

## Server Bricks V2.0

### Status of this Memo

This document proposes a standard for the National Institutes of Health (NIH) and requests discussion and suggestions for improvements. Distribution of this memo is unlimited.

### Table of Contents

1	Introduction.....	2
2	Enterprise and Mid-Range Server Bricks .....	2
2.1	Enterprise and Mid-Range Server Platform Processor .....	2
2.2	Enterprise and Mid-Range Operating System .....	4
3	Assumptions.....	6
4	References.....	6
5	Contact .....	7
6	Security Considerations .....	7
7	Changes.....	7
8	Authors' Addresses.....	8
9	Summary of Comments .....	8

## 1 Introduction

This document updates the NIH Technical Architecture Standard for servers and processors for the NIH community. These proposed bricks were developed based on baseline information provided by a survey for IC technologists in 2005 and made current through market analysis. Tactical and Strategic recommendations are based on recent analysis of those technologies coupled with research from Gartner analysts.

By establishing and following these standards, NIH can evolve towards a more homogenous server environment which can provide significant cost savings in the following areas:

- Allows technologists to develop deeper skills in fewer technologies
- Simplifies systems management because of fewer operating environments need to be managed
- Positions NIH for better volume purchase discounts
- Positions NIH for better and more frequent use of Virtualization

## 2 Enterprise and Mid-Range Server Bricks

Enterprise servers consist of the platform hardware and the operating system that together support the operating environment to support application and database servers that serve the entire NIH organization. Enterprise servers typically serve hundreds, if not thousands, of concurrent users and utilize high-availability and redundant configurations to minimize downtime. Mid-range servers consist of the platform hardware and operating system that together support the operating environment for applications and databases that serve a smaller group of users. Because the distinctions between enterprise and mid-range servers depend on subjective estimates of workload magnitude, these bricks address both enterprise and mid-range servers. These standards are meant to provide guidance when selecting a server for a new application or when upgrading the server environment for an existing application. This NIHRFC cannot replace the capacity planning and operational support analysis needed to ensure the new server environment, including storage subsystems and peripherals (not addressed here) is capable of meeting the size, maintainability, performance and availability requirements of the business.

### 2.1 Enterprise and Mid-Range Server Platform Processor

This brick provides baseline information and the future direction for deploying enterprise and mid-range servers at NIH in terms of the preferred hardware platform. Intel technology continues to lead the server platform in the Industry. IBM, HP, Dell, Sun, and Apple all offer Intel based processors for their Server lines. Alternatively, AMD is positioned to give some alternatives to Intel in products from several of the same manufacturers. These same trends run true into the Blade server lines as well. Blade servers are optimized for small size and high densities in server racks. 64Bit computing is enhancing general processing power and virtualization per server in data centers by allowing larger pools of dynamic memory per physical server. This is important because physical resources such as memory are shared across virtual servers hosted on the physical server.

**Table 1. Enterprise and Mid-Range Server Platform Processor Architecture Brick**

Tactical Deployment (0-2 years)	Strategic Deployment (2-5 years)	Emerging (5+ years)
<p><u>Mid-Range:</u></p> <ul style="list-style-type: none"> <li>■ AMD Opteron</li> <li>■ Intel Xeon</li> </ul> <p><u>Enterprise:</u></p> <ul style="list-style-type: none"> <li>■ AMD Opteron</li> <li>■ Intel Itanium</li> <li>■ IBM zSystems</li> <li>■ IBM POWER</li> <li>■ Sun SPARC</li> </ul>	<p><u>Mid-Range:</u></p> <ul style="list-style-type: none"> <li>■ AMD Opteron</li> <li>■ Intel Xeon future versions</li> <li>■ AMD Athlon future versions</li> </ul> <p><u>Enterprise:</u></p> <ul style="list-style-type: none"> <li>■ Intel Itanium future versions</li> <li>■ IBM zSystems</li> <li>■ Sun SPARC</li> </ul>	<p><u>Mid-Range:</u></p> <ul style="list-style-type: none"> <li>■ GPU's</li> <li>■ Multi-core technology</li> </ul> <p><u>Enterprise:</u></p> <ul style="list-style-type: none"> <li>■ Intel Itanium (Future)</li> <li>■ Grids</li> </ul>
Retirement Targets (Technology to eliminate)	Containment (No new deployments)	Baseline Environment (Today)
<ul style="list-style-type: none"> <li>■ None</li> </ul>	<p><u>General Purpose:</u></p> <ul style="list-style-type: none"> <li>■ Apple Macintosh, including G4, PowerPC</li> <li>■ Hewlett Packard Alpha</li> <li>■ Hewlett Packard PA-RISC</li> <li>■ IBM Power</li> <li>■ Intel Pentium</li> <li>■ Pentium Proprietary Appliance Servers</li> <li>■ SGI MIPS Technologies</li> </ul>	<p><u>Mid-Range:</u></p> <ul style="list-style-type: none"> <li>■ AMD Athlon</li> <li>■ Apple Macintosh, including G4, PowerPC and Xserve G5</li> <li>■ Hewlett Packard Alpha</li> <li>■ Hewlett Packard PA-RISC</li> <li>■ IBM POWER</li> <li>■ IBM eServer zSeries</li> <li>■ Intel Itanium 2</li> <li>■ Intel Pentium</li> <li>■ Proprietary Appliance Servers</li> <li>■ Sun SPARC</li> </ul> <p><u>Enterprise:</u></p> <ul style="list-style-type: none"> <li>■ Apple Macintosh, including G4, PowerPC and Xserve G5</li> <li>■ SGI MIPS Technologies</li> </ul>
Comments		

- Tactical and Strategic products were selected to leverage NIH's investment in products that are a proven fit for NIH's known future needs. Leveraging baseline products in the future will minimize the operations, maintenance, support and training costs for new products.
- Some baseline products have been designated Containment. These products are either not as widely or successfully deployed at NIH, or they do not provide as much functionality, value, or Total Cost of Ownership as the selected Tactical and Strategic products.
- SGI MIPS Technologies are currently used in a CIT special purpose scientific environment and are therefore classified as containment.
- HP Alpha and HP PA-RISC product lines are classified as containment because, according to Gartner research and HP's own published position, HP's strategy for the Alpha product line is to support the install base of their existing customers and to enable transition of those customers to newer technologies.
- AMD Opteron processors address a range of server requirements, while AMD Athlon will address mid-range server requirements.
- Proprietary appliance servers are considered containment due to their specialized purpose.
- NIH will seek even more opportunities to deploy Blade server technologies at the enterprise level, where space and compute densities in the data center are the primary design challenges.
- Special consideration should be made when selecting processors to run virtualization software.
- Processors that lack support for the Intel Virtualization Technology for x86 (Intel VT-x), and AMD Virtualization (AMD-V) require virtualization software that offers binary translation. Commercially VMware is the industry leader for virtualization software that offers binary translation as a feature.

Server class processors produced after 2007 have the Intel and AMD virtualization capabilities built-in. These processors require para-virtualization software solutions in order to enable the virtualization benefits.

Para virtualization architecture offers higher levels of performance versus binary translation, so some server workloads will not be suitable for running on servers using binary translation.

Best Practices for server virtualization processor selection is to not mix processor types between manufacturers currently. It is highly recommended to standardize on processor types as a partitioning mechanism when planning virtual server migration and disaster recovery operations.

[http://en.wikipedia.org/wiki/AMD-V#AMD\\_virtualization\\_.28AMD-V.29](http://en.wikipedia.org/wiki/AMD-V#AMD_virtualization_.28AMD-V.29)

## 2.2 Enterprise and Mid-Range Operating System

This brick provides baseline information and the future direction for deploying enterprise and mid-range servers at NIH in terms of the preferred operating systems.

**Table 2. Enterprise and Mid-Range Operating System Server Brick**

<b>Tactical Deployment (0-2 years)</b>	<b>Strategic Deployment (2-5 years)</b>	<b>Emerging Deployment (5+ years)</b>
<p><u>Mid Range OS:</u></p> <ul style="list-style-type: none"> <li>■ Apple Mac OSX Server</li> <li>■ Microsoft Windows Server 2003 or 2008</li> <li>■ Novell SUSE Linux</li> <li>■ Redhat Linux</li> </ul> <p><u>Enterprise:</u></p> <ul style="list-style-type: none"> <li>■ IBM z/OS</li> <li>■ Redhat Linux</li> <li>■ Sun Solaris</li> </ul>	<p><u>Mid Range OS:</u></p> <ul style="list-style-type: none"> <li>■ Apple Mac OS X Server</li> <li>■ Microsoft Windows Server 2008 or future versions</li> <li>■ Novell SUSE Linux</li> <li>■ Redhat Linux</li> </ul> <p><u>Enterprise:</u></p> <ul style="list-style-type: none"> <li>■ IBM z/OS</li> <li>■ Redhat Linux</li> <li>■ Sun Solaris</li> </ul>	<p><u>Mid Range OS:</u></p> <ul style="list-style-type: none"> <li>■ Other variants of Linux</li> <li>■ Microsoft Windows future Versions</li> <li>■ Future Oracle OS</li> </ul> <p><u>Enterprise:</u></p> <ul style="list-style-type: none"> <li>■ Global Shared Memory Multi-Processor Systems</li> <li>■ Grids</li> <li>■ Cloud Computing</li> </ul>
<b>Retirement Targets (Technology to eliminate)</b>	<b>Containment (No new deployments)</b>	<b>Baseline (As of last review)</b>
<p><u>General Purpose:</u></p> <ul style="list-style-type: none"> <li>■ Microsoft Windows 2000</li> </ul>	<p><u>General Purpose:</u></p> <ul style="list-style-type: none"> <li>■ Custom-built Linux</li> <li>■ Hewlett-Packard HP-UX</li> <li>■ Hewlett-Packard (HP) OpenVMS</li> <li>■ Hewlett-Packard (HP) Tru64 UNIX</li> <li>■ SGI IRIX</li> <li>■ UNIX Variants (Other)</li> </ul>	<p><u>General Purpose:</u></p> <ul style="list-style-type: none"> <li>■ Apple Mac OS X Server</li> <li>■ Custom-built Linux</li> <li>■ Hewlett-Packard HP-UX</li> <li>■ Hewlett-Packard (HP) OpenVMS</li> <li>■ Hewlett-Packard (HP) Tru64 UNIX</li> <li>■ IBM AIX</li> <li>■ IBM z/OS</li> <li>■ Microsoft Windows 2000</li> <li>■ Microsoft Windows Server 2003</li> <li>■ Microsoft Windows Server 2008</li> <li>■ Novell SUSE Linux</li> <li>■ Redhat Linux</li> <li>■ SGI IRIX</li> <li>■ Sun Solaris</li> <li>■ UNIX Variants (Other)</li> </ul>

**Comments**

- Tactical and Strategic products were selected to leverage NIH's investment in products that are a proven fit for known future needs. Leveraging baseline products in the future minimizes operations, maintenance, and support costs of new products
- Some baseline products have been designated Retirement and Containment. These products are either not as widely or successfully deployed at NIH, or they do not provide as much functionality, value, or Total Cost of Ownership as the selected Tactical and Strategic products.
- SGI IRIX is currently used in a CIT special purpose scientific platform and is therefore classified as Containment for general purposes.
- Latest version of Windows will be considered Strategic, as well as its immediate predecessor (i.e. latest two versions will be tactical and strategic).
- HP Tru64 is classified as containment as HP will not enhance this operating system beyond 2006 or support the code beyond 2011.
- IBM's z/OS is classified as Tactical for the Titan, and DB2-based applications.
- Windows 2000 is classified as retirement because Windows Server 2003 and later are to be used for tactical and strategic deployment.
- Other flavors of UNIX are classified as containment because significant broad vendor coverage exists via the Linux operating system.
- NIH currently runs a custom-built source version of Linux (presently running the 2.4 kernel with glibc 2.2.5) which is considered containment as RedHat and Novell SUSE are to be used for tactical and strategic deployment.
- .Microsoft offers 32bit and 64bit versions of their operating systems. Please consider application compatibility before selecting the Operating system version

### 3 Assumptions

All Tactical and Strategic Operating Systems are supported by readily available support mechanisms with periodic patches or bug fixes and enhancements.

Operating System source files and media are under source control to ensure integrity and to reduce the security risk of compromise from freely downloadable distributions.

### 4 References

1. What is a Brick ? <http://enterprisearchitecture.nih.gov/ArchLib/Guide/WhatIsBrick.htm>
2. How to Create and Publish a Technical Standard at NIH  
<http://enterprisearchitecture.nih.gov/About/Approach/StandardsDevelopmentProcess.htm>
3. Apple Xserver <http://www.apple.com/xserve/features/architecture.html>
4. Intel Processor Roadmap <http://download.intel.com/products/roadmap/roadmap.pdf>
5. AMD <http://products.amd.com/en-us/>
6. IBM z/OS <http://www.ibm.com/systems/z/os/zos/>

7. Microsoft Server <http://www.microsoft.com/servers/home.msp>

## 5 Contact

To contact the NRFC Editor, send an email message to [EnterpriseArchitecture@mail.nih.gov](mailto:EnterpriseArchitecture@mail.nih.gov).

## 6 Security Considerations

In compliance with the Federal Information Security Management Act (FISMA) of 2002 and related NIST Special Publications 800-series and FIPS (Federal Information Processing Standards) on IT Security, all server implementations must include adequate security measures to ensure application and data integrity, availability and confidentiality

## 7 Changes

Version	Date	Change	Authority	Author of Change
1.0		Original Draft		Bill Jones and Jay Shah
1.1		Updated version addresses concerns and recommendations from comment period. <ul style="list-style-type: none"> <li>• Removed “Provisional” from title</li> <li>• Added the scientific classification to describe scientific baseline information while only specifying standards for general purpose</li> <li>• Updated standards designation for IBM z/OS and revised</li> </ul>	Author	Bill Jones and Jay Shah

		comments for other standards		
1.2	3/9/2006	<ul style="list-style-type: none"> <li>■ Moved the following technologies from containment to tactical: (1) Apple Macintosh, including G4, PowerPC and Xserve G5 and (2) Apple Mac OS X Server.</li> <li>■ Minor grammatical changes and reordered lists.</li> </ul>	Architecture Review Board (3/9/2005)	Steve Thornton
1.3	10/1/2009	<ul style="list-style-type: none"> <li>■ Revision and Update</li> </ul>		Joe Klosky
1.4	10/6/2009	<ul style="list-style-type: none"> <li>■ Minor grammatical changes and table updates.</li> </ul>		Kiley Ohlson
1.5	12/8/2009	<ul style="list-style-type: none"> <li>■ Made updates based on comments</li> </ul>		Joe Klosky
2.0	12/14/2009	<ul style="list-style-type: none"> <li>■ ARB Approved</li> </ul>		ARB

## 8 Authors' Addresses

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## 9 Summary of Comments

### Comment:

Server Brick has the statement under security as follows:

“All server implementations must include adequate security measures to ensure application and data integrity through enforcement of authentication and authorization, adequate physical security of hardware, network connectivity that complies with security regulations and guidelines, and ongoing cooperation and communication with the vendor to apply fixes to any security vulnerabilities that may become exposed in time.”

Our security team recommends that the following security statement be used in place of /or to augment, the current statements for the security sections found in the RFC:

“In compliance with the Federal Information Security Management Act (FISMA) of 2002 and related NIST Special Publications 800-series and FIPS (Federal Information Processing Standards) on IT Security, all server implementations must include adequate security measures to ensure application and data integrity, availability and confidentiality.”

**Response:**

Good suggestion, text updated

**Comment:**

Although the use of virtualization is touched upon briefly in one paragraph, virtualization software is not included in the bricks. The use of virtualization, specifically a hypervisor, is the core platform for supporting ORS & ORF servers. Four types of virtualization software's come to mind: Microsoft Virtual Server, Citrix XenServer, VMWare Server & VMWare VSphere (previously called ESX). VMWare Server is mid-range and VSphere is an enterprise product - both should be placed in tactical. VMWare ESX (v. 2.5, 3.0, 3.5) should be placed in containment and should have been included in the baseline. Microsoft Virtual Server would be considered an entry-level in tactical and possibly enterprise level for emerging deployment. Citrix XenServer is an enterprise product in tactical deployment (just ask Clinical Center).

Under Baseline there's a bolded item - Microsoft Windows Server 2007; no such critter exists; it's either Server 2003 or Server 2008. Under Retirement Targets, Windows 2000 should be listed as Microsoft is discontinuing updates & support in July 2010.

**Response:**

Virtualization is covered by another brick specifically  
System versions typo fixed  
ITMC voted to move Windows 2000 to retirement

**Comment:**

Enterprise and Mid-Range Server Platform Processor Architecture:

There are some inconsistencies in the tracking of some of the architectures. The Intel Itanium 2 is crossed out of the mid-range support, yet the Intel Itanium is included in the Enterprise-level for tactical deployment. I believe that should be Itanium 2, which is the current shipping Itanium processor.

Operating Systems Brick:

Hewlett-Packard HP-UX is listed in containment. I believe this should be Hewlett-Packard HP-UX (PA-RISC), which corresponds to containment in the processor

architecture brick. HP-UX is a perfectly valid operating system for the Intel Itanium-series processors and significant enterprise deployments are currently running on the Itanium/HP-UX platform, and a current major deployment is underway.

**Response:**

Inconsistencies fixed, now reads Itanium future versions in strategic. HP-UX is an excellent Operating System however it does not have wide spread use in NIH or Industry as compared to other tactical Unix OS's. While the technology is in containment, exceptions are available for this OS.

**Comment:**

It would be helpful if the NIHRFC document referenced the NIHRFC's for prior versions of the bricks.

AMD Althon is an addition both to strategic deployment and to containment. This seems to be conflicting.

For Operating Systems, shouldn't CentOS and OpenSolaris be included wherever Redhat and Sun Solaris are, since they are the unsupported Open Source variants of the supported products? It is a program decision as to how support will be provided.

eRA is just about ready to retire our Tru64 systems, so perhaps it should be moved to retirement unless the OS is in use in other places across NIH. Given that it will not be supported past 2011, perhaps retirement is appropriate in any case.

**Response:**

Some Bricks were derived from the long format technical documents that went through the standards process. In some cases several bricks resulted from the approved document. In these cases, no prior NIHRFC exists.

This inconsistency was fixed - Athon removed from containment.

These two variants of Unix are not as feature rich and their named counterparts are not included in Tactical by design. Exceptions exist for CentOS in use in Biowulf.

The retirement date is noted in the comments. At this time Tru64 will remain in containment due to other installs in NIH.

**Comment:**

2.1 Enterprise and Mid-Range Server Platform Processor

Special consideration should be made when selecting processors to run virtualization software.

Processors that lack support for the Intel Virtualization Technology for x86 (Intel VT-x), and AMD Virtualization (AMD-V) require virtualization software that offers binary translation. Commercially VMware is the industry leader for virtualization software that offers binary translation as a feature.

Server class processors produced after 2007 have the Intel and AMD virtualization capabilities built-in. These processors require para-virtualization software solutions in order to enable the virtualization benefits.

Para virtualization architecture offers higher levels of performance versus binary translation, so high server workloads may not be suitable for servers running binary translation.

Best Practices for server virtualization processor selection is not mixing processor types between manufacturers. It is highly recommended standardizing on processor types as a partitioning mechanism when planning virtual server migration and disaster recovery operations.

[http://en.wikipedia.org/wiki/AMD-V#AMD\\_virtualization\\_.28AMD-V.29](http://en.wikipedia.org/wiki/AMD-V#AMD_virtualization_.28AMD-V.29)

#### Table 1. Enterprise and Mid-Range Server Platform Processor Architecture Brick

Under Tactical Deployment column

Move Intel Xeon (Boxboro / Nehalem) to Tactical Deployment column: Major server manufacturers are offering this CPU technology currently as the default for server orders. Most servers ordered after July 2009 have Nehalem processors in them. HP created a new generation of servers to identify the change in processor architecture. G6

In the Strategic Deployment column

I recommend changing the Intel Xeon (Boxboro / Nehalem) to Intel Xeon (Beckton): The Beckton architecture is the 8 core CPU that is due out in 2010.

#### Table 2. Enterprise and Mid-Range Operating System Server Brick

Under Baseline

Change Microsoft Windows Server 2007 Server to Microsoft Windows Server 2008

Under Tactical

Change Microsoft Windows Server 2003 or Better to Microsoft Windows Server 2003 R2 and 2008 (32bit Edition)

Add Microsoft Windows Server 2003 R2 and 2008 (64-bit Edition)  
Add Microsoft Windows Server 2008 R2

### Emerging Deployments

You might want to add the commercial tags for VMware, CITRIX, IBM, and Microsoft cloud platforms as they are currently known.

Vmware - vCloud  
CITRIX (XEN source) - Xencloud  
IBM - Cloudburst  
Microsoft – Azure

### **Response:**

Excellent note on para-virtualization, added to comments.

Specific INTEL processor names were removed for consistency with other processors.

Microsoft version was updated to include 2008 in Tactical.

Comments were added to ask designers to carefully consider 32 vs. 64bit operating system versions with server's application software compatibility in mind.

We mention Virtualization in this standard briefly to ensure consideration to the processor but virtualization as a whole will become a brick onto itself.

### **Comment:**

I object to the removing of the Power system from the strategic plan and placing it in no new deployments. We currently use Power and plan to continue doing so. It is one of the best CPU processors currently made and provides excellent capabilities in both business and scientific processing. It is certainly more robust and has a potentially better future than Itanium which has been a bust so far and yet is listed in strategic and emerging.

It also makes no sense to show Power as containment but show AIX (which runs on Power) to be strategic.

I also question Sun SPARC as strategic when the future of Sun processors is still up in the air. (Note, Sun Microsystems is misspelled in Table 2).

I don't understand zOS being only tactical but zSystems being strategic. Are you planning to run a different OS on the zSystems?

The tables must be consistent in hardware and software.

The document also says version 1.4 in the title but 1.3 in subsequent pages.

**Response:**

Power Based processors were returned to tactical.

AIX was removed from strategic as Linux runs on Power as well as z/Systems. AIX is not in widespread use at NIH or industry. It is well regarded in capabilities but not commonly used which affects personnel, support, training, compatibility, and costs.

Sun Sparc is part of the overall package Oracle acquired. While its future is not guaranteed, Sun and Solaris give Oracle a complete end to end data center solution. You will also find Oracle OS in the emerging category as an item to carefully watch.

The tables are consistent now.

Versions of the document are now reflected on all headers of the document.

**Comment:**

Windows 2000 mainstream support retired on 6/30/2005. Extended support is retired 7/13/2010

Windows 2003 R2 should be Baselined and Windows 2008 or better should be in tactical and strategic. Windows 2003 R2 last SP was issued March, 2007. Support ends 24 months later.

Also, there are various Windows Server versions that should be noted - enterprise, datacenter, standard and x32 vs. x64. X32 should be baselined and x64 should be tactical.

**Response:**

The ITMC sub-committee voted to move Windows 2000 to retirement.

At this time, 2003R2 is still in Tactical along with 2008. We will add a note to reflect concerns about 2003 mainstream support which now runs till July 2010. At that time, 2003R2 transitions to extended support. NIH is entitled to security and bug fixes as a premiere support client.

<http://www.microsoft.com/windowsserver2003/default.msp>

Added comments to say features vary between Enterprise, Datacenter, and standard version of the operating system. Careful consideration should be taken to select the version that satisfies the business or end users requirements.