

# HP User Society IT-Symposium 2006

3A03



Windows 64bit (X64, Opteron, Itanium)

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## Agenda



- 64-bit Architecture
  - Positioning 64-bit architecture
  - Compatibility and Interoperability
  - Security enhancements
- Windows x64-bit usage benefits
  - Active Directory
  - Terminal Server
  - SQL Server
- Application Support, Development and Tools



## Introduction



- Microsoft is strongly committed to 64-bit computing by developing 64-bit versions of its software products
- Supported 64-bit architectures
  - Intel® Itanium® Processor Family (IPF) – available since 2001
  - Windows 2003 SP1 - X64 Processors
    - AMD Opteron™
    - Intel® EM64T
  - Windows XP Professional x64 Edition
    - AMD Athlon64 XP
    - Intel® EM64T

	Technical Benefits	Business Benefits
Developer Audience	<ul style="list-style-type: none"><li>• Eliminates the 4GB memory barrier inherent in 32-bit systems</li><li>• Same familiar Microsoft® Windows® environment</li></ul>	<ul style="list-style-type: none"><li>• Speeds Time to Market</li><li>• Leverages existing Windows development skills</li></ul>
IT Pro Audience	<ul style="list-style-type: none"><li>• Improves Reliability and Availability</li><li>• Improves Performance and Scalability</li><li>• Same familiar Windows environment</li></ul>	<ul style="list-style-type: none"><li>• Reduces the number of systems you need to manage</li><li>• Reduces Total Cost of Ownership (TCO)</li><li>• Leverages existing Windows administration skills</li></ul>

## Will Code Run Faster on 64-bit?



- Maybe... Depends on a lot of factors
  - Is memory a bottleneck?
  - Is the application CPU bounded ?
  - Are there pointers in the working set data?
  - Is it instruction cache bound?
  - Is it floating point intensive?
  - Does the application use exceptions for control flow?

- **CISC**  
Complex Instruction Set Computing is the instruction set architecture used on x86 processors
- **AMD64**  
“Hammer” family of AMD 64-bit capable x86 processors. Includes Opteron and Athlon64 processors. Uses an extended form of CISC.
- **EM64T (Extended Memory 64 Technology)**  
“Pentium 4” family of Intel 64-bit capable x86 processors. Includes Xeon and Pentium 4 processors. Uses an extended form of CISC.
- **x64**  
Microsoft acronym for processors capable of running Windows 64-bit for Extended Systems. Both AMD64 and EM64T processors are members of this family.
- **EPIC**  
Explicitly Parallel Instruction Computing is a instruction set architecture co-developed by Intel and Hewlett Packard for Itanium processors. CISC incompatible
- **IA64**  
Intel Architecture 64-bit. The “Itanium” family of Intel 64-bit processors. Processor generations include Itanium I, and Itanium II. Uses the EPIC instruction set architecture.
- **IA32**  
Intel Architecture 32-bit. Common slang for “legacy” x86 processors

## Supported Architectures



### x64

(64-bit Extensions)

- Based on 64-bit extensions to the x86 instruction set
- Lets customers take advantage of their investment in 32-bit Windows applications, while also powering the latest 64-bit technology

### IPF

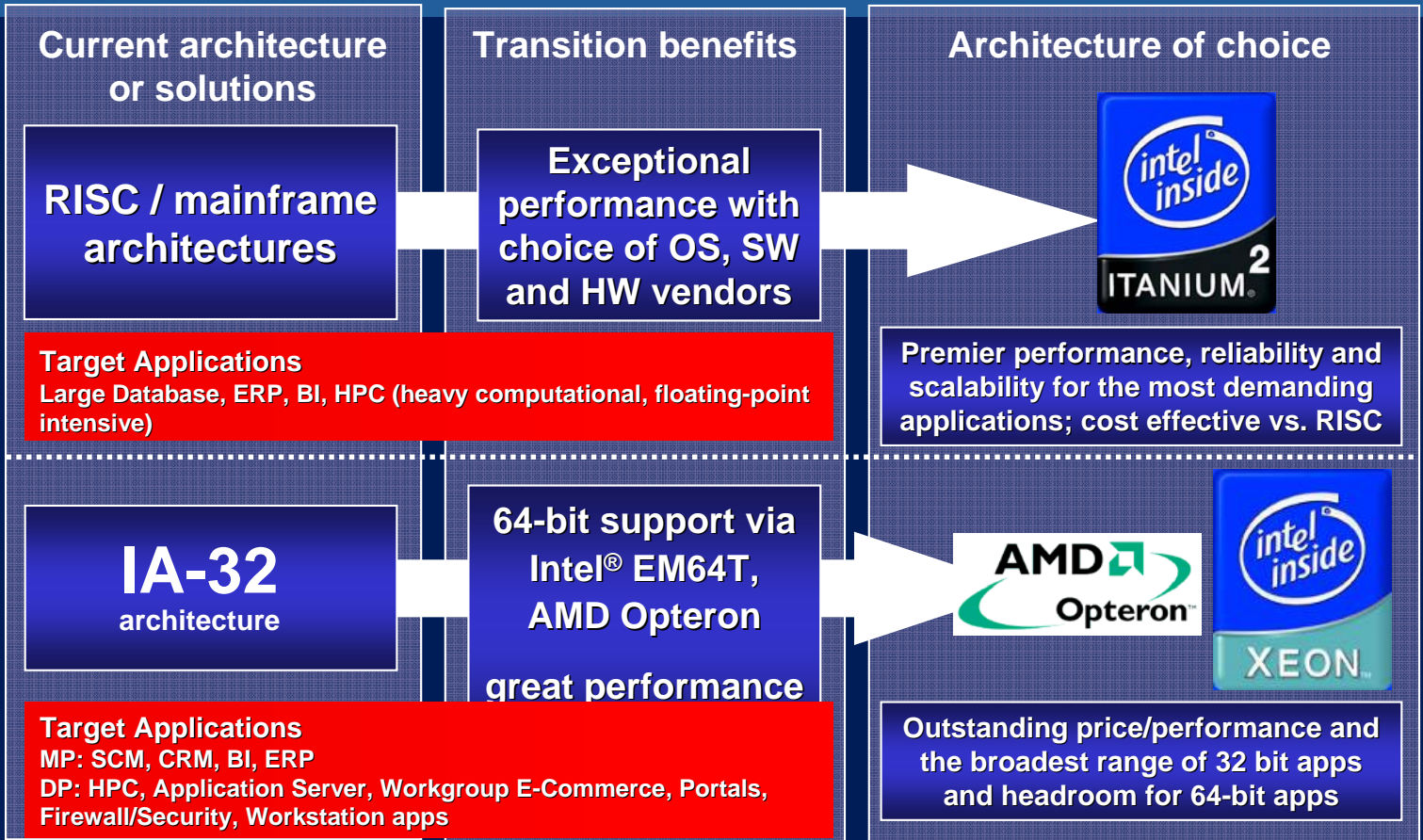
(Intel® Itanium® Processor Family)

- Based on Explicitly Parallel Instruction Computing (EPIC) architecture.
- Gives customers the highest levels of scalability on the Windows platform delivering a cost-effective alternative to RISC architectures

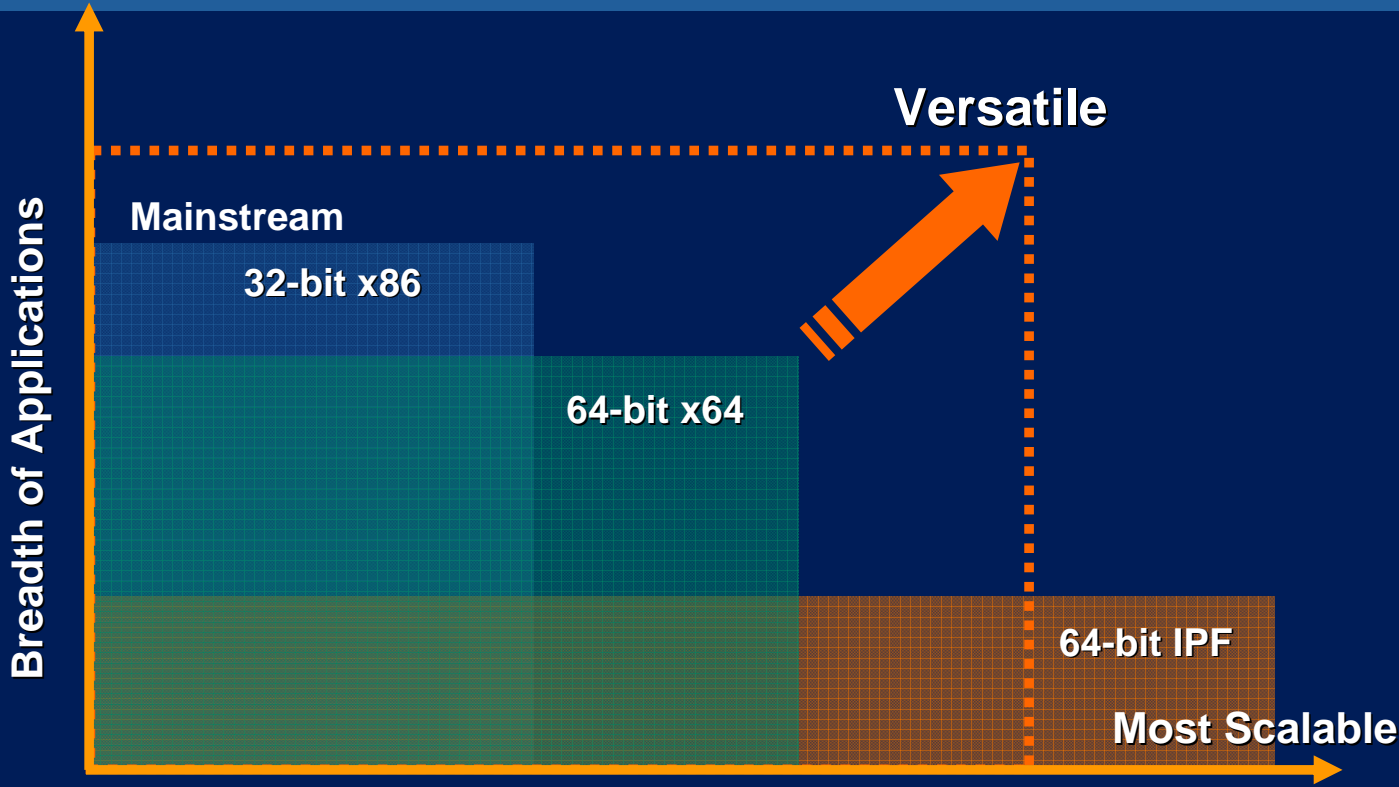
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Check that I can show the logos

Autor; 07.10.2004



# Platform Positioning



Microsoft Product	32-bit	64-bit	
	x86	IPF	x64
Windows® XP Professional x64 Edition			✓
Windows Server™ 2003 Web Edition	✓		
Windows Server™ 2003 Standard Edition	✓		✓
Windows Server™ 2003 Enterprise Edition	✓	✓	✓
Windows Server™ 2003 Datacenter Edition	✓	✓	✓
Microsoft® .NET Framework	✓	✓	✓
Microsoft® SQL 2000 Server™	✓	✓	✓

✓ Available now

✓ New with Windows 2003 SP1

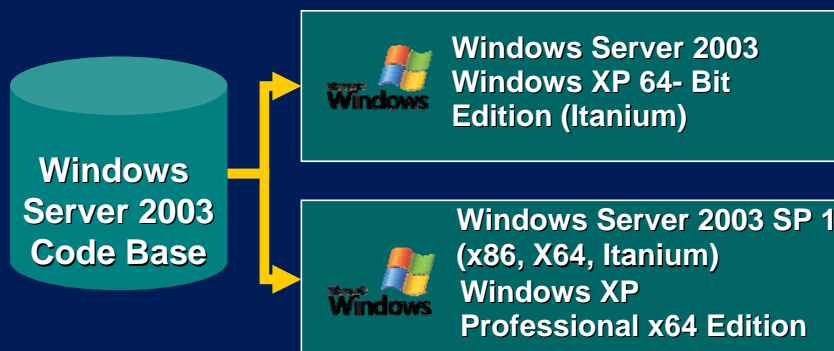
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## Source Code Bases



- Windows now supports three architectures: x86, x64 and Itanium
- All binary versions of Windows for a given release are created from the same source base that follows cross-platform coding rules and is compiled to a specific instruction set
- Does not mean that each binary version has the same features
- A single binary version of Windows for x64 supports both AMD's AMD64 and Intel's EM64T architectures



Released March 2003

32-Bit – Windows Server 2003 (Web, STD, ENT, DTC)

64-Bit – Windows Server 2003 (ENT, DTC) Windows XP 64-Bit Edition v2003; all for Itanium 1, Itanium 2 and greater

Released March 2005

32-bit – Service Pack 1 for 2003 releases  
64-bit – Service Pack 1 for 2003 releases and full releases of Windows Server 2003 (STD, ENT, DTC) x64 Editions and Windows XP Professional x64 Edition

General Memory Limits	32-bit	64-bit
Total Virtual Address Space	4 GB	16 TB
Virtual Address Space per 32-bit process	2GB (3 GB if system is booted with /3gb switch)	4GB if compiled with /LARGEADDRESSAWARE 2GB otherwise
Virtual Address Space per 64-bit process	Not applicable	8 TB
Paged Pool	470 MB	128 GB
Non-Paged Pool	256 MB	128 GB
System Cache	1 GB	1 TB
Physical Memory and CPU Limits	32-bit	64-bit
Windows XP Professional	4 GB / 1-2 CPUs	32 GB / 1-2 CPUs
Windows Server 2003 Standard Edition	4 GB / 1-4 CPUs	32 GB / 1-4 CPUs
Windows Server 2003 Enterprise Edition	64 GB / 1-8 CPUs	1 TB / 1-8 CPUs
Windows Server 2003 Datacenter Edition	64 GB / 1-32 CPUs	1 TB / 1-64 CPUs

## Features in Windows XP Professional x64 Edition



Several features unavailable in previous 64-bit Windows XP releases are included in the Windows XP for x64 release

- Windows Firewall
- Windows Security Center
- DVD video playback (requires third party drivers as with 32-bit Windows XP)
- Windows Media Player
- NetMeeting®
- Fax
- Movie Maker
- Windows Messenger
- MSN® Internet Access client
- ZIP Folders
- Support for .NET Framework
- cc\_NUMA support
- Fast User Switching
- Remote Assistance
- File and Settings Transfer Wizard
- Search Companion
- Open GL
- DirectX® 9
- Themes
- Power Management equivalent to 32-bit XP
- System Restore
- Windows XP Tour
- Home Networking
- Bluetooth



Some features previously unavailable in 64-bit Windows Server are included with the new 64-bit x64 server product

- Windows Media Server
- Fax Server
- cc\_NUMA support



## Features not supported in any 64-bit Windows

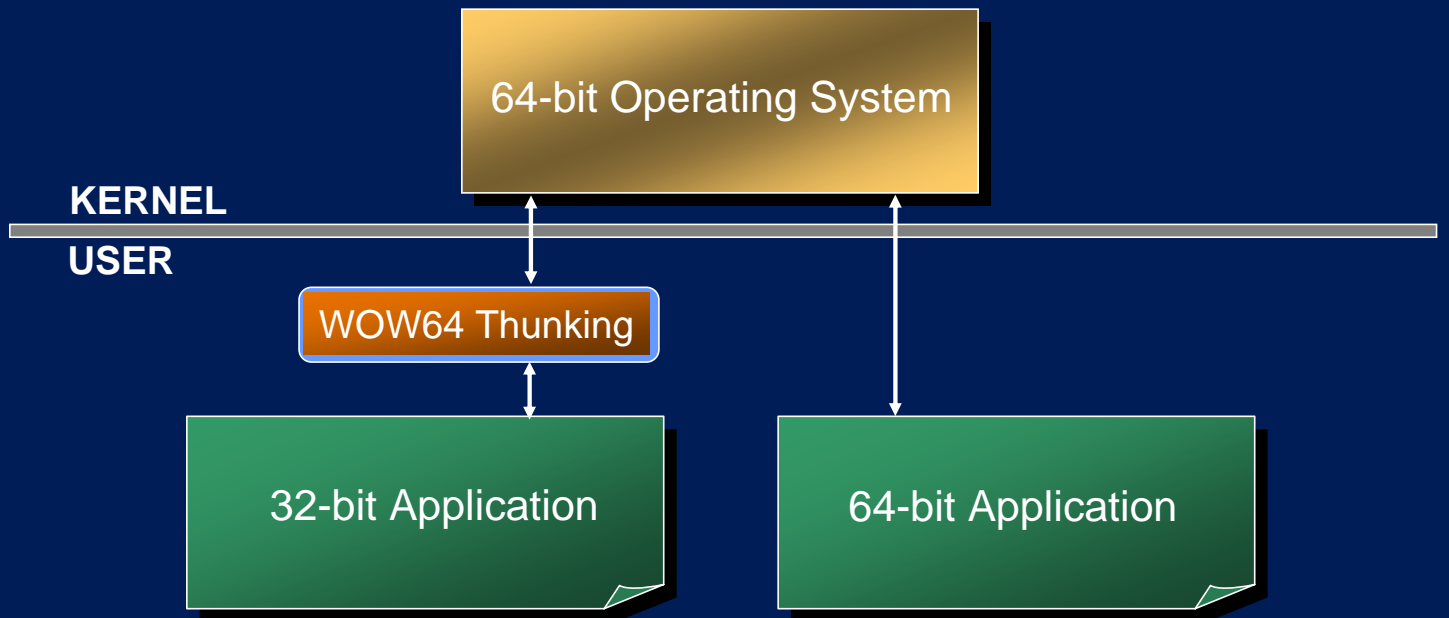
- Subsystems
  - DOS, OS/2, 16-bit and Portable Operating System Interface for UNIX (POSIX)
- Legacy transport protocols
  - IPX/SPX LAN and WAN
  - Client Service for NetWare
  - Services for Macintosh
  - NetBIOS Extended User Interface (NetBEUI)
  - Open Shortest Path First (OSPF)
  - Simple Network Management Protocol (SNMP) over IPX/SPX

- 32-bit Windows code runs through WoW64
- 32-bit drivers must be ported
  - All drivers must be 64-bit; 32-bit drivers will not load
  - Issues with applications that require 32-bit file system filter drivers or other kernel-mode drivers (Anti-Virus, etc...)
- 32-bit processes can NOT load 64-bit DLLs
- No support for DOS, 16-bit, POSIX, or OS/2 apps
  - Special case : Handling of major 16-bit installers
- Windows 2003 SP1 adds support for
  - Running 32-bit ASP pages
  - .NET Framework 1.1 (VS 2003) and 2.0 (VS 2005)
    - Managed code support & run managed ASP.NET
  - Visual Studio .NET 2003
- 4 GB VA space if built as “large\_address\_aware”
  - PAE support for applications using AWE - x64 only

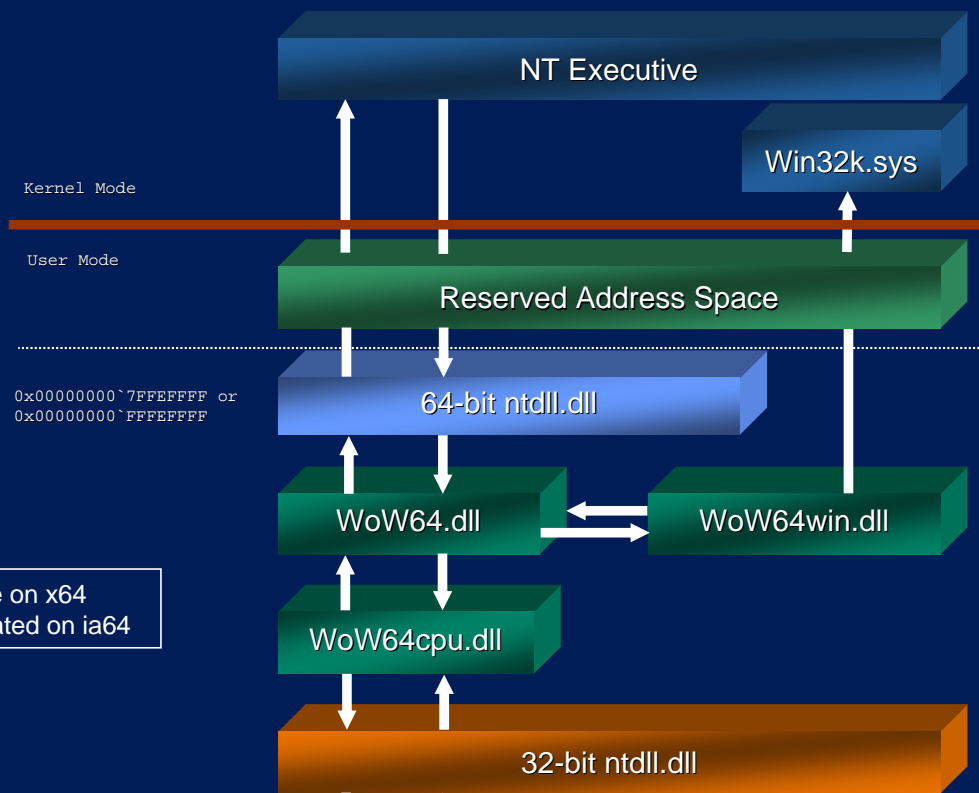
## What Is WoW64?



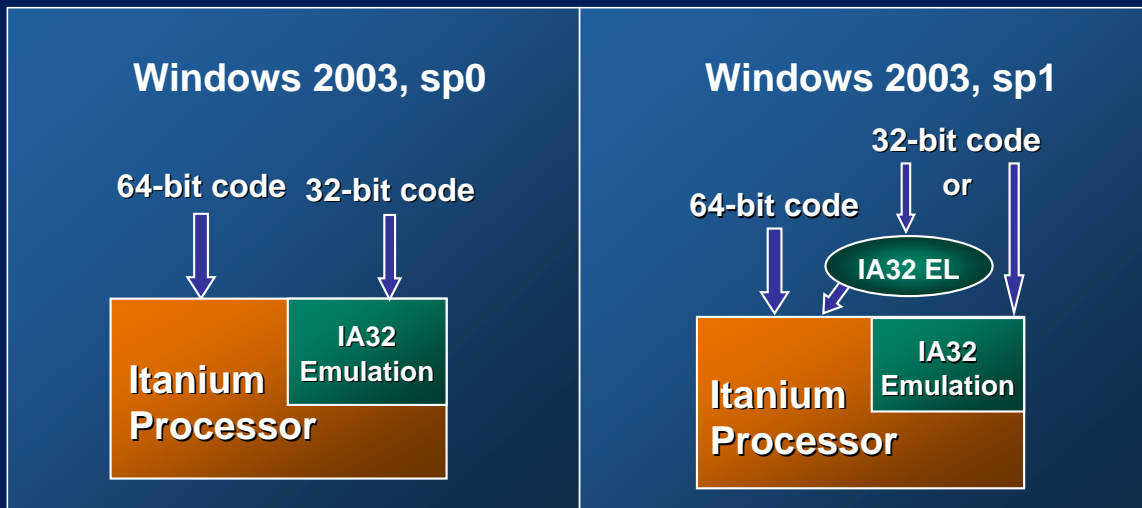
- 32-bit Windows emulation layer on 64-bit Windows
- Installed as part of 64-bit Windows
- Windows installs 64-bit and 32-bit system files
  - 32-bit system files copied to %windir%\sysWow64
  - %SystemDrive%\Program Files (x86) created for 32-bit applications
- Environment variables are duplicated
  - ProgramFiles and ProgramFiles(x86)
  - CommonProgramFiles and CommonProgramFiles(x86)



# Application Execution:



x86 instructions are native on x64  
 x86 instructions are emulated on ia64

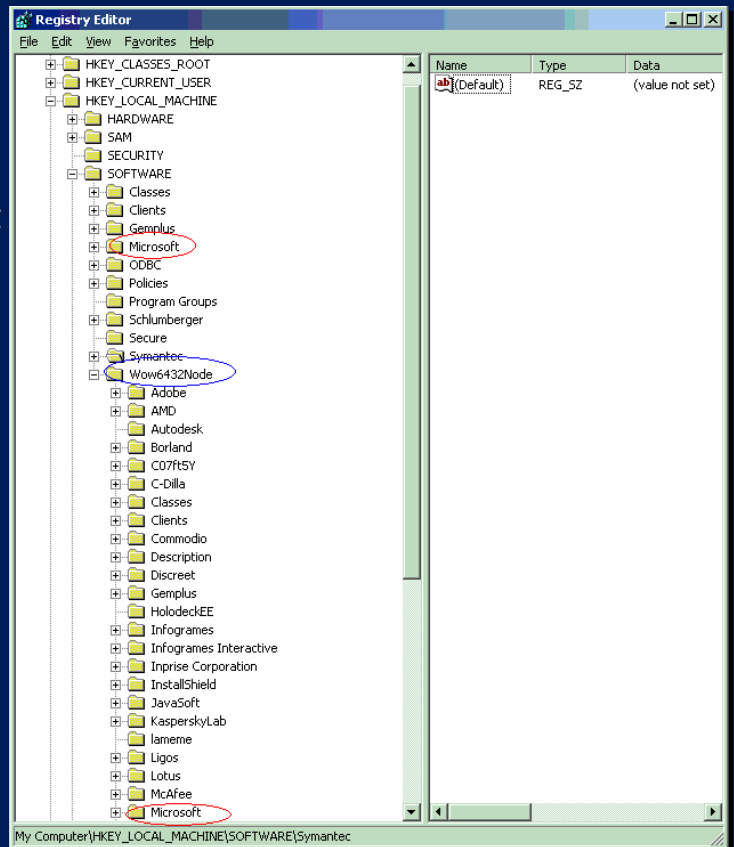


## WoW64 Registry Redirection



- Two views of the registry exist: 64-bit and WoW64
- 64-bit applications see the 64-bit view and WoW64 applications see the WoW64 view
- Why different WoW64 registry views?
  - Compatibility
    - Separates 32-bit application state from 64-bit state
      - For example: Unsupported features stored in the registry
    - Provides a safe execution environment for both 32-bit and 64-bit applications
      - For example: A registry value hosting a DLL path

- Certain parts of the registry are separated
  - HKEY\_LOCAL\_MACHINE\Software
  - HKEY\_CLASSES\_ROOT
- WoW6432Node is created for the 32-bit view
- WoW64 processes are transparently redirected



## WoW64 Registry Reflection








- Enables 64-bit and 32-bit application inter-op through COM
- Mirrors certain registry keys and values between the 32-bit and 64-bit registry views
- Happens in real-time
- Reflected keys are
  - HKEY\_LOCAL\_MACHINE\Software\Classes
  - HKEY\_LOCAL\_MACHINE\Software\Ole
  - HKEY\_LOCAL\_MACHINE\Software\Rpc
  - HKEY\_LOCAL\_MACHINE\Software\COM3
  - HKEY\_LOCAL\_MACHINE\Software\EventSystem
- Ownership-based reflection
  - Helps intelligent reflection of COM servers

- Redirects file-level access from %windir%\system32 to %windir%\syswow64
  - Many 32-bit Windows applications hard-code %windir%\system32
  - 32-bit applications that open or create files under %windir%\system32\... are automatically redirected to %windir%\syswow64\...
  - Helps side-by-side system files installation and compatibility
- Some directories are exempted from redirection
  - Don't contain bitness-sensitive data
    - %windir%\system32\spool
    - %windir%\system32\catroot
    - %windir%\system32\catroot2
    - %windir%\system32\drivers\etc

## Compatibility and Interoperability



<b>32-bit Application</b>	<b>32-bit Application</b>	<b>64-bit Application</b>
<b>32-bit Windows</b> 	<b>64-bit Windows</b> 	<b>64-bit Windows</b> 
<b>32-bit Drivers</b>	<b>64-bit Drivers</b> 	<b>64-bit Drivers</b> 
<b>Devices</b>	<b>Devices</b>	<b>Devices</b>
<b>x86</b>	<b>x64 and Itanium</b>	

Application	x64 Support	Itanium Support
SQL Server 2000 SP4 (64-bit Itanium version released in 2003)	Yes	No
Visual Studio .NET version 2003	Yes	Yes
Visual Studio 2005 ("Whidbey")	Yes	Yes
Exchange Server (all 32-bit versions)	No	No
Microsoft Business Solutions Navision	Yes	Yes
Microsoft Operations Manager 2005 (32-bit MOM manages 64-bit systems with included 64-bit agent)	Yes	Yes
Microsoft Systems Management Server 2003 (SMS client agent and MMC console are working on x64)	No	No
Virtual PC 2004 (evaluating 32-bit support under WOW64 for SP2)	No	No
Virtual Server 2005 SP1 (32 bit guest Virtual Machines)	Yes	No
Microsoft Office 2003, Microsoft Office XP, Project, Visio	Yes	Yes
Microsoft Encarta	Yes	Yes
Microsoft Flight Simulator; Age of Mythology; Age of Empires	Yes	Yes
Microsoft Digital Image Suite	Yes	Yes
Microsoft Streets	Yes	Yes
Microsoft Plus!; Microsoft Plus! Digital Media Edition	Yes	Yes

## Security enhancements



- **Data Execution Prevention (DEP)**
  - Set of hardware (NX) and software technologies that perform additional checks on memory to help protect against malicious code exploits.
- **Kernel patch protection (x64)**
  - Modifying IDT, GDT, System Service Tables, process and thread structures is illegal
    - One of the mechanisms used by Rootkits on Windows x86 platform
    - Enforced on X64 platforms, results in a bugcheck

## “First mover” Workloads: Preliminary Testing

- Key value
  - Extends return on investment in 32-bit applications
  - Provides evolutionary path to 64-bit technology with greater price-performance
- Single code-base
  - AMD-Opteron, Intel Xeon EM64T supported with one product
- Impact
  - Runs most existing 32-bit apps with increased performance
  - 64-bit app platform for best performance & scalability
  - Eliminates Virtual Memory limitations in 32-bit

Workload	Performance and Scale
32-bit Database	up 17%
32-bit Business Apps	SAP 10% more users
Networking	Record 7Gbit/sec xfer
File	111% higher user capacity
Active Directory	2x higher throughput
Terminal Services	50% more Users

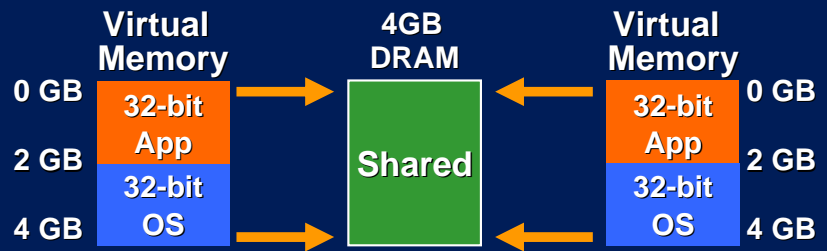
# Windows® for x64-based Systems

Why the 64-bit Operating System Benefits 32-bit Applications



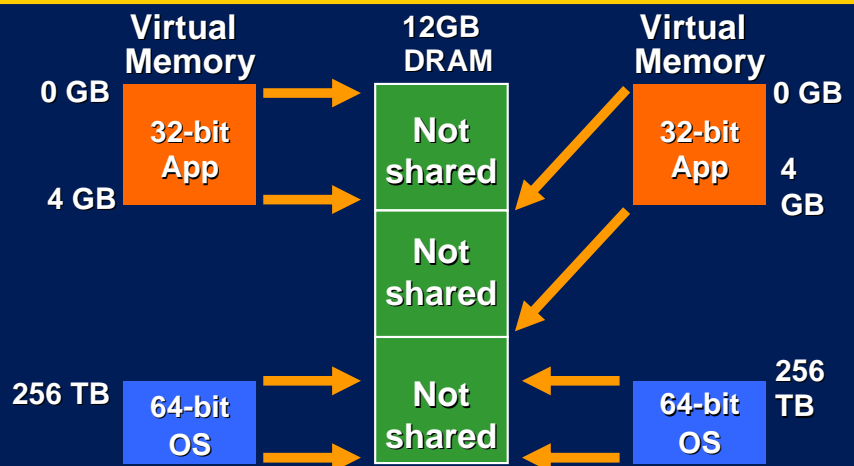
### 32-bit x86 system

- Operating system and applications share virtual and physical memory
- Results in a lot of paging of info in and out of memory
- Limits the size of files and datasets



### x64-based System

- Operating system uses Virtual Memory space outside range of 32-bits
- Application has exclusive use of virtual memory space
- Operating system can allocate each application dedicated portions of physical memory
- Reduces the amount of paging



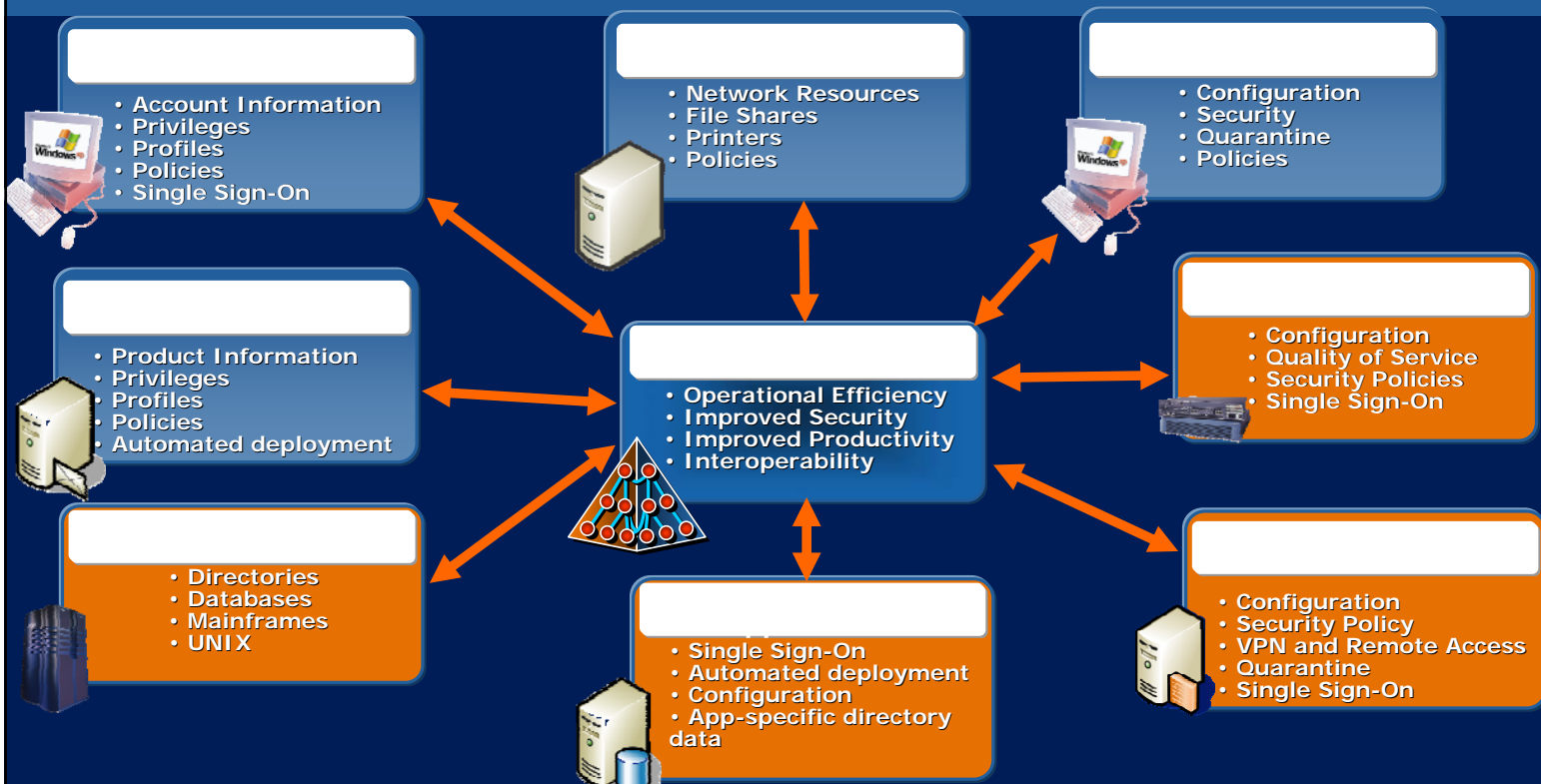




On Windows Server x64

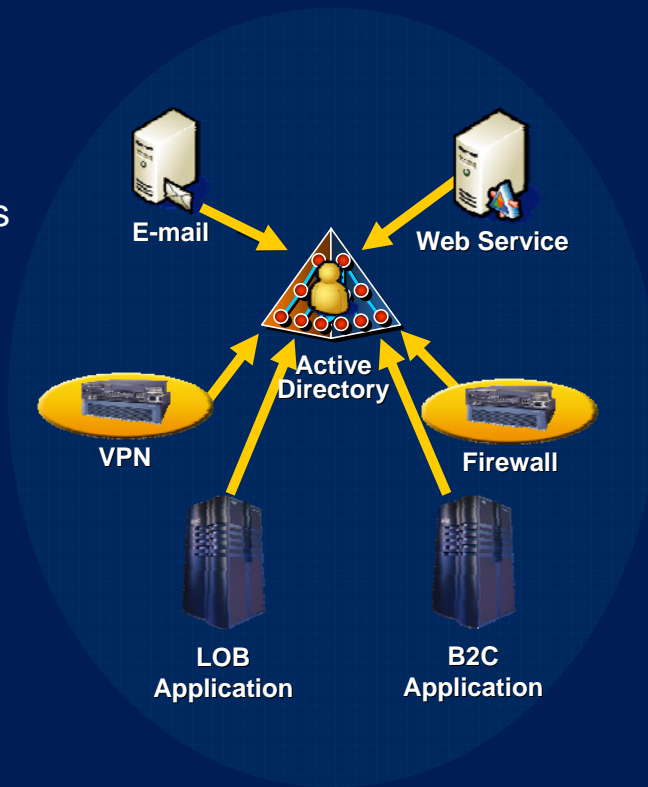
# The Role of Active Directory

Foundation for Identity and Access Management



• Focal-point for network and user management

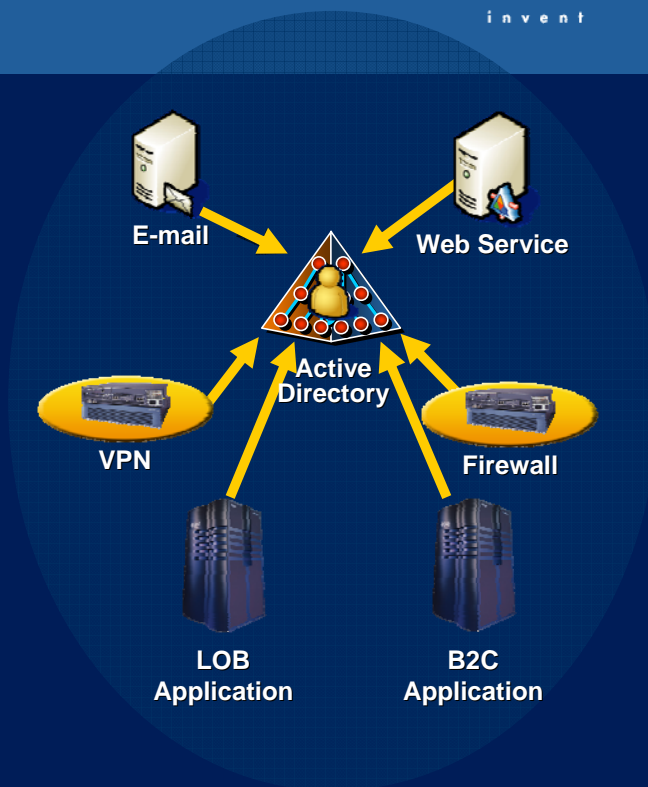
- Consolidate Domains & Servers
  - No limitation on number of users
  - Improved Active Directory scalability hardware = less
  - Reduce the number of domains
- 64-bit enables a customer to further reduce the physical number of Active Directory DCs and GCs
  - Don't forget general redundancy guidelines!



Online Business Enablement and 64-Bit  
Further Scale-up Capabilities



- Scale to millions of users with even less hardware
- Open the memory floodgates
- Third-party 32-bit s/w (on a 32-bit machine will work against a 64-bit DC/GC with no changes
- Ask your third- party ISVs about supporting 64-bit h/w directly



- Do you have enough memory? Are you using the /3GB switch?
- Have you managed disk I/O and load?
- Are you managing performance counters – especially in Exchange?
- Have you analyzed your directory-enabled applications?
  - Efficient search queries?
  - Built correctly?
  - Analyzed placement: ADAM or Active Directory?

## When Should You Think About Deploying Active Directory on 64-Bit Machines?



- Scaling-out stops being effective
- You have Exchange 2000 or Exchange 2003 and e-mail queues are building up
- Your NTDS.DIT file on your DC is >3Gb
- You need to deploy a DC for e-commerce
- When you do a routine h/w upgrade

- Easy to integrate in a 32-bit environment
  - 64-bit and 32-bit Active Directory DCs or GCs co-exist
  - Mix & match in your environment as needed
- Operationally equivalent
  - Backup/restore from 32->64-bit & 64->32-bit
  - MMC and other operations equivalent
- Challenges at the hardware level
  - Do you have 64-bit h/w drivers?
  - Does your A/V software run on 64-bit?

## Terminal Server



## Benefits of Terminal Server

- Centralized access to applications
  - Rapid deployment
  - Centralized updates and support
  - Data security
- Better low-bandwidth performance
  - Remote access
  - Better user experience
  - Minimize networking costs
- Extend Windows to any device
  - Legacy desktops
  - Non-PC desktops (WBT, Mac, UNIX)
  - Lightweight devices (PDA, etc)

## Common Uses

- Remote access to client/server apps
- Branch office access to applications
- LOB application deployment
  - Frequently updated apps
- Structured task worker solutions
- IT as a 'Service'
  - Hosted applications
- Bridge the gap to .NET and Web apps
  - Web-enable legacy Win32 apps

## What we hear from customers



- I would like to support more users per server
- CPU utilization is low on my Terminal Servers
- I want reduce the number of servers
- I want to use servers with more processors

- 32-bit systems
  - Servers often run out of kernel virtual memory rather than CPU
    - All applications must share the same 2 GB kernel address space
    - Adding RAM does not help
  - Most customers run 1P and 2P servers
    - Administrators must deploy and manage many servers
    - Reduces effectiveness of server consolidation
- IA64 systems
  - Incremental users/server outweighed by cost



## Issues with TS Scalability (2)

- Issues with 32-bit and IA64 result in:
  - Large farms of 1P and 2P servers
  - High power and cooling requirements
  - Under-utilized hardware (CPU)
  - Inability to scale up into larger multi-processor systems

- Windows on Windows 64 (WoW64)
- Isolates 32-bit Applications on a 64-bit machine
  - Notably file and registry isolation
- Performance hit?
  - Substantial on Itanium
  - Little to none on x64 !!!

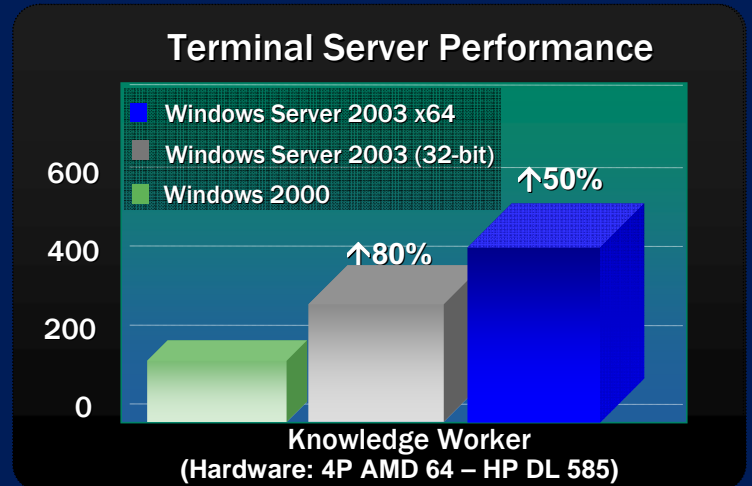
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Windows Server 2003 Datacenter Edition	64 GB / 1-32 CPUs	1 TB / 1-64 CPUs

- Lab testing indicates increased performance
  - Up to 50% improvement in users/server on comparable hardware
  - Knowledge worker simulation
- Largest benefit will be with 4P servers in limited virtual kernel memory scenarios
  - Opportunity for server consolidation

- Registry Setting to Reduce Microsoft® Outlook® 2003 Periodic Polling
  - HKEY\_CURRENT\_USER\Software\Microsoft\Office\11.0\Outlook\RPCConnManagerPoll [dword] 0x600



## Other Benefits



- Fully utilize CPU resources without rewriting applications
- Run 64-bit and 32-bit applications side by side
- Gradually migrate applications
- Increased user density





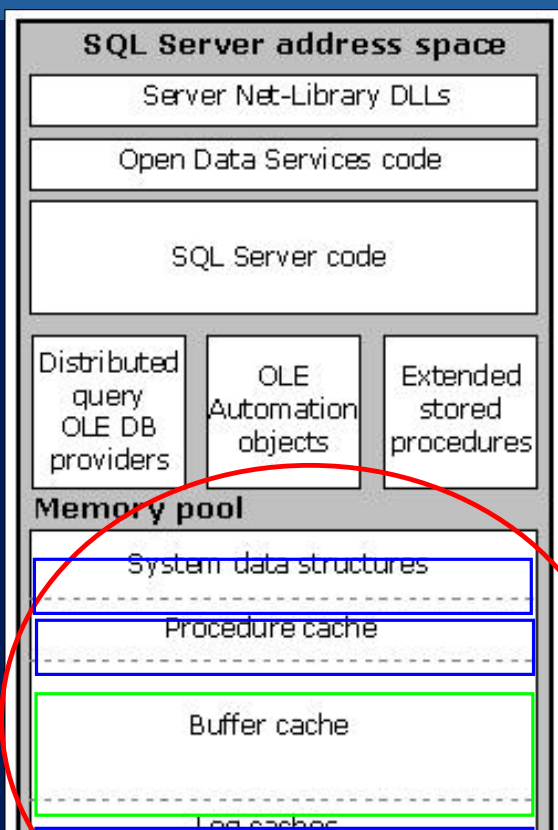
## What is 64-bit SQL Server?



- Same codebase as SQL Server 2000 (off SP3)
- All pointer types are now 64 bit
  - Good news: Lots of virtual memory
- Flat memory addressing to 512GB of RAM
  - Does NOT require AWE support, massive cache useable by all components of SQL: Stored proc, OLAP, sort area... etc.
- Massive Scale-up support
  - 64-way HP, 32-way NEC, 16-way Unisys
  - Until recently MSFT held fastest TPC number
- Easy Database Migration & Integration
  - Detach/Attach, Log shipping, Replication etc.
- 8-node Fail-over clustering support

- Some non-engine SQL components are *not currently supported* on 64-bit:
  - Data Transformation Services\*
  - Graphical Admin Tools
  - Reporting Services
  - Notification Services
  - SQL Mail
  - English query
  - These require a 32-bit supporting instance to host
- Trade off between high processor speed vs. flat memory and scale-up (1.6Ghz vs. 3.2Ghz)
  - Price/performance and full software suite support

## SQL 64-bit address space



- Flat address space
- Applies to all memory structures
  - Procedure cache
  - Data structures
    - Locks
  - Buffer pool
    - Sorts, joins
  - User connections
- DB Page Buffers need not undergo AWE map/unmap

Table	Tot Rows	Data Size(MB)	Index Size (MB)
ORDERS	48,223,600	6,188.32	2,781.53
CUSTOMER	121,303	14.18	4.14
PAYMENT	130,414	11.52	3.21
TOTAL	48,475,317	6,214.02	2,788.88

Re-select data which is already memory-resident

CPU's	64 bit		64-bit Faster by		32 bit	
	CPU Time	Elapsed Time	CPU Time	Elapsed Time	CPU Time	Elapsed Time
16-way	36,120	2,994	2.07	1.87	74,905	5,601
4-way	30,470	7,931	1.85	1.99	56,313	15,819

Query: select sum(Qty) from ORDERS



## Advantages Of Analysis Services (64-Bit)

- Not constrained by 3GB memory limit
  - Dimension memory + Shadow dimensions + Buffer space (partitions)
  - Cache fills remaining space
- Huge dimensions supported in memory
  - MOLAP dimensions are extremely large, but provide best query performance
- On x64 under the WOW64
  - Now have a FULL 4GB of

Dimension  
Memory

Shadow  
Dimensions

Processing  
Buffers

Available  
Cache

- More parallelism in partition processing is possible due to memory advantages
  - Each partition needs “working” memory
- Analysis Services can make use of huge memory available for **query cache and cube processing**
- Faster aggregation processing
  - Aggregations are built in memory during cube processing, **avoiding Temp Files**
- Very large file system cache speeds cube query operations

## Example: Analysis Services

OLAP Large Customer Dimension



- Transaction tracking to customer level – 3 Million key customers
- Migrated to 64-bit allowed support of the full customer dimension
- Memory also speeded data load and aggregation time by **factor of 10**
- Expanded size of customer dimension to **4.5 million**

## SQL Server 2000

- Native 64-bit for Itanium only <sup>1</sup>
  - RDBMS (EE only)
  - Analysis Services (EE Only)
- **NO** 64-bit Tool Support
- **NO** DTS or Reporting Services

## SQL Server 2005

- **All** Servers have native 64-bit engines for Itanium and x64
- Management Tools (GUI) runs in the WoW for 64-bit servers (**Extended Systems AND Itanium**)
  - This is the only WoW support for Itanium across all of SQL Server)

## SQL Server 2000 SP4

### 64-bit Support Matrix



### SQL Server 2000 SP4

	Mngmt. Tools	Database Engine	Integration Services	Analysis Services	Reporting Services
Extended Systems	WOW	WOW	WOW	WOW	WOW
Itanium	No	Yes	No	Yes	No

Extended Systems supports:  
AMD64 and EM64T

- All 32-bit servers will run in the WOW on Extended Systems in 64-bit Mode
- This requires Windows Server 2003 SP1 x64 Edition
- The 64-bit version, SQL Server 2000 Enterprise Edition (64-bit), still runs natively on Itanium hardware.
  - Only Database Engine and Analysis Services
  - SP4 is first Service Pack for SS2K EE (64-bit)

## 64-bit Support SQL Server 2005

	Mngmt. Tools	Database Engine	Integration Services	Analysis Services	Reporting Services
Extended Systems	WOW	Yes	Yes	Yes	Yes
Itanium	WOW	Yes	Yes	Yes	Yes

ALL server components in SQL Server 2005 have native 64-bit builds (Itanium and x64)

- All Server Products will have native 64-bit builds
- Management Tools will not be native 64-bit
  - 32-bit Mngmt. Tools will be supported running in the WoW on 64-bit Operating Systems
    - Will run in the WOW on both Extended Systems and Itanium

## Application Support, Development and Tools



Development Environment	Development platform			Target Platform	
	32-bit	IPF	x64	IPF	x64
<b>Command Line</b>					
MS Platform SDK	✓	☒	☒	✓	☑
<b>Visual Studio 6 w/Service Pack 5</b>					
MS Platform SDK	✓	✗	✗	✓	☑
Win2K3 Server SP1 + SDK	✓	✗	✓	✓	☑
<b>Visual Studio .NET 2003</b>					
MS Platform SDK	✓	✗	✗	✓	☑
Win 2K3 Server SP1 + SDK	✓	✗	✓	✓	☑
Visual Studio .NET 2005	✓	✓	✓	✓	✓

✓ Supported    ☑ Platform SDK SP1    ✗ Works – Not Supported    ☒ Not Available

A2

## Microsoft® Visual Studio® 2005



- Provides a 32-bit Integrated Development Environment (IDE)
  - Installs on 32-bit and 64-bit versions of Windows
  - Contains 64-bit tools and components such as the Microsoft® .NET Framework and Common Language Runtime
- x64 and Itanium at parity in this release including:
  - Visual Studio IDE for editing, building, and debugging 64-bit projects
  - Microsoft® C++® compilers targeting either x64 or Itanium (64-bit-hosted and cross-compilers)
  - Managed code generation which can be agnostic, 32-bit only, or 64-bit only
  - Support for MFC and ATL frameworks in 64bit environment
- Platform SDK

A2      Need the VS 2005 logo  
Autor; 14.10.2004



- Identify which applications need to be migrated
  - Testing for WOW64 might be enough
- Unmanaged C/C++<sup>®</sup>
  - comp
  - Cross compile and test on different platforms
- Managed
  - Pure managed should work without modification
  - Interop is the critical aspect

## Session Summary



- 64-bit computing is going mainstream with x64 architecture
  - Broad industry support
  - Excellent costs / performance & functionality ratio
  - Excellent Compatibility with 32bit apps
    - Watch out applications that have system drivers
    - Check support with your solution vendors
- Evaluate your needs
  - Terminal Server, Database application, AD
  - Others...

