PART ONE

DATABASE ADMINISTRATOR
SKILL SETS AND AREAS
OF RESPONSIBILITY

• Chapter 1  Windows NT/2000 Administration for the SQL Server Database Administrator
• Chapter 2  Designing SQL Server Systems
• Chapter 3  Installing and Upgrading SQL Server/Applying Service Packs
• Chapter 4  Configuring SQL Server
• Chapter 5  Database Implementation
• Chapter 6  Tuning and Monitoring SQL Server
• Chapter 7  Backing Up and Restoring SQL Server
• Chapter 8  SQL Server Replication
• Chapter 9  OLAP Administration via Microsoft SQL Server Analysis Services
• Chapter 10  Server and Database Security Administration
• Chapter 11  Failover Clustering
Chapter 12  Data Modeling
Chapter 13  Data Transformation and Loading
Chapter 14  Technical Writing and Verbal Communication Skills

The first part of this book is written to expose the necessary skill sets that a Microsoft SQL Server Database Administrator (DBA) should possess and to describe the areas of responsibility within which a DBA will perform tasks. The skill sets listed in this part can be acquired through on-the-job training (OJT), Microsoft-approved training sites and material, hardware vendor training, on-site business training, and many other training resources.

Chapter 1 will introduce to you the Windows NT/2000 Administration skills for an SQL Server DBA. It is important to know how SQL Server interacts with Windows NT/2000, and this chapter will inform you of the necessary areas of Windows NT/2000 Administration that will help you to run SQL Server alongside the operating system with great efficiency and ease.

Chapter 2 will assist you in designing a productive and scalable SQL Server System. Topics listed under this chapter discuss capacity planning, server hardware, infrastructure configuration, and performance/scalability considerations.

Chapters 3 through 11 will review all areas of SQL Server administrative tasks that pertain to technology itself: installation, tuning, configuring, database implementation, monitoring, backups and restores, replication, security, failover clustering, and online analytical processing (OLAP). This will allow you to set and define the level of training and knowledge of SQL Server you would want to obtain to represent the SQL Server technology.

Chapter 12 will discuss data modeling principles and techniques. This chapter will expose you to how data modeling can be done and the importance of using it in implementing well-defined and -structured databases within the SQL Server environment.

Chapter 13 will discuss data transformation and loading. Loading SQL Server databases with data from many different types of internal and external data sources is becoming a common task for SQL Server DBAs. This chapter will go over the technology and tools to assist you in handling the importing and exporting of data.

Chapter 14 will discuss the importance of having technical writing and verbal communication skills with which to communicate with team members and customers. Because the workplace is very dynamic and SQL Server implementations are crossing business units and corporations, SQL Server DBAs find themselves in many meetings, communicating the technology to business lead-
ers. Being able to train other company resources in SQL Server technology is an invaluable talent that your customers will enjoy. Creating productive proposals and DBA support documents with ease and efficiency is discussed in this chapter.

As you read this first part, you will understand that the SQL Server role is multifaceted. It is not just about knowing the SQL Server technology. By first reading and then creating a plan to obtain the skill sets, you can become a well-rounded SQL Server DBA.
CHAPTER OBJECTIVES

- Installing the Operating System........ 6
- Configuring Operating System Settings and Options........ 8
- Monitoring the Operating System........ 16
- Summary........ 20

SQL Server is a Relational Database Management System (RDBMS) that runs on the Windows NT/2000 operating system architecture. There are features of the operating system that are critical to how efficient and secure SQL Server will run on the Windows NT/2000 server from the time the operating server is installed and throughout the life cycle of the database server. It is critical to understand these features not only if you are responsible for implementing them but also to verify that they are set correctly. A SQL Server Database Administrator (DBA) will work very closely with its back office counterpart, the Windows NT/2000 Administrator, to ensure that a database server is correctly built, configured, and deployed into the infrastructure.
Installing the Operating System

Windows 2000 Product Line

The Windows 2000 operating system family consists of four products. Table 1–1, summarizes the differences between the Windows 2000 products. Choosing the correct product is essential in heading off reinstalls, rework, and wasted cost in software license fees.

<table>
<thead>
<tr>
<th>Comparison Feature</th>
<th>Professional</th>
<th>Server</th>
<th>Advance Server</th>
<th>Datacenter Server</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total CPUs</td>
<td>2</td>
<td>4</td>
<td>8</td>
<td>32</td>
</tr>
<tr>
<td>Total Memory</td>
<td>4 GB</td>
<td>4 GB</td>
<td>8 GB</td>
<td>64 GB</td>
</tr>
<tr>
<td>Clustering</td>
<td>None</td>
<td>None</td>
<td>Two-Node</td>
<td>Four-Node</td>
</tr>
<tr>
<td>Role</td>
<td>Desktops and laptops</td>
<td>Server</td>
<td>Server</td>
<td>Large server or mission critical</td>
</tr>
</tbody>
</table>

The next chapter will relate these Windows 2000 products to SQL Server 2000 editions for the best implementation.

After choosing the correct Windows 2000 product for your new database server that will run SQL Server 2000, it is time to discuss other features of the operating system that are essential to review before installation: RAID (Redundant Array of Inexpensive Disks) configuration, file systems, and the role of the database server.

To verify or to check what Windows 2000 product and/or service pack level was installed, use the Computer Management tool called *System Tools*. In System Tools, you will find the System Summary Folder under the System Information node.

Software or Hardware RAID

Windows NT/2000 can create and manage software-enabled RAID volumes via Disk Management utilities. The RAID configuration and management is completely handled by the operating system. Software-enabled RAID is cheaper to implement but uses CPU and other system resources to manage the software RAID. Hardware-enabled RAID is implemented by use of a RAID controller and supporting hardware. Hardware-enabled RAID configuration and management is handled by the RAID controller, which has its own CPU and memory. When building a dedicated database server running SQL Server, hardware-enabled RAID should be your choice. Having the RAID controller and not the operating system...
perform much of the disk I/O tasks will allow the server to have an increase in performance, scalability, and tuning functionality.

**Defining the Role of the Database Server**

When deciding the function of the database server that SQL Server software will be installed to, you must take into consideration the concept of a shared role or single role implementation.

- A shared role server will perform more than the role of a database server with SQL Server installed, e.g., Exchange Server, Internet Server, Commerce Server, Transaction Server, a third-party vendor server application, etc. Usage of the CPUs and other resources is shared by all apps running on the server.
- A single role server is referred to as a dedicated server and, in the case of SQL Server, would be a dedicated database server. This implementation allows SQL Server to use the server resources only with the operating system. In addition, tuning for optimum SQL Server performance is much more productive and efficient when using a single role implementation.

Define the role before installing the operating system or SQL Server software and before defining the hardware requirements.

**NTFS, FAT, or FAT32**

You can choose between three file systems, NTFS, FAT, and FAT32, for disk partitions on a computer running Windows NT/2000. NTFS is the suggested file system because of the extra features that it offers (Table 1–2).

<table>
<thead>
<tr>
<th>Feature</th>
<th>NTFS</th>
<th>FAT</th>
<th>FAT32</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compression</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Encryption</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Mount points</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Disk quotas</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Remote storage</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
</tbody>
</table>

NTFS has always been a more powerful and feature-enriched file system than FAT and FAT32. Windows 2000 has improved on NTFS, with support for a variety of features, including Active Directory (Table 1–3), which is needed for domains, user accounts, and other important security features.
### Table 1–3

<table>
<thead>
<tr>
<th>Volume/File Size</th>
<th>NTFS</th>
<th>FAT</th>
<th>FAT32</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard Drive Volumes</td>
<td>Recommended maximum for volumes is 2 TB. LARGER SIZE VOLUMES ARE POSSIBLE.</td>
<td>Up to 4 GB.</td>
<td>Volumes from 512 MB to 2 TB. Limitation in Windows 2000 up to 32 GB.</td>
</tr>
<tr>
<td>Floppy Volumes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Max File Size</td>
<td>File size limited only by size of volume.</td>
<td>2 GB.</td>
<td>4 GB.</td>
</tr>
<tr>
<td>Active Directory</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

### Configuring Operating System Settings and Options

#### Performance Options and Virtual Memory Settings

Getting to the Performance Options and virtual memory option settings is as easy as going to the Control Panel, selecting the System folder, and choosing the Advance tab in Windows 2000 or the Performance tab in Windows NT.

Changing the Application response optimization setting (Figure 1–1) results in a smoother, faster response time to your foreground program. If you want a background task, such as a backup utility or SQL Server, to run faster, choose the Background Services option.

![Performance Options](image-url)
Click on the Change button of the Performance Options window to adjust Virtual Memory settings. Setting your Paging file size (Figure 1–2) and location are critical to how well the operating system and SQL Server 2000 will perform. The recommended size for the paging file is equivalent to 1.5 times the amount of RAM available on your system. This window also allows you to increase the size of the registry. The default setting is appropriate for a dedicated database server. If the database server will have multiple roles assigned to it, increasing the registry size is recommended.

**Network Settings**

The two areas of interest when configuring or viewing Network Configuration information are the Transfer Control Protocol/Internet Protocol (TCP/IP) and Simple Network Management Protocol (SNMP) settings.

You can configure TCP/IP in Windows 2000 by using the following methods:

<table>
<thead>
<tr>
<th>Drive [Volume Label]</th>
<th>Paging File Size (MB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C:</td>
<td>192 - 384</td>
</tr>
<tr>
<td>D:</td>
<td></td>
</tr>
<tr>
<td>E:</td>
<td></td>
</tr>
</tbody>
</table>

**Paging file size for selected drive**

- **Drive:** C
- **Space available:** 630 MB
- **Initial size (MB):** 192
- **Maximum size (MB):** 384

**Total paging file size for all drives**

- **Minimum allowed:** 2 MB
- **Recommended:** 190 MB
- **Currently allocated:** 192 MB

**Registry size**

- **Current registry size:** 21 MB
- **Maximum registry size (MB):** 35

**Figure 1–2** Virtual Memory.
Automatic configuration
Dynamic configuration
Manual configuration

Windows 2000 has the new Automatic Private IP Addressing (APIPA) feature that provides default automatic configuration of the IP address in the reserved range from 169.254.0.1 through 169.254.255.254 and a subnet mask of 255.255.0.0. No automatic configuration of a default gateway, domain name system (DNS) server, or WINS server is available. If your network consists of a single network segment that is not connected to the Internet, APIPA is designed for you.

TCP/IP configuration can be done dynamically (Figure 1–3) and automatically when using Dynamic Host Configuration Protocol (DHCP). Dynamic configuration requires the configuration of a DHCP server that will assign IP address, subnet mask, default gateway, DNS server, NetBIOS node type, and WINS server configuration information to a DHCP client. Dynamic configuration (using DHCP) is not recommended for servers. It is recommended for desktops in medium-to-large TCP/IP networks.

![Image of Local Area Connection Properties dialog box]
When manually configuring the properties of the TCP/IP protocol through the properties of a network connection (Figure 1–4), you can assign a static IP address, subnet mask, default gateway, DNS server, and WINS server. This is the preferred manner in setting up a database server’s network configuration, even if a DHCP is present.

You can verify IP-level connectivity via a few command line tools: Ping, PathPing, Ipconfig, routeprint, and tracert. The tools can assist in:

- Checking IP configuration
- Verify default gateway, DNS, and WINS server info
- Connecting to another IP address
- Verifying Persistent Route Table entries

The SNMP service is an optional service that can be installed after the TCP/IP protocol has been successfully configured to allow for remote, centralized management of computers.
To access the information that the SNMP agent service provides, you need to implement an SNMP management system software application. The Windows 2000 SNMP Service supports but does not currently include any SNMP management software. SNMP management software must be running on the host, which acts as the management system. Following are the two components necessary to implement SNMP successfully.

1. **SNMP management system.** The management system, also called *management console*, sends information and update requests to an SNMP agent. Any computer running SNMP management software is an SNMP management system. The management software application does not need to run on the same host as the SNMP agent. The SNMP management system requests information from a managed computer, called an *SNMP agent*, such as the hardware configurations. The management system is not restricted to reading; it can initiate a change to an agent's configuration.

2. **SNMP agent.** The SNMP agent responds to management console requests for information. The Windows 2000 SNMP Service, which is agent software, responds to information requests from one or multiple management systems. The SNMP Service can be configured to determine which statistics are tracked and which management systems are authorized to request information. Typically, agents do not originate messages but only respond to them. The only agent-initiated message is called a *Trap Message*. A trap is an alarm-triggering event on an agent, such as a system reboot or overheating error.

**Time Syncing**

It is critical to have your database server's time synchronized to a reliable external time source to ensure data integrity within the databases. If the time on a database server was to get out of sync, it could create unreliable data that is date- and time-based within the database. There is a Time Service tool within the Windows NT/2000 Resource Kits that can be configured on a database server to synchronize time to an external source.

**Display Settings**

Configuring the video and monitor settings is as important on a server as it is on a desktop system. Having the Display Properties dialog box come up every time after logging in, due to an incorrect configured display setting, can be a nuisance, not only to work being done at the local console but also to administrators logging onto the server with remote control software. It is highly recommended to use a video driver supplied by the hardware vendor and not to choose the standard Windows VGA driver.

The screen saver option is set to *none* and should remain this way, unless you want to show the server name via the Marquee Screen Saver. If so, use
the centered and slow speed options. Beware, the screen saver will use CPU resources.

The wallpaper option can also be utilized to show the server name for server systems that do not have the capability to project the server name onto the display. Create the smallest bmp file possible, so as to save memory resources.

**Registry**

Windows 2000 stores much of how it is configured and how applications installed on the server are configured within a structure called a *registry*. The registry is made up of keys and values.

Two important tools for accessing the registry are regedt32.exe (Figure 1–5) and regedit.exe (Figure 1–6). The differences and functionality of the tools can be found in the online Help file. The most noticeable difference is the ability to set security within the registry on the regedt32.exe tool.

Two areas of the registry that should be configured on a database server are the security of the SQL Server Software keys and the CD-ROM Autorun feature. A third optional area is related to Dr. Watson.

![Registry Editor](image)

*Figure 1–5*  Regedt32.exe.
Full control permissions should be set for the Administrators group, the local system account, or the SQL Server Service account for all the keys under HKEY_LOCAL_MACHINE\Software\Microsoft\Microsoft SQL Server.

The Autorun feature for a CD-ROM should be disabled on a database server to restrict an application setup process to run when a CD-ROM is inadvertently put into the CD-ROM player of the database server. Change the Autorun value in the following registry key: HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\CDRom.

To disable the Autorun feature, change the Autorun value to 0. You must restart the computer for this change to take effect.

If you are having problems with Dr. Watson running on the database server, you can disable it via the following key: HKEY_LOCAL_MACHINE\Software\Microsoft\WindowsNT\CurrentVersion\AeDebug.

To disable the Dr. Watson feature, delete the Aedebug Key. Before performing the delete, you may want to export the registry key so that you may be able to restore the key at a later time.

**NOTE:**

Disabling the CD-ROM Autorun feature does not affect the ability of the server to be booted by a CD-ROM.
Event Viewer

The Event Viewer is a resource for viewing system events: startup of the operating system, startup and failures of services, etc. The events can be informational, warning, or error-based.

Set the When maximum log size is reached option (Figure 1–7) to Overwrite events when needed for the Application Log, System Log, and Security Logs. Also, the log sizes can be adjusted and should be increased from their default sizes to accommodate more entries before they are overwritten. Set the log sizes to 4,096 or more.

NOTE:

SQL Server writes only to the Application Log.
Monitoring the Operating System

Computer Management Tool

Computer Management (Figure 1–8) is a single, consolidated desktop tool that can manage local or remote computers. It can be used to:

- Monitor system events, such as logon times and application errors, via the Event Viewer
- Create and manage shares
- View a list of users connected to a local or remote computer
- Start and stop system services, such as the Task Scheduler and the Spooler
- Set properties for storage devices
- View device configurations and add new device drivers
- Manage server applications and services, such as the DNS or DHCP services
- View and configure Disk Volumes

### Figure 1–8

Computer Management.
Choosing the Monitoring Method, Interval, and What to Monitor

The choices available for monitoring the operating system and SQL Server are graphs, log files, and database storage.

Graphs are useful for short-term, real-time monitoring of a local or remote computer. Graphs can be used for temporary viewing of info that will not be saved or to recall log file info in a graphical format. Graphing can view data in many visual perspectives and manners that allow for unique monitoring methods.

Routine monitoring that may be necessary to meet Service Level Agreement (SLA) requirements should be done by logging the information to files or database-type storage to allow for data to be recovered and reanalyzed. This is also the most practical way to monitor multiple SQL servers.

When determining the interval of logging the activity, choose an interval that will best record the activity in a manner that will allow for capturing it and exposing it for the most productive review. Here are some tips:

- If you are monitoring for a specific problem, you may want to vary the interval.
- If you are monitoring activity of a specific process at a specific time, set a frequent update interval.
- If you are monitoring a problem that shows itself slowly, such as a memory leak, use a longer interval.
- Consider the overall length of time you want to monitor when first choosing this interval. Updating every 10 seconds is reasonable if you’ll be monitoring for no more than 3–4 hours. If you’ll be monitoring a system for a day or more, setting the interval shorter than 300 seconds can cause the system to generate a large amount of data, which can be difficult to read and analyze, not to mention the increased overhead of running performance logs and alerts.
- Monitoring a large number of objects and counters can also generate large amounts of data and consume disk space.

Find a balance between the number of objects you monitor and the interval of monitoring to keep log file sizes within manageable limits. Start by monitoring the activity of the following components, in order:

- Processors
- Memory
- Disks
- Network

Table 1–4 shows the minimum counters recommended for monitoring a database server.
To use the Performance Monitor’s physical and logical disk counters, you must first run the Diskperf utility. Once you run Diskperf and restart the computer, Performance Monitor can collect disk data. Otherwise, Performance Monitor displays zeros for all counter values for the disks.

You must be a member of the Administrator’s local group on a computer to run Diskperf on it. Run Diskperf from a command prompt window. At the command prompt, type the following, then restart the computer:

c:\> diskperf -y

This enables the counters on a standard disk configuration. The counters remain enabled, even when you reboot, until you remove them by using the diskperf -n option. To run Diskperf on a remote computer, type the following command (substituting as appropriate for ComputerName), then restart the computer:

diskperf -y \\ComputerName

### Task Manager

Windows Task Manager provides information about programs and processes running on your computer (Figure 1–9). The following are some of Task Manager’s features and capabilities:
Windows Task Manager—Performance tab.

- Displays the most frequently used performance measures for processes
- Checks the status of the programs that are running
- Can end programs that have stopped responding
- Displays the activity of running processes, selects what columns to view on the processes tab, and can determine how they will be sorted
- Graphs and displays data on CPU and memory usage
- Allows for changing the priority of a running program
- Can assign a process to a particular processor
- Shows Kernel Times

Virus Scanning

A database server should be constantly scanned for viruses. There are many third-party vendors offering antivirus software at different levels of complexity and functionality. Make sure that the package you purchase can be managed remotely and can store virus-scanning information to a remote repository. This
will allow for updates to the antivirus agent on the database server to be updated quickly and to recover virus information if the server is corrupted and can't be accessed.

Summary

Being aware of the many components of the operating system environment that are crucial in implementing a robust, secure, and scalable SQL Server environment is extremely important and required. You may not be completely responsible for administering the Windows NT/2000 environment, but it is the SQL Server DBA’s responsibility to understand what areas of Windows NT/2000 Admin interface with SQL Server’s performance and functionality to ensure that they are set and configured correctly.