Windows Server 2008
High Availability Program

Customer White Paper

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For the latest information, please see [www.microsoft.com/windowsserver2008/enterprise](http://www.microsoft.com/windowsserver2008/enterprise)

Contents

[Overview 1](#_Toc187662010)

[Good, Better, and Best System Availability 2](#_Toc187662011)

[System Configurations 3](#_Toc187662012)

[Hardware 3](#_Toc187662013)

[Operating System 3](#_Toc187662014)

[Drivers 3](#_Toc187662015)

[Components Not Supported 4](#_Toc187662016)

[Testing 5](#_Toc187662017)

[Managing the System 6](#_Toc187662018)

[Best Practices: ITIL and MOF 6](#_Toc187662019)

[Configuration 6](#_Toc187662020)

[Change Management 7](#_Toc187662021)

[Other Services 7](#_Toc187662022)

[Reactive Support 8](#_Toc187662023)

[How to Purchase 9](#_Toc187662027)

[Additional Resources 10](#_Toc187662028)

[Frequently Asked Questions 11](#_Toc187662029)

[Appendix: Additional Availability Options 13](#_Toc187662030)

[Failover Clustering 14](#_Toc187662031)

[Fault Tolerance 13](#_Toc187662032)

[Dynamic Hardware Partitioning 13](#_Toc187662033)

[Microsoft Exchange Server and SQL Server Availability Features 14](#_Toc187662034)

[Appendix: Detailed Hardware Requirements 15](#_Toc187662035)

# Overview

Maximum uptime is essential when a server failure could disrupt critical line-of-business (LOB) applications or bring large numbers of virtualized workloads that share the same physical server offline. By reducing the number of system failures, however, you can avoid the costs and lost revenue associated with unplanned downtime.

With the Windows Server® 2008 High Availability Program, systems are designed to be highly available, which can ensure the maximum uptime for business-critical workloads and large-scale virtualization, where reliability and uptime are essential. The program addresses the primary reasons servers fail (hardware failures, server configuration, driver and management issues) through:

* Highly available system configurations with redundant components, the latest reliability, availability, and serviceability (RAS) technologies, and signed drivers.
* A preinstalled 64-bit version of a high-end edition of Windows Server® 2008 (Windows Server® 2008 Enterprise, Windows Server® 2008 Datacenter, or Windows Server® 2008 for Itanium-Based Systems) that includes clustering capabilities.
* Proactive best practices for configuring and managing servers.
* Business-critical reactive support to quickly resolve issues that may arise.

The High Availability Program is ideal for all virtualization and business-critical systems, including custom LOB applications, Microsoft® BizTalk® Server, IBM DB2, Microsoft® Exchange Server, Oracle® database, SAP® applications and Microsoft® SQL Server™.

# Good, Better, and Best System Availability

The "Designed for Windows Server 2008" logo helps customers identify products that deliver a high-quality computing experience with the Windows Server 2008 operating system. Hardware, software, and device drivers can qualify for the logo by meeting the requirements published in the Windows Logo Program. Hardware vendors must test their own products using a downloadable test suite and submitting passing test results to the Windows Quality Online Services (Winqual) web site. You should experience very high hardware availability with servers that have been tested by the server vendor and have the “Designed for Windows Server 2008” logo. Most of the servers you purchase are probably in this category and are often referred to as “industry-standard servers.”

By deploying servers that are “Designed for the Windows Server 2008 High Availability Program,” you should experience better system availability and less unplanned downtime due to hardware failures. The minimum hardware requirements are significantly higher for the High Availability Program than the standard logo. The minimum hardware components are listed in the Detailed Hardware Requirements appendix.

The best availability comes from the full Windows Server 2008 High Availability Program in which you deploy hardware that is Designed for the Windows Server 2008 High Availability Program and fully tested and configured by your server vendor, follow best practices for change management, and have the server provider also provide high quality end-to-end support on the server and operating system.

Table Comparison of Server Availability Options

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Availability** | **‘Hardware** | **OS License** | **Support** | **Services** |
| **Good** | Designed forWindows Server 2008” qualified systems | Any edition purchased anywhere (server vendor, retail, or volume licensing) | Standard server vendor support and Microsoft support | Optional |
| **Better** | “Designed forWindows Server 2008 High Availability Program” qualified systems | Enterprise, Datacenter, or for Itanium-Based Systems through volume licensing or server vendor | Standard server vendor support and Microsoft support | Optional, recommend system configuration and change control |
| **Best**  | “Designed forWindows Server 2008High Availability Program” qualified systems | Enterprise, Datacenter, or for Itanium-Based Systems preinstalled and configured by your server vendor  | End-to-end support from your server vendor for hardware and operating system | System configuration required from server vendor, but change control and management are optional |

# System Configurations

## Hardware

The core component of the Windows Server 2008 High Availability Program is using high-quality hardware configurations with the latest RAS technologies to reduce the likelihood of unscheduled downtime due to hardware component failures. Server vendors must meet or exceed the minimum hardware components and be part of the Windows Server 2008 High Availability Program to be able to sell servers qualified as “Designed for Windows Server 2008 High Availability Program.”

The minimum hardware requirements are:

* Processors must be 64-bit (x64 or IA64 only)
* Two or more socket-capable
* N+1 hot swap power supplies for system or blade chassis
* Hot swap fans for system or blade chassis
* SATA and SAS hard drives allowed (but not ATA)
* Client-focused components not allowed, such as game ports and Bluetooth
* Any storage RAID technology is acceptable; customer request will determine software based, host bus adapter (HBA), or array
* Failure Alert Indicators for system or blade chassis
* MPIO or redundant IO Fabric required
* LBFO or redundant IO Fabric required
* RAID 1 or 5 memory, or other technology, capable of exceeding standard ECC “single bit correct, double bit detection” required

The complete requirements are in the “OEM Hardware Criteria for the High Availability Program” document at <http://www.microsoft.com/whdc/system/platform/srver/HAprogram.mspx>.

## Operating System

The Windows Server 2008 High Availability Program requires the server vendor to preinstall a 64-bit version of Windows Server 2008 Enterprise, Windows Server 2008 Datacenter, or Windows Server 2008 for Itanium-Based Systems to take advantage of the availability and scalability features not found in Windows Server 2008 Standard. For example, the three high-end editions have failover clustering capabilities and can accommodate up to 2 terabytes of RAM. See the [Additional High Availability Options](#_Appendix:_Additional_Availability) appendix for more information. With a more scalable edition of Windows Server 2008, you have the flexibility to increase the server capacity to meet growing needs of business-critical workloads without having to rebuild the server, which could lead to additional downtime. Over Windows Server 2008 Standard, the high-end editions scale to support more processors, memory, and several types of network policy server connections. Visit the Windows Sever 2008 “compare editions” site for more information on feature and role differences between editions, <http://www.microsoft.com/windowsserver2008/editions/overview.mspx>.

## Drivers

High quality drivers are essential for high availability to prevent driver-related issues from causing the operating system to crash. All drivers must be digitally signed by Microsoft, enabling administrators to know whether a legitimate publisher has provided the software package for higher security.

In Windows Server 2008, new features take advantage of code-signing technologies, and new requirements for security in the operating system enforce the use of digital signatures for some kinds of code. The x64 versions of Windows Server 2008 require Kernel Mode Code Signing (KMCS) in order to load kernel-mode software.

Reliable components provide a foundation for reliable servers. Therefore, every kernel-mode component that a server vendor includes in a server system, and that runs Windows Server 2008 and qualifies as a Designed for Windows Server 2008 High Availability Program system:

* Must be tested, and
* Must have a Microsoft signature indicating that testing has been completed for that component.

Any device and driver that has a device category Logo Program that applies to that device:

* Must meet that device category’s Logo Program requirements, and
* Must be tested according to the test requirements for that device category.

Devices and associated drivers for which no device category Logo Program or tests exist:

* Must be tested using the Unclassified test program, and
* Must receive a Microsoft signature.

Applications or utilities that server vendors include in those systems that have kernel-mode components (such as drivers and DLLs):

* Must be tested using the Unclassified test program, and
* Must receive a Microsoft signature.

*Note:* The High Availability Program does not require that customer- or vendor-developed applications be listed under the Windows Server 2008 Certified Server Applications Program. The only requirement for applications to be supported by the system vendor or Microsoft on systems enrolled in the Windows Server 2008 High Availability Program is to be compatible with Windows Server 2008.

However, Microsoft *does* recommend that applications and utilities that have been qualified as “Certified for Windows Server 2008” be used if possible. These products have been tested for reliability and are recommended for customers who want to have the highest possible application or service availability.

## Components Not Supported

The Windows Server 2008 High Availability Program does not support some device or driver categories, such as image capture or gaming, because these drivers are typically client-system focused. Such devices and their associated drivers are not supported in a Windows Server 2008 High Availability Program server system and should not be included in any Windows Server 2008 High Availability Program configurations that server vendors provide.

Device categories not supported in High Availability Program configurations include the following:

|  |  |
| --- | --- |
| * Kernel-mode print drivers1
 | * Gaming
 |
| * CD audio2
 | * Bluetooth
 |
| * Broadcast receiver
 | * Infrared Data Association (IrDA)
 |
| * 1394 tape, storage, net, and so on
 | * Asynchronous transfer mode (ATM)
 |
| * USB tape, storage, net, and so on
 | * Cable modem
 |
| * Video capture
 | * Digital subscriber line (DSL) modem
 |
| * Still imaging/Windows Image Acquisition (WIA)—such as cameras
 | * Soft modem
 |

*Notes:*
1The default system policy for Windows Server 2008 is to not load any kernel-mode printer drivers. Thus, printer drivers that do require kernel-mode execution are not supported for systems running Windows Server 2008. The policy setting helps to prevent use of such drivers.

2Audio (miniport, synthesizer, and codec) and speech input are supported if the system must be managed by users who cannot use a keyboard or mouse.

*Important:*This document might not cover future technologies or categories of devices or drivers. Microsoft reserves the right to modify this document and its requirements, as necessary, after consulting with participating server vendors, to include the requirements and standards for any new technologies, features, devices, or drivers as they apply to the Windows Server 2008 operating system.

## Testing

Server vendors must test fully configured systems that meet or exceed the minimum hardware requirements for the Windows Server 2008 High Availability Program when they run the Windows Server logo tests. This is also true for retest with service packs and new versions of the Windows Server operating system. We recommend you receive confirmation from your server vendor that they support the upgrade and have successfully retested your system model with new service packs and versions before upgrading to ensure there are not issues to mitigate.

The company system being tested must include all the features and components installed and configured that the High Availability Program requires, including the following:

* Two storage adapters with MPIO configured
* Two network adapters with Teaming configured
* RAID 1, RAID 5, or other memory protection enabled and configured
* N+1 and hot swap power and fans installed and configured
* Alert functionality enabled in BIOS, firmware, or drivers, as appropriate
* RAID protection for boot, system, and paging volumes enabled and configured, which can be one of the following:
* Software-based RAID provided by the operating system or a Windows Server 2008 logo-qualified driver that supports RAID
* Hardware-based RAID adapters
* A storage array supporting RAID

# Managing the System

To properly manage a server for the highest availability, we recommend you follow the best practices from the Information Technology Infrastructure Library (ITIL) or Microsoft® Operations Framework (MOF), including configuring, managing, and updating your server. The exact processes and methodologies recommended by your server provider may vary based on integration with their services organization, tools, support services and policies.

## Best Practices: ITIL and MOF

Information Technology Infrastructure Library is a widely recognized framework for IT service management. ITIL provides a collection of best practices to achieve high availability of service and accommodate system growth through books, or “sets” of texts, that detail related functions, like software support and computer operations. The ITIL publications, training, and services companies listed in Additional Resources are available to help you learn and implement the ITIL best practices.

Microsoft Operations Framework builds on and extends the ITIL to provide IT managers with an actionable set of prescriptive guidelines for improving operations. MOF enables you to assess the maturity of your current IT service management, prioritize the processes of greatest concern, and apply proven principles and best practices that can help you optimize the management of your Windows Server platform.

Today there is tremendous pressure on IT organizations to reduce costs, increase service levels, and deliver demonstrated business value. In light of these pressing concerns, the success of continuous improvement depends on addressing people and process, as well as technology. The goal of MOF is to help IT organizations achieve reliability, availability, supportability, and manageability in their mission-critical systems. Because MOF practices are easy to incorporate, either selectively or comprehensively, operations staff can realize tangible benefits by following the model. Applying the principles of ITIL to the Microsoft technology platform, MOF provides a foundation to help IT organizations meet the challenges described above and support the goal of continuous improvement. MOF presents proven team structures and operational processes and applies best practices derived from the experience of Microsoft operations groups, partners, and customers to improve the efficiency and quality of IT operations.

With MOF guidance, you are able to assess your current IT service management maturity, prioritize your processes of greatest concern, and apply proven principles and best practices to optimize your management of the Windows Server platform.

## Configuration

The operating system, drivers, and hardware are initially configured by the server vendor. Configuration management is the critical process responsible for identifying, controlling, and tracking all versions of hardware, software, documentation, processes, procedures, and all other inanimate components of an IT organization. The goal of configuration management is to ensure that only authorized components, referred to as configuration items (CIs), are used in the IT environment and that all changes are recorded and tracked throughout the components’ life cycles.

Configuration management is thus responsible for performing a baseline assessment of the IT production environment. Change management uses this baseline assessment in evaluating the impacts of a change and depends on the accuracy of the configuration data to ensure that these impacts can be understood and communicated appropriately. The change logs are vital to identifying potential issues leading to system instability or downtime.

To achieve this goal, the configuration management process includes the following objectives:

* To identify configuration items and their relationships and add them to the configuration management database (CMDB)
* To enable access to the CMDB and CIs by other service management functions (SMFs)
* To update and alter CIs following any changes made to IT components during the release management process
* To establish a review process that ensures that the CMDB accurately reflects the production IT environment

## Change Management

The change control service is a process to ensure coordinated delivery of hardware and software updates. Organizations require a disciplined process that can introduce required changes into this environment with minimal disruption to ongoing operations.

The organizational and infrastructural changes subject to change management include hardware, software, system components, services, documents, and processes—anything deliberately introduced into the IT environment that could affect its functioning. Often these changes are reflected in the service-level agreements existing between the IT department and the business it serves. IT personnel and named groups (who play well-defined roles) carry out the change management function, which can also be enhanced by use of technology.

Effective change management can help you:

* Make critical system highly available while reducing the chances of human error.
* Control the changes made to critical systems throughout the product life cycle.
* Simplify the process of regulatory and standards compliance while lowering costs.
* Enhance quality of service and optimize operations by implementing ITIL procedures and best practices.
* Gain a view of change that is aligned to business and that ensures the configuration data accuracy.

## Other Services

Additional services and tools used by server providers to increase availability will vary. Determining if these optional services and tools are necessary for your workload is a decision between the additional “nines” of availability you need versus the incremental cost to implement or subscribe to them. For example, by using remote monitoring through your server vendor, you may be able to achieve even higher availability. Remote monitoring can proactively detect potential causes of downtime, so that you may take corrective action and replace failing hardware components prior to system failure.

Other services might be available from your server provider to increase the availability of your Windows Server 2008 High Availability Program solution include,

* Vendor-specific or third-party Clustering Enhancements
* Remote Monitoring
* Call Home
* Operational Audit
* Architecture Assessment
* Environmental Review
* Integration Testing
* Availability Review
* Security Assessment
* Quarterly Review
* On-site Spares

# Reactive Services

The Windows Server 2008 High Availability Program is heavily focused on addressing the causes of unplanned downtime and providing the highest levels of support to resolve hardware and operating system issues. Your server vendor provides a single point of contact for complete support of the end-to-end hardware and operating system with high service levels. They are available to proactively address issues in advance of system failure and quickly respond in the event of system failure.

The server vendor provides end-to-end 24x7 support for hardware and operating systems, with escalations to Microsoft Dedicated Windows Server Support Engineers. As part of the server vendor support, the server vendors have the ability to go onsite within 6 to 24 hours. The exact Service Level Agreement for response time will vary by server provider, your physical server locations, and your agreement with the server provider.

By having access to high-end support engineers and support relationships between Microsoft and your server provider, issues are resolved quicker by having a single point of accountability with your server provider, having support engineers at Microsoft who become familiar with your server modules and support issues are managed end-to-end by a single contact point at Microsoft. This also helps with resolution of issues identified before they lead to unplanned downtime.

Additional reactive and proactive support services may be available and vary by server vendor.

# How to Purchase

The Windows Server 2008 High Availability Program is available exclusively from participating server vendors. Server models that are Designed for the Windows Server 2008 High Availability Program can be found in the Windows Server Catalog ([www.windowsservercatalog.com](http://www.windowsservercatalog.com)). A system that has qualified for the Windows Server 2008 High Availability Program is indicated by the “High Availability” Additional Qualification notation as part of the server product entry in the Windows Server Catalog.

Because not all models a server vendor sells may be qualified for the program, server vendors must have unique model names/numbers for their services that are designed for the Windows Server 2008 High Availability Program. The servers must be sold with at least the minimum configurations that meet the Windows Server 2008 High Availability Program hardware criteria.

A High Availability Option Kit may be added to a model’s base configuration to add the necessary components to bring the base configuration up to the minimum requirements of High Availability Program servers.

If you are purchasing a server online from a server vendor’s Web site, the base server models on the site should include a configuration that meets or exceeds the minimum hardware requirements for the Windows Server 2008 High Availability Program. You may be able to modify the configuration, but should not be able to remove components that would cause the configuration to no longer meet the minimum hardware requirements.

In addition to purchasing a server designed for the Windows Server 2008 High Availability Program, we recommend that you subscribe to your server vendor’s additional components and services to enroll the server in the full Windows Server 2008 High Availability Program for the best high availability.

# Additional Resources

High Availability portal:
[www.microsoft.com/HA](http://www.microsoft.com/HA)

Windows Server 2008 High Availability Program page:
[www.microsoft.com/windowsserver2008/HAprogram](http://www.microsoft.com/windowsserver2008/HAprogram)

Windows Server 2008 High Availability white paper:

[www.microsoft.com/windowsserver2008/enterprise](http://www.microsoft.com/windowsserver2008/enterprise)

Windows Server 2008 Dynamic Hardware Partitioning white paper:

[www.microsoft.com/windowsserver2008/enterprise](http://www.microsoft.com/windowsserver2008/enterprise)

Windows Server Catalog:
[www.windowsservercatalog.com](http://www.windowsservercatalog.com)

Windows Server 2008 High Availability Program Hardware Criteria for Server Vendors: <http://www.microsoft.com/whdc/system/platform/srver/HAprogram.mspx>

Microsoft Operations Framework:
[www.microsoft.com/technet/solutionaccelerators/cits/mo/mof/default.mspx](http://www.microsoft.com/technet/solutionaccelerators/cits/mo/mof/default.mspx)

The ITIL Community Forum:
[www.itilcommunity.com](http://searchdatacenter.techtarget.com/sDefinition/www.itilcommunity.com/)

ITIL and IT Service Management Zone:

[www.itil.org.uk](http://searchdatacenter.techtarget.com/sDefinition/www.itil.org.uk/)

# Frequently Asked Questions

### Q: Can I make an existing server with Windows Server 2008 or an early version part of the Windows Server 2008 High Availability Program?

**A:** Customers are not permitted to use hardware components and systems that are qualified or certified for Windows Server 2008 to assemble an arbitrary configuration to be supported in the High Availability Program. Microsoft or Microsoft server vendor partners cannot properly support such an arbitrary configuration through the High Availability Program because that configuration would not have been validated through testing. Customers should work with their server vendor partners if they want a specific configuration to be tested, qualified for, and supported through the Windows Server 2008 High Availability Program.

### Q: Can a customer purchase a server Designed for Windows Server 2008 High Availability Program without purchasing High Availability Program services or support?

**A:** Yes, server vendors can sell servers designed for Windows Server 2008 High Availability Program without a Windows Server 2008 server vendor license or accompanying services and support. This will provide customers with higher availability than purchasing standard logoed hardware but they may not receive the same level of overall availability and response times. In these cases, recommend that the customer still purchase your highest level of hardware support, even though the server is not part of the High Availability Program.

### Q: Why are the high-end editions of Windows Server 2008 required for the High Availability Program?

**A:** The Windows Server 2008 High Availability Program includes Windows Server 2008 Enterprise, Datacenter, and for Itanium-Based Systems, because these editions have higher scalability and high availability features, such as clustering. These capabilities are typically needed for business-critical workloads that are not present in Windows Server 2008 Standard or Windows® Web Server 2008.

### Q: How do I order servers Designed for Windows Server 2008 High Availability Program on a server provider’s web sites?

**A:** Not all server providers will have their servers Designed for Windows Server 2008 High Availability Program available to purchase online to ensure your server meets or exceeds the minimum hardware requirements and is properly configured for your environment. Start with the “High Availability” server list on the Windows Server Catalog ([www.windowsservercatalog.com](http://www.windowsservercatalog.com)) to find models Designed for the Windows Server 2008 High Availability Program.

### The default configurations for some server models will meet or exceed the minimum requirements for the Windows Server 2008 High Availability Program, while others may require additional components, such as a “High Availability option kit.” Work with your server provider to ensure the server model and configuration you purchase has been qualified as Designed for Windows Server 2008 High Availability Program and is properly configured to meet or exceed the minimum hardware requirements for the program.

### Q: How does a customer receive maintenance for a Windows Server 2008 High Availability Program server?

**A:** Maintenance consists of hotfixes, service packs, new version rights, and reactive support. Hotfixes and service packs are available from Microsoft at no additional cost; however, “unnecessary” hotfixes should not be installed and service packs should only be installed after the server vendor has tested them on the server model.

For new version rights, the customer should add Software Assurance coverage to the OEM license sold with the server hardware within 90 days of purchase through their Volume Licensing agreement. End-to-end reactive support on the hardware and operating system should come from the server vendor, and the customer should not install the new version before the server vendor tests and certifies the new operating system on the server.

# Appendix: Additional Availability Options

The high-end editions of Windows Server 2008 have additional high availability capabilities, many of which are enabled by special hardware.

Table Comparison of Windows Server 2008 high-end editions

|  |  |  |  |
| --- | --- | --- | --- |
| **Windows Server 2008 Edition** | **Failover Clustering** | **Fault Tolerant** | **Dynamic Hardware Partitioning** |
| Enterprise | 16 nodes | Yes | Hot add memory |
| Datacenter | 16 nodes | Yes | Hot add and replace memory and processors |
| For Itanium-Based Systems | 8 nodes | Yes | Hot add and replace memory and processors |

In addition to hardware, operating system, and system management best practices, additional high availability capabilities may be part of your applications, such as Microsoft Exchange Server and SQL Server. Architectural design and configuration of your applications and databases can affect availability.

## Fault Tolerance

To extend hardware availability, some versions of Windows Server®, such as Windows Server 2008 Enterprise, Windows Server 2008 Datacenter and Windows Server 2008 for Itanium-Based Systems, are designed to fully support fault-tolerant servers. Fault-tolerant servers are those that have complete redundancy across all hardware components. If a primary component fails, the secondary component takes over in a process that is seamless to the application running on the server. As such, fault-tolerant systems “operate through” a component failure without loss of data or application state.

Support for fault-tolerance in Windows Server 2008 is handled completely at the kernel and hardware abstraction layer—a method that makes it transparent to applications. In addition, fault-tolerant servers that are Windows® based must pass the same rigorous Windows Hardware Compatibility Tests (HCT) as other servers, ensuring that the applications running on them will behave no differently. As such, companies that embrace fault tolerance on Windows achieve very high levels of availability, but also realize the full range of other benefits provided by the Microsoft platform and Microsoft® .NET Framework technologies.

## Dynamic Hardware Partitioning

Microsoft further enhances server availability and fault tolerance with dynamic hardware partitioning. Windows Server 2008 works with one or more isolated hardware partitions, each assigned its own processors, memory, and I/O host bridges that are independent from any other hardware partitions. On servers that can be dynamically partitioned, the configuration of partition units that are assigned to a hardware partition can be changed while the system is running.

With Windows Server 2008 Enterprise, you can hot add additional memory to these partitions without restarting the instance of the operating system that is running on the hardware partition; in Windows Server 2008 Datacenter and Windows Server 2008 for Itanium-Based Systems you can hot add or replace memory and processors to partitions without a reboot. This increases the reliability, availability, and serviceability of your servers. For example, you can replace a processor that shows signs of failing, or you can add spare processors to a partition as demand increases.

## Failover Clustering

Failover clustering improves server availability at the operating system level by building redundancy into your system to help eliminate single points of failure (in this case, the point of failure being reliance upon a single server to run a vital workload).

A failover cluster is a group of independent computers with two or more shared disks that work together to increase the availability of applications and services. The clustered servers, called nodes, are connected by physical cables and software; they usually include multiple network connections and data storage connected to the nodes via storage area networks (SANs).

Most clustered applications and their resources are assigned to one cluster node at a time. If the failover cluster detects the failure of the primary node for a clustered application, or if that node is taken offline for maintenance, server clusters start the clustered application on a backup cluster node. Client requests are immediately redirected to the backup cluster node to minimize the impact of the failure.

Some clustered applications may run on multiple cluster nodes simultaneously, including SQL Server and Exchange Server. For “cluster-aware” workloads such as these, failover clusters provide scalability in addition to high availability: client requests can be distributed among multiple cluster nodes and administrators can meet increased demand and traffic by adding additional nodes to the cluster.

## Microsoft Exchange Server and SQL Server Availability Features

Microsoft has built features for enhancing the availability of your Microsoft Exchange Server, Microsoft SQL Server workloads. The high-availability features of Exchange Server center on redundancy for mailbox servers including continuous replication and clustering. Continuous replication, which provides data availability for the system, is the process of automating the replication of closed transaction log files from a production storage group to a copy of that storage group that is located on a second set of disks on the local computer or on another server altogether. After being copied to the second location, the log files are then replayed into the copy of the database, thereby keeping the storage groups synchronized with a slight time lag. Such replication can be done between separate disk sets on a single server, between servers without shared storage, and with standby recovery servers.

In addition to supporting failover clustering, SQL Server maintains database availability through database mirroring and log shipping. Database mirroring is a software solution to increase database availability by supporting almost instantaneous failover with no loss of committed data. Database mirroring can be used to maintain a single standby database (mirrordatabase) for a corresponding production database (principal database). The mirror database is created by restoring a database backup of the principal database with no recovery. You can use the mirror database indirectly for reporting purposes by creating a database snapshot, which provides you with read-only access to the data as it existed when the snapshot was created.

Like database mirroring, log shipping operates at the database level. Log shipping provides database-level redundancy with two or more instances of SQL Server. It uses scheduled jobs to automatically back up, copy, and restore transaction logs to maintain secondary copies of a database on a standby server. Unlike database mirroring, log shipping allows multiple secondary databases, which makes it a better solution for applications that demand multiple failover sites. Log shipping can be configured with a time delay for applying transaction logs on the standby server to provide protection against user errors. Log shipping can also be used to reduce load on the primary server by using a secondary server for read-only query processing.

# Appendix: Detailed Hardware Requirements

Following is a list of system requirements for servers to be qualified as Designed for Windows Server 2008 High Availability Program.

### 1. System hardware and firmware must meet Windows Logo Program version 3.11 or later requirements.

All hardware and firmware components for which logo programs exist must, at a minimum, qualify for the Windows Server 2008 Logo Program, as defined in *Microsoft Windows Logo Program System and Device Requirements*, available at <https://winqual.microsoft.com> (a Winqual account is required).

### 2. System processor and memory must meet minimum requirements.

The following minimum capabilities must be present:

* Support for expansion to at least two processors per sockets.
* System memory of 2 GB of RAM, expandable to at least 4 GB of RAM.

### 3. System must meet minimum power supply requirements.

These requirements include the following:

* The system must include power supply protection that uses N+1 (meaning that the system has a redundant spare unit).

The system overvoltage and undervoltage protection and power supply switch-over circuitry should be able to regulate according to the system load. For each voltage in the system, the output voltages of the redundant power supplies should be within the range of values that can guarantee the proper operation of the system, no matter which supply is active. Power-supply switch-over should occur swiftly enough to maintain normal server system operation.

* The system must allow a qualified individual in the field to replace the module (or modules) that constitute its source of power. The system must implement hot-swapping capabilities for power supply replacement and power supply redundancy.

### 4. System must meet minimum fan requirements.

These requirements include the following:

* The system must include fan protection that uses N+1 (spare unit).
* The system must allow a qualified individual in the field to replace the fan module (or modules).
* The system must implement hot-swapping capabilities.

### 5. System must meet minimum requirements for the storage subsystem.

These requirements include the following:

* The server can include only one or more of the following: SCSI host controller, Fibre Channel adapter, RAID adapter, SATA adapter, and SAS adapter or iSCSI adapters.

*Note:* Advanced Technology Attachment (ATA) (also known as IDE, EIDE, or ATAPI) controllers and storage devices, to include RAID versions of these devices, cannot be used in High Availability Program server systems for any purpose.

* All storage delivered with the server must include a RAID solution, described as follows:
* Software RAID, supplied by either Microsoft or the vendor.
* RAID adapter.
* RAID array.
Note: In all cases, this means that at least the boot, system, and paging disks must be mirrored or otherwise RAID protected.
* The server must include an MPIO solution for any external storage.

*Note:* Blades that use a single I/O channel to connect to storage, networking, and other devices must have a redundant fabric instead of MPIO.

* The system must include hot-swappable hard drives that:
* Have a local indicator that shows which drive or drives require replacement.
* Are ejectable without powering off the system or array.
* Are ejectable without requiring a system down period.
* *Note:* The combination of the RAID requirement on boot, system, and paging devices and of the hot swap requirement for all drives is intended to ensure that customer systems are not required to be rebooted or powered off to replace any hard drive. RAID protection of the boot, system, and paging drives means that removal of a failing drive can be done while the system is online. Additionally, even if other volumes are not RAID protected, Windows Server 2008 unmount capability allows those drives to be taken offline, if necessary.

### 6. System must meet minimum requirements for networking.

The server must include a network teaming or LBFO solution.

*Note:* Blades that use a single I/O channel to connect to storage, networking, and other devices must have a redundant fabric instead of LBFO.

### 7. System must include failure-alert indicators.

Alert indicators that indicate failure or imminent failure should be provided. The design can use visual, network, paging, fax, or e-mail notifications as the alerting mechanism, depending upon the system design.

*Required:* The following are required sources of alert indicators for systems to be qualified for the High Availability Program:

* Cooling fan malfunction, including system and power supply fans.
* System and processor over-temperature.
* Power module failure.
* Disk drive error.
	1. A hot-swappable drive must have a local indicator that shows which drive or drives are ready for replacement, facilitating the servicing process and improving reliability by reducing possible errors.

This indicator should be on the drive chassis. The device’s “eject” signal can be used to activate a replacement indicator. Designers can choose to use existing light-emitting diodes (LEDs) for dual purposes to fulfill this requirement, but the LED display should clearly show when a drive is ready for removal, as opposed to other information.

* 1. For systems with multiple drives, an individual replacement indicator should be physically associated with each hot-swappable drive slot.

*Recommended:* The chassis open (intrusion) source of alert indicators is recommended for servers qualified for the High Availability Program:

### 8. System must include memory protection that exceeds standard ECC.

Standard ECC memory protection is defined as the ability to correct a single-bit memory error and to detect a double-bit memory error. Given the large memory capacities of current and future systems, the system must provide protection for memory contents in excess of that norm for the system to be considered highly available.

Any method or technology that provides a greater level of protection is permissible for servers qualified for the High Availability Program. Examples include such technologies as:

* Mirrored or RAID 1 memory protection
* RAID 5 memory protection
* Single Device Data Correction
* Double Device Data Correction

*Note:* The preceding list is not exclusive; other memory protection technologies are acceptable for the High Availability Program.

### 9. System must have a unique name, firmware, or BIOS identification.

Server systems with a base model that do not include the features and components that the High Availability Program requires can have a system name (for example, “Model 10000”). If this server is also offered with a High Availability Program configuration, the system name for the configuration must be different from the base model name (for example, “Model 10000-HA”). This ensures that the base model and High Availability Program configuration model of the same server can be uniquely identified.

There is no requirement that High Availability Program systems be identified with new name plates, badges, or other physical identifiers.

*Note:* All references to “system name” refer to the system name identifier provided by the server’s firmware or BIOS.

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