



Server Consolidation with SQL Server 2008

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Summary: This White Paper outlines the benefits and savings that you can make by consolidating your databases on SQL Server 2008.

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Introduction

In the light of recent economic events, organizations around the world now need to operate in a more challenging environment, and as a result, many are seeking ways to minimize the costs associated with maintaining and developing their IT infrastructures. While cutting budgets is one way that this can be achieved, making the right strategic investments in their IT infrastructures will help companies to reduce costs and at the same time to develop and maintain their competitive edge. Organizations that take this approach will see savings in the short term, and will be best positioned to take advantage when the economic climate improves.

Over the last few years, organizations have tended to use increasing numbers of applications to manage business processes, provide new services, and gain insights into business performance. Consequently, the number of application servers and data storage servers that are required to support those applications has grown significantly. In many organizations, the hardware costs and the overhead of deploying and maintaining multiple servers throughout the enterprise is a major financial and logistical challenge.

At the same time, advances in hardware and software technologies have opened up opportunities to reduce costs through consolidation. Consolidation is simply the act of gathering applications from multiple physical locations to a single location. It can occur either by installing all of those applications onto a single physical machine or by creating multiple “virtual” computers on one physical set of hardware. This results in better utilization of available hardware capacity. Modern IT servers can handle significantly greater workloads, meaning that it is now possible to consolidate servers without sacrificing performance or availability. The costs associated with buying and maintaining servers are reduced and administration is more efficient, which in turn yields further savings.

Forces Driving Consolidation

Organizations are turning to consolidation with increasing frequency, and not only because of the obvious financial benefits. Companies that consider server consolidation may do so for a number of very compelling reasons, including:

- **Reduced overall total cost of ownership (TCO).** In the current economic climate, keeping costs down is imperative. Consolidation can help you to achieve this in several ways:
- **Reduced administration.** By standardizing and reducing the number of servers, businesses reduce the complexity of the infrastructure they must administer. Fewer support staff can therefore manage the same service demands. For

international companies, this standardization also facilitates the provision of 24/7 support using worldwide support resources.

- **Reduced operations costs. Increase in service capacity and growth** are achieved with better utilization of resources. Typically, fewer servers are required, resulting in hardware and power savings.
- **Reduced data center costs.** Site space formerly used for IT services can be returned to the business, and existing facilities can be used more efficiently.
- **Reduced revenue loss through higher uptime/availability.** Consolidation reduces the cost of implementing high-availability solutions, which reduces revenue losses due to downtime.
- **Improved service management.** By standardizing and reducing the complexity of service infrastructure, organizations facilitate more effective service management processes, tools, and automated system administration.
- **Simplified contingency planning solutions.** A simpler service infrastructure means that more services can be restored when a site failure occurs.
- **Reduced licensing costs.** In most consolidation scenarios, licensing is reduced because there are fewer servers that require licenses. However, even when this is not the case, the other savings you make will still result in a lower TCO.
- **Improved quality of service (QoS).** Consolidation improves up-time and can deliver better performing systems.
- **Increased reliability and availability.** Server consolidation makes it more economic to provide high-availability configurations and dedicated support staff. Organizations also benefit from implementing better storage management and service continuity solutions.
- **Improved performance.** Standardized systems deliver more predictable performance, and proprietary technologies such as data compression can improve query response times.
- **Improved infrastructure agility.** In uncertain times, flexibility and the ability to respond quickly to changing needs of the business can help to maintain the competitive edge. Consolidation results in a more standardized, centralized and dynamic infrastructure, which makes it possible for systems to be more responsive to change and to quickly adapt to business needs.

- **Improved consistency.** Consolidating on a single platform improves interoperability, and makes your systems more productive and easier to manage:
- **Better integration.** Using a single platform makes for better systems integration, which improves data consistency and reduces the complexity of tasks such as extract, transform, and load (ETL) operations.
- **Centralized management.** Because consolidation facilitates centralized management, it becomes easier to implement standard policies across your systems.
- **Reduced carbon footprint.** With greater emphasis on sustainability, many organizations are striving to reduce the environmental impact that their activities have. Consolidation enables organizations to reduce their energy consumption by using less hardware as well as by using that hardware more efficiently.
- **Improved resource utilization.** Organizations may already have the resources that they need in order to consolidate. It is not uncommon for companies that possess powerful servers to be using only a relatively small percentage of those servers' capacity. Consolidating by using these servers enables a company to make more efficient use of their resources and requires no extra investment in hardware.

Key Enablers for Consolidation

The growing interest in consolidation is due to several factors that make it a realistic proposition for more organizations than before:

- **Improvements in hardware.** Consolidation relies upon hardware that can handle the increased workload that consolidating brings. However, consolidation does not necessarily require a large investment in high-end servers, and can often be achieved by using standard commodity hardware. In recent years, powerful servers have become available to more organizations as prices have become more affordable. Processors and other hardware have increased in power, with 64-bit systems, multi-core and multi-processor systems now commonplace. Dedicated technologies, such as AMD-V and Intel VT, exist to enable optimal performance in virtualized environments. Data storage systems with improved I/O, including storage area networks (SANs) and network attached storage (NAS) are no longer the preserve of high-performance critical workloads. All of this makes it possible to reduce costs by employing a smaller number of more powerful machines to host consolidated services.

- **Improvements in software.** As hardware has improved, so has the software that can take advantage of it. The rich feature set offered by Microsoft® SQL Server® 2008 Enterprise Edition, coupled with the virtualization capabilities of Microsoft Windows Server® 2008, provides a robust, reliable, high-performance platform for consolidation. Specifically, SQL Server 2008 offers:
 - Flexible deployment options that enable consolidation in many different scenarios, from a small number of databases on a single instance to multiple instances running in their own dedicated virtual operating systems.
 - Administrative tools, such as SQL Server Management Studio (SSMS), Windows System Resource Manager (WSRM), and System Center Virtual Machine Manager (SCVMM), that enable you to centrally manage, monitor, and troubleshoot consolidated data systems, resulting in greater efficiency.
 - Scalability and performance features that enable your databases to grow without a loss in performance. For example, Resource Governor enables you to manage contention between applications for resources by prioritizing competing workloads.
 - Powerful tools and technologies that you can use to migrate data and databases when creating your consolidated solution. These include backup and restore, attach and detach, and SQL Server Integration Services, a powerful extract, transform, and load (ETL) utility that ships with SQL Server 2008 at no extra cost. There are also tools that make it straightforward to upgrade and migrate SQL Server 2000 and SQL Server 2005 databases into a consolidated SQL Server 2008 environment.
 - A range of high-availability technologies, including up to 16-node clusters and improved failover cluster support when used with Windows Server 2008.
- **Advances in networking technologies and improvements in bandwidth.** To ensure efficient response times for servers on networks that have multiple sites and limited bandwidth, it has been common practice to place servers within each site on the network. However, as bandwidth availability and networking technologies have improved, it has become possible to centralize servers while maintaining acceptable response times.
- **Virtualization.** The advent of hypervisor based hardware virtualization software such as Hyper-V™, available with Windows Server 2008, makes it possible to

reduce the number of physical servers by replacing them with virtual servers. You can run many virtual servers on a single physical server and move virtual machines from one physical server to another with ease, making it possible to redistribute workloads and to move from test to production environments quickly and with little or no disruption. Virtual servers share the hardware resources of their physical host server, but each virtual server is isolated from the others, has dedicated resources allocated to it, and can be configured with independent security settings as well as other features.

The Trend towards Consolidation

Throughout the industry, there is a growing trend towards consolidation as more companies respond to the drivers and enablers outlined above. In the current economic climate, it is not difficult to see why this is the case, given the savings that consolidation can deliver. Based on research published in a recent Forrester Consulting report(June 2008 “**The Forrester Wave™: IT Consolidation Consultancies, Q2 2008**”), Table 1 shows the aggregated responses of various companies to the question:

What are the top database initiatives you are currently pursuing for your enterprise databases?

Database standardization	43.9%
Clustering and virtualization	41.2%
Automate database administration	38.5%
Database consolidation	37.2%
Database archiving (information life-cycle management)	33.1%

Table 1: Trend towards consolidation

Options for Consolidating with SQL Server 2008

There are four main options for using SQL Server 2008 as a platform for consolidation:

- Multiple databases consolidated into a single database
- Multiple databases consolidated to a SQL Server 2008 instance
- Multiple SQL Server 2008 instances per physical server
- Multiple virtual machines per physical server (virtualization)

Multiple Databases Consolidated to a Single Database

In some cases, it may be possible to consolidate multiple databases into a single database in a single instance, as shown in Figure 1.

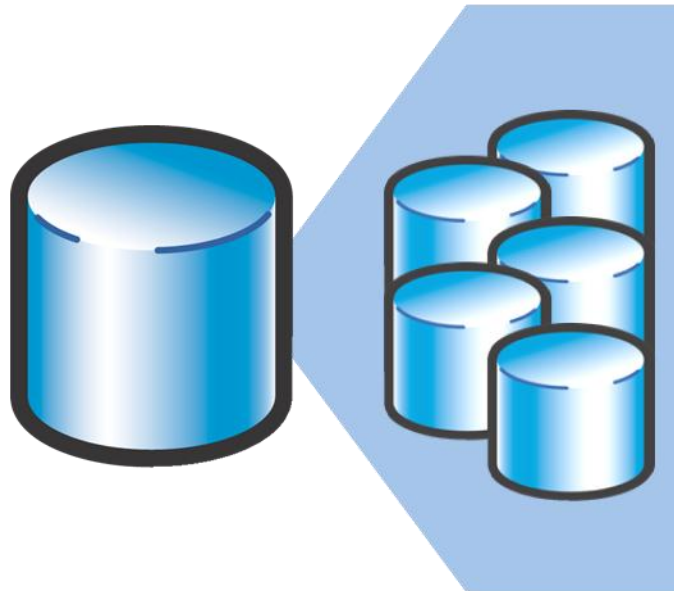


Figure 1: Multiple databases consolidated to a single instance

For example, separate departmental databases could be subsumed into a single database, assuming that there are no operational or security barriers to prevent this. Applications that query the existing databases will be able to query the consolidated database with, typically, minimal re-coding required. Maintaining just one database is generally simpler and more cost-effective than maintaining multiple databases because, typically, fewer servers are required, backup management can be simplified (although individual backups can take longer), and you can use Resource Governor to manage contention.

Multiple Databases Consolidated to a SQL Server 2008 Instance

Probably the simplest approach to consolidation is to use a single instance of SQL Server 2008 with multiple databases, as shown in Figure 2. This approach is suitable when all of your databases have similar security, manageability, and compatibility requirements, and your hardware can provide the required level of performance and scalability for the workloads that are generated in all of the databases. The benefits of this approach include lower licensing and administrative costs, because you need to license and manage only one instance. Also, because each SQL Server instance that you install requires its own resources in terms of memory, disk, and so on, running a single instance makes better use of the available hardware than running multiple instances.

The number of databases that you can host will be dictated in part by the available hardware and the edition of SQL Server 2008 that you are using. SQL Server 2008 Standard Edition supports up to 4 CPUs; SQL Server 2008 Enterprise Edition is limited only by the limitations of the host operating system. Within a single instance, you can use Resource Governor to prioritize workloads and to prevent queries that dominate resource consumption and deny access to CPU and memory resources to other applications.



Figure 2: Multiple databases in a single SQL Server 2008 instance

Multiple SQL Server 2008 Instances per Physical Server

A single-instance, multiple-database strategy may not always be appropriate, for example, in situations where you have databases with different security, manageability, or compatibility requirements. When this is the case, you can obtain the required level of isolation by running multiple instances of SQL Server 2008 concurrently on a single server to consolidate your data services. This approach is illustrated in Figure 3.

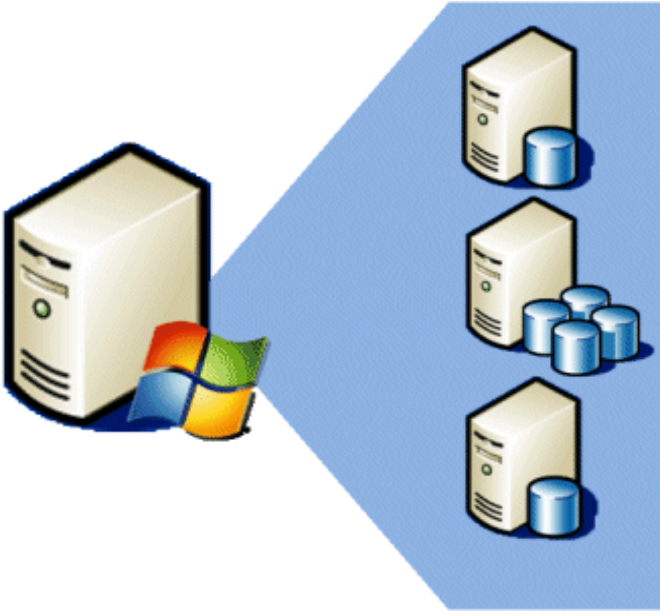


Figure 3: Multiple instances of SQL server 2008 on a single server

Security is tighter because each instance has its own set of services, and you can prevent users from accessing data not just by denying them access at the database level, but at the server instance level. Furthermore, the authentication mode for each instance (SQL Server and Microsoft Windows® or Windows only) can be configured separately. By selectively enabling features such as CLR integration on only the instances where they are required, you can maintain minimal surface area exposure. However, this strategy does not enable complete isolation, because the sysadmin role can still access all instances on the machine.

Using this strategy, administrative functions such as backups of system databases are also isolated, and you can use Resource Governor within each instance to manage resource allocation for that instance. Using multiple instances to consolidate puts greater strain on the server, because each instance has its own resource requirements and you must take account of this when assessing your hardware requirements.

The edition of SQL Server 2008 that you use will determine the maximum number of instances that you can host per server. As you can see from Table 2, SQL Server 2008 Enterprise Edition offers the greatest number of instances per server (up to 50) and is generally the better choice for larger implementations and those that need the flexibility to grow.

Edition	Maximum instances
SQL Server 2008 Standard Edition	16*
SQL Server 2008 Enterprise Edition	50*

*Depending upon available system resources and workload

Table 2: Multi-instance support in SQL Server 2008

Multiple Virtual Machines per Physical Server (Virtualization)

For complete isolation at the operating system level, you can use a virtualization technology such as Microsoft Windows Hyper-V to host multiple virtual database servers on a single physical server, as illustrated in Figure 4. By using Microsoft Windows Server 2008 with the Hyper-V role, you can install multiple virtual operating systems on one computer and each of these virtual operating systems can host multiple instances of SQL Server 2008. By consolidating using virtualization, you achieve a good level of isolation between databases with different workloads, security requirements, manageability requirements, or compatibility requirements. The benefits are that you minimize the number of servers and licenses required and simplify the network infrastructure.

The hard disks of each virtual machine (VM) exist either as VHD files on the host operating system, which makes them very easy to back up and move to other servers, or as pass-through disks, which are physical disks that are allocated for the sole use of the virtual machine, and which provide excellent I/O performance. VMs provide an ideal environment for development and testing, because you do not need to maintain test environments that consist of multiple physical servers, and deployment to a live environment is simplified.

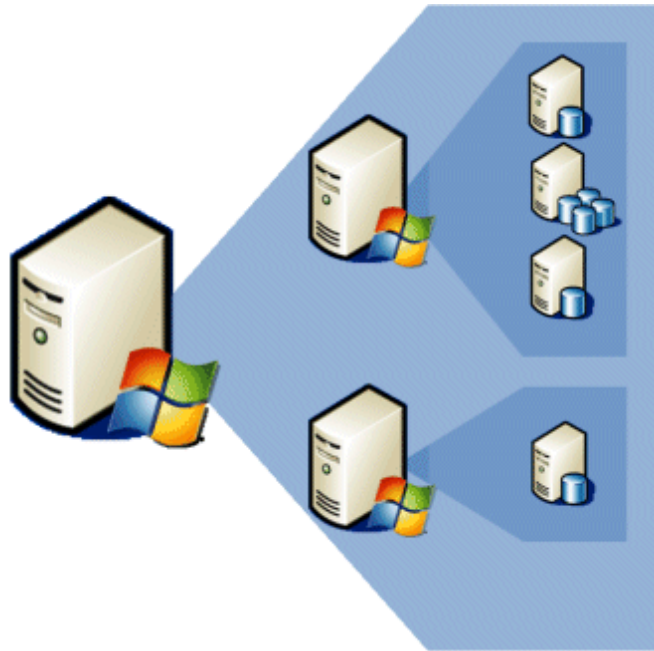


Figure 4: Virtual database servers

While you can install any edition of SQL Server in a VM, the licensing condition for SQL Server 2008 Enterprise Edition enables you to purchase one Windows license and one SQL Server license for each physical processor on the server, and run an *unlimited* number of VMs, each of which can host one or more SQL Server 2008 instances. This makes it possible for a single powerful server to host as many SQL Server instances as you require, and to add instances to it in the future without incurring extra licensing costs.

You can migrate VMs between physical servers quickly and easily, and with minimal downtime. This enables administrators to improve performance by making optimal use of server resources, to scale databases as required, and to perform scheduled maintenance, all with little or no impact on users. Windows Server 2008 R2 Hyper-V offers two mechanisms for migrating VMs: Quick Migration and Live Migration. Quick migration involves saving, moving, and restoring a VM to a new machine, and its use will usually involve a short period of downtime. Live migration enables the migration of VMs with virtually no downtime using a “memory to memory” operation. You can use Live Migration with both VHDs and network-attached pass-through disks.

Virtualization places a greater strain on servers than a simpler single or multiple instance strategy, and you need to carefully assess the impact of each virtual machine in terms of the resources it will consume. The AMD-V and Intel VT processor architectures that Windows Hyper-V leverages are designed specifically for virtualization, and they minimize the impact that running virtual machines has on a system.

The following table summarizes the differences between using multiple instances and using multiple virtual machines for consolidation.

	Multiple SQL Server Instances	Multiple VMs
Isolation	Shared Windows instance	Dedicated Windows instance
CPU Resources	Number of CPUs visible to Windows instance	Maximum Windows 2008 – up to 4 virtual CPUs Windows 2003 – up to 2 virtual CPUs
Memory	Server Limit Flexible (max server memory)	Statically allocated to VM Offline changes only No ability to “over commit” memory resources 64GB limit per VM 2 TB limit per Host
Storage	SQL Data Files with standard storage options	SQL Data Files using pass-through or Virtual Hard Disks exposed to VM
Resource Management	WSRM (process level)	Hyper-V guest VM
Number of instances	50	Practical limit determined by physical resources
Support	Normal rules apply	SQL 2008 , SQL 2005
High Availability	Normal rules apply	DBM, Log Shipping

Table 3: Summary of differences between using multiple instances and multiple virtual machines for consolidation

Considerations for Choosing a Server Consolidation Strategy

Choosing a server consolidation strategy for database servers can present a number of considerations. Key factors in deciding on the best consolidation strategy for your data services include:

- **Hardware resources.** Each consolidation approach has a different effect on hardware resource usage. Consider whether 32-bit or 64-bit hardware will provide the best performance and scalability for your solution. The general trend is towards the use of 64-bit hardware.
- **Workload isolation.** While the goal of consolidation is to reduce the number of servers as much as possible, you should profile the workloads performed by

different database applications, and consider whether they should be isolated from one another for performance or other reasons.

- **Application compatibility.** Some applications may have specific requirements for data access protocols, collation, or other configuration options that might be incompatible with other applications.
- **Manageability.** Consolidation generally simplifies management by centralizing the resources that require management. However, you must consider the effect of maintenance tasks, such as backups and index management, on the consolidated system. You must also consider the security implications of consolidation, because operators with administrative rights in one database system might not require administrative rights in others.
- **Availability.** Your consolidation strategy might affect your choice of a high-availability solution. For example, database mirroring provides failover protection at the individual database level and server clustering protects the entire instance. Additionally, database mirroring provides for lesser data loss in case of failures..
- **Security.** In some cases, it may be prudent to isolate database applications for security reasons. For example, one application might require that a feature be enabled in the database server, such as common language runtime (CLR) integration or Database Mail. If you isolate this database you can enable the required functionality while retaining a minimal surface area for other database applications.

The strategies outlined above illustrate the flexibility that you have when consolidating on SQL Server 2008. Furthermore, these strategies are not mutually exclusive; for example, your solution could blend the first two, using multiple instances on a single server, with each instance hosting multiple databases. Whatever your current setup, SQL Server 2008 provides all the flexibility that you will need to build the consolidation solution that is right for your organization.

Choosing the Appropriate Edition of SQL Server 2008 for Consolidation

Consolidated systems present you with different challenges from non-consolidated systems, so you need to choose an edition of SQL Server 2008 that can meet these specific challenges. SQL Server 2008 Enterprise Edition is the natural choice because of its superior hardware support, richer functionality, and better support for scalability and future growth. The higher initial investment cost of Enterprise Edition when compared to Standard Edition can be recouped very quickly through the savings it will enable you to make and the losses in revenue that it can help you to avoid. For

example, on consolidated systems, the window for planned downtime is reduced and the cost of unplanned downtime is increased, so an effective high-availability solution is critical. Both SQL Server Standard Edition and SQL Server Enterprise Edition feature server clustering, but only Enterprise Edition supports up to sixteen nodes (Standard Edition supports just two). This enables you to handle multiple simultaneous unplanned failovers as well as to manually failover for maintenance purposes without affecting other applications, keeping your systems highly available, enabling you to meet SLAs, and avoiding loss of revenue.

This section outlines the key features of SQL Server 2008 that enable consolidation, and highlights why Enterprise Edition is the most appropriate platform for consolidation.

Support for Hardware Resources

SQL Server 2008 Enterprise Edition can support very large size of RAM (up to 2TB). It also supports more processors than SQL Server 2008 Standard Edition (64 CPUs compared to Standard’s 4), enabling Enterprise Edition to scale to true enterprise deployments and making it possible for you to consolidate more databases onto fewer physical servers. Table 3 compares the hardware support offered by SQL Server 2008 Standard Edition and SQL Server 2008 Enterprise Edition.

	SQL Server 2008 Standard		SQL Server 2008 Enterprise	
	32-bit	64-bit	32-bit	64-bit
Maximum number of CPUs	4	4	32*	64*
Hot-swap CPU and RAM	No	No	Yes*	Yes*

* On Windows Server 2008 Datacenter Edition. (Windows Server 2008 R2 offers support for up to 256 logical CPUs.)

Table 4: Hardware support offered by SQL Server 2008 Standard Edition and SQL Server 2008 Enterprise Edition

In addition to better hardware support, SQL Server 2008 Enterprise Edition supports hot swapping of CPUs and memory modules. This enables you to add resources and scale up without incurring downtime.

Licensing

You can license SQL Server 2008 in per-server mode (with the appropriate number of Client Access Licenses or CALs) or in per-processor mode. SQL Server 2008 Enterprise Edition offers special licensing conditions that can result in significant savings for a consolidated system:

- **Server Licensing.** A server license covers unlimited SQL Server instances on the physical server and on any number of virtual machines.
- **Processor Licensing.** As long as all of the physical processors on the server are licensed, you can install unlimited instances on the physical server and also on any number of virtual machines hosted on that server.
- **License mobility.** You can move virtual machines freely between physical servers without any licensing restrictions. This helps you to optimize the use of available server capacity and redeploy virtual servers as required.

These licensing conditions apply to Enterprise Edition only.

High Availability

One of the most frequently voiced concerns about consolidation is that using fewer servers increases the risk of system downtime if any servers fail. SQL Server 2008 Enterprise Edition offers comprehensive high-availability features that will help to keep your systems highly available:

- **Failover clustering.** Clustering offers automatic (or manual) failover of SQL Server instances. SQL Server 2008 Standard Edition supports cluster with a maximum of two nodes. SQL Server 2008 Enterprise Edition offers support for up to 16-node clusters when used with Windows Server 2008, giving you greater redundancy and more control over how services fail over, as discussed earlier. Cluster Services in Windows Server 2008 features major improvements that make it easier to create and manage clusters, and which offer better scalability and reliability. The cluster validation tool helps you to verify the integrity of your SQL Server 2008 failover cluster.
- **Database mirroring.** Mirroring enables you to ensure that individual databases remain available at all times. Using mirroring, you can maintain an exact copy (mirror) of a database that becomes available to users through automatic failover if the principal database becomes unavailable. Enhancements to mirroring in SQL Server 2008 include:
 - Log stream compression, which minimizes the network bandwidth used when transferring data between the principal and the mirror databases.
 - Automatic suspect page recovery using the mirror database. This removes the need to manually recover individual pages from backup.
 - Transparent redirection from any client on failover. Clients do not need to be reconfigured to access the mirror database when failover occurs.

- With Enterprise Edition, you can mirror databases asynchronously. Asynchronous mirroring (or mirroring in high-performance mode) offers better performance because the principal server sends confirmations to clients writing to the database without waiting for acknowledgement from the mirror server. The trade-off is the risk of a small amount of data loss.
- **Peer-to-peer replication.** Peer-to-peer transactional replication involves two or more servers that replicate database changes to one another in near-real time. This enables you to spread read operations over multiple servers and also provides redundancy. Enhancements in SQL Server 2008 Enterprise Edition include:
 - Simplified configuration and management.
 - The addition of nodes to a peer-to-peer replication configuration without stopping system activity.

You can use these technologies together to ensure that databases and services remain highly available. For example, you can cluster the physical (parent) server and use database mirroring between SQL Server instances in virtual machines.

Data Compression and Backup Compression

Consolidated systems must often support very large volumes of data, which leads to increased costs, especially when storage is handled through expensive SANs. Large data volumes can also reduce the performance of a system because much of its workload can involve moving data. One of the biggest bottlenecks on a database system is I/O, but because compression minimizes the I/O for a given volume of data, performance is improved. SQL Server 2008 Enterprise Edition supports data compression, which enables you to store your data more effectively, reduces the cost of storage on a consolidated system, and significantly improves performance for large I/O-bound workloads. The amount of disk capacity that you can save can be significant. A recent report by Forrester Consulting ([Total Economic Impact of SQL Server 2008 Upgrade](#)) found that for one organization:

“The data compression feature in SQL Server 2008 [Enterprise Edition] has significantly reduced the amount of storage required. On average, the customer is reducing storage space by 50%. It was able to free up one terabyte (TB) of storage space for the existing 2005 SQL Server databases. Additionally, the amount of storage added in future years will be reduced from 500GB to 250GB per year. The result is that no storage needs to be added to support the SQL Server databases for the next three years.”

Compression also helps in reducing the cost of business continuity. For disaster recovery purposes, one or multiple copies of the data is backed up on disk, tapes and

other storage mechanisms, which directly translates to costs in terms of storage hardware. Backup compression addresses these concerns on both fronts: the size of the backup is reduced substantially, depending on the content of the data being compressed, and the overall time to back up and restore is similarly reduced. However, backup compression comes at the cost of CPU usage, so this might have an impact on your online workload.

Security

Consolidated databases bring additional security concerns, such as ensuring that users and administrators can access the data to which they require access, while restricting unauthorized access to other data on the same server. SQL Server 2008 Enterprise Edition has new and improved features that help to keep your consolidated systems secure:

- **Transparent data encryption (TDE).** Use TDE to encrypt and de-encrypt entire databases automatically. The process is transparent to applications, which do not require modification to take advantage of TDE, with the result that the development effort required to achieve greatly improved levels of security is virtually eliminated.
- **Extensible key management.** SQL Server's support for enterprise key management enables you to integrate SQL Server encryption into your enterprise cryptographic infrastructure.
- **Levels of isolation.** You can isolate applications at three levels:
 - **Database.** Control access to individual database on a user-by-user basis.
 - **Server.** Control access to individual instances by using logins. In SQL Server or Windows integrated authentication.
 - **Operating System (physical or virtual).** Control access to the operating systems that host SQL Server instances by using local Windows or Active Directory® accounts.
- **SQL Server Audit.** A key security requirement in an enterprise is the ability to audit activity in databases automatically and to be able to generate consistent audit reports for all database server instances. Consolidation simplifies this process, because there are fewer servers to manage. SQL Server 2008 Enterprise Edition includes extensive auditing capabilities that enable you to log activity at both the server and database level, including changes to the data and schema. You can define auditing filters to specify the actions to audit based on actions, objects, and security principals, and specify where the auditing

information should be recorded. After you configure auditing on one instance of SQL Server 2008, you can apply these settings to other instances on the server. You can consolidate the audit results for your entire organization in one place, use Reporting Services to create customized reports, and use Analysis Services to analyze the centralized audit data.

Scalability and Performance

Consolidation makes use of existing hardware as well as, in some cases, new hardware. The decision is based on workload types and future workload projections. A scalable server such as SQL Server 2008 will mitigate some risk by helping organizations make decisions about hardware with the confidence that SQL Server can scale when required. The other big challenge with consolidation is resource contention. Resource prioritization will help application business needs. SQL Server 2008 Enterprise Edition provides some key new features to meet these challenges:

- **Resource Governor.** Resource Governor enables organizations to define resource limits and set priorities for different workloads. This enables the differentiation of workloads within a single instance on a consolidated server and the control of memory and processor resources to prevent runaway queries or large workloads from adversely affecting the performance of mission-critical workloads. This ability to proactively control use of resources provides more predictable performance of consolidated data services.
- **Scaling up consolidated servers.** SQL Server Enterprise Edition also provides optimal performance and scalability by providing several features to improve concurrency and prevent locks caused by one process blocking other processes on the server. The locking system in SQL Server 2008 provides greater concurrency and improved lock escalation compared to previous releases. You can organize tables and indexes into partitions on a disk and switch in and out of these partitions individually to reduce contention and improve overall performance. Furthermore, the release of Windows Server 2008 R2 includes support for 256 logical CPUs, offering SQL Server 2008 the ability to scale to unprecedented levels. For more information, see: <http://www.microsoft.com/presspass/features/2008/nov08/11-06winserverr2.msp>
- **Data and backup compression.** As discussed earlier, these technologies can help you save a great deal of storage space, which makes it possible to scale up without purchasing more storage.

Manageability

Server consolidation helps in the centralization of administrative functions. SQL Server 2008 provides a suite of tools to manage, administer, monitor, and troubleshoot consolidated data systems.

Centralizing management with SQL Server Management Studio

SQL Server Management Studio (SSMS) is a great tool for managing a consolidated database environment. SSMS can be used to manage multiple native or virtual SQL Server databases and instances on local or remote servers. SSMS is backward compatible, so you can use it to manage SQL Server 2005 and SQL Server 2000 too. The same consistent SSMS interface is used for managing SQL Server Database Engine instances, SQL Server Analysis Services, SQL Server Integration Services, and SQL Server Reporting Services.

Enforcing configuration policy compliance with policy-based management

Organizations increasingly want to enforce a set of policies to follow regulatory or best-practice requirements. Previously this has involved configuring many tables, databases, and instances, and then periodically checking compliance against these policies. In SQL Server 2008, you can consolidate configuration management by using policy-based management to apply policies to multiple servers, databases, tables, and other targets in the enterprise. Policy-based management enables you to:

- Ensure compliance with policies for system configuration.
- Monitor or prevent changes to the system by authoring policies for the desired configuration.
- Scale management across multiple servers.
- Reduce total cost of ownership by simplifying administration tasks.

You can proactively enforce policies by using triggers, or on a schedule by using SQL Server Agent. Additionally, you can use ad-hoc execution to check or configure target objects against policies in real time.

Centralizing and consolidating monitoring using Data Collector

SQL Server generates valuable data to assist in performance tuning and troubleshooting. Although this is extremely useful, it can also be time-consuming to use multiple tools to identify problems. SQL Server 2008 includes Management Data Warehouse and a suite of tools to help you troubleshoot, tune, and monitor the state of one or more instances of SQL Server 2008. The centralized management of data collection, storage, and reporting of the various performance metrics can help in consolidation planning and ongoing operations.

Migration and Integration

Migrating data is an important part of the consolidation process. This may involve moving data from older versions of SQL Server or from third-party systems. SQL Server 2008 Integration Services is ideally suited for this purpose. It can extract data from a wide variety of sources, including SQL Server, Oracle, Teradata, DB2, Sybase, SAP BI, Siebel, Microsoft Office Access®, Microsoft Office Excel®, XML, and flat file sources. You can use Integrations Service's extensive set of transformations to modify the data (cleaning it, for example) before loading it into your SQL Server 2008 database. Enterprise Edition offers advanced transformations that enable you to perform tasks such as fuzzy lookups and groupings and to create large-scale data warehouses.

You can also consolidate on data analysis and reporting. SQL Server 2008 comes complete with SQL Server Analysis Services and SQL Server Reporting Services at no extra cost. This makes it possible for you to build sophisticated data analysis, data mining, and reporting solutions on a single platform. Tight integration with Microsoft Office Excel and Microsoft Office Word, along with the Report Builder 2.0 tool, makes it easy for users to create reports and interact with Reporting Services, without the need for third-party tools.

Enterprise Edition / Standard Edition Features Comparison Summary

Table 5 shows a summary of the features offered by SQL Server 2008 Enterprise Edition and SQL Server 2008 Standard Edition.

	SQL Server 2008 Standard Edition	SQL Server 2008 Enterprise Edition
Max Databases	32,767	32,767
Max Instances	16	50
Virtualization	Yes	Yes, unlimited
64-bit	Yes	Yes
Max Memory	Operating system maximum	Operating system maximum
Max CPUs	4	64 / 32
Hot-Add CPU and memory	No	Yes
Data Compression	No	Yes
Backup Compression	No	Yes
TDE	No	Yes

SQL Server Audit	No	Yes
Resource Governor	No	Yes
Policy-Based Management	No	Yes
Data Collector	No	Yes

Table 5: Summary of the features offered by SQL Server 2008 Enterprise Edition and SQL Server 2008 Standard Edition

A full list of features for each edition can be found at MSDN:

<http://msdn.microsoft.com/en-us/library/cc645993.aspx>

Conclusion

SQL Server 2008 reduces hardware and maintenance costs by providing a flexible server consolidation solution that enables organizations to save money by centralizing data services on fewer servers. SQL Server 2008 provides support for Windows Server 2008 Hyper-V virtualization. For multiple service instances on a single physical server, it has the tools and functionality necessary for migrating distributed data to a consolidated data center. By providing a centralized data services management interface and policy-based management, SQL Server makes it easy for organizations with multiple data stores to reduce management overhead. The industry-leading features and performance of SQL Server 2008 Enterprise Edition and its ability to explicitly control how server resources are used enables you to consolidate your data services while providing the scalability and performance your applications need.

For more information:

Microsoft SQL Server 2008:

<http://www.microsoft.com/sqlserver/2008/en/us/default.aspx>

SQL Server Developer Center:

<http://msdn2.microsoft.com/sqlserver>

SQL Server TechCenter:

<http://technet.microsoft.com/sqlserver>

Windows Server 2008 R2 multi-processor support:

<http://www.microsoft.com/presspass/features/2008/nov08/11-06winserverr2.msp>

Forrester Consulting report:

<http://download.microsoft.com/download/d/1/1/d11349b8-af33-45c4-a89c-f0dc64bbd431/TEI%20of%20SQL%20Server%202008%20Upgrade.pdf>

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