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Module 3: Monitoring Server Performance

Contents

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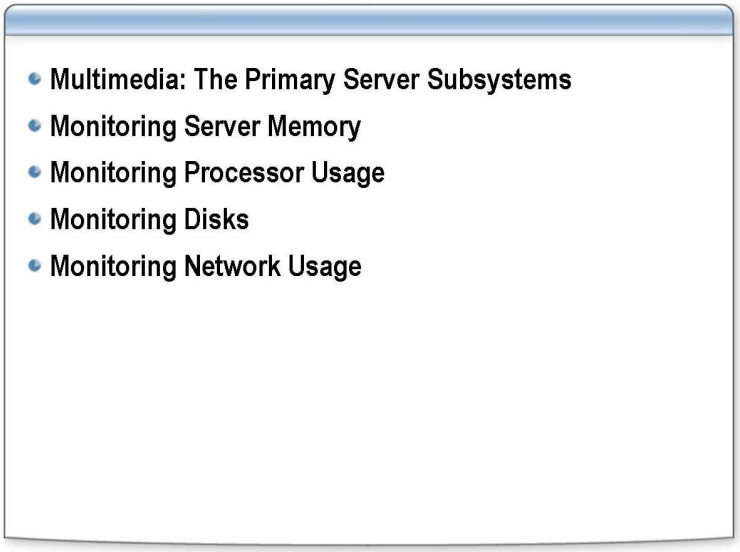
Overview



Introduction

Today's business environment demands that systems administrators ensure that their servers are efficient and reliable. To optimize your server's performance, you must collect performance data that helps you to identify system bottlenecks.

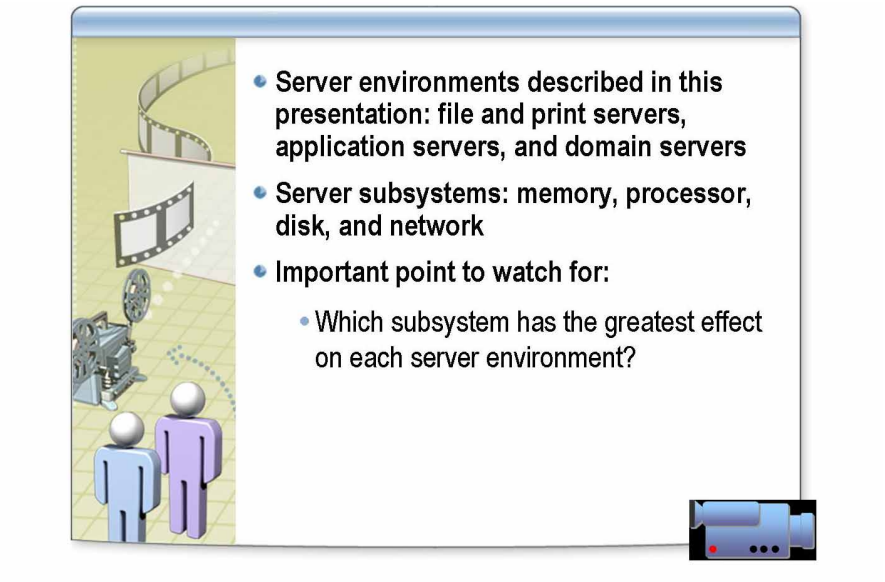
This module covers how to collect performance data by monitoring primary server subsystems. It also covers how to identify system bottlenecks by using the Performance console and Task Manager in Microsoft® Windows® Server 2003.

Objectives

After completing this module, you will be able to:

- Explain how the four primary server subsystems affect server performance.
- Monitor server memory.
- Monitor processor usage.
- Monitor disks.
- Monitor network usage.
- Identify the guidelines for using counters and thresholds.
- Describe the best practices for monitoring server performance.

Multimedia: The Primary Server Subsystems



File location

To view the *The Primary Server Subsystems* presentation, open the Web page on the Student Materials compact disc, click **Multimedia**, and then click the title of the presentation. Do not open this presentation unless the instructor tells you to.

Objective

After completing this lesson, you will be able to describe the effect of each primary subsystem on server performance.

Server subsystems

The four primary subsystems are:

- Memory

  Server memory is the subsystem that is most important to general server performance. If the server does not have enough random access memory (RAM) to hold the data that it needs, it must temporarily store the data on the disk. Disk access is much slower than RAM, so storing data on the disk can significantly degrade server performance.

- Processor

  The most important aspect of processor performance is its level of usage. When an application or other software uses more than its share of the processor's cycles, all the other software that is running operates much more slowly.

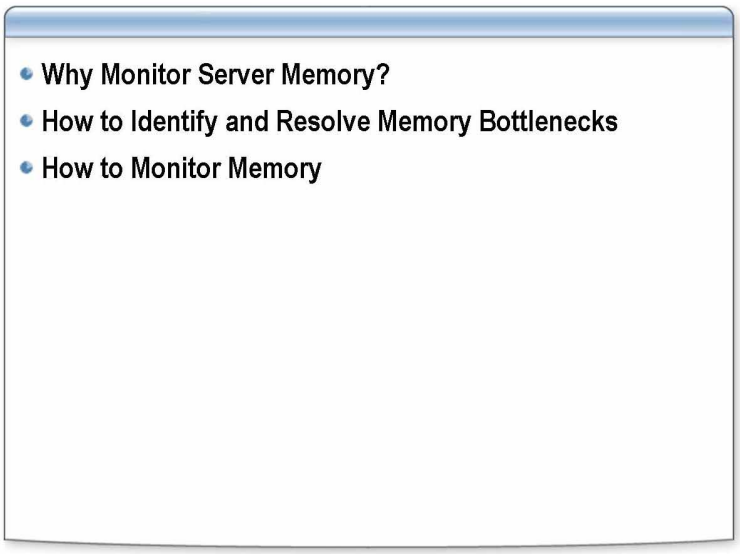
- Disk

  The access speed of the physical disk drive can greatly affect the speed at which applications operate and data is loaded. Also, the disk storage space must be sufficient for you to install applications, store data, and have enough space for the paging file.

- Network

  The performance of your network is affected by the speed of both the hardware in your network infrastructure and the software that is running on your servers and clients.

Lesson: Monitoring Server Memory



Introduction

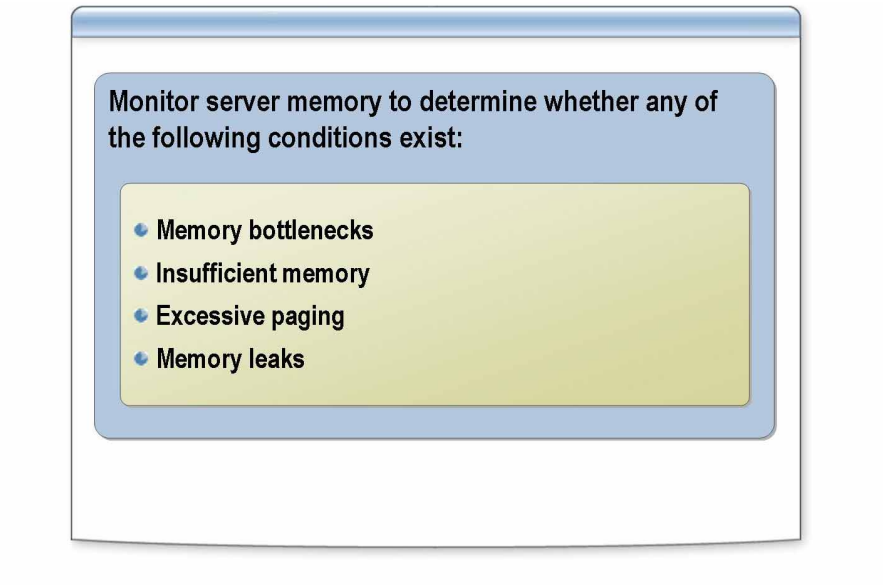
Memory significantly affects server performance. Low memory conditions can slow the operation of applications and services on your server and can also affect the performance of other resources on your server. Therefore, monitoring and analyzing memory usage is one of the first steps to take when you assess the performance of your server.

Lesson objectives

After completing this lesson, you will be able to:

- Explain the purpose of monitoring server memory.
- Identify and resolve memory bottlenecks.
- Monitor memory by using server monitoring tools.

Why Monitor Server Memory?



Introduction

Lack of memory is the most common cause of serious performance problems in computer systems. Even if you suspect other problems, check memory counters to rule out a memory shortage.

Conditions to look for

Monitor server memory to assess the amount of available memory and the level of paging, and to observe the effects of a memory shortage. Monitoring server memory can help you determine whether any of the following conditions exist:

- Memory bottleneck

  Low memory conditions can slow the operation of applications and services on your server and can impact the performance of other resources on your server. For example, when your server is low on memory, paging can be prolonged, resulting in more work for your disks. Because it involves reading and writing to disk, this paging activity may compete with other disk transactions, thereby intensifying a disk bottleneck.

  In turn, all this work by the disk can mean that the processor is used less or is doing unnecessary work, such as processing numerous interrupts due to repeated page faults. *Page faults* occur when the server cannot locate requested code or data in the physical memory that is available to the requesting process. As a result, applications and services become less responsive. Therefore, it is important to monitor memory regularly to detect memory bottlenecks.

- Insufficient memory

  Insufficient memory is the reason for the symptoms we encounter with low memory, and excessive paging. By monitoring server memory, you can use the baseline established to predict when you will need additional memory, and avoid some of these problems.

- Excessive paging

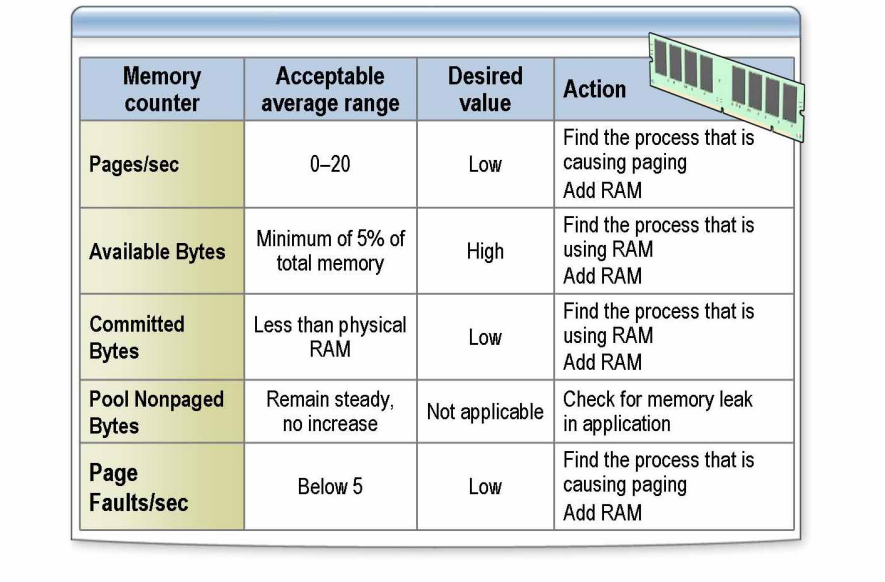
  The indication of memory shortage is frequent paging. *Paging* is the process of moving fixed-size blocks of code and data from RAM to disk by using units called *pages* to free memory for other uses.

  Although some paging is acceptable, because it enables you to use more memory than actually exists, constant paging slows server performance. Reducing paging significantly improves server responsiveness.

- Memory leak

  A memory leak occurs when applications allocate memory for use but do not free allocated memory when finished. As a result, available memory is used up over time, often causing the server to stop functioning properly.

How to Identify and Resolve Memory Bottlenecks



Memory counter	Acceptable average range	Desired value	Action
Pages/sec	0–20	Low	Find the process that is causing paging Add RAM
Available Bytes	Minimum of 5% of total memory	High	Find the process that is using RAM Add RAM
Committed Bytes	Less than physical RAM	Low	Find the process that is using RAM Add RAM
Pool Nonpaged Bytes	Remain steady, no increase	Not applicable	Check for memory leak in application
Page Faults/sec	Below 5	Low	Find the process that is causing paging Add RAM

Introduction

The most common resource bottleneck in servers is caused by lack of memory. Adding memory is the most effective way to improve server performance.

Paged and nonpaged RAM

In Microsoft Windows Server 2003, RAM is divided into two categories: paged and nonpaged. Paged RAM is virtual memory, where it appears that a full range of memory addresses is available to all applications. Windows Server 2003 does this by giving each application a private memory range called a *virtual memory space* and by mapping that virtual memory to physical memory.

Nonpaged RAM cannot use this configuration. Data that is placed into nonpaged RAM must remain in memory and cannot be written to or retrieved from disk. For example, data structures that are used by interrupt routines or those that prevent multiprocessor conflicts within the operating system use nonpaged RAM.

Virtual memory system

The virtual memory system in Windows Server 2003 combines physical memory, the file system cache, and disk into an information storage and retrieval system. The system stores program code and data on disk until it is needed, and then moves it into physical memory. Code and data that are no longer in active use are written to disk. However, when a computer does not have enough memory, code and data must be written to and retrieved from the disk more frequently—a slow, resource-intensive process that can become a system bottleneck.

Hard page faults

The best indicator of a memory bottleneck is a sustained, high rate of hard page faults. *Hard page faults* occur when the data that a program requires is not found in its working set (the physical memory visible to the program) or elsewhere in physical memory, and must be retrieved from disk. Sustained hard page fault rates—over five per second—indicate a memory bottleneck.

Counters used to determine whether memory is a bottleneck

Use the following Performance memory counters to determine whether memory is causing a bottleneck in the system.

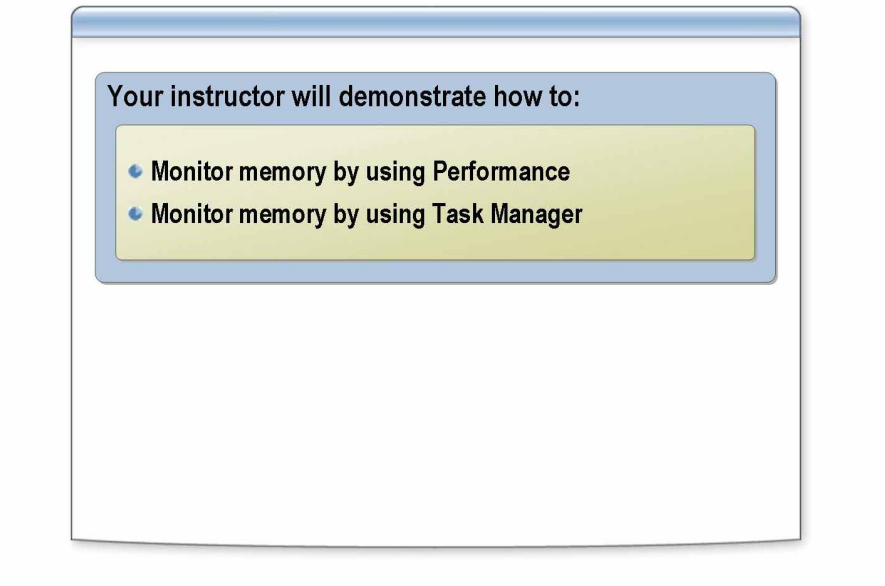
The following list includes two types of counters. The first type of counter is a rate counter, such as Pages/sec and Page Faults/sec. A rate counter samples an increasing count of events over time. To display the rate of activity, the rate counter divides the cache in count values by the change in time. Therefore, to obtain an accurate result, you must monitor rate counters over time—typically for 30 to 60 seconds.

The second type of counter is an instantaneous counter, such as Available Bytes and Committed Bytes. Instantaneous counters display the most recent measurement.

- *Pages/sec*. Number of requested pages that were not immediately available in RAM, and thus were accessed from the disk or were written to the disk to make room in RAM for other pages. Generally, if the value of this counter is over five for extended periods, memory may be a bottleneck in the system.
- *Available Bytes*. Amount of available physical memory. It is normally low, because Windows Disk Cache Manager uses extra memory for caching and then returns it when requests for memory occur. However, if this value is consistently below 5 percent of the total memory on a server, it is an indication that excessive paging is occurring.
- *Committed Bytes.* Amount of virtual memory that is committed to either physical RAM for storage or to pagefile space. If the amount of committed bytes is larger than the amount of physical memory, more RAM may be required.
- *Pool Nonpaged Bytes*. Amount of RAM in the Nonpaged pool system memory area where space is acquired by operating system components as they accomplish their tasks. If the Pool Nonpaged Bytes value shows a steady increase without a corresponding increase in activity on the server, it may indicate that a process with a memory leak is running, and you should monitor it closely.
- *Page Faults/sec.* Number of times a virtual page was not found in memory. If this number is consistently above five, too much memory has been allocated to an application and not enough to the server that you are running.

In Task Manager, to determine whether memory is causing a bottleneck in the system, use the PF Usage memory counter. This counter displays the amount of paging used by the system. A steady increase may indicate that a running process has a memory leak.

How to Monitor Memory



Introduction

This topic covers the procedure for monitoring memory by using Performance and Task Manager.

Procedure for monitoring memory by using Performance

To monitor memory by using the Performance console:

1. Click **Start**, click **Control Panel**, double-click **Administrative Tools**, and then double-click **Performance**.
2. Right-click in the right pane of System Monitor, and then click **Add Counters**.
   a. Under **Performance object**, click **Memory**, select the following counters one at a time, and then click **Add**.
      - Pages/sec
      - Available Bytes
      - Committed Bytes
      - Pool Nonpaged Bytes
      - Page Faults/sec

Note Every time you click **Add** to add a counter, that counter is added to the list of counters in the right pane of System Monitor.

   b. Although not specifically memory object counters, the following counters are also useful for memory analysis:
      - Paging File\% Usage
      - Cache\Data Map Hits %
      - Server\Pool Paged Bytes and Server\Pool Nonpaged Bytes

3. In the right pane of System Monitor, view the counters, and then take the appropriate action to resolve any memory problem.

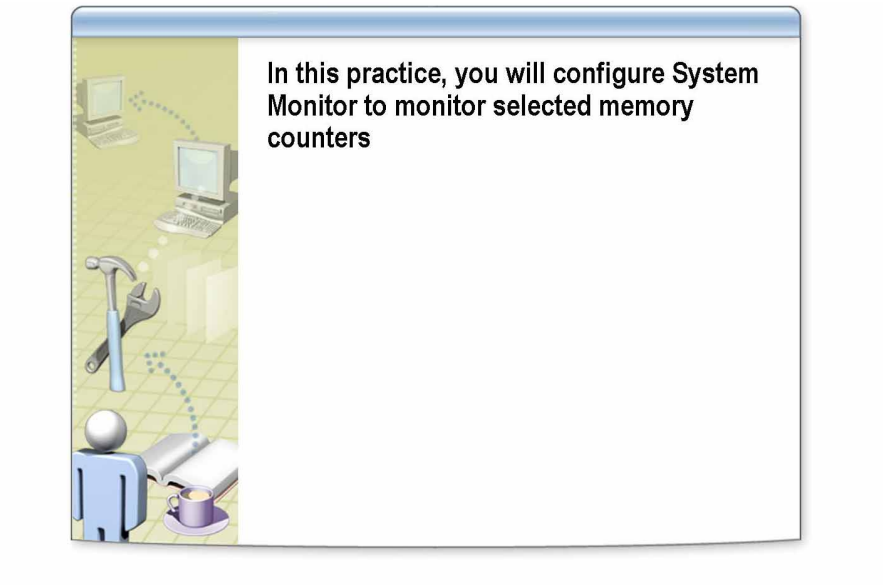
Tip The appropriate action to resolve a memory problem can involve finding the process that is causing paging or using RAM, checking for a memory leak in an application, and adding RAM.

Procedure for monitoring memory by using Task Manager

You can also monitor memory by using Task Manager.

1. Press CTRL+ALT+DEL, and then click **Task Manager**.
2. On the **Performance** tab, monitor the data under Page File, Physical Memory, Kernel Memory, and Commit Charge.

Practice: Monitoring Server Memory



Objective

In this practice, you will configure System Monitor to monitor selected memory counters.

Scenario

You are the systems administrator for an organizational unit on a large network. Recently, you installed an application on a server. Since you installed the application, users are complaining that the system appears to slow down gradually. You want to monitor memory to determine whether a memory leak is causing the problem.

Practice

► **Check for a memory leak**

1. Log on to nwtraders domain as *Computer***User** using your password.
2. Open the Performance console by using the Performance shortcut or by using **Run As**.
3. In System Monitor, add the following memory counters: Available MBytes, Committed Bytes, Pooled Nonpaged bytes, and Page Faults/sec.
4. Open the **System Monitor Properties** dialog box and change the sampling rate to 60 seconds.
5. To allow time for the averaging mechanism of the counters to stabilize, wait for a minimum of two minutes before proceeding.

   Switch to the report view (press CTRL+R), and then fill in the following information as your baseline:

   a. Available MBytes _____
   b. Page Faults/sec _____
   c. Pool Nonpaged Bytes _____
   d. Committed Bytes _____
   e. Pages/sec _____

6. Start Task Manager, click the **Performance** tab, and then record the PF Usage value:

   PF Usage _____

7. Open the C:\MOC\2275\Practices\Mod03 folder, start **leakyapp.exe**, and then click **Start Leaking**.

   Wait for a minimum of two minutes before proceeding to allow the averaging mechanism of the counters to stabilize.

8. Fill in the current information for the following counters:

   a. Available MBytes _____

   b. Page Faults/sec _____

   c. Pool Nonpaged Bytes _____

   d. Committed Bytes _____

   e. Pages/sec _____

9. Start Task Manager, click the **Performance** tab, and then record the PF Usage value:

   PF Usage _____

10. Notice that the Page Faults/sec counter has increased by a factor of 50 or more.

11. Switch to **My Leaky App**, click **Stop Leaking**, and then click **Exit**.

    Wait for a minimum of two minutes before proceeding to allow the averaging mechanism of the counters to stabilize.

12. Fill in the current information:

    a. Available MBytes _____

    b. Page Faults/sec _____

    c. Pool Nonpaged Bytes _____

    d. Committed Bytes _____

    e. Pages/sec _____

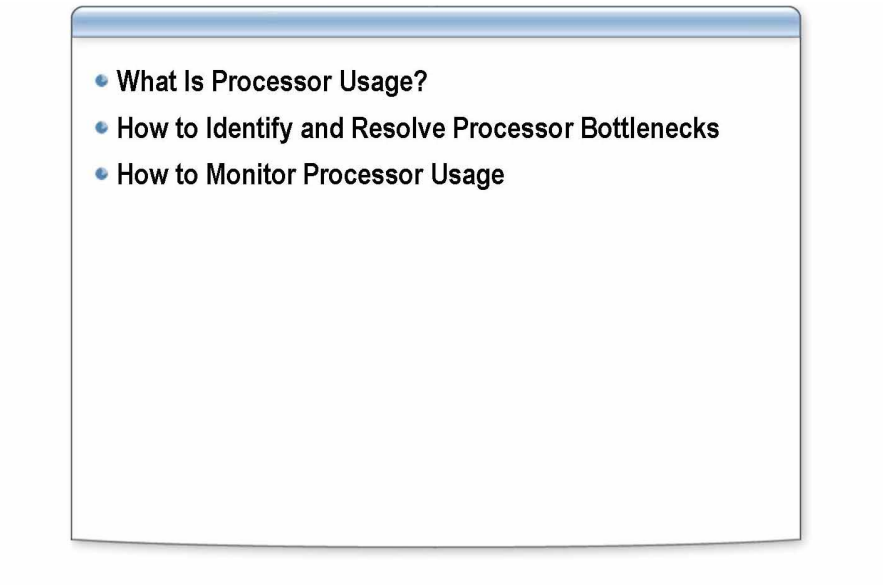
13. Start Task Manager and record the PF Usage:

    PF Usage _____

14. Verify that your counters are back to their baseline levels.

15. Close all windows.

Lesson: Monitoring Processor Usage



Introduction

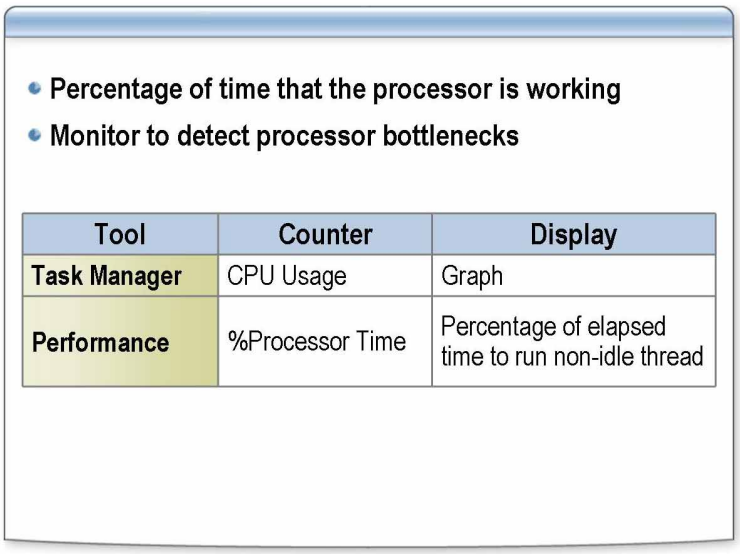
After memory consumption, processor activity is the most important data to monitor on your server. To determine whether a busy processor is efficiently handling all the work on your computer or whether it is overwhelmed, you must examine the processor usage.

Lesson objectives

After completing this lesson, you will be able to:

- Explain processor usage.
- Identify and resolve processor bottlenecks.
- Monitor processor usage by using server monitoring tools.

What Is Processor Usage?



Definition

Processor usage, also called CPU usage, is the percentage of time that the processor is working. You must monitor processor usage to detect processor bottlenecks.

In Windows Server 2003, you can use Task Manager as well as Performance to monitor processor activity and usage. The counter that defines processor usage in each of these tools is named:

- CPU Usage in Task Manager.
- % Processor Time in Performance.

CPU Usage

In Task Manager, CPU Usage displays a graph indicating the percentage of time the processor is working. This counter is a primary indicator of processor activity. View this graph to see how much processing time you are using. If your computer seems to be running slowly, this graph may display a high percentage.

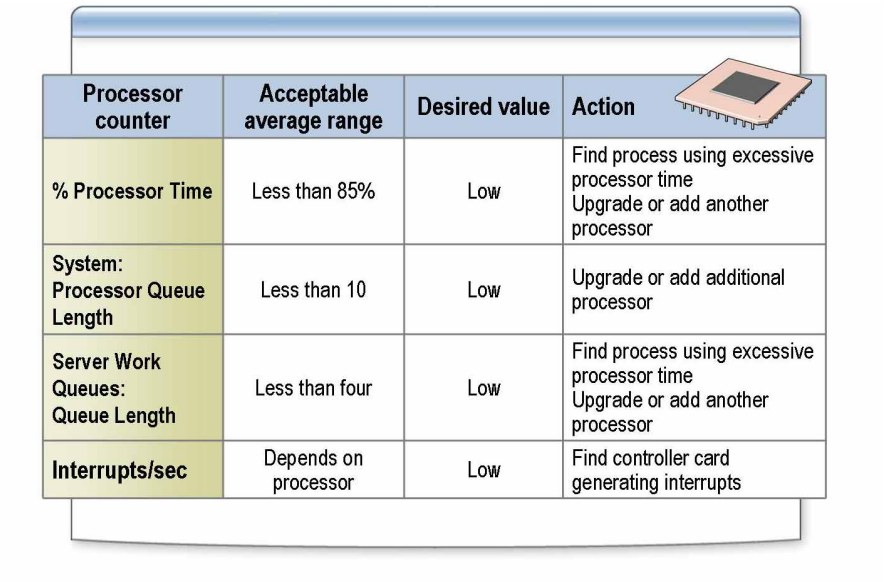
% Processor Time

In Performance, % Processor Time is the percentage of elapsed time that the processor spends to execute a non-idle thread. Each processor has an idle thread that consumes cycles when no other threads are ready to run.

This counter is the primary indicator of processor activity. It displays the average percentage of busy time observed during the sample interval. It calculates this value by monitoring the time that the idle process is active and subtracting that value from 100%.

It is important to monitor this counter on symmetric multiprocessing (SMP) systems just as it is on single-processor systems. SMP enables any one of the multiple processors in a computer to run any operating system or application thread simultaneously with other processors in the system. Observe processor usage patterns for individual processors and for all processors over an extended period. Also, consider the number of threads in the system's processor queue to determine whether high processor usage is limiting the system's ability to accomplish work.

How to Identify and Resolve Processor Bottlenecks



Processor counter	Acceptable average range	Desired value	Action
% Processor Time	Less than 85%	Low	Find process using excessive processor time Upgrade or add another processor
System: Processor Queue Length	Less than 10	Low	Upgrade or add additional processor
Server Work Queues: Queue Length	Less than four	Low	Find process using excessive processor time Upgrade or add another processor
Interrupts/sec	Depends on processor	Low	Find controller card generating interrupts

Introduction

Just about every activity that occurs on a server involves the processor. The processor on an application server is generally busier than the processor on a file and print server. As a result, the level of processor activity, and what is considered normal, is different between the two types of servers.

Two of the most common causes of processor bottlenecks are CPU-bound applications and drivers, and excessive interrupts that are generated by inadequate disk or network subsystem components.

Determine a bottleneck

Monitor processor counters to help determine whether the processor is causing a bottleneck:

- *% Processor Time*. Measures the amount of time that the processor is busy. When processor usage consistently runs over 85 percent, the processor is a system bottleneck. Analyze processor usage by monitoring individual processes to determine what is causing the processor activity.
- *System: Processor Queue Length*. Number of requests in the queue for the processor. It indicates the number of threads that are ready to be executed and are waiting for processor time. Generally, a processor queue length that is consistently higher than two may indicate congestion. To determine the cause of the congestion, you must further analyze the individual processes that are making requests on the processor.

- *Server Work Queues: Queue Length*. Number of requests in the queue for the selected processor. A consistent queue of over two indicates processor congestion.
- *Interrupts/sec*. Number of interrupts that the processor is servicing from applications or from hardware devices. Windows Server 2003 can handle thousands of interrupts per second. A dramatic increase in this counter value without a corresponding increase in system activity indicates a hardware problem. The problem could be a device that is unable to keep up with the rest of the system, like a disk controller or network interface card (NIC).

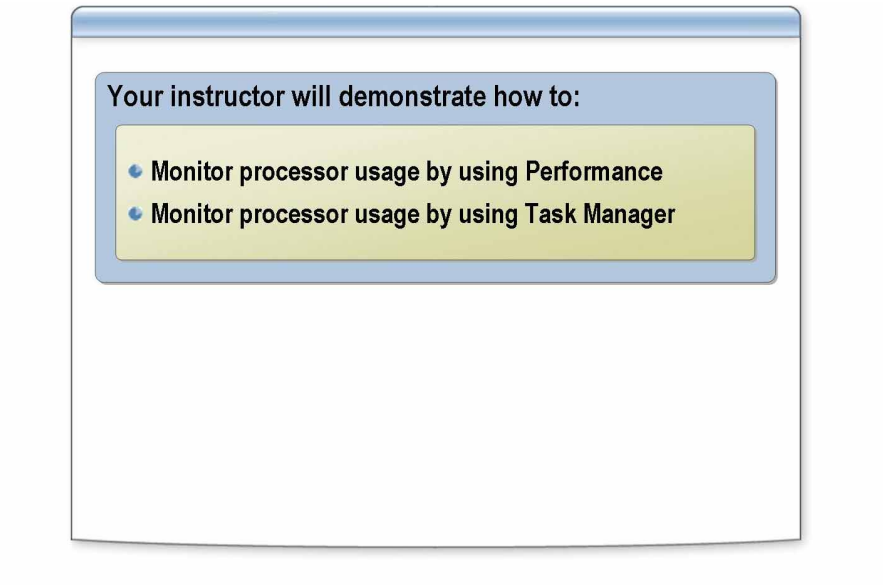
  For example, if a conflict occurs between a hard disk controller and a network adapter card, monitor the disk controller and network adapter card. Determine whether excessive requests are being generated by monitoring the queue lengths for the physical disk and network interface. Generally, if the queue length is greater than two requests, check for slow disk drives or network adapters that could be causing the queue length backlog.

Actions to resolve processor bottleneck

If you determined that the processor is a system bottleneck, you can perform the following actions to improve performance:

- Add a faster processor if the system is a file and print server.
- Add multiple processors for application servers, especially if the application is multithreaded.
- Offload processing to another system on the network, such as users, applications, or services.
- Upgrade your network card, disk adapter card, or controller cards. In general, 32-bit intelligent adapters are recommended. Intelligent adapters provide better overall system performance because they allow interrupts to be processed on the adapter itself, thereby relieving the processor of this work.

How to Monitor Processor Usage



Introduction

To keep your system running efficiently, you must monitor the system's processor to detect any bottlenecks from time to time. Bottlenecks occur only when the processor is so busy that it cannot respond to requests on time. These situations are indicated, in part, by high rates of processor activity, but mainly by long, sustained queues and poor application response.

Procedure for monitoring processor usage by using Performance

To monitor processor usage by using Performance:

- To open Performance, click **Start**, click **Control Panel**, double-click **Administrative Tools**, and then double-click **Performance**.

  In the Performance window, System Monitor is selected by default. In the right pane of System Monitor, the % Processor Time counter is displayed.

Procedure for monitoring processor usage by using Task Manager

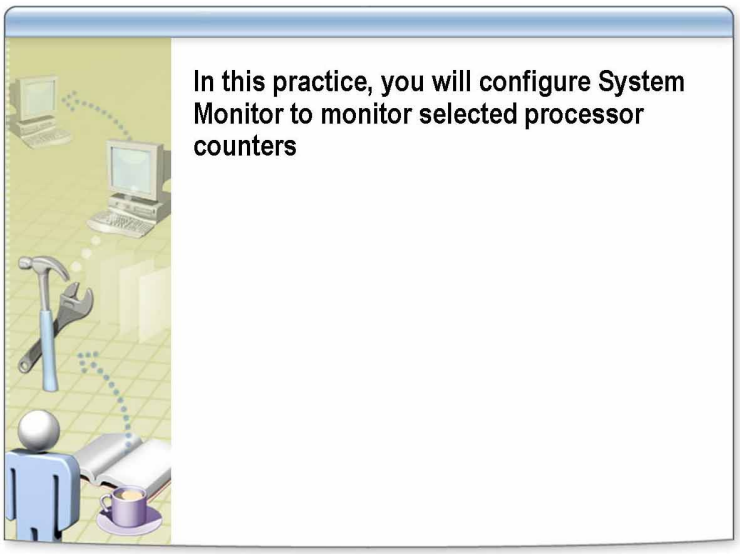
To monitor CPU usage by using Task Manager:

1. Press CTRL+ALT+DEL, and then click **Task Manager**.

Note You can also open Task Manager by right-clicking the taskbar or by pressing CTRL+SH+ESC.

2. On the **Performance** tab, view the **CPU Usage** and the **CPU Usage History** counters.

Practice: Monitoring Processor Usage



Objective

In this practice, you will configure System Monitor to monitor selected processor counters.

Scenario

You are the systems administrator for an organizational unit on a large network. Recently, you installed an application on a server. Since you installed the application, users are complaining that the system is slow and you want to monitor the processor to determine whether the application is causing a bottleneck.

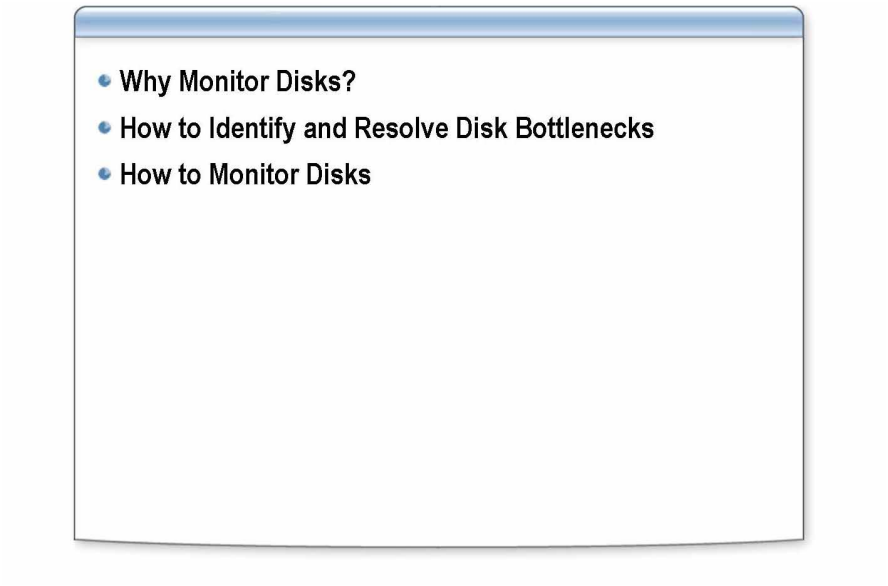
Practice

► **Determine whether an application is causing a processor bottleneck**

1. Log on to **nwtraders** as *Computer***User** using your password.
2. Open the Performance console by using the Performance shortcut or by using Run As.
3. Click **System Monitor**, and then add the **System\Processor Queue Length** counter.
4. Record the information for the following counters:
   a. Processor\% Processor Time _____
   b. System\Processor Queue Length _____
5. Open C:\Moc\2275\Practices\Mod03, and then start the **cpustres.exe** application.
6. Set the **Activity** level for Thread 1 to **Maximum**.
7. Record the information for the following counters:
   a. Processor\% Processor Time _____
   b. System\Processor Queue Length _____
8. Is **cpustres.exe** causing a bottleneck? How can you tell?

   _____
9. Close all windows.

Lesson: Monitoring Disks



Introduction

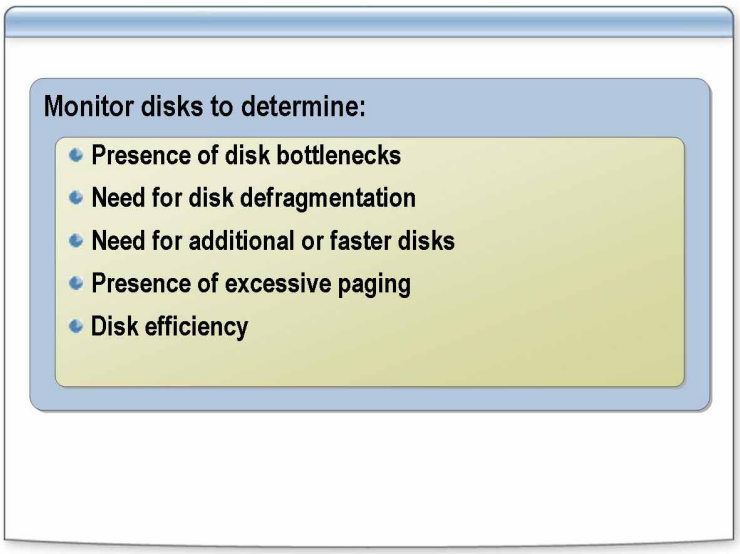
The disk subsystem handles the storage and movement of programs and data on your server, giving it a powerful influence on the overall responsiveness of your server. The Performance console provides disk-specific counters that enable you to measure disk activity and throughput.

Lesson objectives

After completing this lesson, you will be able to:

- Explain the purpose of monitoring disks.
- Identify and resolve disk bottlenecks.
- Monitor disks by using System Monitor.

Why Monitor Disks?



Introduction

Monitor disks to keep your systems working efficiently. You can also use the data that you collect when you monitor disks to plan for future hardware and software upgrades.

Disk bottlenecks

The existence of a disk bottleneck is indicated by the presence of all of the following conditions:

- Sustained rate of disk activity well above your baseline
- Persistent disk queues that are longer than two per disk
- Absence of a significant amount of paging

Without this combination of factors, it is unlikely that a disk bottleneck exists.

Monitoring disk efficiency

Consider disk capacity and disk throughput when evaluating your starting configuration. Use the bus, controller, cabling, and disk technologies that produce the best throughput that is practical and affordable. Most computers perform adequately with moderately priced disk components. However, if you want to obtain the best performance, you may want to evaluate the latest disk components that are available.

If your configuration contains various types of disks, controllers, and buses, the differences in their designs can affect throughput rates. You might want to test throughput by using these various disk systems to determine whether some components produce less favorable results overall or only for certain types of activity, and then replace those components as needed.

Also, certain kinds of volume-set configurations can offer performance benefits. For example, striped volumes can provide better performance because they increase throughput by enabling multiple disks to service sequential or clustered I/O requests. A *striped volume* is a volume whose data is interleaved across two or more physical disks. The data on this type of volume is allocated alternately and evenly to each of the physical disks. A striped volume cannot be mirrored or extended.

Note For more information about striped volumes, see Module 5, "Managing Disks," in Course 2275, *Maintaining a Microsoft Windows Server 2003 Environment.*

System Monitor supports monitoring volume sets with the same performance objects and counters that are provided for individual disks. Notice that hardware-based RAID (Redundant Array of Independent Disks) devices report all activity to a single physical disk and do not show distribution of disk operations among the individual disks in the array. RAID is a category of disk drives that combine two or more drives into one volume for fault tolerance and performance.

Note For more information about RAID, see Appendix E "Managing Fault-Tolerant Disks," in Course 2275, *Maintaining a Microsoft Windows Server 2003 Environment.*

Be aware of the seek time, rotational speed, access time, and data transfer rate of your disks by consulting manufacturer documentation. Also consider the bandwidth of cabling and controllers. The slowest component determines the maximum possible throughput, so be sure to monitor each component.

To compare the performance of different disks, monitor the same counters and activity on the disks. If you find differences in performance, you might want to distribute workload to the disk that performs better, or replace slower performing components.

How to Identify and Resolve Disk Bottlenecks

Physical disk counter	Acceptable average range	Desired high or low value	Action
% Disk Time	Under 50%	Low	Monitor to see if paging is occurring Upgrade disk subsystem
Current Disk Queue Length	0–2	Low	Upgrade disk subsystem
Avg. Disk Bytes/Transfer	Baseline or higher	High	Upgrade disk subsystem
Disk Bytes/sec	Baseline or higher	High	Upgrade disk subsystem

Introduction

Disks store programs and the data that programs process. While waiting for a computer to respond, it is frequently the disk that is the bottleneck. In this case, the disk subsystem can be the most important aspect of I/O performance. However, problems can be hidden by other factors, such as the lack of memory.

Performance disk counters are available with both the **LogicalDisk** and **PhysicalDisk** performance objects. **LogicalDisk** monitors logical partitions of physical drives. It is useful to determine which partition is causing the disk activity, which may indicate the application or service that is generating the requests. **PhysicalDisk** monitors individual hard disk drives and is useful for monitoring disk drives as a whole.

Important Both **LogicalDisk** and **PhysicalDisk** objects are automatically enabled on demand. Therefore, you do not have to enable them manually with the **diskperf – y** command.

Counters used to determine whether the disk is a bottleneck

When analyzing disk subsystem performance and capacity, monitor the following Performance disk subsystem counters for bottlenecks:

- *% Disk Time*. Indicates the amount of time that the disk drive is busy servicing read and write requests. If this is consistently close to 100 percent, the disk is being used very heavily. Monitoring individual processes helps determine which process or processes are making the majority of the disk requests.
- *Current Disk Queue Length*. Indicates the number of pending disk I/O requests for the disk drive. If this value is consistently over two, it indicates congestion.

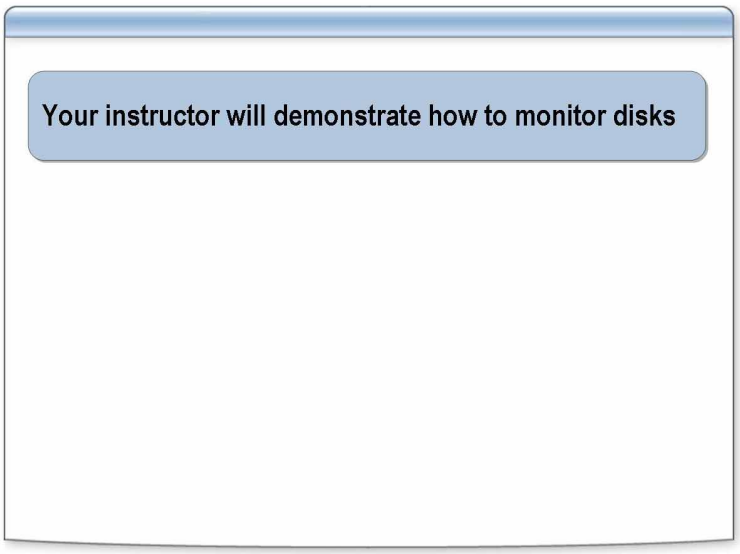
- *Avg. Disk Bytes/Transfer.* The average number of bytes transferred to or from the disk during write or read operations. The larger the transfer size, the more efficient the system is running.
- *Disk Bytes/sec*. This is the rate at which bytes are transferred to or from the disk during write or read operations. The higher the average, the more efficient the system is running.
- *LogicalDisk\% Free Space*. This is the amount of disk space available.

Actions to resolve disk bottleneck

If you determine that the disk subsystem is a system bottleneck, a number of solutions are possible, including the following:

- Defragment the disk by using Disk Defragmenter.
- Rule out a memory shortage. When memory is scarce, the Virtual Memory Manager writes more pages to disk, resulting in increased disk activity. Before you add hardware, make sure that memory shortage is not the source of the problem because low memory is a common cause of bottlenecks.
- Add a faster controller, such as Fast SCSI-2, or an on-board caching controller.
- Add more disk drives in a RAID environment. This solution spreads the data across multiple physical disks and improves performance, especially during read operations.
- Offload processing to another system on the network, such as users, applications, or services.

How to Monitor Disks



Introduction

A disk bottleneck occurs when disk performance decreases to the extent that it affects overall system performance. You need to observe many factors to determine the level of disk performance.

Monitor disks to detect performance issues before they cause problems.

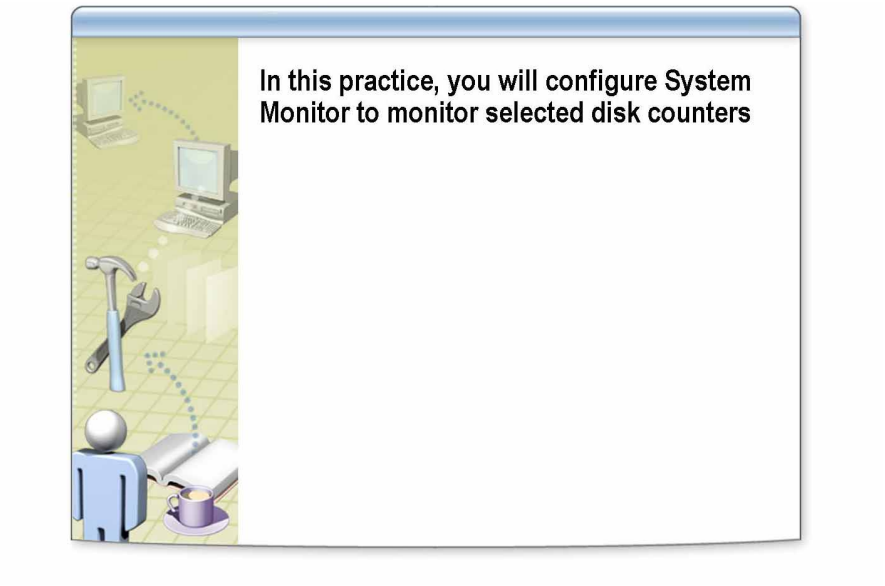
Procedure

To monitor disks:

1. Click **Start**, click **Control Panel**, double-click **Administrative Tools**, and then double-click **Performance**.
2. Right-click in the right pane of System Monitor, and then click **Add Counters**.
3. In the **Add Counters** dialog box, under **Performance object**, select **PhysicalDisk**, select the following counters, and then click **Add**.
   - % Disk Time
   - Avg. Disk Bytes/Transfer
   - Current Disk Queue Length
   - Disk Bytes/Sec
4. View the counters in the right pane of System Monitor and take the appropriate action to resolve any disk issue.

Tip To resolve a disk bottleneck, you may need to determine whether paging is occurring and, if so, upgrade the disk.

Practice: Monitoring Disks



Objective

In this practice, you will configure System Monitor to monitor selected disk counters.

Scenario

You are the systems administrator for an organizational unit on a large network. Recently, you installed an application on a server. Since you installed the application, users are complaining that the system is slow. You want to monitor the disk to determine whether the application is causing the problem.

Practice

► **Monitor disk counters**

1. Log on to **nwtraders** as *Computer***User** using your password.
2. Open the Performance console by using the Performance shortcut or by using **Run As**.
3. On the **Start** menu, click **Help and Support**. Record how long it takes to start Help.

   _____

4. Close Help and Support Center.
5. Click **System Monitor**, and then add the following counters:
   a. Memory\Page Faults/sec
   b. PhysicalDisk\% Disk Time
   c. PhysicalDisk\Current Disk Queue Length
   d. System\Processor Queue Length

6. Record the information for the following counters:
   a. Memory\Pages/sec _____
   b. Memory\Page Faults/sec _____
   c. PhysicalDisk\%Disk Time _____
   d. PhysicalDisk\Current Disk Queue Length _____
   e. Processor\% Processor Time _____
7. Open C:\Moc\2275\Practices\Mod03 and start the **disk.bat** application.
8. Switch to report view, and then record the information for the following counters:
   a. Memory\Pages/sec _____
   b. Memory\Page Faults/sec _____
   c. PhysicalDisk\%Disk Time _____
   d. PhysicalDisk\Current Disk Queue Length _____
   e. Processor\% Processor Time _____
9. On the **Start** menu, click **Help and Support** and record how long it takes to start Help.

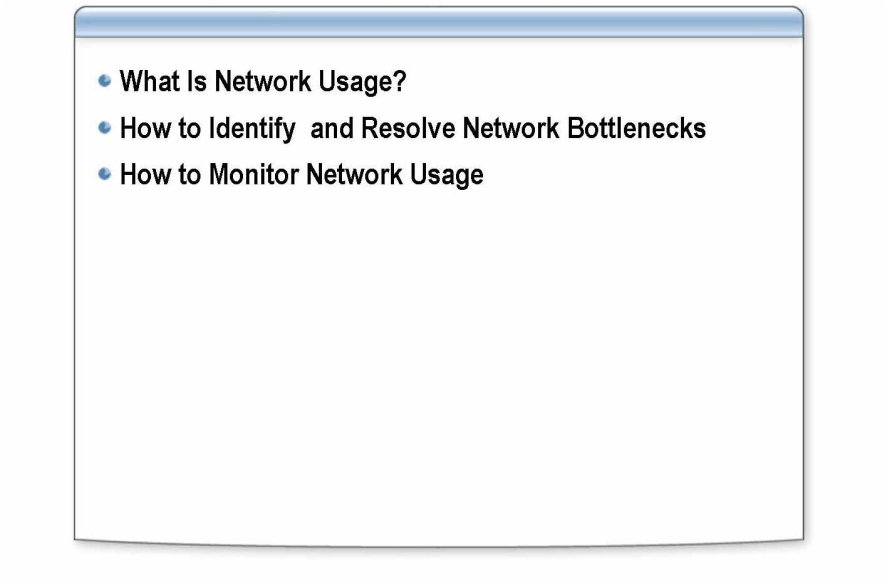
   _____

10. Is disk.bat causing a disk bottleneck? How can you tell?

    _____

11. Close all windows.

Lesson: Monitoring Network Usage



Introduction

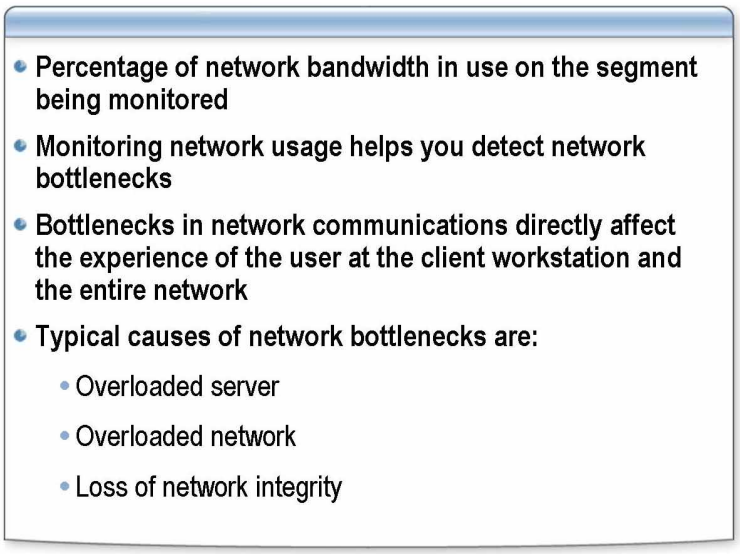
Communications across a network is increasingly important in any work environment. Similar to the processor or disks on your system, the behavior of the network affects the operation of your system. Optimize your system's performance by regularly monitoring network usage, such as network traffic and resource usage.

Lesson objectives

After completing this lesson, you will be able to:

- Explain network usage.
- Identify and resolve network bottlenecks.
- Monitor network usage by using server monitoring tools.

What Is Network Usage?



Definition

Network usage is the percentage of network bandwidth that is in use on the segment that is being monitored.

Network bandwidth

Network bandwidth is measured in several different ways:

- The rate at which bytes are transferred to and from the server.
- The rate at which data packages are sent by the server. Data packages include frames, packets, segments, and datagrams.
- The rate at which files are sent and received by the server.

Effective network bandwidth varies widely depending upon the transmission capacity of the link, the server configuration, and the server workload.

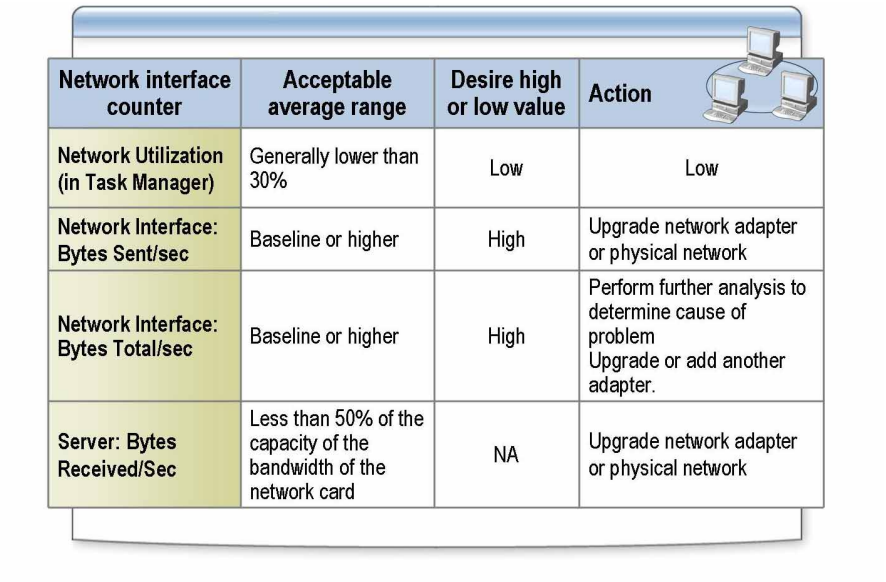
Why monitor network usage?

You monitor network usage to detect network bottlenecks. Network bottlenecks directly affect the experience of the user at the client workstation and the entire network. A network bottleneck limits the number of clients that can simultaneously access your server.

Typical causes for network bottlenecks are:

- An overloaded server.
- An overloaded network.
- Loss of network integrity.

How to Identify and Resolve Network Bottlenecks



Network interface counter	Acceptable average range	Desire high or low value	Action
Network Utilization (in Task Manager)	Generally lower than 30%	Low	Low
Network Interface: Bytes Sent/sec	Baseline or higher	High	Upgrade network adapter or physical network
Network Interface: Bytes Total/sec	Baseline or higher	High	Perform further analysis to determine cause of problem Upgrade or add another adapter.
Server: Bytes Received/Sec	Less than 50% of the capacity of the bandwidth of the network card	NA	Upgrade network adapter or physical network

Introduction

Network bottlenecks are difficult to monitor because most networks are complex. Also, many elements can affect the performance of the network. You can monitor various objects and counters on the network, such as server, redirector, network segment, and protocols. Determining which ones to monitor depends upon the environment.

Counters used to determine whether the network is a bottleneck

Use the following commonly monitored counters to form an overall picture of how the network is being used and to help uncover network bottlenecks:

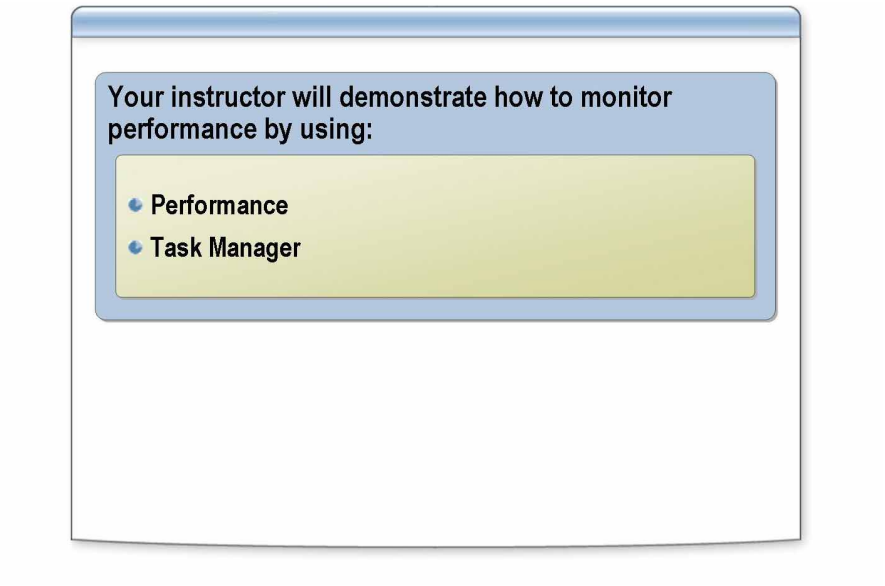
- *Task Manager: % Network utilization*. The percentage of the network bandwidth in use for the local network segment. You can use this counter to monitor the effect of various network operations on the network, such as user logon validation and domain account synchronization.
- *Network Interface: Bytes Sent/sec*. The number of bytes that are sent by using this network adapter card.
- *Network Interface: Bytes Total/sec*. The number of bytes that are sent and received by using this network adapter card. Use this counter to determine how the network adapter is performing. The Bytes Total/sec counter should report high values, to indicate a large number of successful transmissions.
- *Server: Bytes Received/sec*. Compares the bytes received per second counter to the total bandwidth of your network adapter card to determine whether your network connection is creating a bottleneck. To allow room for spikes in traffic, you should usually use no more than 50 percent of capacity. If this number is very close to the capacity of the connection, and processor and memory use are moderate, the connection might be causing a problem.

Actions to resolve network bottleneck

By viewing the preceding counters, you can view the amount of activity on the server for logon requests and data access. If you determine that the network subsystem is causing a bottleneck, you can perform various actions to alleviate the bottleneck. These actions include the following:

- Add servers to the network, thereby distributing the processing load.
- Check and improve the physical layer components, such as routers, switches, and cabling.
- Divide your network into multiple subnets or segments, attaching the server to each segment with a separate adapter. This method reduces congestion at the server by spreading server requests.
- Divide your network traffic into appropriate segments. For example, configure your network so that systems that are shared by the same group of people are on the same subnet.
- Unbind network adapters that are used infrequently.
- For best performance, use adapters with the highest bandwidth that is available. Note, however, that increasing bandwidth increases the number of transmissions and in turn creates more work for your system. For example, the system must generate more interrupts. Remove unused network adapters to reduce overhead.
- Use offline folders to work on network applications without being connected to a network. Offline folders make use of client-side caching, thereby reducing network traffic.

How to Monitor Network Usage



Introduction

It is important to monitor the network usage of your servers so that you can detect network bottlenecks. You can monitor network usage by using either the Performance console or Task Manager.

Procedure for monitoring network usage by using Performance

To monitor network usage by using Performance:

1. Click **Start**, click **Control Panel**, double-click **Administrative Tools**, and then double-click **Performance**.
2. Right-click in the right pane of System Monitor, and then click **Add Counters**.
   a. Under **Performance object**, select **Network Interface**, select the following counters, and then click **Add**.
      - Network Interface\Bytes Sent/sec
      - Network Interface\Bytes Total/sec
   b. Under **Performance object**, select **Server**, select the following counter, click **Add**, and then click **Close**.
      - Server\Bytes Received/sec
3. View the counters in the right pane of System Monitor and take the appropriate action to resolve any network problem.

Tip The appropriate action to resolve a network problem can involve upgrading or adding another adapter. You can also segment the network or limit the protocols that are in use.

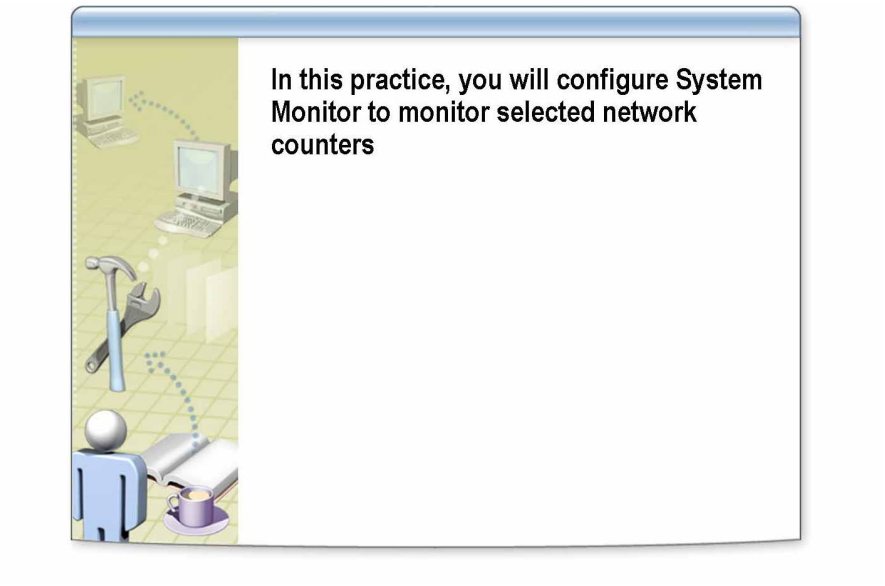
Procedure for monitoring network usage by using Task Manager

To monitor network usage by using Task Manager:

- Press CTRL+ALT+DEL, and then click **Task Manager**.

  On the **Networking** tab, in the bottom pane of Windows Task Manager, the Network Utilization counter is displayed.

Practice: Monitoring Network Usage



Objective

In this practice, you will configure System Monitor to monitor selected network counters.

Scenario

You are the systems administrator for an organizational unit on a large network. Recently, you installed an application on a server. Since you installed the application, users are complaining that the system is slow. You want to monitor the network connection to determine whether it is causing the bottleneck.

Practice

► **Monitor the network connection**

1. Log on to **nwtraders** as *Computer***User** using your password.
2. Open the Performance console by using the Performance shortcut or by using **Run As**.
3. Click **System Monitor**, and then add the following counters:
   a. Network Interface\Bytes Sent/sec
   b. Network Interface\Bytes Total/sec
   c. Server\Bytes Received/sec
4. Record the information for the following counters:
   a. Network Interface\Bytes Sent/sec _____
   b. Network Interface\Bytes Total/sec _____
   c. Server\Bytes Received/sec _____
5. Start Task Manager, and then click the **Networking** tab.
6. Record the Network Utilization: _____

7. Open a command prompt, and then type the following commands:

   CD \Moc\2275\Practices\Mod03

   Connect *PartnerComputer*

   (where *PartnerComputer* is the name of your partner's computer)

8. Switch to report view, and then record the information for the following counters:

   a. Network Interface\Bytes Sent/sec _____

   b. Network Interface\Bytes Total/sec _____

   c. Server\Bytes Received/sec _____

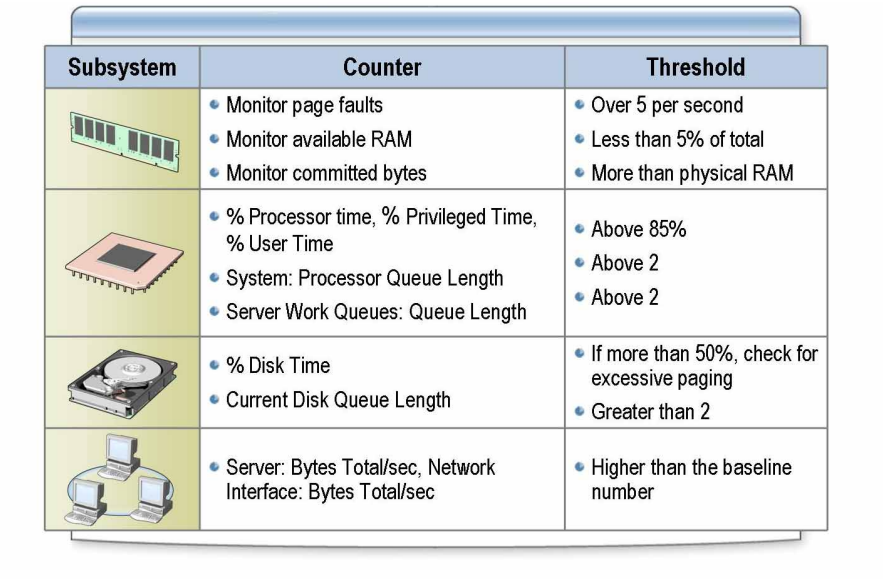
9. In Task Manager, record the Network Utilization: _____

10. Do any of these counters indicate the presence of a bottleneck? If so, which counter?

    _____

11. Close all windows.

Guidelines for Using Counters and Thresholds



Introduction

Deviations from your baseline provide the best indicator of performance problems. You can also check for various types of bottlenecks by monitoring the counters for each subsystem and checking them against the recommended thresholds.

Memory bottlenecks

Check for memory bottlenecks by monitoring the following counters:

Counter	Threshold	Action
Page faults	Sustained page fault rates over 5 per second	Add more memory to the server
Available RAM	Less than 5% of total memory	Add more memory to the server
Committed bytes	Less than physical RAM	Add more memory to the server

Processor bottlenecks

Check for processor bottlenecks by monitoring the following counters:

Counter	Threshold	Action
% Processor time, % Privileged Time, % User Time	Consistently above 85%	Upgrade your current processor or add another processor
System: Processor Queue Length, Server Work Queues: Queue Length	Above 2	Upgrade your current processor or add another processor

Disk bottlenecks

Check for disk bottlenecks by monitoring the following counters:

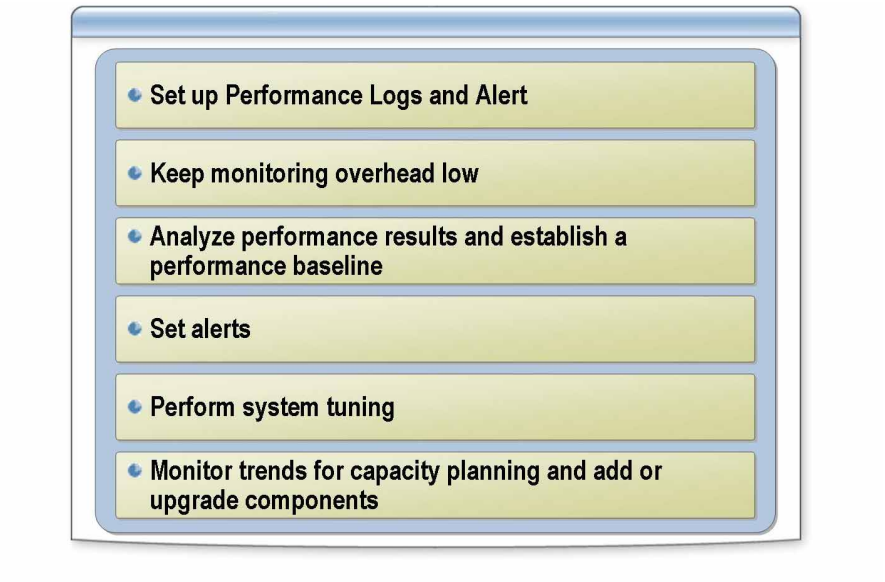
Counter	Threshold	Action
% Disk Time	More than 50%,	Check for excessive paging (memory bottleneck). If excessive paging is not the problem, replace the disk with a faster unit
Current Disk Queue Length	Greater than 2	Upgrade the hard disk

Network bottlenecks

Check for network bottlenecks by monitoring the following counters:

Counter	Threshold	Action
Server: Bytes Total/Sec, Network Interface: Bytes Total/sec	Higher than the baseline numbers	Upgrade the network adapters or the physical network

Best Practices for Monitoring Server Performance



Introduction

Use the following best practices when you monitor the performance of a server.

Performance Logs and Alerts

- Set up Performance Logs and Alerts to monitor your server.

  Set up Performance Logs and Alerts to report data for the recommended counters at regular intervals, such as every 10 to 15 minutes. Retain logs over extended periods of time, store data in a database, and query the data to report on and analyze the data as needed for overall performance assessment, trend analysis, and capacity planning.

  For best results, perform the following tasks before starting System Monitor or Performance Logs and Alerts on the computer that you want to monitor for diagnostic purposes:

  - Stop screen-saver programs.
  - Turn off services that are not essential or relevant to monitoring.
  - Increase the paging file to physical memory size plus 100 MB.

Low overhead

- Keep monitoring overhead low.

  In general, the performance tools are designed for minimal overhead. However, you may find that the overhead increases under each of the following conditions:

  - You are running System Monitor in graph view.
  - You selected an option other than the default, current value, for a report view.
  - You are sampling at very frequent intervals, less than three seconds apart.
  - Many objects and counters are selected.

  Other aspects of performance tool operation that affect performance include file size and disk space that is used by log files. To reduce file size and related disk space usage, extend the update interval. Also, log on to a disk other than the one you are monitoring. Frequent logging also adds demand on disk input and output (I/O).

  If monitoring overhead is a concern, run only the Performance Logs and Alerts service; do not monitor by using a System Monitor graph.

  During remote logging, frequent updating can slow performance due to network transport. In this case, it is recommended that you log continuously on remote computers but upload logs infrequently, for example, once a day.

Performance baseline

- Analyze performance results and establish a performance baseline.

  Review logged data by using the System Monitor graph or by exporting it for printing. Compare the values against the counter thresholds to verify that resource usage or other activity is within acceptable limits. Set your baseline according to the level of performance that you consider satisfactory for your typical workload.

Alerts

- Set alerts.

  Set alerts according to the counter values that you consider unacceptable, as defined by baseline evaluation.

System tuning

- Perform system tuning.

  Tune system settings and workload to improve performance, and repeat monitoring to examine tuning results.

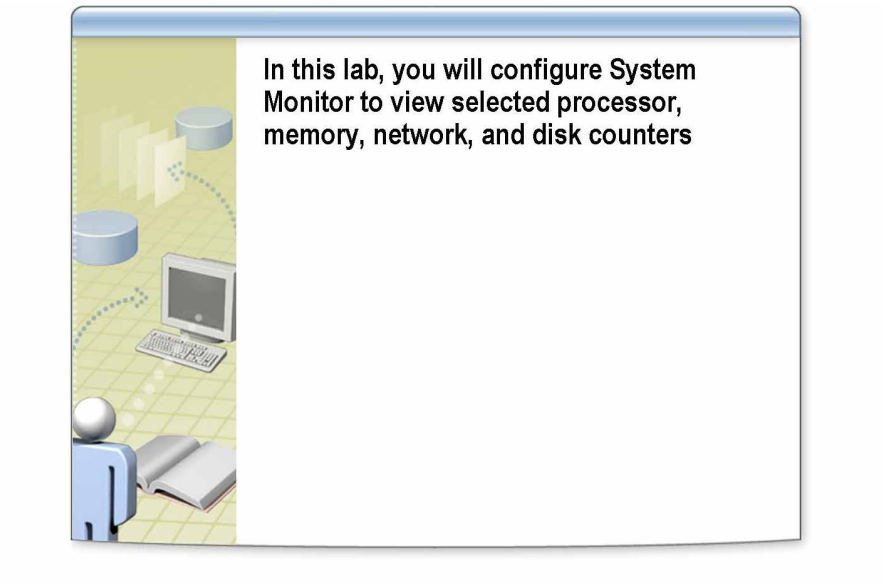
Trends

- Monitor trends for capacity planning, and add or upgrade components.

  Maintain logged data in a database, and observe changes to identify changes in resource requirements. After you observe changes in activity or resource demand, you can identify where you may require additional resources.

Note Use Microsoft Operations Manager for enterprise organization. Microsoft Operations Manager is designed to monitor multiple servers simultaneously. Microsoft Operations Manager provides comprehensive event management, proactive monitoring and alerting, reporting, and trend analysis in a large-scale organization.

Lab A: Monitoring Server Performance



Objectives

After completing this lab, you will be able to:

- Configure System Monitor to track CPU usage.
- Create an alert.
- Configure a high CPU usage alert.
- Configure the messaging service.
- Test the alert.

Scenario

You are the systems administrator for an organizational unit on a large network. Recently, users have been complaining that access to the department server is slow. After doing some initial research, you believe that CPU usage is too high. You fix the problem, but you want to be warned before it happens again. You need to configure Performance so that you receive both a visual and an audible alert when CPU usage is running high.

Estimated time to complete this lab: 20 minutes

Exercise 1
Starting Performance with Administrative Credentials

In this exercise, you will log on as a user and then use the **Run as** command to open the Performance Monitor with administrative credentials.

Tasks	Specific instructions
1. Log on to your computer.	▪ Log on to the computer using your domain user account.
2. Start Performance.	▪ Use the **Run as** command to start Performance with administrative credentials.

Exercise 2
Configuring System Monitor to Track High CPU Usage

In this exercise, you will configure System Monitor to track high CPU usage.

Tasks	Specific instructions
▪ Delete the default counters from System Monitor.	▪ In the System Monitor pane, delete the Memory\Pages/sec counter and the PhysicalDisk\Avg. Disk QueueLength counter.

Exercise 3
Creating and Configuring an Alert in Performance Logs and Alerts to Track High CPU Usage

In this exercise, you will create and configure an alert in Performance Logs and Alerts to track the high CPU usage on your server.

Tasks	Specific instructions
1. Create an alert named CPU Alert 2.	▪ Expand **Performance Logs and Alerts**, and then click **Alerts**. ▪ Right-click **Alerts,** click **New Alert Settings**, and then type **CPU Alert 2**
2. Configure an alert so that it triggers when CPU usage is less than 1 gigabytes (GB).	▪ In the **CPU Usage** dialog box, under **Comment**, type **Monitors CPU usage** ▪ Open the **Add Counters** dialog box. ▪ Add the **Processor\% Processor Time** Counter. ▪ Configure the alert to trigger when the value is over **50%**.
3. Send a network message to the console when the alert is triggered.	▪ On the **Action** tab, type the name of your computer in the **Send a network message to** box, and then press ENTER.

Exercise 4
Enabling the Messenger Service

In this exercise, you will enable the messenger service.

Tasks	Specific instructions
1. Start Computer Management with administrative credentials.	▪ Use the **Run as** command to start Computer Management with administrative credentials.
2. Enable the messenger service.	▪ Expand **Services and Applications**, and then click **Services**. ▪ In the details pane, open the properties for **Messenger**. ▪ Change the **Startup type** to **Manual**, and then press ENTER. ▪ Right-click **Messenger**, and then click **Start**.
3. Close Computer Management.	▪ Close Computer Management.

Exercise 5
Testing the High CPU Usage Alert

In this exercise, you will test the high CPU usage alert.

Tasks	Specific instructions
1. Test the high CPU usage alert.	▪ Start the following program: C:\MOC\2275\Labfiles\Lab03\cpustres.exe ▪ In Performance, view System Monitor. ▪ In the **CPU Stress** dialog box, change the activity for **Thread 1** to **Maximum**. ▪ When the CPU usage exceeds 50%, the alert will trigger a message every 5 seconds. ▪ Close **CPU Stress** to stop the messages.
2. Close all windows and log off.	▪ Close all windows and log off.