft has introduced a series of .NET server products. These servers sit on top of the Windows 2000 Server family and each provides specific features and benefits. When assembled together, the .NET servers can provide a complete business solution. While most of these products do not yet actually include .NET features, Microsoft chose to label them as .NET for marketing reasons – to get customers to start thinking about .NET. Here’s a brief description of the key .NET servers that might integrate in some way with SAS.

- **Exchange 2000**

Exchange 2000, along with Windows 2000 and SQL Server 2000, makes up the core of the .NET enabled platform by providing messaging, collaboration and infrastructure. It includes a Web Storage System for building business applications and support for data, audio and video conferencing services. SAS supports Exchange services and can run in Exchange environments.

- **SQL Server 2000**

SQL Server 2000 has made tremendous strides in terms of scalability and performance in the past year. SQL Server consistently wins most all price/performance benchmarks as well as several total performance benchmarks. SAS supports SQL Server as a data repository and SAS Enterprise Guide can also be used to view SQL Server Analysis Services OLAP cubes. SAS also recently accepted Microsoft (and Hyperion’s) invitation to co-chair the “XML for Analysis Committee. This committee is charged with mapping out the specifications for XML for Analysis for both OLAP and data

mining which will help make it easier to integrate business intelligence applications using XML.

- **BizTalk Server 2002**

Biztalk Server 2002 provides a gateway for exchanging XML documents between different applications and organizations for e-business (B2B, B2C). BizTalk 2002 is among the first of the .NET Servers to incorporate some of the actual .NET infrastructure. SAS can support BizTalk by reading and writing MSMQ packets to the BizTalk queue.

- **SharePoint Server**

SharePoint Server is both a portal server and a collaboration server. SAS currently supports SharePoint via the WebDAV (Web Distribution, Authoring, Versioning) protocol. Additionally, SAS output can be encapsulated into web parts for use with SharePoint's digital dashboard.

Other .NET Servers include Application Center 2000, Host Integration Server 2000, Mobile Information Server 2000, ISA Server 2000, Content Management Server and Commerce Server 2000. Most of these are not likely to be of direct interest to SAS users and additional information on them is available from the authors or on the Microsoft web site.

.NET MY SERVICES (HAILSTORM)

Another component of the .NET vision is the cleverly titled ".NET My Services". .NET My Services includes products like Microsoft Passport and "MyAlerts". They are componentized web applications that provide a service such as authentication or weather/travel/etc. alerts. .NET My Services is oriented to home/consumer use. Microsoft has announced a commercial/business version of this vision code named "Blizzard" though few details have been announced.

IMPACT OF .NET

A year ago, it was too soon to determine the impact of the .NET strategy in the marketplace. However, in the past year, the impact has become apparent as most every software vendor has announced or launched some sort of web services strategy (e.g. SunOne, WebSphere) and many analysts and industry spokesman proclaiming that web services will have a drastically more significant impact than the world wide web has had.

SAS can support web services today (reference paper presented by Dan Jahn of SAS and the SAS/ABC Technologies products) and through projects like the XML for Analysis committee and numerous discussions with Microsoft and other vendors, SAS is exploring additional ways of integrating with and supporting web services.

STATE OF THE ART: 32-BIT AND 64-BIT PROCESSORS

This past year saw continued improvements in processor speed with current processor speeds at 2 GHz (and rising) and the introduction of the Intel Itanium Processor Family of 64-bit processors.

For the Intel-based IA-32 family of processors, the Pentium 4 processor and Xeon processors are now available. The Pentium 4 processor provides the highest throughput levels in PC desktops. Xeon (Pentium 4-based) processors, used in servers only, include a memory-addressing mode that allows use of more than 4GB of memory, which is the typical limit for 32-bit computers. This mode, which actually uses 36-bits of addressability instead of the otherwise standard 32-bits, raises total memory availability from 4GB (2^{32}) to 64GB (2^{36}). Version 8 of the SAS System takes advantage of this capability though its support for ESMA (Extended Server Memory Architecture). This architecture allows an application to utilize more memory than the Windows NT operating system is capable of accessing via an Intel-supplied driver program.

Windows 2000 Advanced Server and Datacenter Server platforms also take advantage of this capability natively using Intel's Physical Addressing Extensions (PAE), which is similar to ESMA but much more integrated into normal operating system operation. PAE is a 32-bit only feature since it is tied to Intel 32-bit CPUs. Intel 64-bit CPUs don't have this same limitation since they have larger registers. PAE memory allows applications to utilize memory beyond the 4GB address space currently available to most Windows 2000 based programs. Windows 2000 Advanced Server is limited to 8GB, and Windows 2000 Datacenter server is limited to 64 GB. Even with PAE enabled, the underlying architecture of the system is still based on 32-bit linear addresses. This effectively retains the 2 GB of application space and 2 GB of kernel mode space because only 4 GB of addresses are available. However, multiple processes can immediately benefit from the increased RAM since they are less likely to encounter physical memory restrictions and begin paging. Additionally, applications can be modified to use the AWE API to allocate memory outside of the applications process space, bypassing the 2 GB limit for applications. SAS version 9 will be adding support for PAE on 32 bit platforms.

Last year, Intel began volume shipments of the new 64-bit Itanium processors. Later this year, the McKinley version of Itanium will be introduced, offering much more powerful 64-bit capabilities. As part of the SAS-Intel partnership, SAS is working closely with Intel in the SAS-Intel Advanced Research Center (SIRC), a joint development laboratory at SAS' Cary headquarters, to ensure that SAS version 9 and future versions of SAS features will exploit the features of the Itanium family. This lab provides Intel with the understanding needed in designing its next generation of processors for demanding applications like SAS for maximum performance and functionality.

SAS will continue to support IA-32 compatible processors from AMD.

More on Itanium Processor Family

SAS views the Itanium Processor Family of 64-bit Intel processors as very significant because of the vastly increased scalability it will allow for truly high-end applications. While ESMA and EMA provide some scalability improvement on 32-bit platforms, 64-bit processors and operating systems can provide dramatic performance improvements. With 64-bit addressing, memory can be addressed up to 2^{64} (or 18,446,744,073,709,551,616) bytes, opening the door to more sophisticated algorithms that can benefit from the vast memory space. Not only can SAS users run more sophisticated algorithms but SAS users can also load more data into memory delivering on the ability to support "in memory databases" for significantly faster analytics.

Itanium also includes hardware compatibility with IA-32 software and new throughput enhancements. These enhancements include:

- Ability to execute multiple instruction sequences concurrently, which is called Instruction Level Parallelism, effectively multiplying throughput by the parallelism factor.
- Larger set of processor registers allowing higher degrees of algorithm optimization.
- Instruction predication to facilitate a more consistently busy processor. Using predication, multiple code sequences can execute in "what-if" scenarios whose outcome only later becomes known.
- Improved floating point performance to speed typical mathematical operations, of which SAS applications are typically comprised.
- Speculative data loading to request data early and execute programs as if the data were retrieved in a timely fashion. Again, this is another form of "what-if" processing that allows the processor to

remain busy and ready for multiple eventualities.

Last summer, SAS was the first software company to demonstrate an application running on a 32-way, 64-bit system. Using a Unisys ES7000, with 32 Itanium processors, SAS successfully demonstrated SAS WebHound and SAS/Insight at the Intel Developer Forum.

AMD will introduce an x86-64 processor for 64-bit computing that uses a different architecture design that is not compatible with the Intel IA-64 design. SAS has not announced any plans to test SAS or support SAS on this AMD x86-64 architecture.

Choosing 32-bit or 64-bit Systems

While there can be significant benefits provided by 64-bit computing, many users of SAS software will likely continue to utilize 32-bit computing platforms for a variety of reasons:

- Some applications won't need the vastly improved memory scalability to perform their basic tasks.
- Performance of 64-bit Itanium systems might not be significantly different from then-current 32-bit processors for applications in which scalability isn't a concern.
- 32-bit systems will continue to evolve and remain attractive due to performance and feature improvements.
- Although SAS products will 64-bit with version 9, other companies' software packages may remain 32-bit. The premium price of a 64-bit PC may not be easily justified, even if that PC can run 32-bit applications well.
- Later generations of the IA-64 family (code named McKinley, Madison, and Deerfield, listed here in the expected delivery order) should demonstrate large improvements over Itanium. In some cases, initial Itanium performance may not be significantly different from IA-32 processors for many applications.

Intel is committed to continuing development of both 32-bit and 64-bit systems. This will lead to a wider range of choices for SAS software users and improved price/performance on Intel-based systems.

SAS is committed to taking full advantage of Intel's design features in both the IA-32 and IA-64 product lines. Microsoft's current plans are to support Itanium with the Whistler release. Initial support is expected to be for desktop versions of Whistler in late 1H01 with support for server systems in 2H01.

NEW SYSTEM PRODUCTS

In the past year Windows-based Intel systems have demonstrated that they can now deliver mainframe-class performance, scalability and reliability. Unisys has been shipping its ES7000 32-way Windows/Intel system for well over a year with very positive results. At least one other vendor has announced a greater than 8-way system and others have announced landmark new computer systems that attempt to exploit these new processor and operating system features.

CONCLUSION

The major changes with Microsoft in the past year have been the introduction of Windows XP and Visual Studio .NET along with the further fleshing out of the .NET vision. In the next year, the release of the Windows.NET Servers, with broad support for 64-bit computing will provide a significant opportunity for SAS users.

SAS users need to be sure to remain relatively current on Windows technology, especially given that Microsoft has stopped support for Windows 95 and Windows 98 and that SAS version 9 will not be supported on Windows 95, Windows 98 or Windows Me.

SAS is continuing to increase our investments in our relationships with Intel and Microsoft to provide a highly optimized SAS solution for the Windows and Intel platform.

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