



# Database Security

*Chapter 4*  
*Microsoft SQL Server Installation*



# Objectives

- Identify the considerations that an administrator must take into account prior to installation
- Install the Microsoft SQL Server 2008 for Windows operating systems
- Configure Microsoft SQL Server 2008 Services for Windows platforms
- Secure the installation and configuration of Microsoft SQL Server 2008



# Planning for a Microsoft SQL Server Installation

- Microsoft SQL Server
  - Significant database enterprise solution
  - Has improved scalability and performance
  - Easy to use and low cost
- Installation of Microsoft SQL Server
  - Simple as any other Microsoft application installation
  - Administrators must make several decisions
  - Understanding requirements, available versions, and available features necessary to design an effective solution



# Meeting the Requirements

- Hardware requirements for SQL Server 2008
  - Processor type
  - Processor speed: 1.4 GHz (64 bit) 1.0 GHz (32-bit)
  - Hard drive storage: 350 MB
  - Main memory storage: 512 MB RAM
- Suggested not to run on machines with only the minimum requirements
  - Microsoft recommends at least 2.0 GHz processors and 2 GB RAM to function properly



# Meeting the Requirements (cont'd.)

- Appropriate hard drive space depends on organization's current and future needs
- Size of the database differs depending on which features are installed

<b>Edition</b>	<b>Minimum CPU type</b>	<b>Minimum CPU speed/recommended</b>	<b>Operating systems</b>	<b>Minimum memory/recommended memory/maximum memory</b>
Enterprise IA64	Itanium	1.0 GHz/ 2.0 GHz	Windows Server 2008 64-bit Itanium Windows Server 2003 64-bit Itanium Data Center Windows 2003 64-bit Itanium Enterprise	512 MB/2 GB/ Operating system maximum
Enterprise X64	AMD Opteron, AMD Athlon 64, Intel Xeon EM64T, Intel Pentium IV EM64T	1.4 GHz/ 2.0 GHz	Windows Server 2008 64-bit x64 Standard Windows Server 2008 64-bit x64 Data Center Windows Server 2008 64-bit x64 Enterprise Windows 7 Ultimate Windows 7 Enterprise Windows 7 Professional Windows 7 64-bit x64 Ultimate Windows 7 64-bit x64 Enterprise Windows 7 64-bit x64 Professional Windows Server 2003 64-bit x64 Standard SP2 Windows Server 2003 64-bit x64 Data Center SP2 Windows Server 2003 64-bit x64 Enterprise SP2 Windows Server 2008 64-bit x64 Web	512 MB/2 GB/ Operating system maximum

**Table 4-1 SQL Server software and hardware requirements (continues)**

<b>Edition</b>	<b>Minimum CPU type</b>	<b>Minimum CPU speed/recommended</b>	<b>Operating systems</b>	<b>Minimum memory/recommended memory/maximum memory</b>
Standard x64	AMD Opteron, AMD Athlon 64, Intel Xeon EM64T, Intel Pentium IV EM64T	1.4 GHz/ 2.0 GHz	Windows Server 2008 64-bit x64 Web Windows Server 2008 64-bit x64 Standard Windows Server 2008 64-bit x64 Datacenter Windows Server 2008 64-bit x64 Enterprise Windows 7 Ultimate x64 Windows 7 Enterprise x64 Windows 7 Business x64 Windows Vista Ultimate x64 Windows Vista Enterprise x64 Windows Vista Business x64 Windows XP Professional X64 Windows Server 2003 64-bit x64 Standard SP2 Windows Server 2003 64-bit x64 Data Center SP2 Windows Server 2003 64-bit x64 Enterprise SP2	512 MB/2 GB/ Operating system maximum
Enterprise X86 (32-bit)	PIII	1.0 GHz/ 2.0 GHz	Windows Server 2008 Enterprise Windows Server 2008 Web Windows Server 2008 Data Center Windows Server 2008 64-bit x64 Standard Windows Server 2008 64-bit x64 Enterprise Windows Server 2008 64-bit x64 Data Center Windows Small Business Server 2003 Standard Windows Small Business Server 2003 Premium Windows Server 2003 Standard SP2 Windows Server 2003 Enterprise SP2 Windows Server 2003 Premium SP2 Windows Server 2003 64-bit x64 Standard SP2 Windows Server 2003 64-bit x64 Data Center SP2 Windows Server 2003 64-bit x64 Enterprise SP2	512 MB/2 GB/ Operating system maximum

**Table 4-1 SQL Server software and hardware requirements (continues)**

Edition	Minimum CPU type	Minimum CPU speed/recommended	Operating systems	Minimum memory/recommended memory/maximum memory
Standard X86 (32-bit)	PIII	1.0 GHz/ 2.0 GHz	Windows Server 2008 Enterprise Windows Server 2008 Web Windows Server 2008 Data Center Windows Small Business Server 2008 Windows Server 2008 64-bit x64 Standard Windows Server 2008 64-bit x64 Enterprise Windows Server 2008 64-bit x64 Data Center Windows 7 Ultimate Windows 7 Enterprise Windows 7 Professional Windows 7 64-bit x64 Ultimate Windows 7 64-bit x64 Enterprise Windows 7 64-bit x64 Professional Windows Vista Ultimate x64 Windows Vista Enterprise x64 Windows Vista Business x64 Windows XP Professional SP2 Windows XP Professional X64 SP2 Windows Server 2003 32-bit Standard Windows Small Business Server 2003 Standard Windows Small Business Server 2003 Premium Windows Server 2003 Standard SP2 Windows Server 2003 Enterprise SP2 Windows Server 2003 Premium SP2 Windows Server 2003 64-bit x64 Standard SP2 Windows Server 2003 64-bit x64 Data Center SP2 Windows Server 2003 64-bit x64 Enterprise SP2	512 MB/2 GB/ Operating system maximum

Table 4-1 SQL Server software and hardware requirements (cont' d.)

<b>Feature</b>	<b>Storage cost</b>
Complete Data Engine Core	250 MB
Complete Analysis services and data files	90 MB
Complete Reporting and Reporting Manager services	120 MB
Complete Integration Services	120 MB
Complete Client Components	240 MB
Complete Server Books Online	240 MB

**Table 4-2 Storage used by SQL Server 2008 features**

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# Supported Platforms

- Not all editions of SQL Server 2008 support the same operating systems
- Deciding on the most appropriate operating system a critical choice
  - Determines available features
  - Mistake can damage system performance and scalability
- 64-bit versions of SQL should be used:
  - To fully leverage capability of 64-bit OS



# Operating System Requirements

- Operating systems compatible with Microsoft SQL Server 2008
  - Windows Server 2008
  - Windows Server 2003
  - Windows 7
  - Windows Vista
  - Windows XP



# Other Software Prerequisites

- Software required to enable installation of 32-bit and 64-bit Microsoft SQL Server editions
- General software
  - .NET Framework 3.5 SP11
  - Microsoft Windows Installer 4.5 or later
  - Internet Explorer 6 SP1 or later
  - Latest version of PowerShell
  - Microsoft Data Access Components (MDAC) 2.8 SP1 or later



# Other Software Prerequisites

- Network software
  - Shared Memory
  - TCP/IP
  - Named Pipes
  - Virtual Interface Adapter Via Protocols



# Network Resource Requirements

- Network design and architecture
  - Play large role in reliability and efficiency of client-server environment
- Changes to network's hardware and software:
  - May be necessary with implementation of SQL Server
- Test environment to ensure it can handle data traffic
  - Test network cards, switches, cables, and other devices



# Making the Difficult Decisions

- Customization
  - One of SQL Server's greatest selling points
  - Software includes many customization options
  - Available features vary with different editions of SQL Server
- Important decisions
  - Choosing an edition
  - Choosing features
  - Licensing options

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# Choosing an Edition

- Different editions developed to meet specific needs
- Available editions
  - SQL Server Express Edition
  - Compact 3.5
  - Workgroup Edition
  - Web Edition
  - Developer Edition
  - Standard Edition
  - Enterprise Edition

<b>Edition</b>	<b>CPUs supported</b>	<b>Maximum addressable memory</b>	<b>Maximum database size</b>
SQL Server Express (x86, x64)	1	1 GB	4 GB
SQL Compact	OS maximum	OS maximum	4 GB
SQL Server Workgroup (x86 and x64)	2	4 GB on a 64-bit OS and the OS maximum on a 32-bit one	No maximum
Web (x86, x64)	4	OS maximum	No maximum
SQL Server Developer (x86, x64, and IA64)	OS maximum	OS maximum	No maximum
Standard (x86, x64)	4	OS maximum	No maximum
Enterprise (x86, x64, and IA64)	OS maximum	OS maximum	No maximum

**Table 4-3 SQL Server editions and hardware requirements**

Year	Version	Comments
1987	Sybase SQL Server	Released for UNIX
1988	SQL Server	A joint effort between Sybase and Microsoft, included support for use on OS/2 Capable of storage and handling of personal and small department use
1989	SQL Server 1.0	Fine-tuned, focused support for OS/2 Capable of storage and handling of personal and small department use
1990	SQL Server 1.1	Added support for Windows 3.0 Capable of storage and handling of personal and small department use
1993	SQL Server 4.2	Integrated with Windows NT; capable of storage and handling of personal and small department use
1994		Microsoft and Sybase split; Sybase continues to focus on UNIX database systems while Microsoft focuses on Windows
1995	SQL Server 6.05	First version to be written solely by Microsoft; database engine rewritten to support small business and e-commerce applications
1996	SQL Server 6.5	Gaining prominence
1998	SQL Server 7.0	Database engine rewritten to support small-to-medium-sized businesses Additional features include analysis services and data transformation services
2000	SQL Server 2000 enterprise database	First version to support enterprise environments; database engine was enhanced for improved performance and scalability; provided full support of online operations of businesses, improved development, and analysis tools
2005	SQL Server 2005	Engine rewritten to include integration services, .NET Framework giving the user the ability to create .NET SQL Server-specific objects
2008	SQL Server 2008	Additions to 2005 to include additional data types, use of Language Integrated Query (LINQ), and XML; enhanced support of large installations

**Table 4-4 Timeline of Microsoft SQL Server releases**



# SQL Server Features and Components

- Microsoft SQL Server includes several features administrators can include or exclude from an installation
- Modular packaging goal
  - Provide customizable, lightweight server with environment-specific capabilities
- Server tools
  - Fundamental tools available with an installation of Server 2008



# SQL Server Features and Components (cont'd.)

- Database Engine Services
  - Heart of SQL Server database
  - Responsible for data storage, retrieval, manipulation, and security
  - Two subcomponents: Replication and Full Text Search
- Reporting Services (SSRS)
  - Provides different ways to present and deliver data



# SQL Server Features and Components (cont'd.)

- Analysis Services (SSAS)
  - Provides online analytical processing (OLAP) and data mining
  - Designed for fast, frequent processing of data and queries
- Integrated Services (SSIS)
  - Joins and normalizes data from different sources



# SQL Server Features and Components (cont'd.)

- Management tools
  - SQL Server Configuration Manager
    - Used to configure installation
  - SQL Server Management Studio
    - Administrative interface to SQL Server database
  - Business Intelligence Development Studio
    - Application development environment
  - Client Tools Connectivity
    - Enables communication between client and server
  - Server Profiler
    - Provides graphical user interface



# Licensing Options

- Express and Compact editions are free for download
- More available features come with higher licensing costs
- Three specific terms of licensing
  - Per Processor Licensing
  - Per Server Plus Device Client Access License (CAL)
  - Per User Plus Device CAL
- Types of CALs
  - SQL CAL, Workgroup CAL



# Locating Help

- Contracts can be formed to provide help in many different areas
- Help resources
  - SQL Server books online
  - Web sites
  - The Microsoft Online Books
  - Microsoft SQL release notes
  - Microsoft SQL forums
  - Bloggers
  - Twitter



# Installation

- Installation may begin after:
  - User obtains desired copy of Microsoft SQL Server
  - Hardware and software requirements are met
  - Desired edition and features have been selected
- If prerequisites have not been met:
  - SQL Server will require updates before installation



# The Server Installation Center

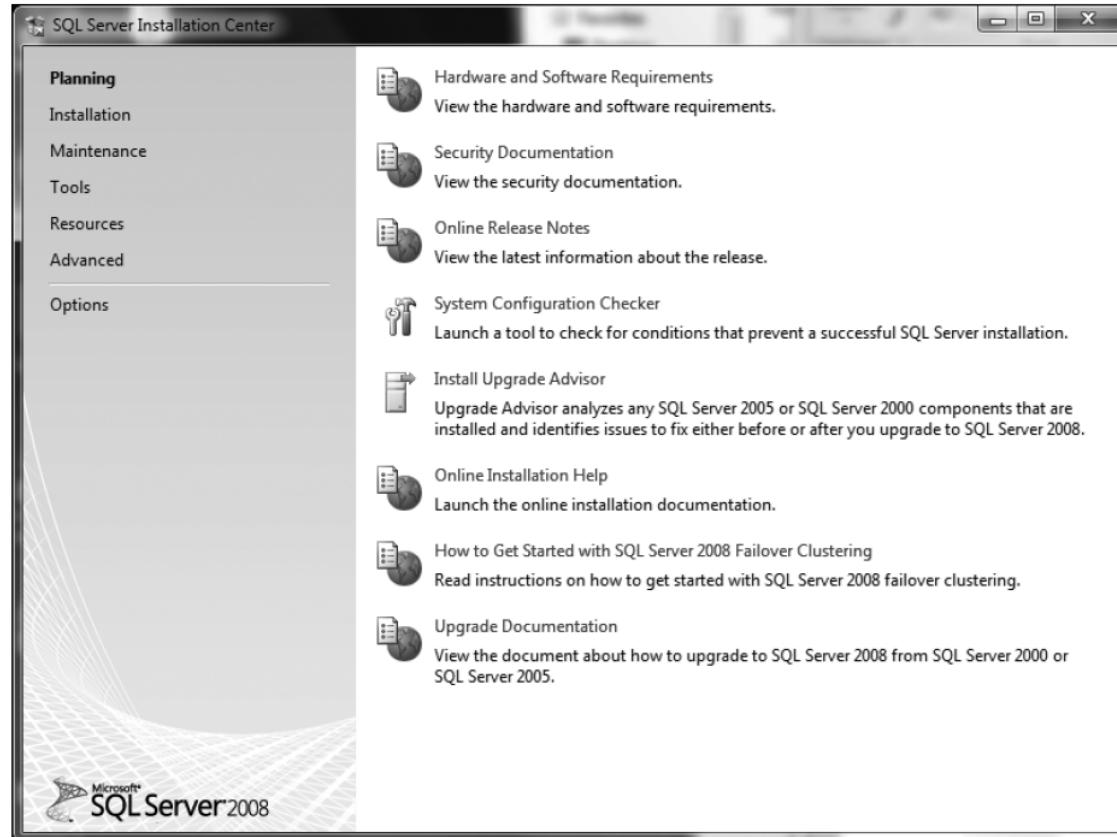


Figure 4-2 SQL Server Installation Center – Planning page  
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# The Server Installation Center (cont'd.)

- Planning page provides planning resources and tools
  - Hardware and software requirements
  - Security documentation
  - Online release notes
  - System configuration checker
  - Install upgrade advisor
  - Online installation help
  - How to get started with SQL Server 2008 failover clustering



# The Server Installation Center (cont'd.)

- Installation page links
  - New SQL Server stand-alone installation or add features to an existing installation
  - New SQL Server failover cluster installation
  - Add node to an SQL Server failover cluster
  - Upgrade for SQL Server 2000 or 2005
  - Search for product updates



# The Server Installation Center (cont'd.)

- Maintenance page links
  - Edition upgrade
  - Repair
  - Remove node to an SQL Server failover cluster
- Tools page
  - System configuration checker
  - Installed SQL Server features discovery report
  - Upgrade integration services package



# The Server Installation Center (cont'd.)

- Resources page
  - Books Online
  - TechCenter
  - Developer Center
  - Product Evaluation Web site
  - License Agreement
  - Register your copy of SQL Server 2008 Express
  - Microsoft Privacy Statement
  - Community
  - CodePlex samples Web site



# The Server Installation Center (cont'd.)

- Advanced page
  - Install-based configuration file
  - Advanced cluster preparation
  - Advanced cluster completion
- Options Page
  - Specify which edition architecture of SQL Server to install
  - Specify installation media root directory if not using CD for installation



# Step-by-Step Installation

- Steps in this section intended for installing the Enterprise Edition of Microsoft SQL Server 2008

1. Insert CD and double-click setup executable file

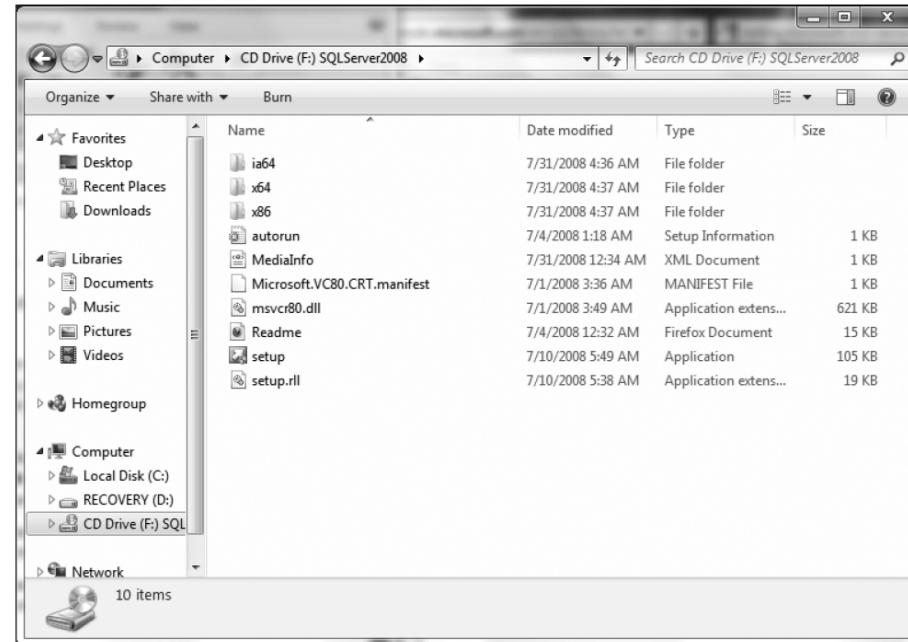


Figure 4-1 Locating the setup file  
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# Step-by-Step Installation (cont'd.)

2. Planning page of SQL Server installation center will appear
  - Click Installation on left to bring up Installation page

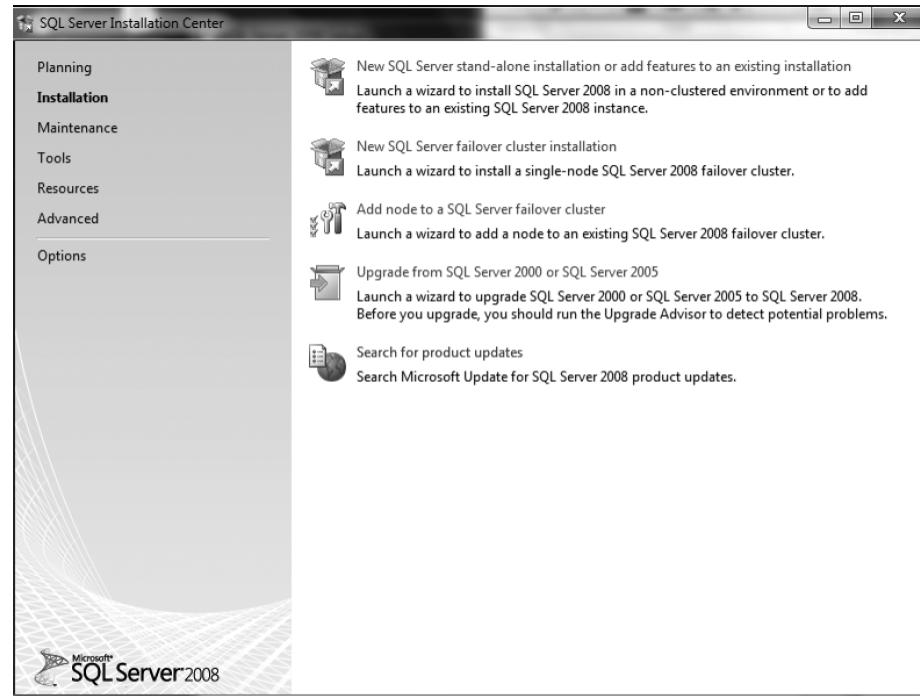


Figure 4-3 Installation page  
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# Step-by-Step Installation (cont'd.)

3. Click New SQL Server standalone installation or add features to an existing installation
  - Click OK

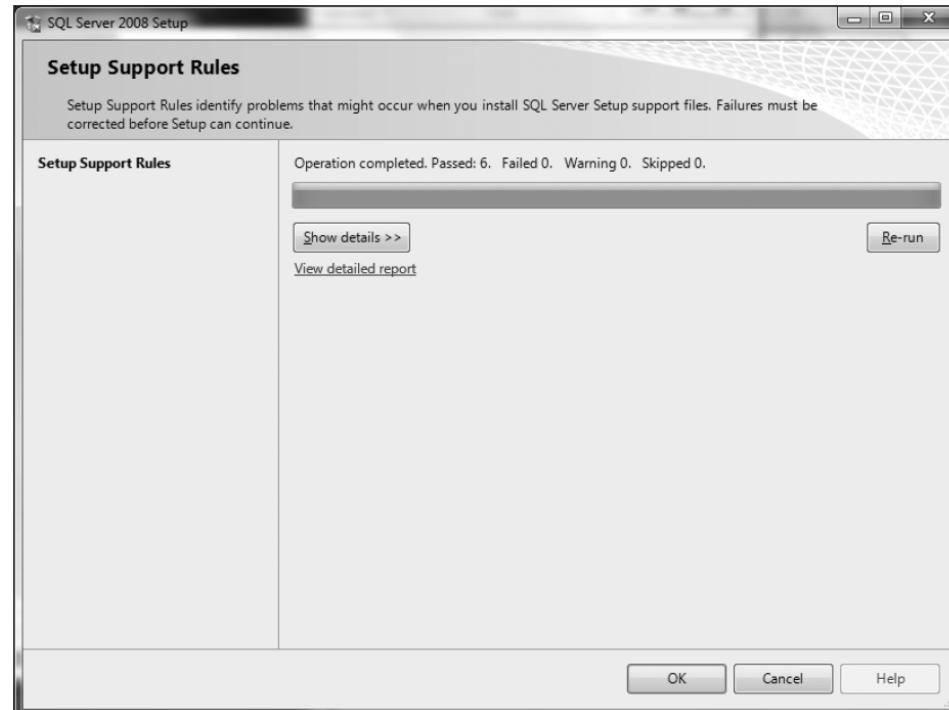


Figure 4-4 System configuration checker  
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# Step-by-Step Installation (cont'd.)

4. Installation Wizard will install SQL Server prerequisites software if needed
  - Click Next to install prerequisites
5. Configuration checker will provide details about the system state of the computer
  - Click Next
6. Enter the product key
  - Use drop down list to specify edition if using a free edition
  - Click Next

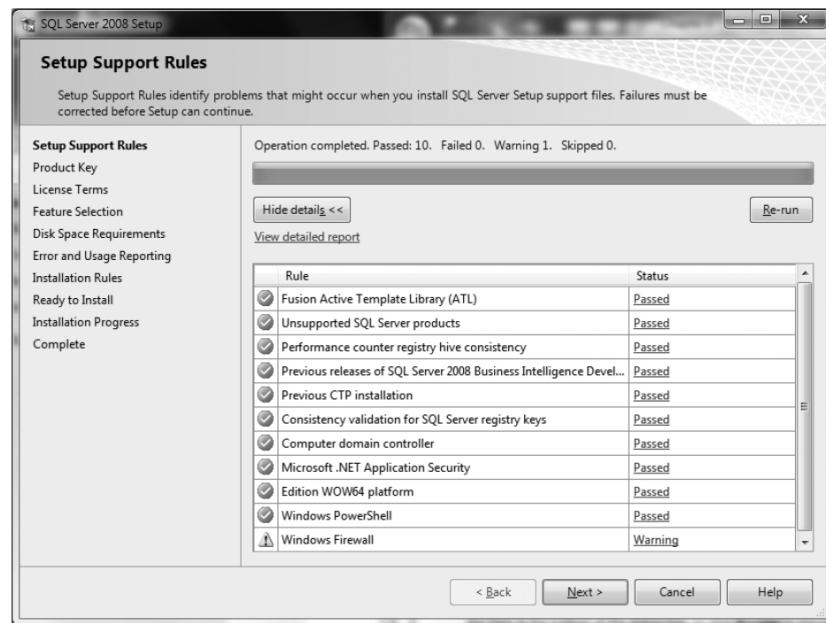


Figure 4-5 System configuration checker details  
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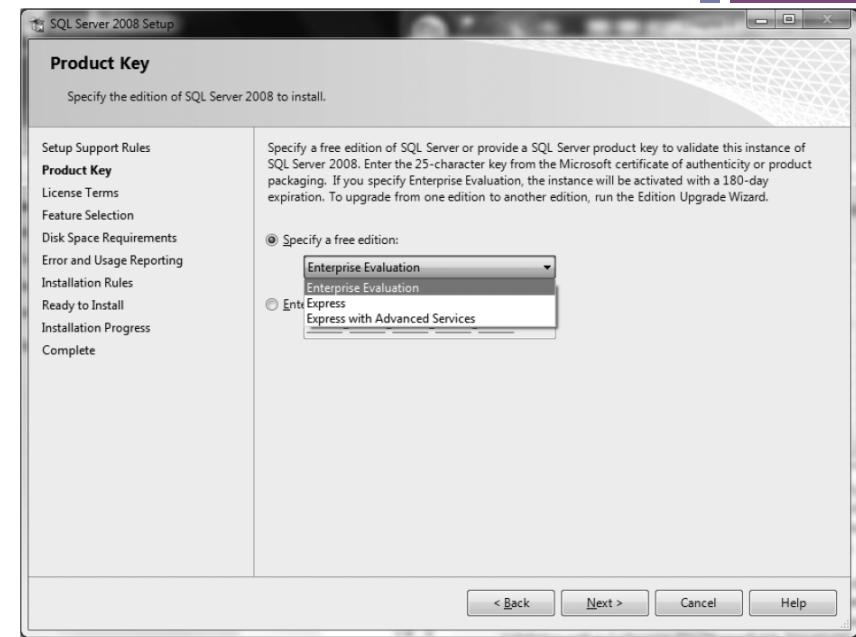
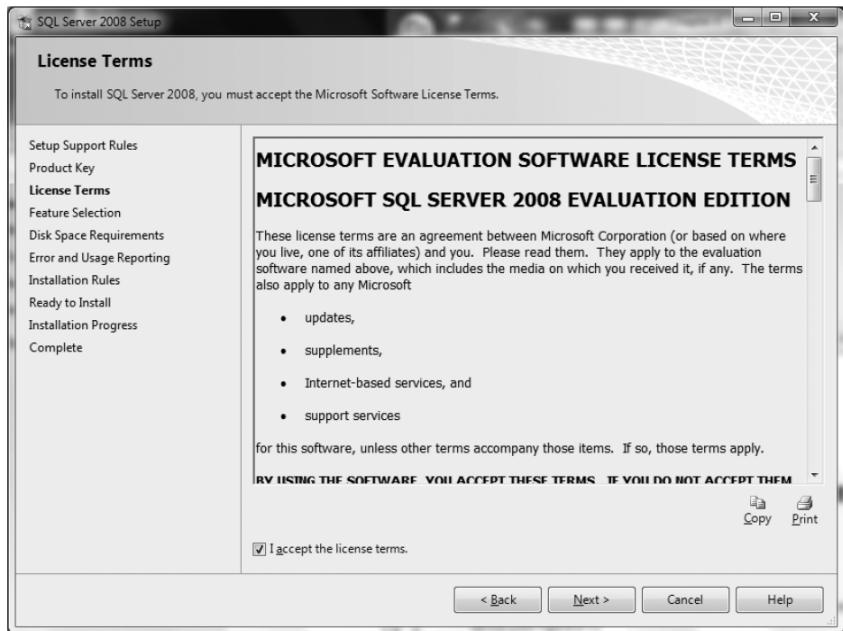


Figure 4-6 Product Key window  
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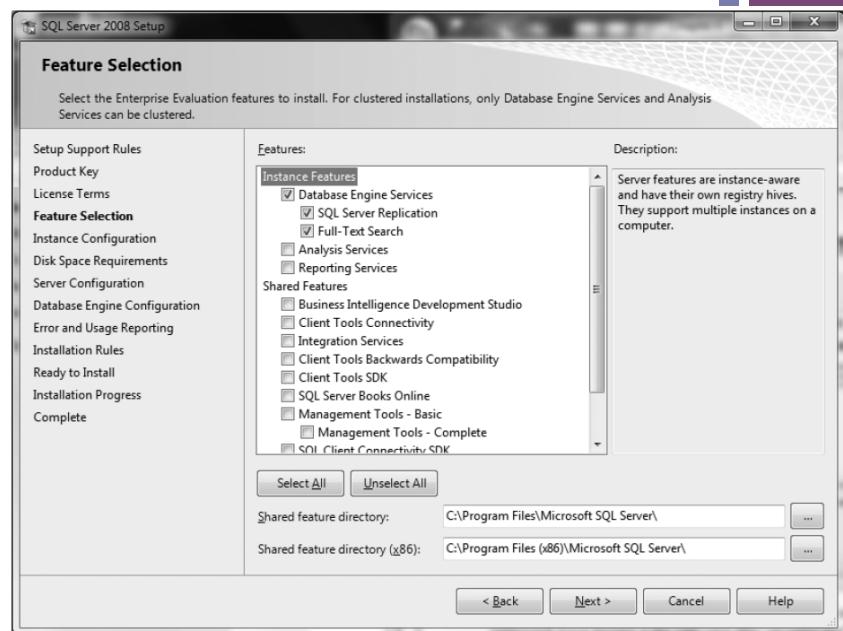


# Step-by-Step Installation (cont'd.)

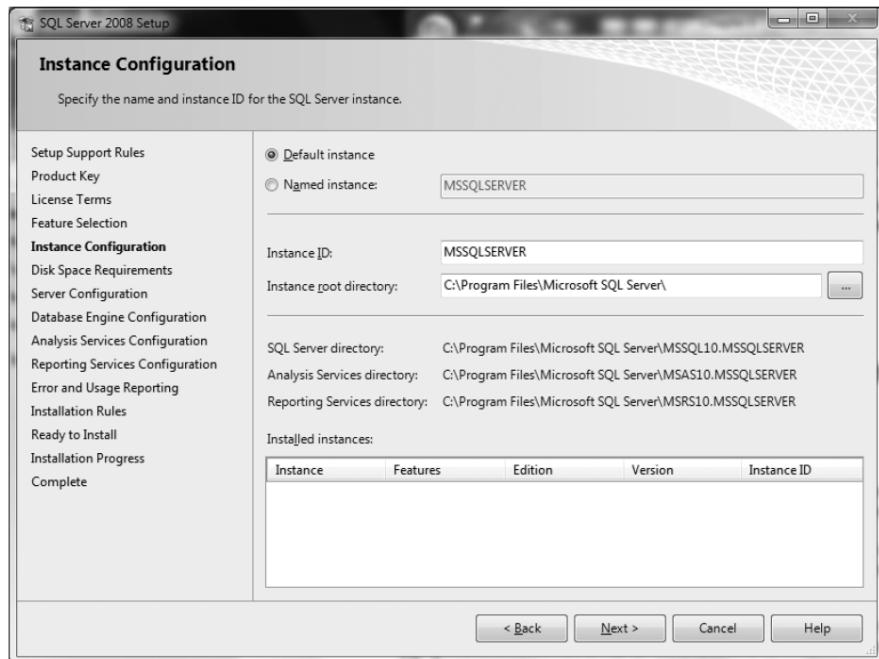
7. Accept the license terms
  - Click Next
8. Select features and components to customize your installation
9. Specify whether to use a default instance or a custom named instance and instance directory
  - Click Next
10. Disk Space Requirements Window calculates the required disk space for specified features



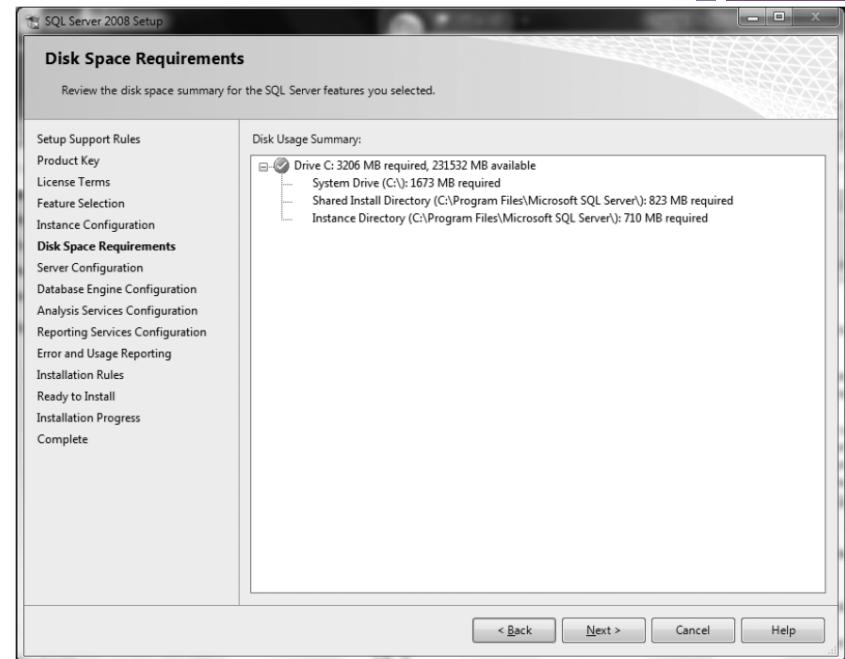
**Figure 4-7 Licensing Terms window**  
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**Figure 4-8 Feature Selection window**  
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**Figure 4-9 Instance Configuration window**  
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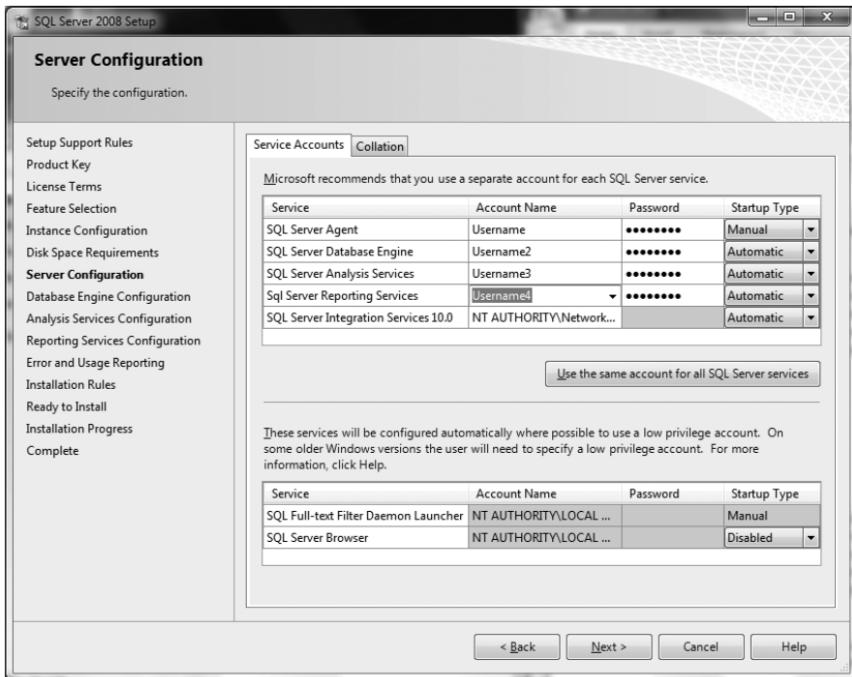


**Figure 4-10 Disk Space Requirements window**  
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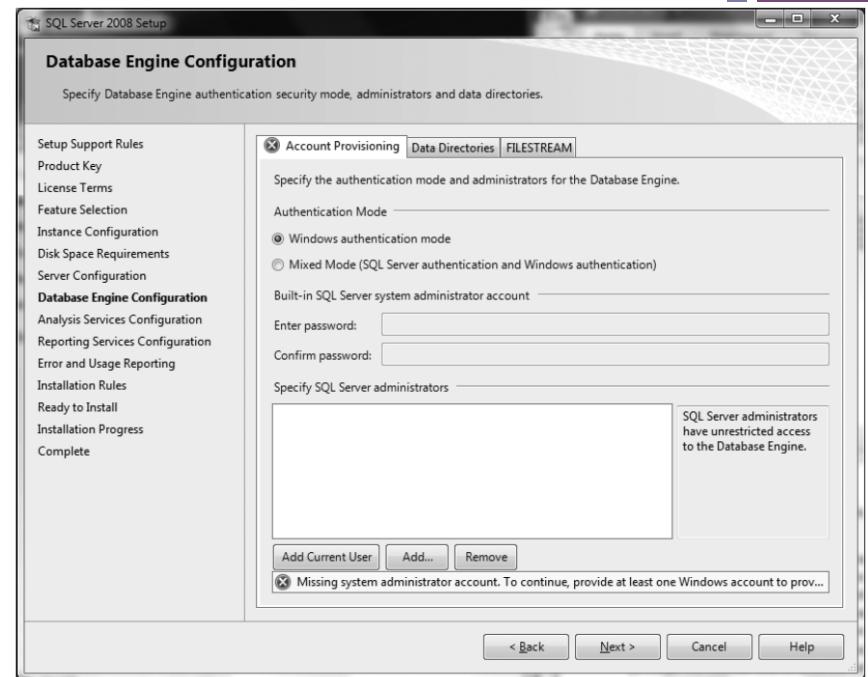


# Step-by-Step Installation (cont'd.)

11. Some services will require a username and password
  - Specify login accounts
  - Change names by clicking Account Name and Password fields
12. Set security mode to Windows Authentication (recommended) or Mixed Mode Authentication
  - Add system administrator account by clicking Add Current User
  - Click OK



**Figure 4-11 Service Accounts window**  
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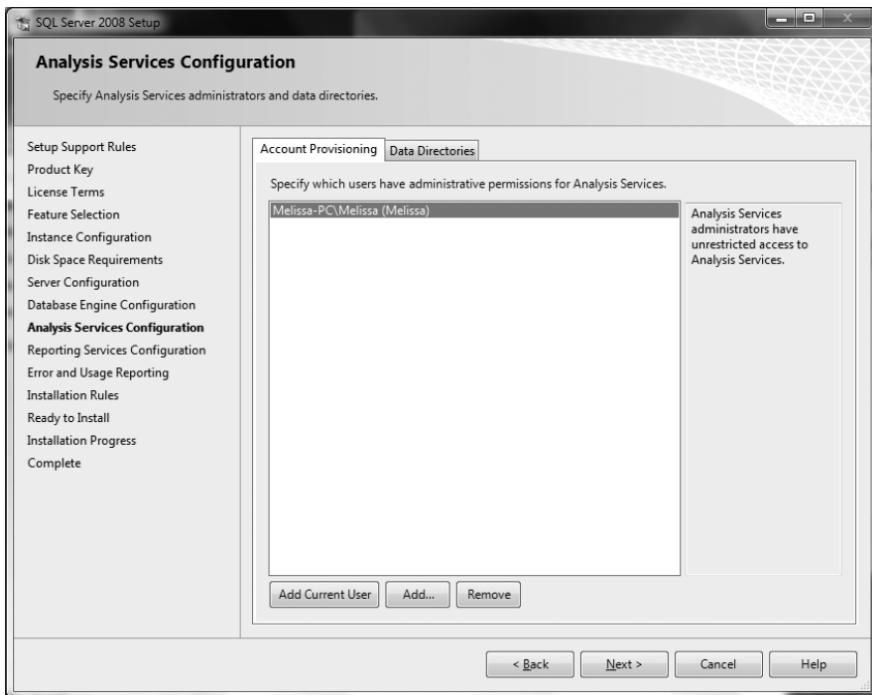


**Figure 4-12 Database Engine Configuration window**  
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# Step-by-Step Installation (cont'd.)

13. Specify users or accounts that will have administrator privileges for Analysis Services
  - At least one system administrator must be specified
  - Click Add Current User
  - Click Add or Remove to add or remove accounts from the list of system administrators
  - Click OK, then Next
14. Specify the kind of Reporting Services installation to create
  - Three choices: Native Mode, SharePoint Integrated Mode, and Not Configured



**Figure 4-13 Analysis Services Configuration window**  
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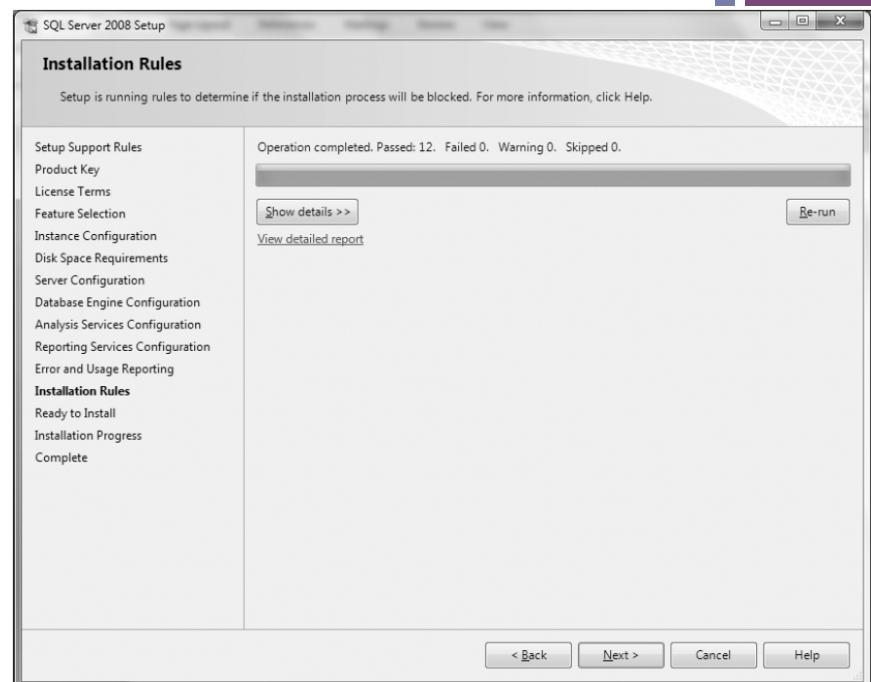
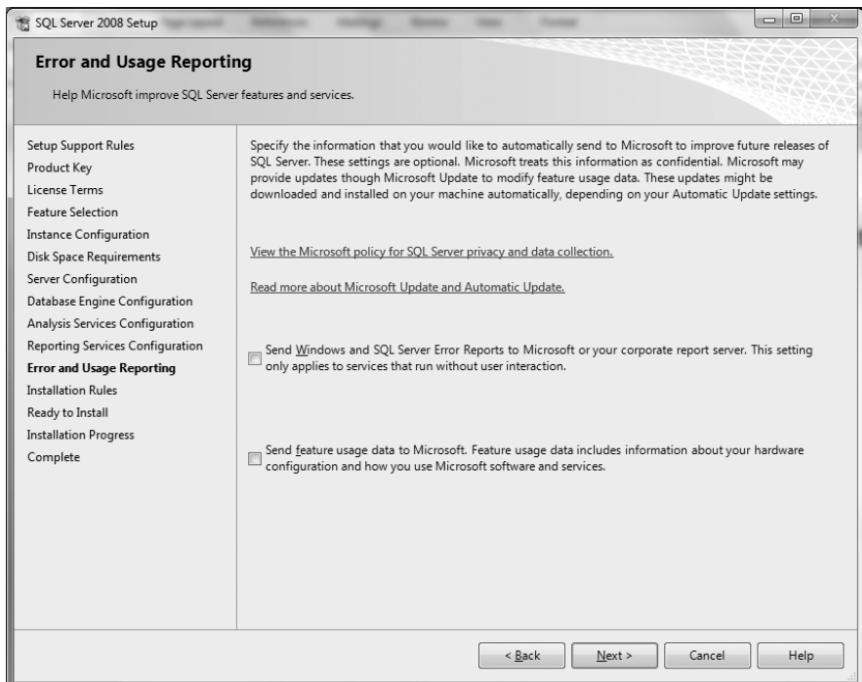


**Figure 4-14 Reporting Services Configuration window**  
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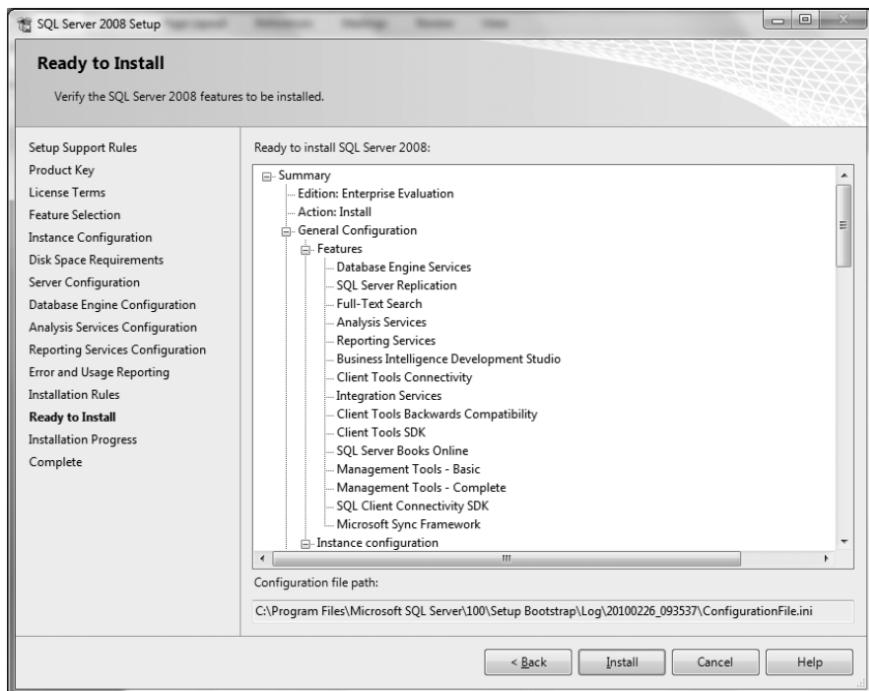
# Step-by-Step Installation (cont'd.)

15. Set options in the Error and Usage Reporting window
  - Click Send Windows and SQL Server Error Reports to Microsoft or your corporate report server
  - Click Next
16. System configuration checker will run again to validate the configuration
17. Click Install on the Ready to Install window
18. Click Close on the Complete window

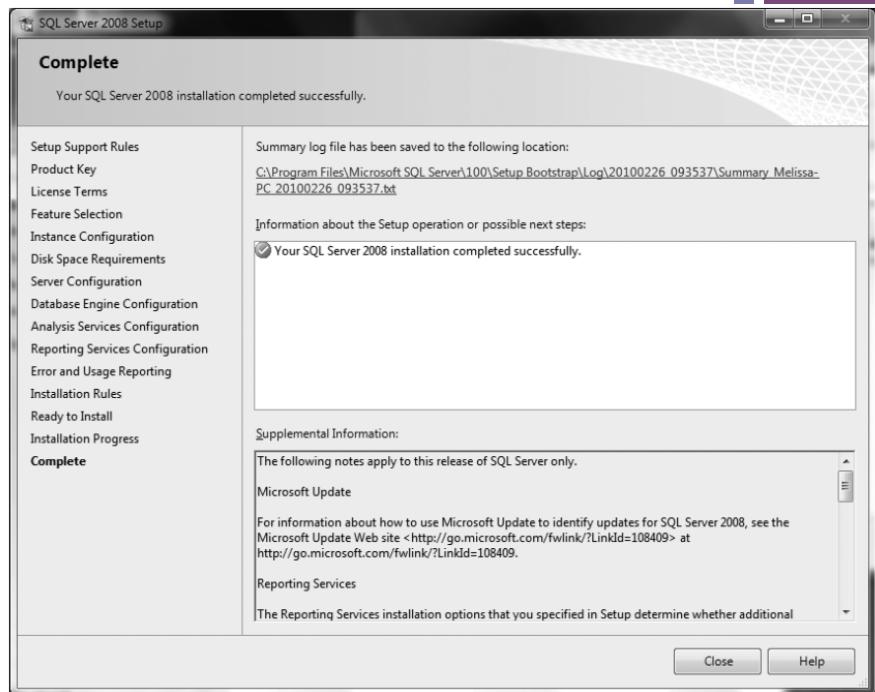


**Figure 4-15 Error and Usage Reporting window**  
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**Figure 4-16 Final system configuration check**  
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**Figure 4-17 Ready to Install window**  
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**Figure 4-18 Completion window**  
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# Additional Security Considerations for SQL Server 2008

- Microsoft SQL Server popularity continues to increase
  - Security attacks also increasing
- Security steps prior to installation
  - Security must be addressed promptly
  - Designers should plan security strategy



# Security Steps Prior to Installation

- Best practices for SQL Server security
  - Place servers behind firewalls and locked doors
  - Use multiple internal and external firewalls, create subnets, and require strict authentication
  - Isolate database servers from public networks and eliminate all connections to unnecessary segments of the network
  - Use a very selective strategy when deciding which users to give permission to access the database

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# Security Steps Prior to Installation (cont'd.)

- Best practices for SQL Server security (cont'd.)
  - Configure ports on a computer, and on an individual basis
    - Avoid group range exceptions whenever possible
    - Never leave ports open and unmanaged
  - Choose servers for your SQL Server installation that use an NTFS file system
    - Provides extra security through encryption and access control list permission implementation
  - Encrypt your connection to the server using SSH or SSL



# During Installation

- Apply policy-based management
  - Manage it centrally
- Use encryption and auditing services
  - Transparent data encryption (TDE) enables encryption and backups without affecting the user
  - Enhanced auditing features allow tracking data access and data modification
- Apply passwords to services individually and uniquely



# During Installation (cont'd.)

- Choose Windows authentication over Mixed authentication
  - Avoids passwords being sent over the network
- Strictly enforce a strong password policy
- Change default usernames whenever possible
  - Change usernames of root passwords



# After Installation

- Never store passwords in plain text format files
  - Use strong encryption techniques
- Use a multilayered approach to access
  - Create specific roles at server, application, and database layers
- Run services under separate Windows accounts that are local or have minimum rights
- Apply principle of least privilege when creating accounts



# After Installation (cont'd.)

- Keep security updates and patches current
- Configure auditing services to enable login auditing at both OS and SQL Server level
  - Review logs frequently
- Disable all guest accounts
- Group database users on a different global group if possible
- Use error logs and ensure their security



# After Installation (cont'd.)

- Never use the administrative account to run the database service engine
  - Use an account having the least privilege possible
- Ensure all file and disk shares on the SQL Server computer are read-only whenever possible



# Transparent Data Encryption (TDE)

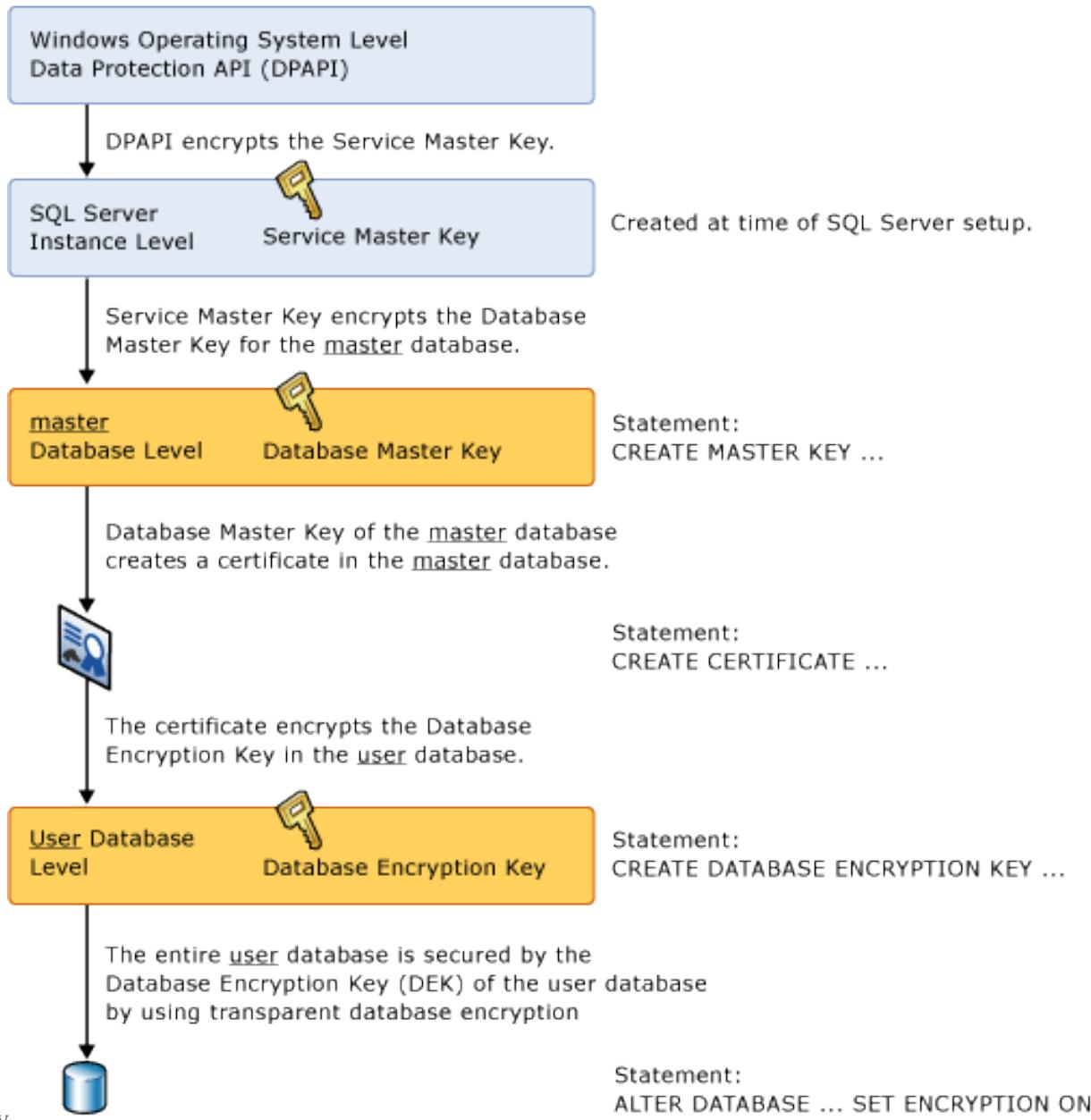
- Transparent Data Encryption (TDE) encrypts SQL Server and Azure SQL Database data files, known as encrypting data at rest. You can take several precautions to help secure the database such as designing a secure system, encrypting confidential assets, and building a firewall around the database servers. However, in a scenario where the physical media (such as drives or backup tapes) are stolen, a malicious party can just restore or attach the database and browse the data.
- One solution is to encrypt the sensitive data in the database and protect the keys that are used to encrypt the data with a certificate. This prevents anyone without the keys from using the data, but this kind of protection must be planned in advance.



# Transparent Data Encryption (TDE)

- TDE performs real-time I/O encryption and decryption of the data and log files. The encryption uses a database encryption key (DEK), which is stored in the database boot record for availability during recovery. The DEK is a symmetric key secured by using a certificate stored in the master database of the server or an asymmetric key protected by an EKM module. TDE protects data "at rest", meaning the data and log files. It provides the ability to comply with many laws, regulations, and guidelines established in various industries. This enables software developers to encrypt data by using AES and 3DES encryption algorithms without changing existing applications.

## Transparent Database Encryption Architecture





# Transparent Data Encryption (TDE)

- Create a master key
- Create or obtain a certificate protected by the master key
- Create a database encryption key and protect it by the certificate
- Set the database to use encryption



# Transparent Data Encryption (TDE)

```
USE master;
GO
CREATE MASTER KEY ENCRYPTION BY PASSWORD = '<UseStrongPasswordHere>';
go
CREATE CERTIFICATE MyServerCert WITH SUBJECT = 'My DEK Certificate';
go
USE AdventureWorks2012;
GO
CREATE DATABASE ENCRYPTION KEY
WITH ALGORITHM = AES_128
ENCRYPTION BY SERVER CERTIFICATE MyServerCert;
GO
ALTER DATABASE AdventureWorks2012
SET ENCRYPTION ON;
GO
```



# Summary

- Microsoft SQL Server offers flexible installations
  - Several decisions must be made during planning phase
- Supported in Windows XP, 2003 Server, Vista, 2008 Server, and Windows 7
  - Supported platforms depend on edition
- There are software prerequisites for installing Microsoft SQL Server
- Seven different editions include Express, Compact, Workgroup, Web, Developer, Standard, and Enterprise



# Summary (cont'd.)

- Optional server tools include Database Engine Services, Reporting Services, Analysis Services, and Integrated Services
- Optional management tools include Configuration Manager, Server Management Studio, Business Intelligence Development Studio, Client Tools Connectivity, and Server Profiler
- Three different licensing options are available
- There are several resources that offer help
- Prior to installation, security should be considered