64-bit Windows Comments

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- Some slides courtesy of Microsoft

Why 64-bit Windows?

- **Many server workloads are straining the limits of 32-bit x86 architecture**

- **Almost all new servers are shipping 64-bit capable systems**

- **Windows Server 2003/2008 x64 can run existing 32-bit applications**

- **New applications will be written for 64-bit only (for example: Exchange Server 2007)**

32-bit Architecture

- **4 GB address space**
  - 2 GB Kernel virtual address space
    - Shared across processes
  - 2 GB User mode virtual address space
    - Each process has it's own
- **Kernel VA includes**
  - System Page Table Entry (PTE) area – KM thread stacks 900 MB
  - Paged Pool – page tables, kernel objects 270 MB
  - System Cache – file cache, registry 500 MB
  - Non Paged Pool 256 MB

Kernel VA (2 GB)

User VA (2 GB)

System PTEs (900 MB)

Paged Pool (270 MB)

System Cache (500 MB)

Non Paged Pool, (256 MB)
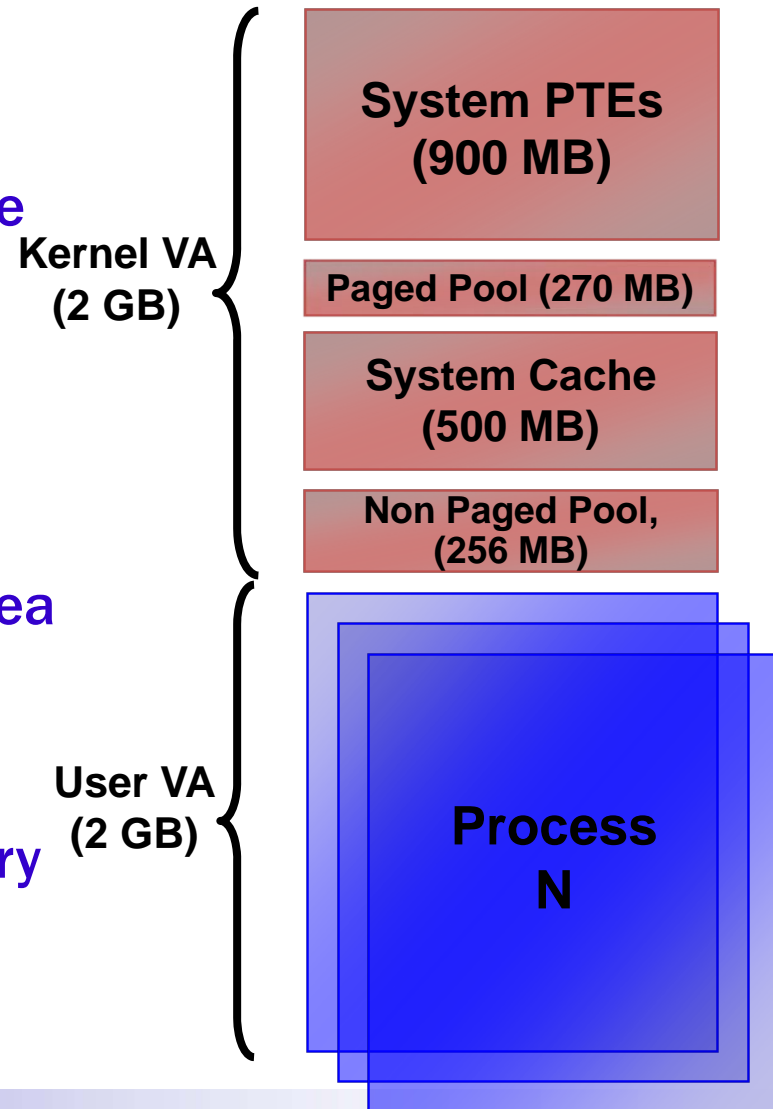
Process N

Limitations of 32-bit x86

- **User processes are limited to flat 4 GB virtual address space**

  - **User processes limited to flat 4 GB virtual address space**

  - **Windows typically occupies the first 2 GB of memory**

  - **Applications must use complex workarounds to map to additional memory (e.g., Address Windowing Extensions [AWE])**

  - **Translating between virtual and physical memory impacts performance**

- **64-bit Systems eliminate the 4 GB memory barrier**

12 GB

4 GB

AWE Window

AWE Memory

**Server App Address Space**

Physical Memory
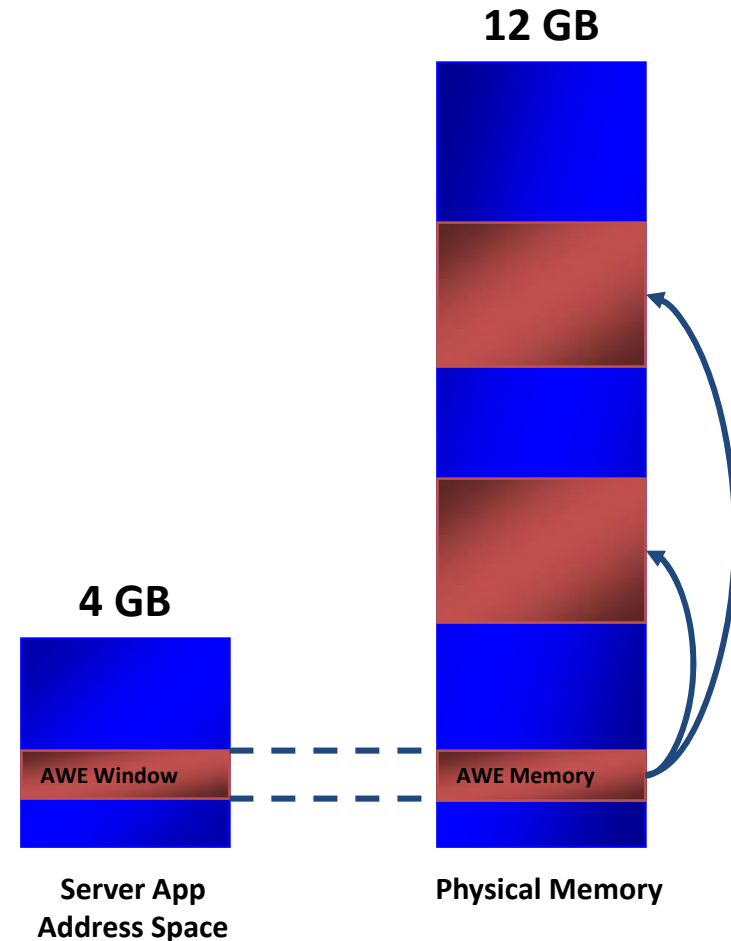
Technical limits of 32-bit

- The kernel virtual address space size limitations on x86-based systems have the following effects:
  - Limits the number of sessions supported. Increased session count eventually causes paged pool and system PTE exhaustion.
  - Limits high-user memory usage scenarios. Increased amounts of physical memory use significant kernel virtual address space. Therefore, there is typically little benefit in exceeding 8 GB of physical memory for x86-based systems.
  - Degrades cache performance. High paged pool usage triggers a reclaim process for system cache data structures which in turn affects cache performance. This translates to slower response times on actions that are related to file access operations, such as opening a file, scrolling, listing the contents of a folder, and others.
  - Reduces the amount of kernel virtual address space available in some special hardware configurations. For example, 2 bytes of virtual address space is lost for each byte of hot-swap memory, significantly reducing the available kernel virtual address space.

64-bit Architecture

- **16 TB address space**
  - 8 TB Kernel virtual address space
    - Shared across processes
  - 8 TB User mode virtual address space
    - Each process has it's own
- **Kernel VA includes**
  - System Page Table Entry (PTE) area – KM thread stacks 128 GB
  - Paged Pool – page tables, kernel objects 128 GB
  - System Cache – file cache, registry 1 TB
  - Non Paged Pool 128 GB

System PTEs (128 GB)

Paged Pool (128 GB)

System Cache (1 TB)

Non Paged Pool, (128 GB)

Kernel VA (8 TB)

**Process N**

User VA (8 TB)
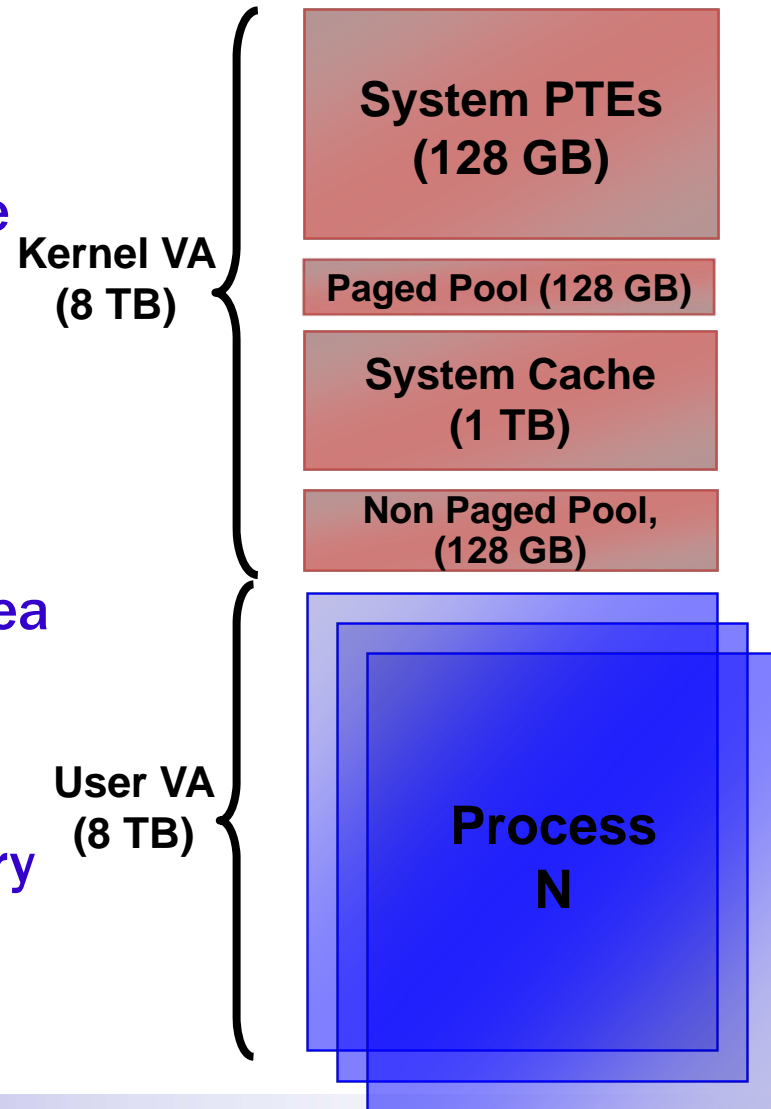
Benefits of 64-bit (x64)

- **For IT Professionals**
  - Runs 32-bit apps at high performance
    - 4GB User VA for Large Memory Aware Processes
  - Runs 64-bit applications
    - 8 TB Virtual Address Space
    - Reduction in Mapping and Soft Page Faults in Most Cases
    - Eases Migration to 64-bit infrastructure

- **For Developers**
  - Eliminates need for complex workarounds to 32-bit memory constraints
  - Huge Virtual and Physical Memory Increase
    - Process VA Space 2731x to 4096x Larger on x64
    - Physical Memory Max Currently 8x Larger on x64
    - Nonpaged and Paged Pool ~256x Larger on x64
    - Allows Solution of More Complex Problems

32-bit Process Address Space (2GB)

64-bit Process Address Space (8TB)
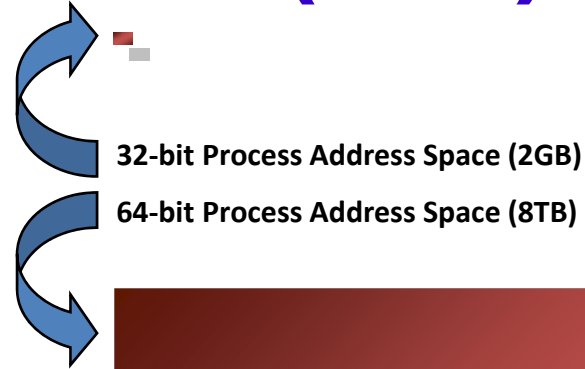
Compatibility and Flexibility of x64

- Runs 32-bit software without recompile
- Runs 64-bit Windows, drivers and software specifically compiled for x64
- Can act like an x86 when booted into 32-bit operating system and runs all 32-bit applications
- Runs 32-bit applications at higher performance
- Runs 64-bit applications natively

Windows Server 2003 & 2008

Edition		32-bit x86	64-bit x64	64-bit Itanium
Web	Microsoft Windows Server 2003	Up to 2-way, 2 GB RAM	N/A	N/A
Standard	Microsoft Windows Server 2003 R2	Up to 4-way, 4 GB RAM	Up to 4-way, 32 GB RAM	N/A
Standard	Windows Server 2008	Up to 4-way, 4 GB RAM	Up to 4-way, 32 GB RAM	*
Enterprise	Microsoft Windows Server 2003 R2	Up to 8-way, 64 GB RAM	Up to 8-way, 1 TB RAM	Up to 8-way, 1 TB RAM
Enterprise	Windows Server 2008	Up to 8-way, 64 GB RAM	Up to 8-way, 2 TB RAM	*
Datacenter	Microsoft Windows Server 2003 R2	Up to 32-way, 64 GB RAM	Up to 64-way, 1 TB RAM	Up to 64-way, 1 TB RAM
Datacenter	Windows Server 2008	Up to 32-way, 64 GB RAM	Up to 64-way, 2 TB RAM	Up to 64-way, 2 TB RAM

* For 2008, there is one version for Itanium known as *Windows Server 2008 for Itanium-based Systems*

Demartek Experience

- Demartek test lab has run all projects except one in the last 18 months using Windows Server x64 (64-bit)

- Because of much larger memory space, I/O requirements for some applications are noticeably reduced
  - NTFS caches better with 64-bit and 8+ GB RAM
  - Exchange 2007 has 50% - 70% I/O reduction

I like 64-bit Windows

- No special switches, modes, hassles for large memory

- Management applications are the same for 64-bit and 32-bit

- 64-bit applications allow for more parallel activities

- Memory prices continue to drop
  - I paid < $300 for a 4GB server (ECC) memory module

- I run Vista Ultimate x64, dual-Xeon, quad-core, 8GB RAM on my desktop

Windows x64 Secret

- **Windows XP x64 and Windows Vista x64 ship with two different versions of Internet Explorer (I.E.)**
  - 32-bit, also found on all other platforms
  - 64-bit, full 64-bit application
- **There is no 64-bit Flash player (yet)**
  - Visits to websites when using I.E. 64-bit can't display Flash advertising

Contact me

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