



CHAPTER 3

Configuring Windows 2000



There are three basic configurations of Oracle on Windows 2000: as a management platform, as an Oracle client, and as a database server.

The first configuration is the platform from which you will manage Oracle installations across various machines on various operating systems. Most system and database administrators are given a desktop PC to perform day-to-day tasks that are not DBA specific (such as reading e-mail). From this desktop, you can also manage Oracle components installed on other operating systems (for example, Solaris, Linux, and HP-UX). Even so, you will want to configure Windows 2000 to make your system and database administrative tasks quick and easy.

The Oracle client software configuration is used in more configurations than you might first suspect:

- Web applications that connect to an Oracle database:
 - IIS 5 ASPs that use ADO to connect to an Oracle database
 - Perl DBI application running on Apache that connects to an Oracle database
 - Any J2EE application server that uses the thick JDBC driver
- Client/server applications:
 - Desktop Visual Basic application that uses OLEDB or ODBC to connect to an Oracle Database
 - Desktop Java application that uses the thick JDBC to connect to Oracle

In any of these configurations, at least an Oracle client installation is required. In some cases, software vendors may hide this fact from the user; but the Oracle client libraries are necessary to connect to the database *unless* you use the JDBC thin driver.

Operating system configuration offers the greatest return on investment in cases where Windows 2000 hosts the Oracle database. In this chapter, we will review some key things you can do to optimize Windows 2000 configuration to interact with Oracle. Here are the tips and techniques we offer in this arena:

- Optimizing Windows 2000 for Oracle
- Upgrading to multiple processors
- Working with the Computer Management Console
- Building custom MMC consoles
- Using the Windows 2000 shell
- Integrating Windows 2000 and Unix
- Using the Resource Kit appropriately

- Using tools from the Sysinternals web site
- Using the Event Viewer
- Managing disks
- Using the Task Scheduler Service
- Understanding and controlling the Windows 2000 environment
- Understanding Active Directory
- Remote Administration with MMC
- Remote Administration with VNC
- Remote Administration with the Windows 2000 Telnet Server
- Remote Administration with pcAnywhere and other commercial tools
- Locating other resources
- Contemplating the future of Windows

The Oracle RDBMS on Windows 2000 should usually run alone on its own server-class machine. In order to best ensure reliability and performance, you will need to configure the version of Windows 2000 you are running to best work with Oracle.

Tuning Windows for Oracle

One of the more common issues that Oracle database administrators face is how to configure the operating system to optimize it for database usage. In this section, we give you a number of quick tips you can implement to improve your operating system configuration for Oracle.



Optimize Windows 2000 for Oracle

Below are a number of tips you can implement right away to improve performance, availability, and manageability.

Know When Rebooting Is Required

In Windows 2000, there are far fewer tasks that require you to reboot. Here is a list of some that still do require you to reboot:

- Making changes to the configuration of an ISA card



- Adding or removing communication ports
- Installing a service pack or hotfix
- Changing the computer name
- Changing the system font
- Promoting a server to a domain controller
- Changing the DNS suffix
- Changing the IP address of a DNS server
- Installing Terminal Services
- Changing the system's locale

Use a Wallpaper to Identify Your System's Key Information

Create a JPEG file that identifies key information about the system such as node name, CPUs, memory, network cards, disk, and Oracle installation details (for example, Oracle home location and default Oracle SID). You can do this easily with MS Paint or any other graphics tool. This handy identifier keeps you from running commands on the wrong remote system, a common problem when many GUI remote desktops are running at one time. The JPEG also makes it easier to determine if you have connected to the correct remote computer. Check out the free bginfo tool from Sysinternals that makes getting this information even simpler.

Optimize Use of Device Drivers

Make sure that you are using a stable device driver and configure the device optimally to best serve a dedicated Oracle server. A bad device driver can make an otherwise rock solid system randomly transform into a blue screen generator. With the next generation of the Windows OS there will be a higher level of device driver certification. Windows 2000 Datacenter already requires a level of certification to allow for the new features and to ensure overall system integrity. Follow that trend and stick with heavily integrated systems from vendors like Compaq and others (see the Oracle Technology Network web site mentioned in the section "Resources" later in this chapter).

Many device drivers have configuration screens or Registry settings that allow you to optimize use of the device for your application. Become familiar with these settings and learn the effect of setting changes on your applications through the use of performance baselines and controlled testing.

Optimize CPU Usage and Configuration

Before running out to get that new 64 CPU Datacenter server, you may want to try some of the following suggestions to improve CPU utilization.

Upgrade Kernel to Multiprocessor When Adding Second CPU In Chapter 1, we alluded to a simpler process on Windows 2000 for upgrading the OS kernel when going from a single processor to multiple processors. As promised, here are the steps:

1. Go into the Computer Management Console (see Figure 1-5 in Chapter 1 for a depiction of the Computer Management Console). Under System Tools, select the Device Manager.
2. Click the plus sign (+) next to the computer name to expand the list of devices, and then expand the device called Computer. You should see a display similar to Figure 3-1. As you can see in the figure, this machine already has the multiprocessor driver installed.
3. To upgrade your kernel, simply right-click, choose Properties, and then select the Driver tab in the dialog box that appears. Click the Update Driver button.
4. The Upgrade Device Driver Wizard appears and walks you through the steps for upgrading the processor device driver.

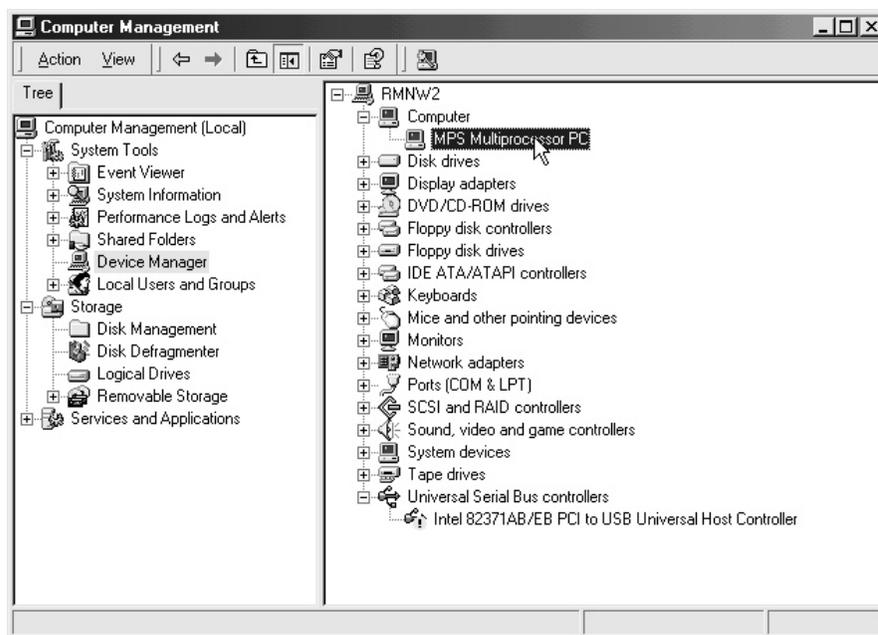


FIGURE 3-1. Computer Management Console multiprocessor device driver



Disable Screensavers A screensaver can suck an amazing amount of CPU and provide no useful purpose to a database server. In particular, disable the 3GL screensavers. Screensavers can grab valuable CPU from the OS and Oracle. If you must use a screensaver, use the Blank Screen screensaver to minimize CPU usage.

Log Out Log out of your system when you are not doing something that requires you to remain logged on to the console. This will help minimize running applications.

Configure the System as an Application Server Set Performance Options to Background Services on the Advanced tab of the System applet in the Control Panel (or right-click My Computer and then select Properties). This gives priority to applications running as services, such as the Oracle Services, as opposed to programs a user starts when logged in to the GUI desktop.

Monitor the System for Highly Interruptive Hardware Hardware that consumes CPU interrupts and time should be avoided. Often, inexpensive hardware is cheaper because it offloads work onto the CPU. Higher quality hardware will handle calculations on the peripheral's own resources. As an example, try to maintain the following options for disk controllers and network cards:

- Network cards that support DMA, as opposed to PIO-supported bus mastering
- 64-bit PCI disk controllers kept on a PCI bus separate from network controllers

Use Performance Monitor to track the Processor Object's % Interrupt Time counter. Baseline and benchmark this counter, and then monitor it regularly to spot possible problems. You can experience immediate performance gains where I/O is a bottleneck by switching to a good hardware RAID controller from the Windows 2000-supplied software RAID feature.

Keep Security Auditing to a Minimum The more layers of security auditing that are implemented, the more that the CPU has to spend cycles on this operation. Audit when and where necessary, and only to the level that is appropriate to your environment.

Optimize Network Configuration

Network configuration is an important performance piece that can easily become the hidden performance bottleneck. Try the following tips to avoid problems and tune your system.

Configure Network Cards to Use the Fastest Speed and Mode Available

This is, as opposed to “auto detection,” the default setup for most NICs. If it is optimal and possible, enable the Full Duplex setting and manually set the maximum line speed.

Remove Unneeded Network Protocols Try to keep TCP/IP the sole protocol stack if you can. If you must include NetBEUI, understand that it is a chatty protocol that can hamper your network capabilities. NetBEUI was implemented by Microsoft as a protocol for small workgroup networks and is largely discouraged even by Microsoft now. If you do not have a specific need for SPX (for example, you are using Netware), then make sure you remove SPX as well.

Optimize Net Protocol Bind Order Set the primary protocol, typically TCP/IP, to be at the top of the list of protocols in the Advanced Settings dialog box, accessible through the Advanced file pull-down menu in Network and Dial-up Connections. Make sure to do this for each NIC.

Disable or Optimize File Sharing for Oracle Ideally, you should disable the Microsoft “share” functionality to minimize security exposure and network traffic. If you need to use the File and Printer Sharing for Microsoft Windows feature, enable the option Maximize data throughput for network applications from the Connection Properties dialog box for each network card installed on your system.

Optimize Disk Configuration

Oracle can be a very I/O-intensive application. Make sure that you properly configure and tune the disk and file system. Here are a few tips to help you begin your journey.

Distribute File System Activity Across Disks and Controllers Proper distribution of I/O is one of the first rules a database administrator learns. It is often one of the first performance axioms a database administrator will remember. Identify hot Oracle files using Stats Pack (see Chapter 9, or refer to the comprehensive Oracle Press book *Oracle High-Performance Tuning with STATSPACK*) and OS tools like Perfmon. Alter your disk configuration and file layout to spread I/O across disks and controllers.

Ultimately, you should stripe activity to evenly spread activity properly across volumes, according to the type of disk access for particular files, and at the same time meet your fault tolerance goals. Review the section “Disk Management” in this chapter for more information on fault-tolerant configuration suggestions.

Defragment Disks Prior to Creating or Placing Data Files on a Disk The fragmentation state of an Oracle datafile remains the same from the time of creation



until the file is resized either manually or through autoextend. To *safely* defragment a datafile, the instance should be shut down. Oracle documentation actually indicates that the service should also be stopped in order to ensure safe defragmenting, although our investigations with Sysinternals utilities such as Process Explorer and Filemon do not show that the service holds any handle on datafiles once the instance has been shut down. At any rate, you can avoid having to deal with defragmentation if your file system has enough contiguous free space to ensure that the datafile will not be fragmented when created. More tips on defragmenting and working with Oracle datafiles appear in Chapter 5.

Don't Use Disk Compression Oracle database files don't support disk compression. Avoid it like the plague when dealing with Oracle files. There are certain situations on user workstations where disk compression can be useful. We find it useful for our collection of scripts and source code used for database and system administration.

Don't Use Disk Encryption Encryption, like disk compression, adds a layer of processing that slows disk reads and writes. If you are worried about encrypting your data, then use the DBMS_OBFUSCATION package and Label security to selectively encrypt sensitive portions of data instead.

Do Not Use More Than 70 Percent of Free Disk Space To maintain optimal disk performance, it is important that you don't use the whole disk. This limit pertains to seek speed, space for the OS file system (NTFS) to do its work, the ability to maintain a defragmented disk, and concentration of disk head movement to the faster inner tracks of the platters. If you have disk space to burn, then you may see performance gains on some disk subsystems when you avoid using more than 50 percent of disk capacity to minimize seek distance and keep data on the inner tracks of the platters.

Use More Disks Rather Than Large Disks You can help distribute I/O, maintain greater throughput, and decrease response times by using smaller disks of at least the same seek time and rotational speeds. For example, four 9GB 9ms seek time 10K rotational speed drives will offer you better performance than one 36GB 9ms seek time 10K rotational speed drive. This configuration also provides more flexibility in layout and faster recovery times for hardware failure.

Optimize Memory Usage

Because Oracle 9i now requires 512MB of RAM for a database installation, we likely do not have to prompt you to avoid wasting memory. Do not forget to include the memory used by your connections as well as the SGA in your memory usage estimates for the oracle.exe process.

Run Oracle on a Dedicated Server Oracle can be a memory hog. In particular, do *not* run an Oracle database on a system that performs the following functions:

- Primary or backup domain controller (or a domain controller, if in a Windows 2000–only domain)
- File server
- Print server
- Remote Access Server
- Router, proxy, or firewall of any kind

Don't Use Fancy Wallpapers If you have a valid use for wallpaper, keep the size of the file to a minimum.

Disable Unnecessary Services Do the best you can to disable services that you will not need to run your system. If you need a service's functionality intermittently, then set the startup type to Manual. The first thing to do is check with your network and system administrators to verify the requirement to run a specific service in your enterprise. In particular, consider the following suggestions:

- If your system doesn't need to print regularly, then stop the Print Spooler service and set its start type to Manual.
- Stop the License Logging Service unless you specifically require it.
- You should not use a dynamically assigned IP address (DHCP) on a database server, nor should a database server act as a DHCP server. Make sure the DHCP Client and DHCP Server Services are disabled.

Learn the services you need for your environment and use them sparingly. Keep a list of the services you will expect to see running on your system to identify possible hacks and cracks as well.

Do Not Automatically Start Programs You Don't Need Check the contents of your Startup menu (Start | Programs | Startup). If the contents include anything that is not absolutely necessary, then remove the unnecessary items. Be aware that you may have a Startup menu for the current user and one for the default user. Check both.

Span Paging Files Across Physical Volumes Create at least two paging files across two physical disks. You can create up to four paging files and still experience performance benefits. Make sure that the total size of your paging files is at least



two times your physical memory. Ideally, you should not have a page file on the same drive as your OS, but doing this disables crash dump creation when the system fails. You may want to keep it off the system drive on very stable certified systems. The ideal configuration is four page files located on four striped volumes spread across multiple disk controllers.

Properly Size Your Paging Files Make sure that your paging file is at least two times the size of your physical memory. We often see problems when people upgrade machine memory, but make no changes to their page file configuration. Monitor page file usage from Perfmon via the Paging File Object's % Usage Peak counter. Make sure that your paging file is always sized greater than or equal to peak usage. This will avoid the expensive process of growing the paging file.

Do Not Create Databases with Options You Do Not Need If you do not need options like the Oracle JVM in the database, do not install them. You can drastically reduce memory usage if you don't use the Java option. Be sure that you need the buffer cache, shared pool, large pool, and java pool initial allocations. Resize these pools to match your needs.

Microsoft Management Console

As we mentioned in Chapter 1, the Microsoft Management Console is a framework that can be customized with various predefined Windows 2000 and third-party snap-ins. This framework makes centralized management through a single console easier than ever. In this section, we will first discuss the Computer Management Console that comes with the OS and follow with tips on customizing your own MMC.



Computer Management Console

The management of the operating system in Windows NT was done largely through disparate, unrelated programs and applets in the Control Panel. Windows 2000 has centralized and "componentized" computer management through the use of various incarnations of the Microsoft Management Console (MMC). From a single location, you can view and control services, manage disks and users, view the Event Log, create Performance Log views, and much more (see Figure 1-5 back in Chapter 1). You will find the Computer Management Console in the Administrative Tools program group along with other useful MMC incarnations, such as dedicated performance and services consoles.

In this section, we will discuss the key information and snap-ins available from the Computer Management Console. These include the System Summary section, Disk Management, Event Logs, Services, Local Users & Groups, and the Performance

Monitor. We will also provide some tips on using the Computer Management Console for managing remote machines.

System Summary

The System Summary can be found by expanding the plus sign (+) next to System Information. Highlight the System Summary folder in the left pane to view information about your machine in the right pane. Here you will see the full OS version, the name of the machine (system name), total physical memory (RAM), and total virtual memory, among other tidbits of information. Total virtual memory is the total amount of memory available to the system, including physical RAM plus the page file. This summary can be saved to a text file or to a System Information file by right-clicking the System Summary folder.



NOTE

*This same information can be found by entering **winmsd** at a command prompt. Although the System Summary and the Computer Management Console are specific to Windows 2000, **winmsd** and **winver** can be run on a Windows NT 4.0 machine to display similar information.*

Services

We briefly described services in the architecture section of Chapter 1. In this chapter, we will examine where service information is stored and viewed. Services can be accessed from the Computer Management icon (under Services and Applications), and can also be viewed by going to Start | Programs | Administrative Tools | Services.

Once into the services, you can view the service name, an optional description you can modify to your delight, current run status, the startup type (Manual, Automatic, or Disabled), and which account the service uses to Log on as. You can sort on each of these columns by clicking the column heading. For example, click the Startup Type column heading to view all services that will start at boot time grouped together.

To change or view more service detail, right-click the service and select Properties. Under the General tab, you will see what executable the service calls and the Startup type. Under the Log On tab, the account that runs the service is displayed. As noted previously, a service will log on and start up its associated process whether or not anyone has actually logged on to the machine. Most services log on as the Local System account by default. This is a Windows 2000 operating system account that exists on every machine, yet each machine's System account is unique to



the machine on which it exists. We will discuss how the logon account affects Oracle Services in more detail in Chapter 4.

Services can be stopped or started by right-clicking and selecting the appropriate option, and they can also be managed at the command prompt by issuing either **net stop <servicename>** or **net start <servicename>** (for example, **net stop oracleserviceorcl**). Entering **net start** by itself will give a complete list of all currently running services.

The Recovery tab allows you to determine actions that take place if a service fails for some reason. This allows a service to be automatically restarted if it fails, run a job upon failure, or even reboot the machine if this service fails. This is a rather basic way to provide a modicum of high availability for certain processes. We will discuss more robust methods of achieving high availability, such as clustering and the Oracle Failsafe feature, in Chapter 11. The final tab is the Dependencies tab. This tab allows you to view other services that must be running before this service can be started.

Disk Management

Expand the Storage node of the Computer Management Console and select Disk Management (aka Disk Administrator). From this console, you can partition new drives, repartition existing drives, format drives, and assign or unassign drive letters.

The Disk Management display will show you the logical drives on the top half, including the drive capacity, the amount of free space, and the file system for existing logical volumes. The lower half of the display will show you the physical layout of the disks, starting with Disk 0. In this area of the display, logical drives will be shown as a part of whichever physical disk they actually belong to. You will also see each volume's file system type. To learn more about the new features of Windows 2000's volume management, check out the section "Managing Disks" later in this chapter.

Event Viewer

Event Viewer is the logging mechanism for events on Windows 2000. Operating system errors and informational messages will be written to the System Log. Applications running on the system, including Oracle9i Server, will write informational and error-related messages to the Application Log. In order for this to occur, the Event Log Service must be running.

You can also save log information by right-clicking and choosing Save As. If you save the file as type *.evt*, you must open this file from within the Event Viewer. Saving it as a text file will allow the data to be viewed from any text editor. You can send a saved version of your Event Log to Oracle Support for analysis that might help solve your problem. The binary-formatted *.evt* log files will change their timestamps on events to sync up with the computer on which they are opened. Therefore, if you

save the file from a computer running in the Eastern time zone, and open it on a system running in the Mountain time zone, the timestamps will be off by two hours. For more details on using the Event Logs for system administration, check out the section “Using the Event Viewer” later in this chapter.

Managing Users and Groups

User and Group management is now done via the Local Users and Groups snap-in, under System Tools in the Computer Management Console. From here, you can add, modify, and delete users and groups on the local system, or simply view which users are part of which groups.

There are two types of users on Windows 2000: domain users and local users. A group is simply a logical association of users with like needs and purposes, and grouping users simplifies the tasks of granting access to certain resources on the system. Although it is beyond the scope of this book to give a complete description of Windows 2000 domains and managing accounts in a domain environment, it is important to understand certain differences. Domain users are authenticated on a remote machine called a *domain controller*, and many of the privileges for a domain account are set on the domain controller, rather than on the local machine. A user account may be a member of the Domain Administrators group, yet not have any privileges on the local system because the account is not part of the Local Administrators group. A domain account and a local account may even have the same names; however, they are treated as entirely separate entities. Permissions assigned to the domain account will not translate to the local account, and vice versa. Also, be aware that passwords on Windows 2000 are case sensitive, but usernames are not.

To view whom you are currently logged on as, simply press the CTRL-ALT-DEL keys simultaneously. This will clear your screen and display a Windows Security dialog box with a Logon Information section that tells you the username under which you are logged in the format of *COMPUTERNAME\Username* (see Figure 3-2). Check this against the system name on the System Summary page, as described earlier in this chapter. If the computer name displayed in the Windows Security dialog box is *not* your local system name, then you are logged on to the domain. You will see the importance of this in Chapter 4, as Oracle9i Server requires that installations be done while logged on to the local computer as a member of the Local Administrators group.

Remotely Managing Servers Using the Computer Management Console

You can connect to other Windows 2000 nodes to monitor and manage them remotely via the Computer Management Console by right-clicking the Computer Management root of the tree of items and browsing to the node you want to manage



FIGURE 3-2. Find the computer name and username.

or entering the node name directly. If you want to manage disks from a remote node, you must upgrade from the volume management tool installed with Windows 2000 to the VERITAS Volume Manager for Windows 2000 (see Figure 3-3). With this upgrade you also gain much more flexibility and manageability in disk management. Check out the section “Managing Disks” later in this chapter.

You can also send a pop-up message to the console of various computers from the Management Console by right-clicking the root of the tree again, navigating to the All Tasks menu, and selecting Send Console Message (see Figure 3-4). From here, enter the recipient node names and the message. Note that these nodes need to have the Messenger Service running to allow the pop up message to appear. This feature is useful in a shop with numerous database or system administrators who may be working on the same machine at the same time.

Make Your Own Snap-Ins

The MMC is a framework that is available for independent software developers to develop their own snap-ins that allow administrators to better centralize and customize system administration. Developers interested should review the Platform



SDK's MMC start page at http://msdn.microsoft.com/library/en-us/mmc/hh/mmc/mmcstart_1dph.asp, as well as the WMI sections of the Platform SDK.



Building Custom MMC Consoles

The MMC is a useful tool in and of itself because it lets you customize and build your own version of the Computer Management Console for DBA-related activities.

You will not find the MMC itself anywhere within the Start menu because it is only a framework. You start your own version of the MMC via a command line, run prompt, or shortcut you create that executes **mmc**. If you have a Windows keyboard, you can press WINDOWS LOGO KEY+R to bring up the run prompt (see Figure 3-5), type **mmc**, and press ENTER.

From this empty framework you can add various snap-ins that are of interest to you, and then save these as .msc files for later use. To add your own counters of interest, follow these steps:

1. With a blank MMC up, press CTRL-M.
2. From the Add/Remove Snap-In dialog box, click the Add button on the Standalone tab.
3. From the Add/Remove Standalone Snap-in dialog box, select the snap-in of interest to you, and then click Add (see Figure 3-6).
4. For some snap-ins, you will be prompted to select either the local computer or a remote machine that the snap-in will connect to. If you select a remote node, you will be able to perform the function of the snap-in from one machine upon another. Select as appropriate for your needs. For snap-ins that do not offer the option to control remote nodes, you will be immediately

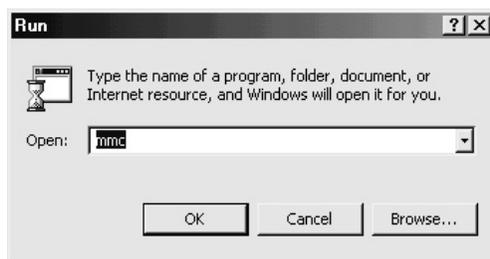


FIGURE 3-5. Standard Windows 2000 run prompt

returned to the Add/Remove Standalone Snap-In dialog box. Repeat step 3 for each snap-in you are interested in.

5. On the File pull-down menu select Save As, and save the configuration to the standard location for your system management files.

There is a special snap-in type named **ActiveX Control**. The Performance Monitor chart in the Performance MMC console, found in the Administrative Tools program group, is an ActiveX Control that you can add as a snap-in to your custom console. You can create custom real-time monitoring of systems to identify current problems or bottlenecks. Add the computer management snap-ins or the individual snap-ins that you are interested in, and then add the ActiveX Control named System Monitor for each view you would like to see of system resources. To add a System Monitor control, follow the first two steps given previously for adding snap-ins. Select ActiveX Control in the Add Standalone Snap-In dialog box and click Add. The Insert ActiveX Control Wizard will appear. Click the Next button to advance to the next step. Scroll down the list of available controls and select System Monitor Control. Click the Next button, name your new System Monitor view to match the collection of counters and charts you will add to the control, and click Finish.



FIGURE 3-6. Add a stand-alone snap-in to an instance of the MMC.



The following are examples of System Monitor views you can create in your customized MMC:

- CPU Monitor
- Disk Monitor
- Network Monitor
- Memory Monitor
- Database Process Monitor

Once you have a System Monitor control for each of these areas of interest, you can add the appropriate counters. Learn more about each counter by using the Help file from the Resource Kit (RK), which is discussed in the section “Using the Resource Kit Appropriately” later in this chapter. For example, you might add the following counters to your CPU monitor view:

- System Object: Processor Queue Length
- Processor Object: % Processor Time for each processor and the _Total
- Processor Object: % User Time for each processor and the _Total
- Processor Object: % Interrupt Time for each processor and the _Total
- Processor Object: % Privileged Time for each processor and the _Total

If you have a system with a large number of counters you wish to display all at once, then you will want to change your view from Chart to Histogram or Report view. You may instead decide to format the view to create distinctive lines for the _Total instance of the processor objects and the % Processor Time counter, the key counter for aggregate understanding of CPU usage. While you are getting familiar with the various counters and are in the process of identifying bottlenecks, we suggest that you develop a number of views and adjust scales to help identify issues. If you are a numbers person only, then try the Report view. This view shows you the numbers as a snapshot is taken. Report viewing is most useful with counters that simply do not belong on the same scale but need to be evaluated together. Over time you will find that there are certain key views that help you identify problems with your system and/or your database.

The real-time monitoring is a reactive and immediate approach that will help you become familiar with what to do in an emergency or when a problem only occurs for a short defined time. In order to get a bigger picture view over a longer period of time, you will want to use the Performance Logs and Alerts functionality.

Performance alerts allow you to capture an event and react to it by doing one or more of the following:

- Log an entry in the Event Log (default action).
- Send a network message to a machine.
- Start a Performance Log.
- Run a program and pass it pieces of the alert's components for processing.

For example, you might want to set an alert that fires if the oracle.exe process's working set of memory grows larger than 80MB or the amount of available memory drops below 5MB. When that alert fires, you automatically send an e-mail to the database administrator's pager with the details of the alert, and start a predefined log that keeps extensive track of the system's CPU, process, and memory activity.



NOTE

For performance alerts and logs to work you must have the Performance Logs and Alerts Service started. You can also use various features of Oracle Enterprise Manager to perform these functions from a central location; and in that case, you will need to have the Oracle 9i Agent Service running. We suggest that you are familiar with both methods to ensure that you have and know how to use the right tools at the right time.

Command-Line Management

There was a time when almost all Oracle administration had to be done from the command line. With the improvements in Oracle Enterprise Manager and other GUI tools such as Net Manager, management of Oracle can be done from either a GUI tool or the command line. Still, the command line offers some advantages that the GUI cannot. You can do remote operating system and database administration without incurring a large overhead. On a system that is not responsive at the desktop level, you can often be very successful at the command line. The command line offers many benefits to those that know how to use it successfully. This section helps you use the command line to make database and system administration more effective and efficient.



Using the Windows 2000 Shell

The Windows NT/2000 shell is a friend to those that are familiar with the command line from DOS and anyone that has a Unix background. Although



a good argument can be made that the Unix command-line tools and utilities are superior to those that come with Windows 2000, the Windows 2000 command line is very useful. This is particularly true once you add command-line utilities from various resources to your path.

The first thing you need to do is customize the command prompt to allow for your particular needs as an Oracle user. After doing this, you can easily copy and paste using the mouse, navigate back over the results of your commands, and make the command prompt more readable for yourself.

You may want to make changes to your command prompt for just your current session or be able to save a variety of configurations for specific classes of tasks. Windows 2000 no longer displays the command prompt in the Programs menu. Instead, the default shortcut command prompt is now buried in the Accessories menu.

Start by creating a shortcut based on the default shortcut, titled Command Prompt, found in Start | Programs | Accessories. To create your own copy to edit to your liking, follow these steps:

1. Select Start | Programs | Accessories.
2. The list shown should contain the Command Prompt shortcut. Right-click the shortcut and select Send To | Desktop. This will create a copy of the default shortcut on your desktop to use as a template from which to work (see Figure 3-7).
3. Make a copy of the new Command Prompt shortcut that is now on your desktop. This will be your first custom configuration.
4. Right-click the shortcut and select Properties. This will bring up the Properties dialog box, in which you specify various properties for your shortcut. Change the name and other values to suit your needs, save your changes, and close the dialog box. We use a shortcut called dbadmin for administration that starts in our scripts directory and has a screen buffer size height of 300, a window size height of 40, and Quick Edit and Insert modes turned on.
5. Click OK to save the shortcut and put it in a location that is convenient for you—for example, on the Quick Launch toolbar or on you desktop.

You may want to change the default command prompt shortcut. If so, then navigate back to the Accessories menu, right-click over the top of the Command Prompt shortcut, and click Properties. Make your changes and save them.

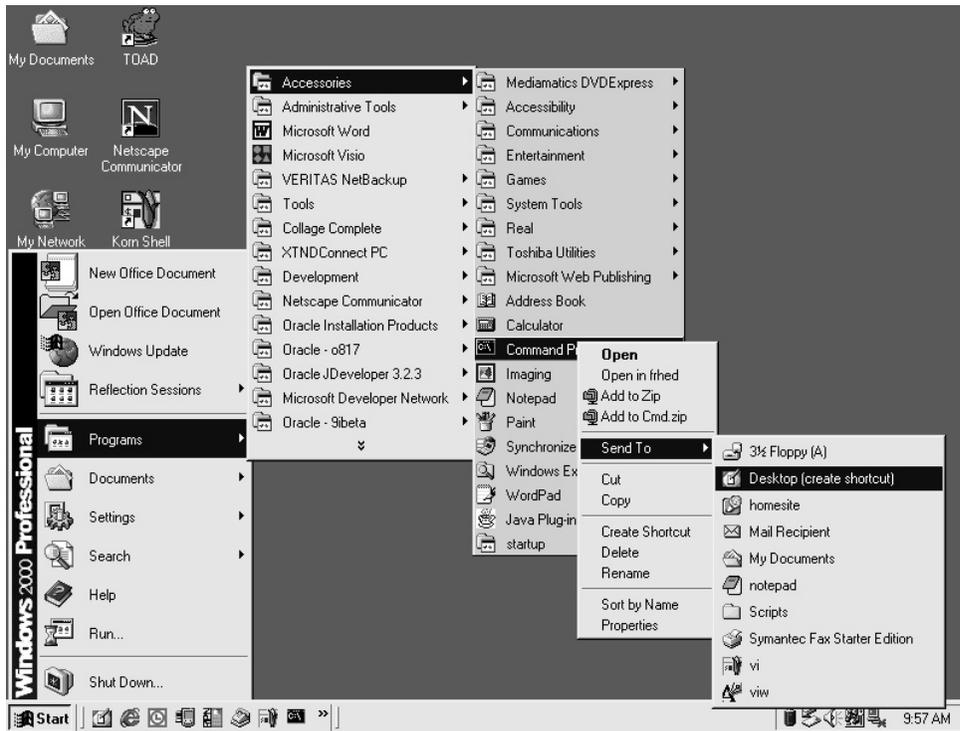


FIGURE 3-7. Copy the Command Prompt shortcut to the desktop.



NOTE

Because many people often start a command prompt from the run prompt (see Figure 3-7), we suggest that you also make the changes to a command prompt window that has been started at the run prompt. Save the setting for the shortcut, and these settings will be maintained for future run prompt uses.

If you want to save the changes just for your session, edit the command prompt once it is started by pressing ALT-SPACEBAR, clicking Properties, and making the changes you want for your session. Once you've finished making your changes, click OK and take the default for Apply Properties. This will keep your changes for the life of that command prompt.



In the sections that follow, you will find descriptions of the most relevant elements for each tab of the Shortcut Properties dialog box.

General Properties

This tab contains the essentials of any shortcut, including the times last accessed, modified, and created.

- **Title** Specify a title to your liking for simple identification.
- **Read-Only** Enable this check box if you want to keep yourself and others from accidentally making permanent changes to the shortcut. This enforces editing of the shortcut directly, as opposed to editing on-the-fly.

Shortcut Properties

This tab is used to set the action behavior of the shortcut.

- **Target** The `cmd.exe` has a number of useful command-line options that you can use to your advantage. To display these options, enter the following at a command prompt:

```
C:\> cmd /?
```

You might want to start up a command-line SQL*Plus that does not prompt you right away for username and password, and when finished with SQL*Plus exits to a `C:\>` prompt. You can accomplish this with the following target:

```
%SystemRoot%\system32\cmd.exe /K sqlplus.exe /nolog
```

Unless you use the command-line option `/D`, the commands found in the Registry (see Figure 3-8) at `HKEY_LOCAL_MACHINE\Software\Microsoft\Command Processor\AutoRun` and `HKEY_CURRENT_USER\Software\Microsoft\Command Processor\AutoRun` will execute when you start the command line. Make sure you check these Registry entries when troubleshooting a problem unique to the command line. You can also use the AutoRun Registry entry to run a script to configure your environment. In Figure 3-8, you can see how we have created the Registry entry to set the Oracle environment whenever we start a command prompt. If you want the program only for the Oracle user, then make sure you are logged in as oracle (or whatever user you have created to install the Oracle software), and add or change the AutoRun entry under the `HKEY_CURRENT_USER` Registry tree. Once again, to troubleshoot environment issues, use the `/D` command-line option to turn off the execution of any **AutoRun** command found.

- **Start In** Change this setting if you would like to start on a particular drive in a particular directory. For instance, you can set this property to your scripts directory for database administration work and to your source directory for development work.
- **Shortcut Key** Use this to set a key combination that is not used in any applications you would like to be able to start the shortcut from if you are a command-line junkie. Be aware that overly complicated key combinations may be difficult to reproduce.
- **Run** Typically, you will want to use a normal window, but there may be times where you would like the prompt to run full screen. In those cases, set this property to Maximized. You can toggle to a Maximized command prompt window any time while the prompt is in the current window via the key combination ALT-ENTER.
- **Change Icon** This button brings up a dialog box that allows you to select the icon you will display for the shortcut. If you plan to create a shortcut specifically for running SQL*Plus, then you may want to browse to the sqlplusw.exe file and select its icon.
- **Comment** You can include a description that will be displayed as the tool tip when hovering over the icon.

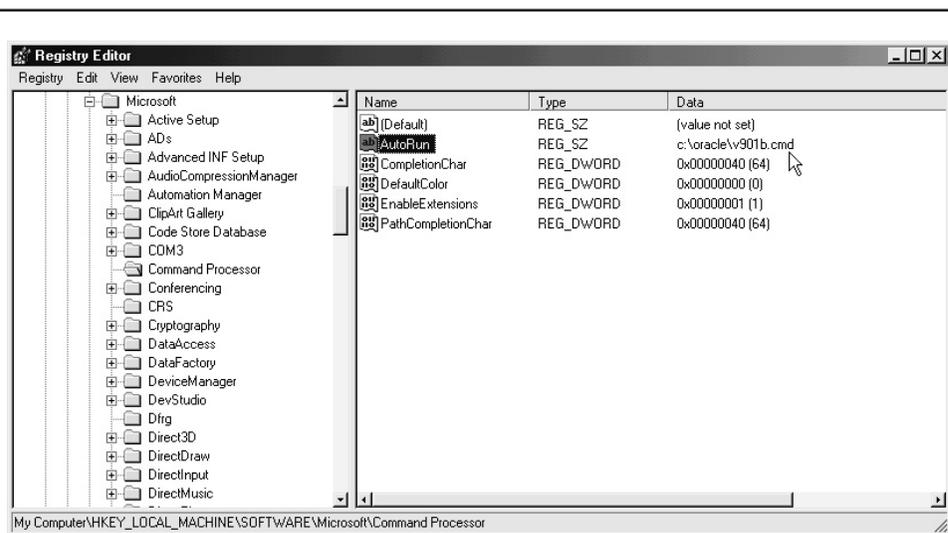


FIGURE 3-8. *AutoRun a command file on command-line startup.*



Options Properties

This tab is unique to the command-line shortcut. Use its values to change how you can interact with the command line and some look and feel options.

- **Cursor Size** We keep this at the default setting, Small; but according to your eyes' ability to spot the blinking cursor, you may want to select Medium. Be aware that if you set this property to Large, the cursor will then look like the one used to indicate Insert mode.
- **Command History** You can use the up and down arrows to navigate the history of this cmd.exe process. The Buffer size property sets the number of commands to keep in the history. The Number of buffers property indicates the number of cmd.exe processes that are able to have their own history buffers. Finally, the Discard old duplicates property allows you to eliminate duplicate entries of the same command in your history. Set this property to fit your preference.
- **Quick Edit Mode** We always have this option turned on. It allows us to use the mouse to select areas of the command prompt screen—it works slightly different from a word processor selection via the mouse, but is very useful for coming up with quick lists for pasting of a column of output from a command into a document or script.

With this property set, select the area of interest, and then press ENTER to actually copy the area to the Windows Clipboard. If you wish to paste directly back into the command line, just right-click immediately after you make your selection to paste it in. To summarize: paste via right mouse click, and copy via mouse click-and-drag.

Font Properties

Do you find that the command prompt text is too small to see? Do you think that the command prompt default fonts are obnoxiously large? You can change the font selection and size to meet your needs from this tab.

Layout Properties

The key elements to adjust here are buffer screen size and window size.

Window size allows you to determine how many lines you want to view at a time and how many characters across you want to be able to see. The default is 80 characters across, assigned as the width, and 25 lines down, assigned as the height.

The Buffer Screen Size setting assigns the size of the buffer that the command prompt will keep in memory. SQL*Plus queries usually have column widths that extend beyond the default width of the command line in SQL*Plus. You can specify the effective width of the command line by setting the buffer screen size width to a

value greater than the sum of the column widths you wish to display. You also need to change the SQL*Plus setting for *linesize* to an equivalent value (for example, SET LINES 9999). You can then use the command-line horizontal scroll bar to navigate the results. You can now spool the output of a SQL statement, otherwise useless in the default configuration, to a file, and then import the resulting file into Microsoft Excel as a delimited-by-space file.

Changing buffer screen size height allows you to review the history of your commands. Set this value to an appropriate size to meet your needs. We use 300 as a default, and have used a setting as high as 9000 to ensure navigation for results that would otherwise never be seen again.



NOTE

Setting the buffer size and some of the other properties affects the size of the executable in memory. Verify that the memory usage for your configuration is acceptable by looking at the memory used by cmd.exe via the Task Manager (start with the key combination CTRL-SHIFT-ESC) on the Process tab in the Mem Usage column. Be aware that multiple command prompts will show up as multiple processes with the same name. We have also found that very large buffer and history property changes tend to drain CPU resources and cause paging as well.

Colors Properties

You may wish to set these to increase readability. Many people prefer black text on a white background. You may want to set up a prompt that has a background to distinguish it as a potentially dangerous command prompt for administrative or long-running tasks.



Unix Integration Tools

The previous sections have demonstrated how to create a command prompt that is much more productive than the default prompt, but Windows NT and Windows 2000 both lack the command-line tools and daemons that Unix offers. To integrate Windows 2000 into a Unix network, you need to know about the key services that Windows 2000 does not normally provide:

- X server
- NIS or NIS+



MKS Toolkit

We highly recommend the MKS Toolkit as a replacement for the command prompt and a development environment for Unix lovers stuck on a PC. Here is a list of only a few of the native Unix utilities that come with the MKS Toolkit: alias, awk, sed, xargs, cat, chmod, chown, ls, grep, egrep, env, find, head, tail, cmp, cut, cp, vi, who, tar, compress, uncompress, diff, df, dircmp, du, id, umask, tee, ipcs, ipcrm, kill, od, mv, and ps.

The MKS Toolkit comes in a variety of flavors at a variety of prices. You can find the package that is right for integration with your Unix network at <http://www.mks.com>.

Microsoft Services for Unix

Microsoft Services for Unix (SFU) is an add-on package for Windows NT and Windows 2000. It includes a special version of the MKS korn shell and a selection of the utilities from MKS as well. We were surprised and disappointed that it didn't include sed and therefore doesn't really qualify as a command shell replacement, but instead serves as a supplement to enable better integration with Unix systems. It includes these services:

- Client and server software for NFS with a variety of other services that allow integration of your systems with Unix environments that heavily use NFS.
- NIS tools to enable migration and integration with NIS security environments (a needed complement to the NFS utilities).
- A version of the MKS korn shell with over 60 utilities such as grep, ls, ps, cat, and vi. If you want full shell capability, get MKS to complement SFU.

At under \$200, this package ultimately gives you the services you will need to do most integration with Unix networks, and a little shell scripting functionality. It may or may not meet your needs. If you need to mount NFS volumes, it is a nice, less expensive alternative to other more full-featured NFS clients, such as Hummingbird.

For more information on services for Unix, and a great variety of white papers on how to integrate Windows 2000 environments with Unix, check out <http://www.microsoft.com/microsoft/sfu>.

Cygwin

For those who are not able or willing to fork out hundreds of dollars for a toolkit and don't need many of the daemons, check out Cygwin (<http://www.cygwin.com>). The Cygwin project is the combination of a DLL written by Cygnus that allows a developer to use Unix system calls. This capacity enables porting of the GNU

development tools and utilities. Once installed, you can use the tools and utilities from the Bash shell provided, or you can use the tools and utilities from the Windows command shell (cmd.exe.)

Hummingbird's Maestro and Exceed

Hummingbird provides Maestro as an NFS suite for the PC, and Exceed as a connectivity suite for the PC, including an X server. These are popular tools for doing Oracle installations from PCs now that Oracle's installer requires X. Check out the installation documentation for Solaris and other Unix platforms for specifics at <http://docs.oracle.com>. You can also read more about Hummingbird's product line at <http://www.hummingbird.com>.



Using the Resource Kit Appropriately

The various Windows 2000 Resource Kits are made up of key references, printed books that can also be found online, as well as tools and utilities. Many of these utilities could be considered indispensable. On the other hand, many of the included utilities give hackers a variety of tools they can use to manipulate your system and others on the network. In the right security context, the Resource Kit should be installed at least in part to help you with system administration and provide utilities you can use to write useful DBA scripts. In the wrong security context (for example, outside your firewall or on systems where a variety of users might have access), the Resource Kit can be used to gain access to all kinds of juicy information.

One of the things you can do to avoid security problems is to install only particular executables that are useful and leave off the rest. Also keep these executables out of the normal environment, and instead use an environment-setting script to alter the path to include the utilities when needed. To ensure even greater safety, you can rename some of the utilities to your liking in order to hide them from users who may be looking for them by name. Here is an example of a script you might put somewhere in your path to add the Resource Kit utilities to your path for administration activities for this session:

```
SET PATH=%PATH%;D:\PROGS\RK
```

Key Resource Kit Online Sites

The Resource Kit is much more than what gets installed on a disk. Some of its most useful elements are its published documentation. These online resources will help



you keep up with changes in the Resource Kit and access electronic versions of the printed materials.

- **Windows 2000 Resource Kit** The indispensable set of toolkits' home on the Web.
<http://www.microsoft.com/windows2000/techinfo/reskit/default.asp>
- **Windows 2000 Online Resource Kit Books** The online version of the printed materials in a searchable and indexed form on the Web.
<http://www.microsoft.com/windows2000/techinfo/reskit/en/default.asp>
- **Windows 2000 Server Resource Kit Tools** A list of all the utilities with a description, and a link for some to deeper descriptions and downloads.
http://www.microsoft.com/windows2000/techinfo/reskit/rktour/server/S_tools.asp
- **Windows 2000 Resource Kit Web Resources** Resources that are listed in the printed materials and found on the Web.
<http://www.microsoft.com/windows2000/techinfo/reskit/WebResources>
- **Windows 2000 Resource Kit Free Tool Downloads** A selection of the tools that are included on the Resource Kit CD-ROM.
<http://www.microsoft.com/windows2000/techinfo/reskit/tools>

Some of the must-have free utilities are described in the following table:

Free Tool	Description
Kill	Kills processes from the command line. The unique function of this tool is its ability to force the killing of the process with the -f command-line option.
Dumpel	Dumps the content of the Event Log to a tab-delimited file. Use this utility in the command line.
Installation Monitor	Tracks the changes made by setup programs to the Registry.
Now	Echoes the current date and time along with arguments passed to the utility. Use this utility in the command line or in batch files.
Qslice	Shows the CPU usage of a process that lets you drill down to the thread level. You can use this tool along with queries to V\$SESSION, V\$PROCESS (use SPID = THREAD ID in decimal—you'll need to convert the result to hex), and V\$BGPROCESS to differentiate between the various background processes.

Support Tools

If you cannot justify the cost of the Resource Kit for each machine, then you can still take advantage of the support-oriented tools of the Resource Kit that Microsoft includes on the operating system installation media. You can find them on the Windows 2000 CD-ROM in the directory \Support\Tools. Here are some of the important executables installed with the support tools: kill, netdiag, pmon, poolmon, pvviewer, reg, logtime, logevent, ntimer, timethis, typeperf, and tlist. For details on each of these, try the command followed by /? or take a look at the Help file that is installed with the support tools.

Tool	Description
diruse	Determines disk space usage in a directory if used in your batch files. diruse /M . will show the number of megabytes in use for the current directory.
forfiles	Cycles through a list of files in a directory or files in a directory tree. Use in your batch files.
freedisk	Checks for disk space and returns 0 if an operation is possible; otherwise, returns 1. Use this tool in batch files to avoid running out of disk space.
logevent	Writes to the Event Log from your batch file to log results into the OS facility. Use this tool in the command line.
mcast	Sends or listens for multicast packets. Use for examining network characteristics and for testing reactions to multicast packets.
netset	Views and configures the network from the command line.
ntimer	Shows elapsed time to complete a command line and breaks down CPU time for the command (User/Kernel/Idle/Total).
pathman	Adds and removes elements to and from the path environment variable.
pmon	Provides a command-line view of processes such as the GUI Task Manager's Process tab.
pvviewer	Examines process details from this GUI tool. Also sets process and thread priorities.
reg	Finds, reads, and manipulates Registry entries.
setx	Sets user- and system-level variables into the Registry at the command line.
scanreg	Finds Registry entries that match a pattern from the command line.



Tool	Description
timethis	Times the response of a command line. For example, timethis lsnrctl status runs the command and shows timing. Elapsed time is usually the most interesting.
typeperf	Displays performance counters on the command line until a key is pressed. The command typeperf 3 "\Processor(0)\% processor time" > ptime.csv will write processor usage on the first processor with a timestamp and value to the file ptime.csv. You can open this file in Microsoft Excel.
tlist	Lists the currently running processes on a machine. If a process ID number is passed as a parameter, then details of the process memory usage, including loaded DLLs, are sent to stdout.
Counters.chm	Performance Counter Reference Help File



Sysinternals

Winternals maintains a freeware site named Sysinternals (<http://www.sysinternals.com>) that has a number of utilities you can use to diagnose problems and help get you out of a jam. In many cases, existing Microsoft tools do not exist to address the problems these freeware tools address. This site is best known for the NTFS hack that allowed the DOS OS to read and work with files on NTFS. If you happen to have the need to understand certain internal features of the Windows NT/2000 kernel, then many of the utilities come with source code.

In particular, you will find the tools useful for examining and troubleshooting problems in which you might need to monitor low-level OS activity. Use Regmon if you want to see exactly what is being read from the Registry. If you need to see what files are being accessed, try Filemon. The following sections discuss some of the utilities from this site:

Process Explorer

Get a good look at what is happening within a process on your system through the Process Explorer (see Figure 3-9). You can see what files this process is using, what Registry entries it is accessing, what devices are being used, and more. You can filter

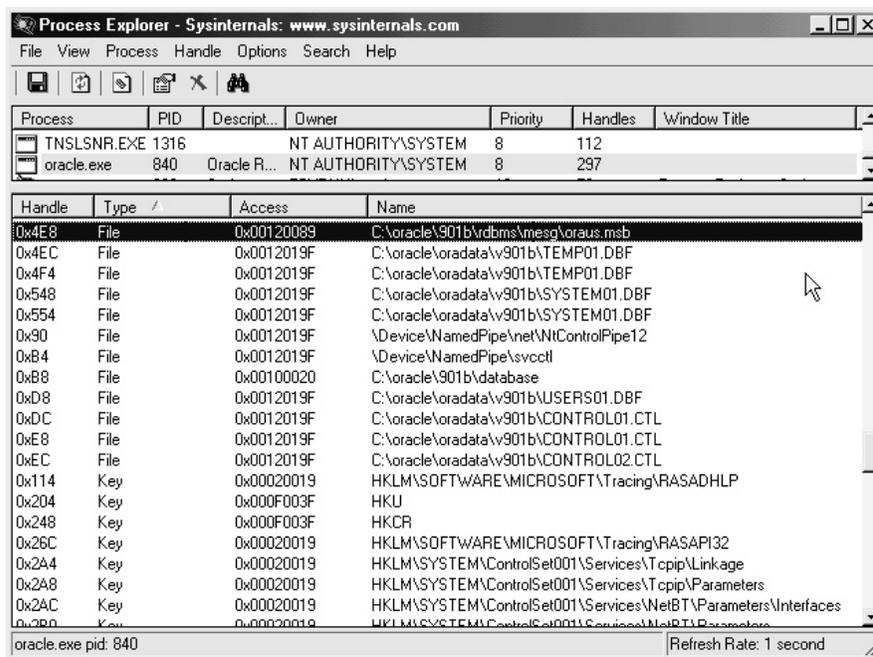


FIGURE 3-9. Sysinternals.com Process Explorer

and highlight according to simple rules you provide. Use this tool to answer questions such as, “What is this process doing?”

Tool	Description
PsUtilities	A collection of command-line utilities you can use to monitor and work with the system.
Regmon, Filemon, Diskmon	Monitors activity on the Registry, file system, and disk volumes in real time. All have the capability to easily filter and highlight to focus your view. These tools are useful for understanding and diagnosing the behavior of the system and applications.
DebugView	Intercepts debug print output by device drivers. It can be used in place of a debugger on your system because it is lightweight and simple to use.



Tool	Description
Listdlls	Indicates what process is using the Oracle DLLs when you are having trouble uninstalling or applying a patch on a system where you cannot use Process Explorer. Passes a process ID as a parameter to get details for just that process.
Sync	Flushes the file system caches to disk. Windows caches access to files in a shared portion of kernel memory to increase performance. This cache is one of the reasons you never want to shut down a Windows 2000 or NT system by just turning off the power. This executable enables you to command the system to flush this cache to disk, thus reducing the risk of problems if power is lost or the system must be improperly shut down.

System Administration

This section addresses three key areas of system administration that are of concern to Oracle database administrators: the Event Viewer, disk management, and scheduled tasks. These elements of administration are essential to understanding the life of a system, managing IO and availability, and completing regular tasks that can be performed without human interaction.



Using the Event Viewer

The Event Viewer on Windows NT and Windows 2000 systems is the repository for warnings, failures, and information logged by the operating system, the auditing mechanism of the domain and/or the local security database, and application-maintained logging. There are three basic logs that are populated:

- System Log
- Security Log
- Application Log

Always check the System Log first if you have any problems with Oracle. This is where you will find problems with disks, controllers, and other hardware, and device drivers, service startup, memory errors, and other system problems.

The Security Log

The Security Log requires some setup to get interesting information. Configure security auditing through policies. A thorough discussion and instructions on how to set up Windows 2000 security policies for your environment is beyond the scope of this book, and we do not feel that we can avoid giving you enough information to be safe. Become very familiar with group policies, security templates, and more security features to design your security infrastructure on Windows 2000. With that said, we will show you how you can track failed local login attempts on a stand-alone server that doesn't participate in a domain:

1. Start the Local Security Policy MMC console found in the Start | Programs | Administrative Tools folder.
2. Expand the Local Policies node, and then click Audit Policy.
3. Right-click Audit logon events and select Security.
4. Click the Failure option in order to log failed logon attempts to the security Event Log, including attempted logons over the network

See Figure 3-10 for an example of a logon failure event.

The Application Log

Oracle uses the Application Log extensively to report on the background process activity, instance status, and a number of other events related to the Oracle database and listener. Be sure to look out for warnings and errors related to Oracle. To simplify instance monitoring, create an Application Log view with a filter on the event source that corresponds to your database SID. For example, oracle.orcl would show up for the ORCL SID (see Figure 3-11 for an example).

Event Log Filtered Views

You can now filter on a variety of aspects of the log. For example, you can create an instance of the MMC with a filtered view of the Application Log to show you *just* the entries for the source of your database instance (see Figure 3-11). For instructions on creating your view, see the section "Building Custom MMC Consoles" earlier in this chapter. Once you have an MMC with the standard Event Log views, right-click the Event Log of your choice and select New Log File View. Rename the new view and adjust the properties to filter appropriately.

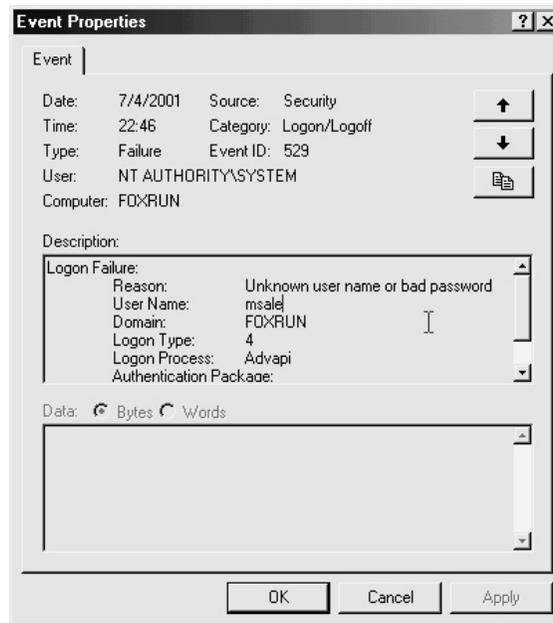


FIGURE 3-10. Security Event Log logon failure event

On Windows NT the Event Logs were not as easy to manipulate and use for administration based on historical trends. You had to use utilities to extract textual data for analysis and reporting outside of the Event Viewer, and the log would become full and prove an annoyance. Much of that has changed in Windows 2000. The Event Viewer has been drastically improved from an administrator's view in Windows 2000. Here is a list of some of the key features of the logs and the viewer to help simplify database and system administration.

Oracle Auditing to the Application Log You can set up the Application Log to enable auditing of logins to the Oracle database as opposed to the OS. Here are the steps you need to take in order to enable the Oracle auditing feature to log on to the Windows 2000 Application Event Log:

1. Set the `init.ora` parameter `AUDIT_TRAIL = OS` for the instances you want to audit.
2. Use `SQL*Plus` to connect to the database as `SYS` and run the script `cataudit.sql` found in `%ORACLE_HOME%\rdbms\admin`.
3. Bounce the database.

From this point forward, the Application Log will show a record for default actions such as connecting as sysdba. See an example of this event in Figure 3-12. You can add additional auditing of particular events via the database. To manage auditing on more actions and objects, see the Oracle documentation.

Circular Logging Avoid those irritating Application Log Full error messages by setting the Log Size parameters for each log. You can set the maximum log size and even log the system's reaction when the maximum size is reached. The three reaction options are as follows:

- Do not overwrite the same activity as in NT.
- Overwrite only events x number of days old.
- Overwrite events as needed.

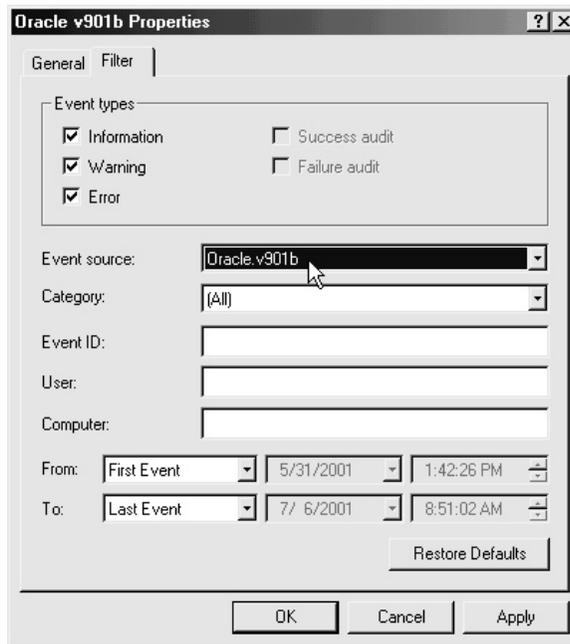


FIGURE 3-11. Filter the Application Log for an Oracle database instance.

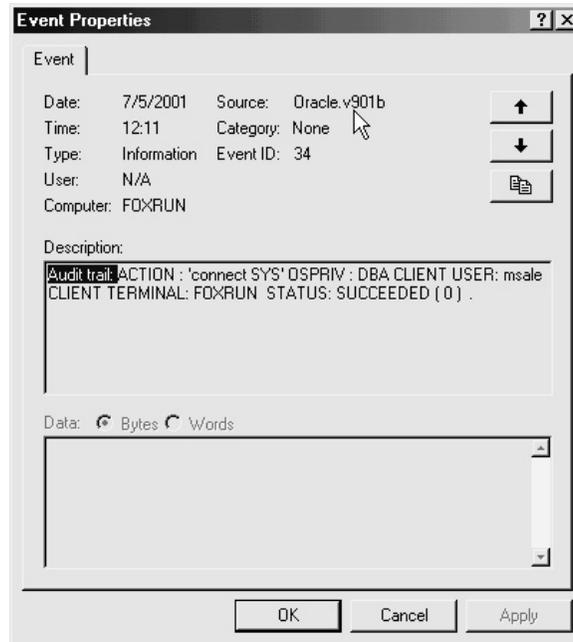


FIGURE 3-12. Example Oracle audit event

Return to defaults at any time via the Restore Defaults button on the Configuration dialog box (see Figure 3-13).

MMC Integration Because the Event View is a stand-alone snap-in for the MMC, you can create valuable custom consoles that give you a filtered and focused view of the history of your system and its applications. Creation of additional filtered log views that are named appropriately grants you incredible flexibility and power.

Save Logs in Various Formats Create your own custom views of the various logs with filters in place, and then export them as text or save them in the following formats:

- Binary .evt event file format
- Tab delimited
- Comma delimited

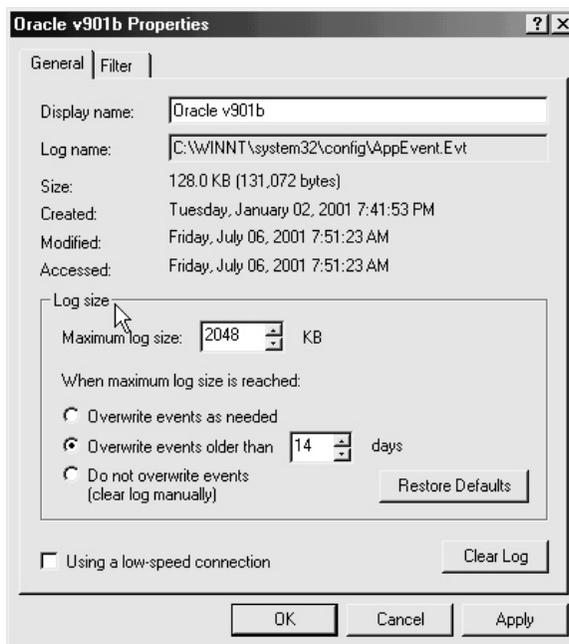


FIGURE 3-13. *Configure Event Log properties*

You can use an .evt file to analyze historical data or to send out support to an organization. With the tab- and comma-delimited formats, you can import data into a database using SQL*Loader or the new Oracle9i feature of external tables for an administrative web site, or analyze and transform the files using Perl or another scripting language. You can also just import the data into MS Excel, and chart the occurrence of events that might affect availability or show activity levels.



Managing Disks

Disk management in Windows 2000 has changed more under the covers than from a user perspective. VERITAS, in cooperation with Microsoft, has provided a piece of its volume management experience in the Windows 2000 Volume Management tools. If you intend to have more than 20 volumes, we strongly suggest that you upgrade to the VERITAS Volume Manager. The flexibility it provides, along with the remote management capabilities and performance tools, make it a worthwhile investment for server farms with large disk arrays. The key user interface difference



for basic disk management is the movement of the tools into the Computer Management console (see the “Computer Management Console” section earlier in this chapter).

Online Disk Management

You can now make most changes to disks and raid configurations without rebooting. You can even add new disks without rebooting if your hardware supports it. If you upgrade to VERITAS Volume Manager, you gain even greater flexibility.

Remote Disk Administration

You can manage disks on remote systems in which you are a member of either the Local Administrators group or the Server Operators group. If you upgrade to VERITAS Volume Manager, your remote management capabilities are far superior. If you need to do remote management, invest in the VERITAS Volume Manager.

Dynamic Disks and Volumes

Dynamic disks and volumes are new to Windows 2000. Basic disks and volumes that were found in Windows NT are still in Windows 2000, but they no longer support certain advanced functionality. Basic disks use partitions, whereas dynamic disks use dynamic volumes. Dynamic disks allow you to have an unlimited number of volumes per disk, as opposed to four partitions per basic disk.

The key change is that in order to create OS-managed RAID sets, you are required to use dynamic disks and volumes. Even though you cannot create Windows 2000 RAID sets on basic disks, you can still manage and upgrade existing volume sets created previously in NT.

If you have a large number of volumes to manage, you can use VERITAS Volume Manager to move subdisks around in order to alleviate performance issues or take slower disks out of a volume and replace them with fast disks on separate controllers—all while the volume is online and without rebooting! You can also take dynamic disks and migrate them to different boxes without data loss when using VERITAS.

Mount Points

You can now mount an NTFS volume or partition to an existing folder. This can help you avoid the limitation of 26-lettered disks and help maintain a more logical structure.

Windows 2000 now provides a defragmenter based on the Diskeeper defragmentation tool (<http://w2k.diskeeper.com>) for manual analysis and defragmenting of a local file system. The full-featured version allows you to schedule defragmenting or even let it decide when to defragment. It can also defragment remote systems that have Diskeeper installed on them, and defragment

more than one volume at a time, an essential for very large systems with terabytes of files to maintain.

**NOTE**

For more on defragmenting from Microsoft, check out the article “Disk Defragmenter in Windows 2000: Maintaining Peak Performance Through Defragmentation,” at <http://www.microsoft.com/windows2000/techinfo/administration/fileandprint/defrag.asp>. Microsoft documents the packaged defragmenter limitations at <http://support.microsoft.com/support/kb/articles/Q227/4/63.ASP>.

**NOTE**

If your datafile systems are properly isolated and implemented at datafile creation time, you should never have to defragment them. You will have to pay attention to fragmenting your Oracle home file system, and the file system or systems where your log and trace files exist.

RAID

Although we won't go into the details of the various permutations of RAID configurations, here we give some key tips to point out the best way to implement (or not) RAID for an Oracle environment.

- Choose hardware RAID over software implementations.
- With hardware RAID controllers, make sure that your controller cache has a battery backup.
- Stay away from RAID 5 for files that need fast writes to disk because RAID 5 performs four physical I/Os for each single logical I/O. Keep at least your redo logs off of RAID 5 volumes.
- RAID 0+1 (striping mirrored sets) gives you fault tolerance without quite as much hit on performance as straight mirroring.
- Stripe (RAID 0) across controllers as well as disks to increase performance.
- Put redo logs and archive logs on a separate disk subsystem than control files and datafiles because logs are accessed sequentially as opposed to datafiles, which are typically accessed randomly.



- If you are going to use Windows 2000 software RAID, buy and use VERITAS Volume Manager for Windows 2000. This is an upgrade to the Disk Manager and allows much greater flexibility and capability. With the VERITAS Volume Manager you can create 0+1 RAID and multiple mirrored volume sets (for example, four volumes mirroring each other as opposed to two volumes mirroring each other) and monitor volumes for hot spots.

File Systems

Windows 2000 supports a number of different file systems, but there is really only one you should use for almost every situation: NTFS. NTFS allows for the combination of large file size, security, optimization for large file performance, and simple recoverability of the system volume via the Recovery Console. On a developer's machine where you might need to duplicate the environment of a client, you may be forced to boot into Windows 98 or some other flavor of the consumer OS. If so, then try and stick with FAT32 and keep all Windows 2000-specific software off of that volume.

Cooked vs. Raw

Oracle already bypasses the file system cache for the most important operations, but it still writes to disk using the file system driver. By moving to raw partitions, you remove the intelligent layers in NTFS and you also lose the benefits that the file system offers, such as security and journaling for recovery. Raw partitions are also quite complex to manage on Windows 2000 and require planning and keeping records. That said, raw partitions can give you a 10 to 15 percent performance gain and are required for Oracle Parallel Server. Take into account the various aspects of your system, your database, and your performance and availability goals, and select raw or formatted file systems appropriately. If you have a system that writes massive amounts of redo entries, you may want to create raw partitions just for your redo logs.

Be Aware of the Number of Drive Letters

The 26 letters for drive assignment can be a serious limitation on a large box. Windows 2000 offers the following workarounds:

- Raw partitions with renamed symbolic links
- Mount points

Be careful when reinstalling Windows 2000 on a system that has more than 26 raw partitions. The installation process assigns these partitions drive letters if you do not delete them before installation, thus forcing you to install on a volume you may not wish to install on.

Defragment Disks

Keeping your disks defragmented improves performance for sequential disk access. When a file is laid down on the disk, it is not altered unless it is autoextended or resized by hand. This means that when you create a datafile, you want a contiguous amount of space big enough to hold the datafile in one chunk. Make sure that you have at least 30 percent of the disk space available after you lay down a datafile to ensure speed and allow for defragmentation tools to work most efficiently after you have created the datafiles.



The Task Scheduler Service

You can schedule operating system jobs with Task Scheduler, accessible from the Control Panel by clicking Scheduled Tasks. The Task Scheduler is the Windows equivalent of the Unix `at` command, but with a nice little GUI interface for creating and managing tasks. You can create tasks that will be run based on a time interval (for example, every hour or every week), one time only, when the system is idle, when the computer starts, or when you log on. The job is run as a particular user and requires a password to log on. You can add multiple schedules for the task that combine any of the schedule elements. If you set the task to run when the system is idle, you can qualify what that means through advanced properties of the task.

The problem with the task scheduler is the lack of ability to schedule tasks to occur more often than once a day, as you can with the Unix cron daemon. To get around this, you can add multiple schedules, but this method has manageability limitations. There are third-party tools that provide very capable scheduling features, but Oracle offers a solution that is OS agnostic and very flexible—the Job functionality of Oracle Enterprise Manager.

The Operating System Environment

One of the keys to successfully running Oracle on Windows is understanding the key elements of the environment that Oracle interacts with. This section will help you to manage Oracle in the unique environment on the Windows operating system.



Understanding and Controlling the Environment on Windows 2000

The Windows 2000 environment can be rather complex if you delve down into the various layers and options available. In this section, we will take a look at underlying structures and the various ways you might be affected by interaction with the environment.



The Oracle environment is not so simple that you can get a comprehensive overview by running the **set** command and reviewing the variables that are currently set on the system. The system and your applications, including Oracle, will also read persistently stored environment settings from the Registry. In order to best administer and troubleshoot your systems, you must also understand how to interact with this environment. For example, when you start the default command line and examine the environment via the **set** command, you will find that the ORACLE_HOME and ORACLE_SID variables are not set. Even so, you can start SQL*Plus and connect to the database. Why? Because Oracle reads these variables from the Registry. To monitor the Registry in real time, you can use the Sysinternals tool Regmon, as described in the “Sysinternals” section earlier in this chapter.

The Windows 2000 Registry is the hierarchical database used to store persistent variables, user information, and system information for both the OS and applications. It is a key component in the Windows OS implementation of the Oracle database and should not be altered without a clear understanding of the edit. You can functionally equate the Registry to an Oracle system datafile, the data dictionary. In the same way that Oracle strongly advises you not to muck around in the SYS schema’s tables, Microsoft does not want the unknowledgeable user mucking around in the Registry. Even so, Microsoft exposes the Registry to administrators through tools such as regedit, and to developers through the API. This access is needed for manageability of the system and organized, manageable storage of persistent system and application variables. To facilitate accurate and flexible Registry management, Microsoft has provided the Resource Kit with a Registry reference (see the section “Using the Resource Kit Appropriately” for more details on the Resource Kit). You can find this reference as part of the online kit resources at <http://www.microsoft.com/windows2000/techinfo/reskit/en/default.asp>. This site features a relatively exhaustive reference to the keys that the OS writes as well as a good overview and explanation of what the Registry is and the structure of the data.

A hierarchical database stores objects in a parent, child, grandchild (and so on) structure. You might be thinking that you don’t know what the structure of a hierarchical database looks like. Our bet is that you have already been working with files and folders in Windows Explorer. Directory hierarchies are conceptually the same structure as a hierarchical database. Some other examples would be Active Directory structures and Oracle’s LDAP information store, OID. The Registry has a few base keys that you will primarily be concerned with. From these keys you will navigate down the tree to the values stored in an element of the tree down the hierarchy. For our purposes, these keys are as follows:

- HKEY_LOCAL_MACHINE (HKLM)
- HKEY_CURRENT_USER (HKCU)

You will be primarily interested in structures beneath these keys that store information about Oracle installations, services, and environment settings that are inherited from the Registry.

Registry and Home Keys

Oracle on Windows systems keeps information regarding Oracle-installed software in the HKLM/Software/Oracle tree of the Registry. Beneath this key are keys that correspond to each Oracle home's individual Registry settings starting with HOME0 and incremented up. In this key you should set variables used by Oracle executables in this home. If you ever wonder what Oracle home is currently being accessed, you can start SQL*Plus at a command line and try to run a script using the environment variable for the Oracle home followed by a file that doesn't exist.

```
SQL> @%ORACLE_HOME%\WHATISIT
SP2-0310: unable to open file "c:\oracle\901\WHATISIT.sql"
```

Notice the error message tells you where it looked for the file, thus giving away the location of the Oracle home. You can repeat this with the various environment variables that are stored in the Registry by replacing ORACLE_HOME with variables such as ORACLE_SID or ORACLE_BASE. For more detail on the Oracle keys in the Registry, see Chapter 4.

Setting Environment Variables at the System or User Level

When you start a program, what are the environment variables that it has access to? Through the Win32 API, a program can obtain a value stored in the Registry, but what about the values that are set by default and available by querying the environment? The User and System environment variables provide name-value pairs accessible via the environment. From the command line, you can add, change, and delete these values. To view these variable settings for the system and for the current user, follow these steps:

1. From your desktop, right-click My Computer and select Properties.
2. Click the Advanced tab.
3. Click the Environment Variables button.

You can view, alter, add, and delete variables for the local user profile (under the HKCU tree in the Registry) and for the system (under the HKLM tree in the Registry).

If your system and user environments have the same variable set to different values, then the value of the user environment variable overrides the system environment variable on the command line.



System environment variables can be found in the Registry at HKLM\SYSTEM\CurrentControlSet\Control\Session Manager\Environment. User environment variables can be found in the Registry at HKCU\Environment.

Setting Environment Variables at a Command Prompt

In order to best ensure that your environment is set the way you need it to be set, you should go to a command line and set your environment there. You can do this via the **set** command either directly at the command line or in a batch file. We suggest that you create a batch file for the different environments you would like to set and put these in your path. You may even want to put them in a directory you create just for batch files you would like to be able to run from a command prompt at any time. This allows you to centralize the location and allows for quick implementation across your server farm. Here is an example of a collection of **set** statements and startup of key services you might have in order to properly create an environment in which to run Oracle utilities:

```
c:\oracle>SET ORACLE_SID=v901b
c:\oracle>SET PATH=%ORACLE_HOME%\BIN\;%PATH%
c:\oracle>net start OracleServicev901b
c:\oracle>lsnrctl start
```

If the service has already been started, then the **net start** command will return a harmless error message indicating that the service is already started. Instead of entering all these commands at the command line one at a time, create a text file with the extension `.cmd` and store it in your path with the following content:

```
SET ORACLE_SID=v901b
SET PATH=%ORACLE_HOME%\BIN\;%PATH%
net start OracleServicev901b
lsnrctl start
```

Some Interesting Keys

Here are some interesting keys that are not prominently documented:

- **ORA_XCPT** Use this key to stop the generation of the core files. The small core file generated on Windows NT/2000 is not normally a problem; but if you have a problem that generates a massive number of the core files, then you can use this parameter to turn their generation off.
Put this one in HKLM/Software/Oracle/HOMEX, where *X* is the number of the Oracle home where you want to turn off core dumps.
- **ORA_SID_XCPT** Functions the same way as the **ORA_XCPT**, but stops the core file generation for just the SID indicated in the key.

- **SQLPATH** This key, kept in each home hive under HKLM/Software/Oracle/HOMEX, acts like the path variable for the command line, but in SQL*Plus. Add directory entries separated by a semicolon.

Setting Permissions on Files/Folders: Oracle Considerations

In order to ensure security, system administrators will often lock down files and directories by removing permissions that are there by default. When working with Oracle on a system, it is important to remember that you will need to perform an installation as the local administrator, and that the account that runs the service for the database instance will need to have full access to Oracle-related files and folders. Here are the details of what you should change to ensure security:

- The user account that installed Oracle needs full control over files and folders in the Oracle home directory structure.
- The account that runs the Oracle Services (the system account, by default) needs full control over the files and directories that hold all Oracle datafiles, control files, password files, archive locations, dump directories (for example, bdump and udump), and other directories that may be used by an instance (for example, directories indicated in init.ora for the parameter UTL_FILE).
- The account that runs the Oracle Services also needs full control over much of the Oracle home directory tree. We suggest that you just give full control to this account, but you may have need to narrow it down further. If so, then make absolutely sure that you grant full control over the %ORACLE_HOME%\bin directory to the account.
- Users who need to run Oracle utilities such as SQL*Plus, Import, Export, and SQL*Loader will need to have read and execute permissions on those executable files.



NOTE

If Oracle will be using any resources that need to be accessed via the network (for example, a mapped drive), then you need to change the account that starts the service to an account you can add the appropriate rights to on the machine that holds the networked resource. This can also be more secure because a hacker could create a service that automatically has the rights of the system account without ever knowing a password.



Active Directory

Active Directory is Microsoft's next-generation hierarchical database for storing objects of interest. Typical objects of interest include users, printers, machines, and many other objects; you can also design and create your own objects. Oracle offers integration for Oracle user authentication and instance connectivity information to be stored in Active Directory and authenticated via the Kerberos package used in Windows 2000 domains.

Net Naming with Active Directory

There are a number of ways to resolve the connection information for a database. The typical method is to set up a `tnsnames.ora` file for each client. This can become unwieldy, and in an environment with a large number of instances, you will run into a character limitation on the size of the `tnsnames.ora` file as well as a performance problem.

Integration with Active Directory allows Windows 2000 domain administrators to set up Active Directory to store connection details that would otherwise be kept in the `tnsnames.ora` file. This centralizes administration of instance connectivity information and in a large environment can drastically reduce time spent troubleshooting connection problems.

Remote Administration

Remote administration tools are an essential element to efficiently managing systems. This section talks about some solutions and the key issues in remote computing on the Windows platform. For those of you that are managing Oracle on Unix systems, you should try and use the same solutions for both platforms. Due to the nature of Windows 2000, you will need at least one GUI remote administration tool no matter what.



Remote Administration with MMC

In the earlier section "Computer Management Console," you learned how to use the Windows 2000 Computer Management Console to remotely administer other Windows 2000 servers. It is important to note that some of the computer management tools do not work remotely, and other means of remote administration are likely needed in combination with MMC-managed remote administration.

Here is a brief review of the method we discussed for connecting to a remote computer with the Computer Management Console:

1. Open the local version of the Computer Management Console.
2. Right-click the node in the left pane titled Computer Management (Local) and select Connect to another computer.
3. Either enter the name of the computer directly or browse to the computer you are looking to manage. Click OK once you have selected the node you wish to manage with your mouse.

From this point, you can manage many of the facilities on the remote computer. In accordance with your network and domain setup, you might be more limited than you think. The best methodology is to try to use the various functions to see what works in your environment.

See the “Computer Management Console” section, earlier, for instructions on how to save a console connecting to a remote computer for later use.



Remote Administration with VNC

Virtual Network Computing (VNC) is a remote administration tool that allows you to access the GUI desktops of both Windows and Unix systems. The key advantages of this tool are that it is free, it works across operating systems, and the client is lightweight. It seems to be slightly slower and lacks many of the other features that tools such as pcAnywhere have, but free is alluring!

One of the little-known features of VNC is that you don't *need* the client software to access the remote desktop. You can use your browser instead. Just form the URL in the address bar of your browser like so: `http://hostname.domainname:5800`. This access method does appear to be slightly slower and even more sensitive to network configuration, but it is great for access on-the-fly where you don't have the VNC client installed.

VNC can be downloaded at <http://www.uk.research.att.com/vnc/> for various operating systems. We use a Linux system to administer various Windows computers at work because we can set it up to do automatic authentication and we don't get the VNC desktop confused with the Linux desktop. A handy tool!



Remote Administration with the Windows 2000 Telnet Server

The Windows 2000 Server product line now comes with a Telnet Service that allows you to get a command line on a remote Windows 2000 Server from any OS. The Telnet Service should *not* be used on nodes outside of your firewall or if you are in any way concerned for security of the passwords used in the Telnet process into



the computer. Why? Because even when using NT Lan Manager (NTLM) authentication, you pass the password in a form that can be recombined and hacked with a software utility quite easily. For a much more secure remote command line, review the commercial version of the SSH daemon for Windows NT/2000 at <http://www.ssh.com>.

For further information on setting up the Telnet Service, check the standard Windows Help file (Start | Help) by searching on the term "telnet." If you do plan on using this service, we suggest that you set it up for initial NTLM authentication, and then if that fails, try the standard username/password challenge you see when using Telnet to get into a Unix system. You set this option in the Registry by running a command-line setup utility as follows:

1. Navigate to Start | Programs | Administrative Tools | Telnet Server Administration.
2. Select the option Display/change Registry settings.
3. Select the option NTLM.
4. Continue through the prompts and set the NTLM value to 2.

Once you have started the service, you use Telnet to access the Unix system directly using NTLM authentication; if you happen to not be able to authenticate via NTLM, you will then be prompted for the username/password combination. If you want to tighten up security to deny even that, you should set the NTLM value to 1 to enable *only* NTLM authentication. Please do note that even with only NTLM authentication, we were able to use a network sniffer and a brute password cracker for NTLM passwords to break into our own setup. Due to the nature of this vulnerability, we suggest that you avoid even NTLM authentication outside your firewall and go directly to the commercial SSH daemon for Windows NT/2000 mentioned previously.



NOTE

The NTLM authentication method has been around since before the inception of Windows NT. Over the years this method has been found to be lacking, and in Windows 2000 a Microsoft implementation of Kerberos authentication has been introduced.



Remote Administration with pcAnywhere and Other Commercial Tools

Most administration of your Windows 2000 server farm can be done via a command line with proper setup, but the easiest and quickest way to complete many tasks is

via a GUI desktop. When we say “easiest and quickest reference,” we are assuming that you have the capacity to work with a GUI tool over the network to manage your computers. If you are working over a slow network (for example, WAN or dial-up network), then we suggest that you do all you can via a command-line interface and use the GUI only when needed and to verify that there are no error notifications that require interaction to continue. Most businesses have already standardized on a particular remote access tool. If your business has not yet found a tool or is not satisfied with what you have, you might want to take a look at these tools.

pcAnywhere

This is the most popular remote administration tool on the market. It has been around for years and works quite well. Over time, pcAnywhere and other remote access tools have become more friendly to enterprise management instead of single-user remote control. We use pcAnywhere at Oracle to manage and support Oracle on Windows and have been happy with the tool. We have also seen other tools at client sites that have features that made management of a large number of systems much easier. Here is a short list of other software packages you can use for remote access:

- Tarentella (the up-and-coming tool for remote access to Windows and X for Unix boxes)
- Timbuktu
- LANTastic
- Remotely Possible
- Carbon Copy
- ReachOut
- NetBus

Resources

To deal with particular challenges you will face, you need to have a number of resources you can turn to for help. This section provides some of the essentials.



Microsoft Resources

Next you will find a number of resources to help you with getting and staying up to speed with the Windows platform in general.



- **Microsoft Developer's Network (<http://msdn.microsoft.com>)** A great resource for understanding the internals of the OS and keeping up to date with the latest.
- **Microsoft's Support Site (<http://support.microsoft.com>)** One of the most thorough online support sites, although you may have to wade through unrelated articles. You will find lots of Oracle-specific documents for developers as well as administrators. We recommend you start here for unknown OS problems, next try the MSDN site, and then go to the *Windows 2000 Magazine* site.
- **Microsoft Technet (<http://www.technet.com>)** This is the IT professional's web site by Microsoft. A good resource to check in on regularly for tips and new features. You will also find a variety of articles that can help you configure the OS to your needs and troubleshoot common problems.
- **Windows 2000 Magazine and its web sites** This is a never-ending resource of excellent tips and techniques that are refreshed on a monthly basis. We strongly suggest subscribing to the magazine, formerly *Windows NT Magazine*, and using the web site. Some of the interesting web sites managed by the magazine are noted here:
 - <http://www.win2000mag.com>
 - <http://www.windows2000faq.com>
 - <http://www.windowsitlibrary.com>
 - <http://www.winscriptingsolutions.com>



Oracle Resources

These resources contain the latest in Oracle technology and reference materials you will need to manage your personal growth in understanding Oracle.

- **Oracle Documentation Center (<http://docs.oracle.com>)** This site has Oracle documentation freely available under the license agreement. If you want to research new products or learn more about installation requirements, check here first.
- **Oracle Technology Network (<http://otn.oracle.com>)** Check out the Windows Technology Section at <http://otn.oracle.com/tech/nt/> for white papers, Oracle software information and downloads, and CD-ROM order forms.
- **ssh.com** This is the source of the commercial SSH version for Windows servers. You will be interested in this package if you need remote administrative capability on boxes that are in an unsecure environment.

Looking Ahead

Today, Oracle on Windows is a very stable, available, and high-performing product. The one area where Oracle is not allowed to shine on Windows 2000 is on very large systems. This is in part due to the fact that Unix is typically chosen over Windows for such systems. The 64-bit future of Windows .NET Server will change all that. Windows will be able to compete with systems and clusters in a way that it never could before. Already, existing changes made between Windows NT and Windows 2000 and proposed improvements in Windows .NET Server make the manageability future of Windows a bright proposition. Oracle is ready and waiting to implement changes that take advantage of this future. This section peers into that future to give you a base for planning and hope for growth and efficiency without having to sacrifice platforms.



The Future of Windows

The future of Windows is headed for enterprise super-server capability and capacity, with the 64-bit versions of the server operating system and continuing domination of corporate and home desktops. Upcoming Microsoft operating systems will have an impact on Oracle's capabilities to use more memory and handle more connections.

Windows XP

Windows XP is the replacement for Windows 2000 Professional. It will have some improvements that are not really relevant to database administrators or even stand-alone server administrators. Even so, it will be one of the first 64-bit Microsoft operating systems available. Despite this fact, it is in no way a server operating system designed to run an Oracle database in a production environment for many users.

The 64-bit version of XP is directed toward workstation users. It is likely that no 64-bit specific software will be available at the time of release. XP will have a number of expanded capabilities that allow power users to upgrade to their hearts delight. At release time, XP will support up to 16 gigabytes of physical memory and up to 8 terabytes of virtual memory. Utilizing 64-bit XP to its fullest will be difficult because 32-bit software usually runs better on 32-bit hardware and slower on 64-bit hardware. Don't use 64-bit XP unless you have software that needs the 64-bit capabilities. Why? XP 64-bit has a minimum physical memory requirement of 1 gigabyte. Ouch!

From a domain management perspective, XP fits right in with the Windows 2000 domain model. Here are some features that might help push corporate PC support for the rollout of XP:

- Improved Plug and Play



- System Restore
- Device driver verifier and rollback
- Built-in firewall
- Built-in remote administration tool

Many of these features, if rolled out as a corporate standard, can drastically reduce the load on a company's PC support department.

From an Oracle perspective, there is no compelling reason to upgrade for the majority of applications that use a database because the client tier of older client/server applications work just fine on Windows 2000 or Windows NT, and the newer n-tier application architecture essentially requires a server operating system. That said, the 32-bit version of XP is an improvement over the initial version of Windows 2000 Professional for end users and for domain administrators working with users whose desktops may still be as old as Windows 95.

Windows Advanced Server Limited Edition 64-Bit

Microsoft has announced a server class version of Windows 2000 that will sport a 64-bit API that developers of large server applications, such as the Oracle RDBMS, can take advantage of. Much of this has been waiting on the release and general commercial availability of the Itanium 64 processor from Intel. Depending upon your needs, this may be the first OS move to consider for development and testing. This version of the OS is tagged "Limited Edition" because it is designed as an interim step to Windows .NET as a 64-bit platform. Microsoft only expects limited use of this OS due to the cost and the eminent release of .NET Server.

Windows .NET

.NET Server is the next version of the Windows OS for the server product line. The beta name was Whistler, and it shares a code base with the XP beta. At the time of this writing, this version is scheduled to be released in early 2002 (in fact, its previous marketing version name was Windows 2002 Server). The name of the OS indicates the push of the development by Microsoft to component or software services offered up by the OS. .NET Server will more than likely be released as a 64-bit version out of the box. This alone will be a boon to Oracle running with a much larger process space, making it capable of handling greater loads and doing more data warehousing work with room to spare.

Like XP, .NET Server will integrate with your existing domain's administrative infrastructure. These are some of the interesting features listed in the design goals for .NET Server:

- Remote support for “headless” servers—servers that have no monitor, keyboard, or mouse.
- Support for NUMA memory access and 64-bit processors

Oracle and the Future of Windows

Oracle has already been in the process of preparing for a 64-bit Microsoft OS release for some time; in fact, Oracle has a beta release of 8.1.6 64-bit, built on top of Whistler Build 2267, available on OTN. But don't get too excited—this release is also built on a special Intel IA64 chip that isn't readily available (unless your company can successfully negotiate with Intel directly to obtain this chip). Once the 64-bit processors from Intel and the server OS from Microsoft go into general availability, Oracle will respond with a 64-bit release as soon as it is possible to ensure its stability and interoperability with the OS.

Summary

There are many things that you can do to improve the interoperability of Oracle and Windows 2000. This chapter has given you some key information that you can use to configure your system today, as well as resources that can be used now and in the future to dig deeper into what you can do to improve manageability, availability, and performance of Oracle on Windows 2000.