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Modul 2 : Windows Operating System



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Chapter 2 - Sections & Objectives

- 2.1 Windows Overview
 - Explain the operation of the Windows Operating System.
 - Describe the history of the Windows Operating System.
 - Explain the architecture of Windows and its operation.
- 2.2 Windows Administration
 - Explain how to secure Windows endpoints.
 - Explain how to configure and monitor Windows.
 - Explain how Windows can be kept secure.

2.1 Windows Overview

Disk Operating System

- Disk Operating System (DOS) - operating system that the computer uses to enable data storage devices to read and write files.
- MS-DOS, created by Microsoft, used a command line as the interface for people to create programs and manipulate data files.
- Early versions of Windows consisted of a Graphical User Interface (GUI) that ran over MS-DOS
- In newer versions of Windows, built on NT, the operating system itself is in direct control of the computer and its hardware.

```
Starting MS-DOS...

HIMEM is testing extended memory...done.

C:\>C:\DOS\SMARTDRV.EXE /X
C:\>dir

Volume in drive C is MS-DOS_6
Volume Serial Number is 4AA6-6939
Directory of C:\

DOS                <DIR>                05-06-17    1:09p
COMMAND.COM        54,645 05-31-94    6:22a
WINA20.386         9,349 05-31-94    6:22a
CONFIG.SYS          71 05-06-17    1:10p
AUTOEXEC.BAT        78 05-06-17    1:10p
                    5 file(s)                64,143 bytes
                                   517,021,696 bytes free

C:\>_
```

Windows Versions

- Since 1993, there have been more than 20 releases of Windows that are based on the NT operating system.
- Beginning with Windows XP, a 64-bit edition was available.
- 64-bit Windows can theoretically address 16.8 million terabytes of RAM
- With each subsequent release of Windows, the operating system has become more refined by incorporating more features.

OS	Versions
Windows 7	Starter, Home Basic, Home Premium, Professional, Enterprise, Ultimate
Windows Server 2008 R2	Foundation, Standard, Enterprise, Datacenter, Web Server, HPC Server, Itanium-Based Systems
Windows Home Server 2011	None
Windows 8	Windows 8, Windows 8 Pro, Windows 8 Enterprise, Windows RT
Windows Server 2012	Foundation, Essentials, Standard, Datacenter
Windows 8.1	Windows 8.1, Windows 8.1 Pro, Windows 8.1 Enterprise, Windows RT 8.1
Windows Server 2012 R2	Foundation, Essentials, Standard, Datacenter
Windows 10	Home, Pro, Pro Education, Enterprise, Education, IoT Core, Mobile, Mobile Enterprise
Windows Server 2016	Essentials, Standard, Datacenter, Multipoint Premium Server, Storage Server, Hyper-V Server

Windows GUI



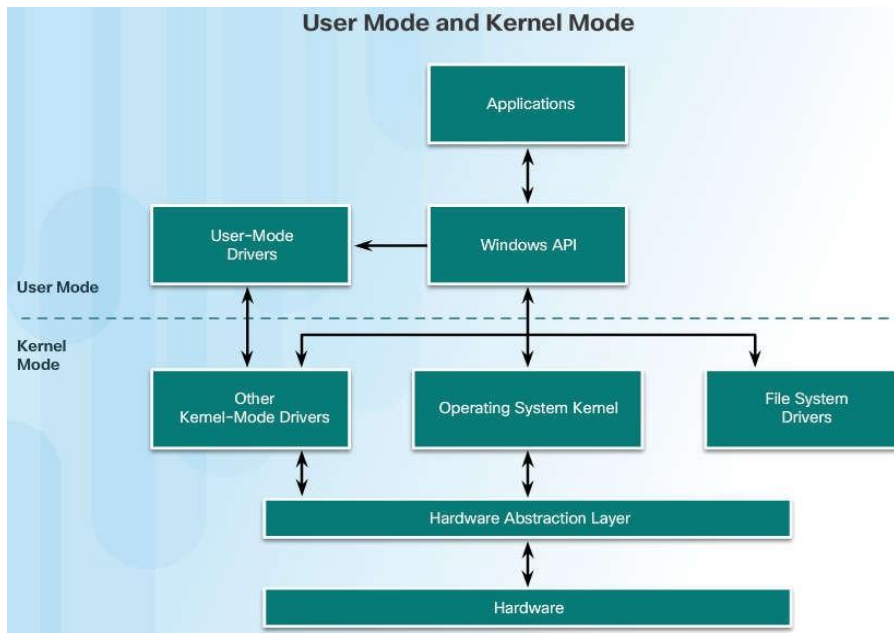
- Windows has a graphical user interface (GUI) for users to work with data files and software.
- Main section of the GUI is the desktop, which contains the Task Bar
- Task Bar includes the Start Menu and Search, Quick Launch items and Notifications Area.
- Right-clicking an icon will bring up additional list of functions, known as a Context Menu.
- Windows File Explorer, is a tool used to navigate the entire file system of a computer.

Operating System Vulnerabilities



- To take advantage of an operating system vulnerability, the attacker must use a technique or a tool to exploit the vulnerability.
- Common Windows OS Security Recommendations:
 - Implement virus or malware protection.
 - Do not allow unknown or unmanaged services.
 - Use encryption.
 - Implement a strong security policy.
 - Review firewall settings periodically.
 - Set File and Share permissions correctly.
 - Use strong passwords.
 - Login as Administrator only when necessary.

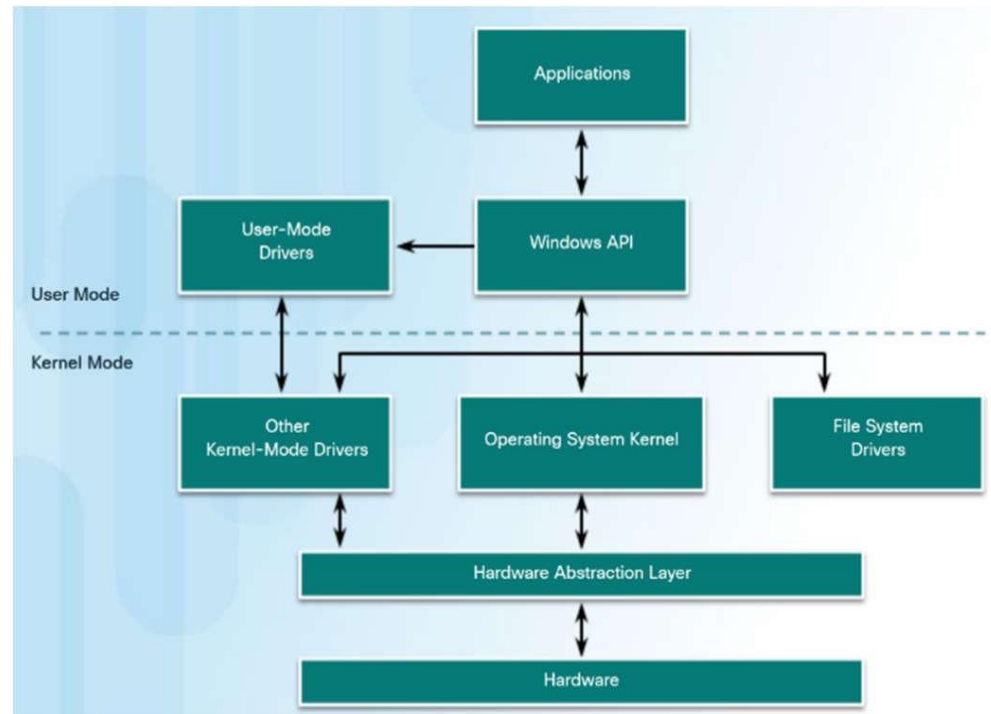
Hardware Abstraction Layer



- A hardware abstraction layer (HAL) is code that handles all of the communication between the hardware and the kernel.
- The kernel is the core of the operating system and has control over the entire computer.
- The kernel handles all of the input and output requests, memory, and all of the peripherals connected to the computer.

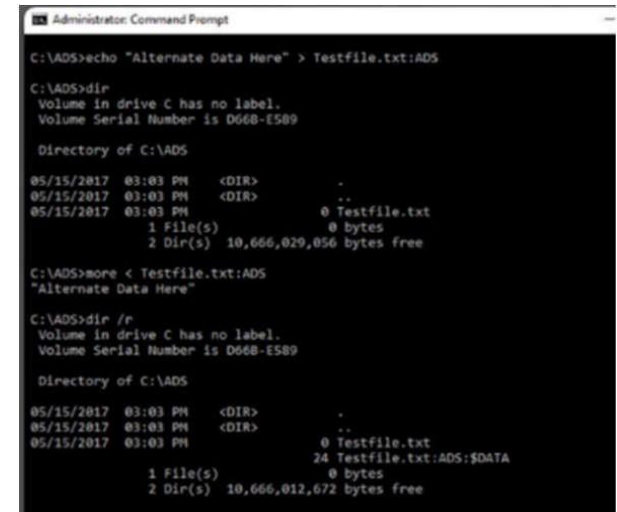
User Mode and Kernel Mode

- There are two different modes in which a CPU operates when the computer has Windows installed: the user mode and the kernel mode.
- Installed applications run in user mode, and operating system code runs in kernel mode.



Windows File Systems

- A file system is how information is organized on storage media.
 - Windows supports the following file systems:
 - File Allocation Table (FAT)
 - exFAT
 - Hierarchical File System Plus (HFS+)
 - Extended File System (EXT)
 - New Technology File System (NTFS)
- NTFS stores files as a series of attributes, such as the name of the file, or a timestamp.
- The data which the file contains is stored in the attribute \$DATA, and is known as a data stream.
- A hard drive is divided into areas called partitions.
- Each partition is a logical storage unit that can be formatted to store information, such as data files or applications.



```
Administrator: Command Prompt

C:\ADS>echo "Alternate Data Here" > Testfile.txt:ADS

C:\ADS>dir
Volume in drive C has no label.
Volume Serial Number is D66B-E589

Directory of C:\ADS

05/15/2017  03:03 PM    <DIR>          .
05/15/2017  03:03 PM    <DIR>          ..
05/15/2017  03:03 PM                0 Testfile.txt
                  1 File(s)            0 bytes
                  2 Dir(s)  10,666,029,056 bytes free

C:\ADS>more < Testfile.txt:ADS
"Alternate Data Here"

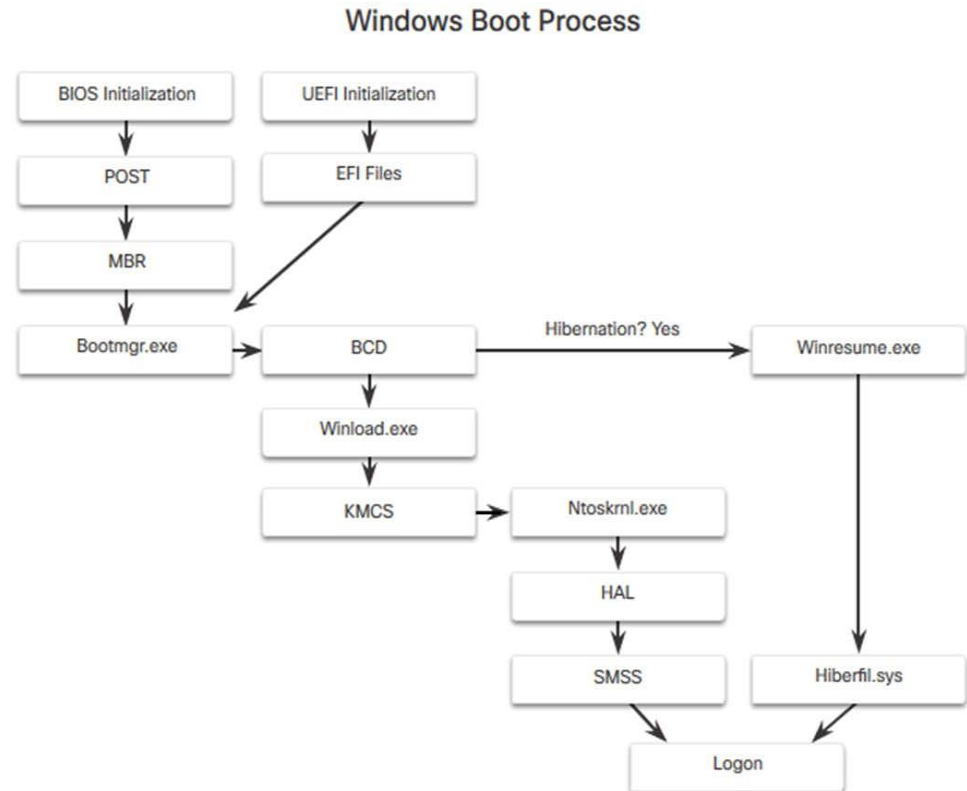
C:\ADS>dir /r
Volume in drive C has no label.
Volume Serial Number is D66B-E589

Directory of C:\ADS

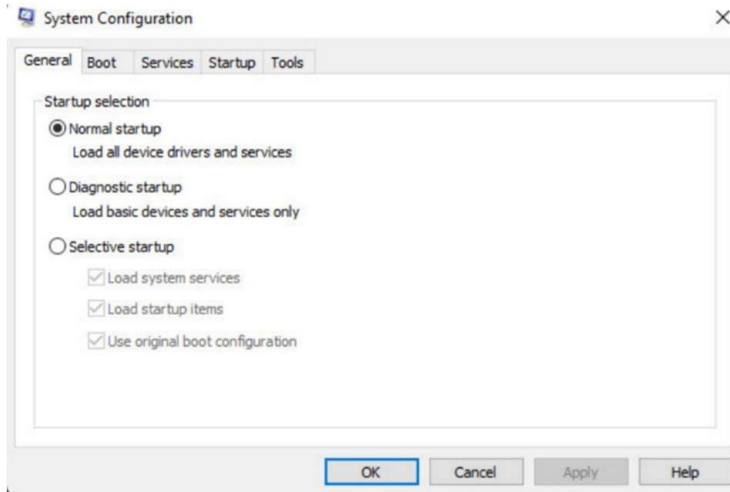
05/15/2017  03:03 PM    <DIR>          .
05/15/2017  03:03 PM    <DIR>          ..
05/15/2017  03:03 PM                0 Testfile.txt
                  24 Testfile.txt:ADS:$DATA
                  1 File(s)            0 bytes
                  2 Dir(s)  10,666,012,672 bytes free
```

Windows Boot Process

- Two types of computer firmware exist: Basic Input-Output System (BIOS) and Unified Extended Firmware Interface (UEFI)
- UEFI was designed to replace BIOS and support the new features.
- Whether BIOS or UEFI, after a valid Windows installation is located, the Bootmgr.exe file is run.



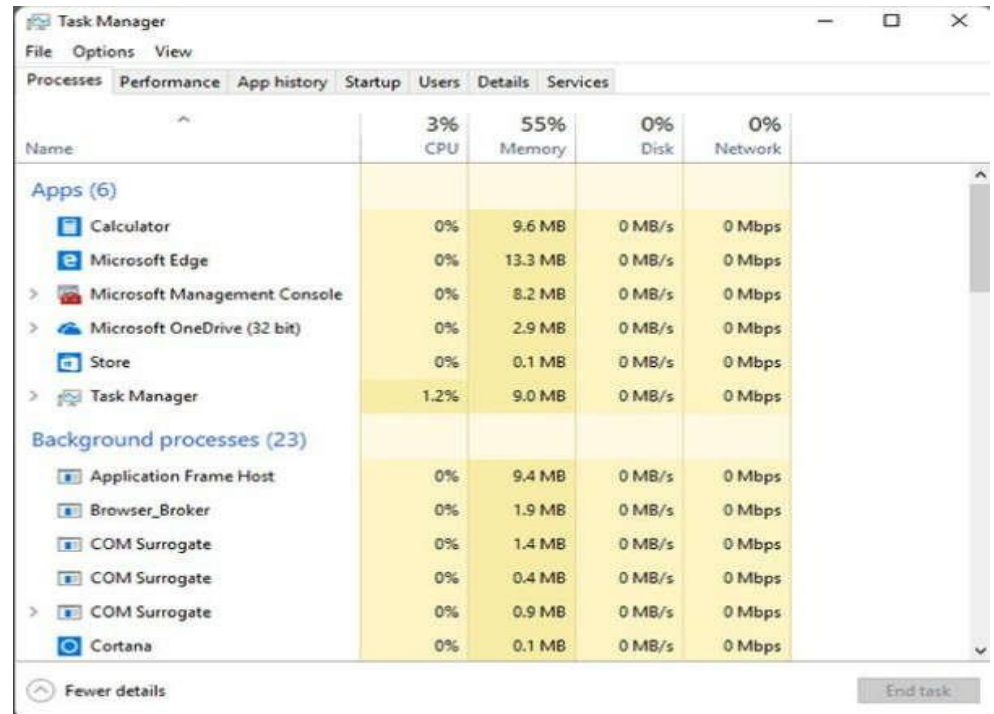
Windows Startup and Shutdown



- Different entries in these registry locations define which services and applications will start, as indicated by their entry type.
 - HKEY_LOCAL_MACHINE
 - HKEY_CURRENT_USER
- These types include Run, RunOnce, RunServices, RunServicesOnce, and Userinit.
- There are five tabs which contain the configuration options:
 - General
 - Boot
 - Services
 - Startup
 - Tools
- It is always best to perform a proper shutdown to turn off the computer.

Processes, Threads, and Services

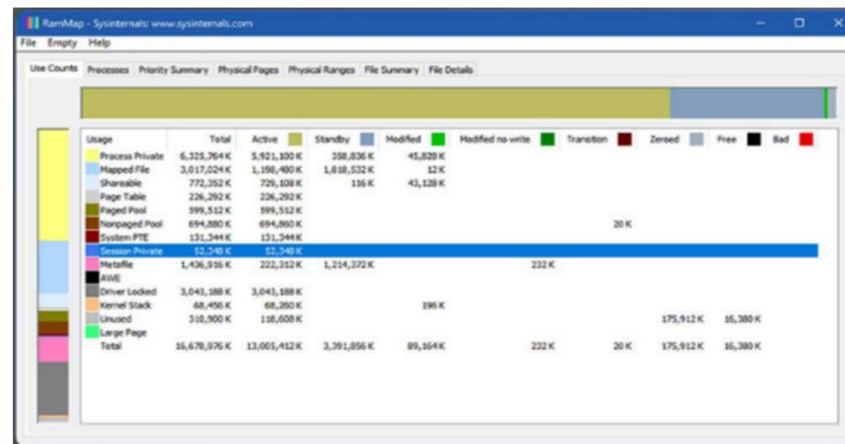
- A process is any program that is currently executing.
- A thread is a part of the process that can be executed.
- In Windows multiple threads can be executed at the same time.
- Some of the processes that Windows runs are services - programs that run in the background to support the operating system and applications.



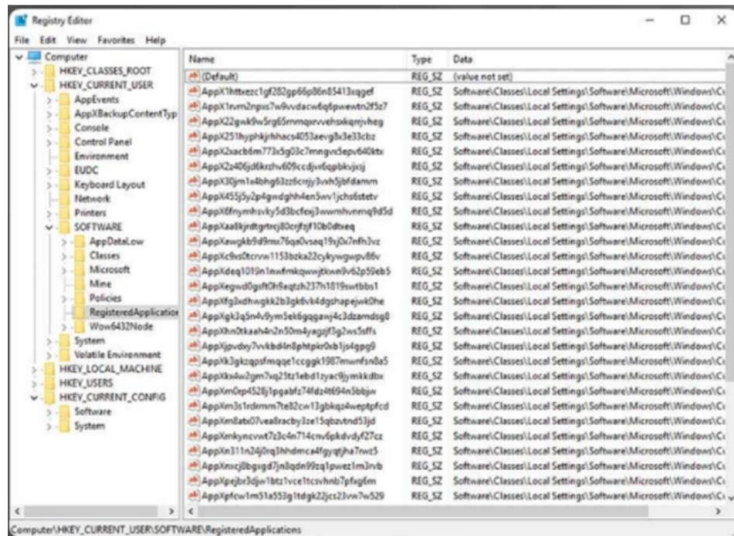
Name	3% CPU	55% Memory	0% Disk	0% Network
Apps (6)				
Calculator	0%	9.6 MB	0 MB/s	0 Mbps
Microsoft Edge	0%	13.3 MB	0 MB/s	0 Mbps
Microsoft Management Console	0%	8.2 MB	0 MB/s	0 Mbps
Microsoft OneDrive (32 bit)	0%	2.9 MB	0 MB/s	0 Mbps
Store	0%	0.1 MB	0 MB/s	0 Mbps
Task Manager	1.2%	9.0 MB	0 MB/s	0 Mbps
Background processes (23)				
Application Frame Host	0%	9.4 MB	0 MB/s	0 Mbps
Browser_Broker	0%	1.9 MB	0 MB/s	0 Mbps
COM Surrogate	0%	1.4 MB	0 MB/s	0 Mbps
COM Surrogate	0%	0.4 MB	0 MB/s	0 Mbps
COM Surrogate	0%	0.9 MB	0 MB/s	0 Mbps
Cortana	0%	0.1 MB	0 MB/s	0 Mbps

Memory Allocation and Handles

- The virtual address space for a process is the set of virtual addresses that the process can use.
- Each process in a 32-bit Windows computer supports a virtual address space that enables addressing up to 4 gigabytes.
- Each process in a 64-bit Windows computer supports a virtual address space of 8 terabytes.
- Each user space process runs in a private address space, separate from other user space processes.
- Sysinternal's RamMap – Used to view memory allocation.



The Windows Registry



- The five hives of the Windows registry:
 - **HKEY_CURRENT_USER (HKCU)** - Holds data concerning the currently logged in user.
 - **HKEY_USERS (HKU)** - Holds data concerning all the user accounts.
 - **HKEY_CLASSES_ROOT (HKCR)** - Holds data about object linking and embedding (OLE) registrations.
 - **HKEY_LOCAL_MACHINE (HKLM)** - Holds system- related data.
 - **HKEY_CURRENT_CONFIG (HKCC)** - Holds data about the current hardware profile.
- Navigation is very similar to Windows file explorer.

- Information about hardware, applications, users, and system settings is stored in the Windows registry.
- The registry is a hierarchical database where the highest level is known as a hive, below that there are keys, followed by subkeys.

Lab – Exploring Processes, Threads, Handles, and Windows Registry



Lab – Exploring Processes, Threads, Handles, and Windows Registry

Objectives

In this lab, you will explore the processes, threads, and handles using Process Explorer in the SysInternals Suite. You will also use the Windows Registry to change a setting.

Part 1: Exploring Processes

Part 2: Exploring Threads and Handles

Part 3: Exploring Windows Registry

Required Resources

- 1 Windows PC with Internet access

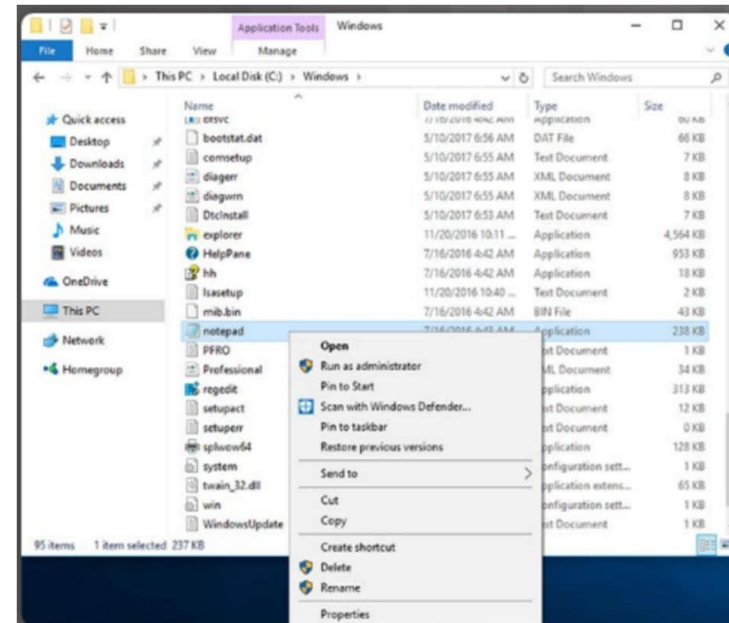
Part 1: Exploring Processes

In this part, you will explore processes. Processes are programs or applications in execution. You will explore the processes using Process Explorer in the Windows SysInternals Suite. You will also start and observe a new process.

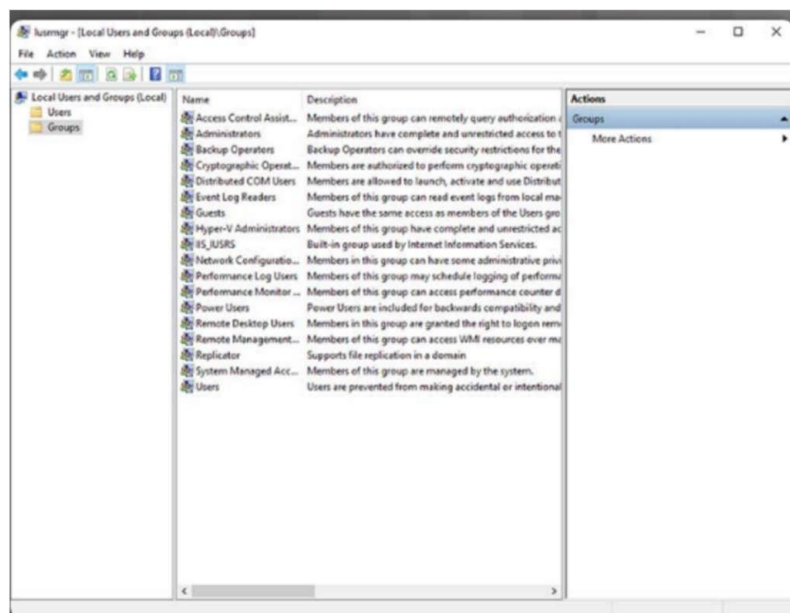
2.2 Windows Administration

Run as Administrator

- Sometimes, it is necessary to run or install software that requires the privileges of the Administrator.
- Use “Run as administrator” or open an Administrator Command Prompt.



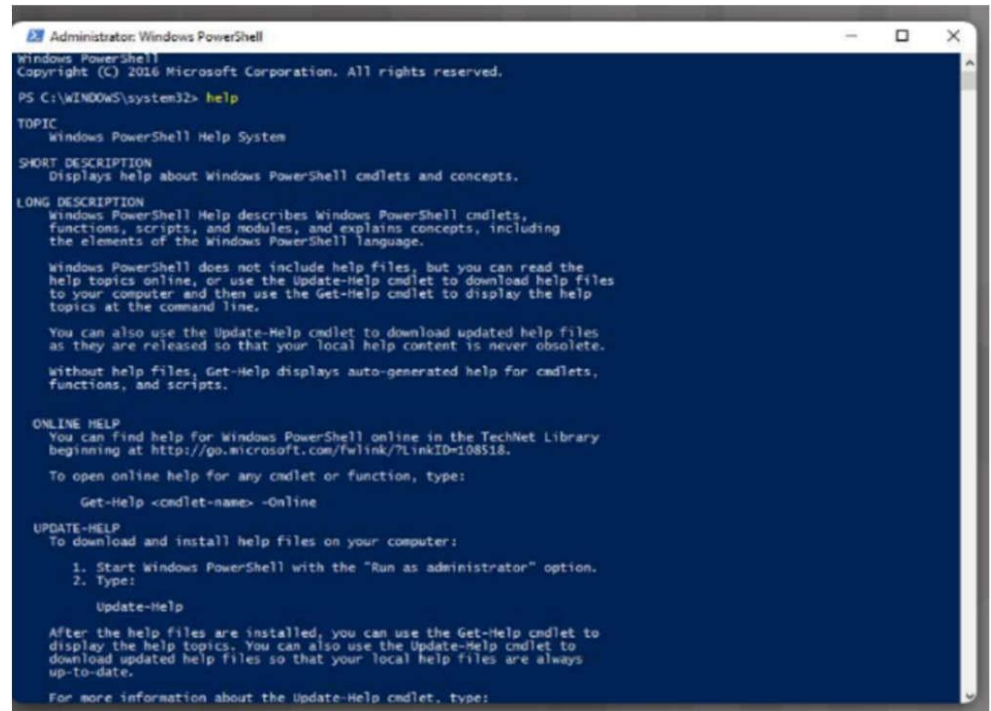
Local Users and Domains



- Local users and groups are managed with the lusrmgr.msc control panel applet.
- A group is named and has a specific set of permissions associated with it. A user placed into a group will have the permissions of that group assigned to them.
- A domain - type of network service where all of the users, groups, computers, peripherals, and security settings are stored on and controlled by a database.
 - This database is stored on computers or groups of computers called domain controllers (DCs).

CLI and PowerShell

- The Windows command line interface (CLI) can be used to run programs, navigate the file system, and manage files and folders.
- Another environment, called the Windows PowerShell, can be used to create scripts to automate tasks that the regular CLI is unable to create.

A screenshot of a Windows PowerShell window titled "Administrator: Windows PowerShell". The window has a blue background and white text. It shows the output of the "help" command. The text includes copyright information for Microsoft Corporation, the command prompt "PS C:\WINDOWS\system32> help", and detailed help information for the "help" cmdlet, including its topic, short description, long description, online help, and update-help instructions.

```
Administrator: Windows PowerShell

Windows PowerShell
Copyright (C) 2016 Microsoft Corporation. All rights reserved.

PS C:\WINDOWS\system32> help

TOPIC
    Windows PowerShell Help System

SHORT DESCRIPTION
    Displays help about Windows PowerShell cmdlets and concepts.

LONG DESCRIPTION
    Windows PowerShell Help describes Windows PowerShell cmdlets,
    functions, scripts, and modules, and explains concepts, including
    the elements of the Windows PowerShell language.

    Windows PowerShell does not include help files, but you can read the
    help topics online, or use the Update-Help cmdlet to download help files
    to your computer and then use the Get-Help cmdlet to display the help
    topics at the command line.

    You can also use the Update-Help cmdlet to download updated help files
    as they are released so that your local help content is never obsolete.

    Without help files, Get-Help displays auto-generated help for cmdlets,
    functions, and scripts.

ONLINE HELP
    You can find help for Windows PowerShell online in the TechNet Library
    beginning at http://go.microsoft.com/fwlink/?LinkID=108518.

    To open online help for any cmdlet or function, type:

        Get-Help <cmdlet-name> -Online

UPDATE-HELP
    To download and install help files on your computer:

        1. Start Windows PowerShell with the "Run as administrator" option.
        2. Type:

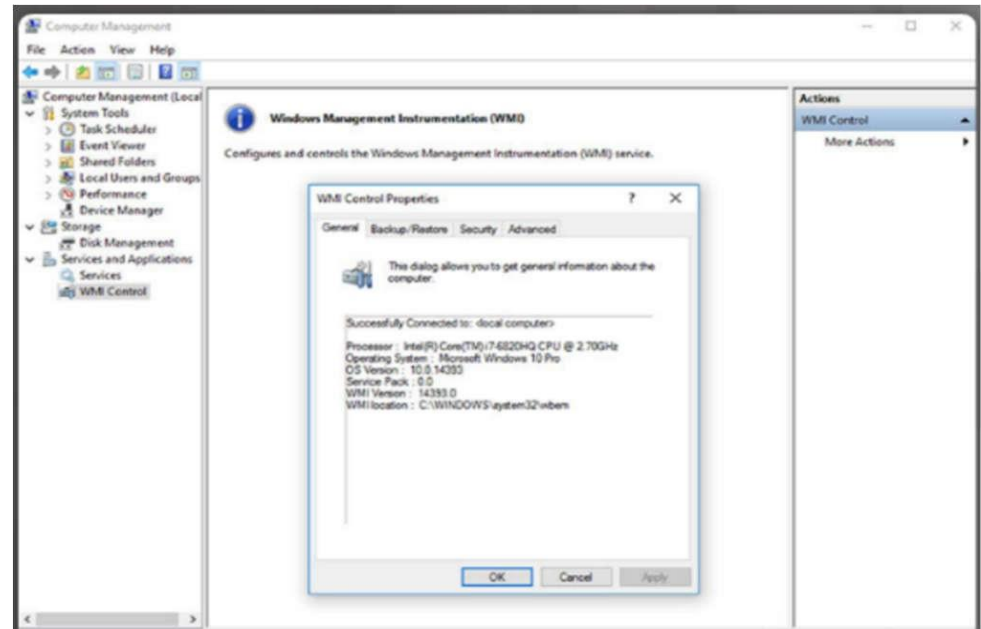
            Update-Help

    After the help files are installed, you can use the Get-Help cmdlet to
    display the help topics. You can also use the Update-Help cmdlet to
    download updated help files so that your local help files are always
    up-to-date.

    For more information about the Update-Help cmdlet, type:
```

Windows Management Instrumentation

- Windows Management Instrumentation (WMI) is used to manage remote computers.
- Some attacks today use WMI to connect to remote systems, modify the registry, and run commands, therefore access should be strictly limited.



The net Command

- The **net** command supports many other commands that follow the **net** command and can be combined with switches to focus on specific output.

```
Commands available are:

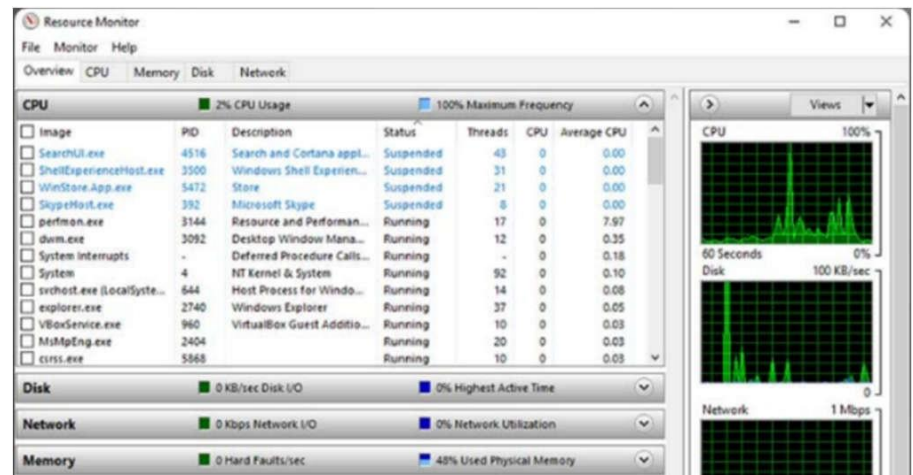
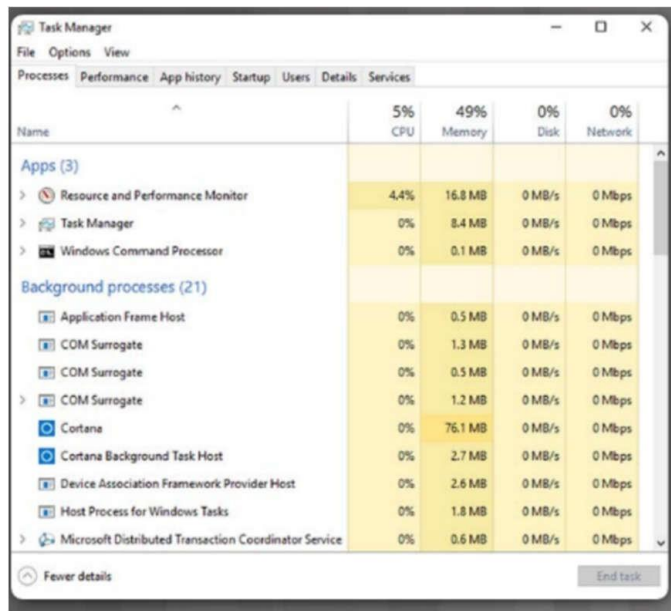
NET ACCOUNTS          NET HELPMMSG          NET STATISTICS
NET COMPUTER          NET LOCALGROUP        NET STOP
NET CONFIG            NET PAUSE             NET TIME
NET CONTINUE          NET SESSION           NET USE
NET FILE              NET SHARE             NET USER
NET GROUP             NET START             NET VIEW
NET HELP

NET HELP NAMES explains different types of names in NET HELP syntax lines.
NET HELP SERVICES lists some of the services you can start.
NET HELP SYNTAX explains how to read NET HELP syntax lines.
NET HELP command | MORE displays Help one screen at a time.
```

- To see a list of the **net** commands, type **net help** at the command prompt.

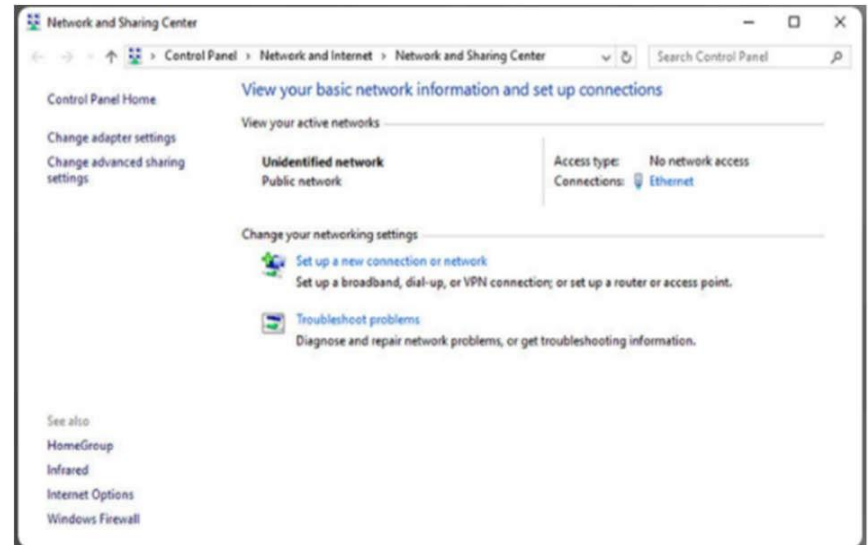
Task Manager and Resource Monitor

- Task Manager provides a lot of information about what is running, and general performance of the computer.
- Resource Monitor is used when more detailed information about resource usage is needed.

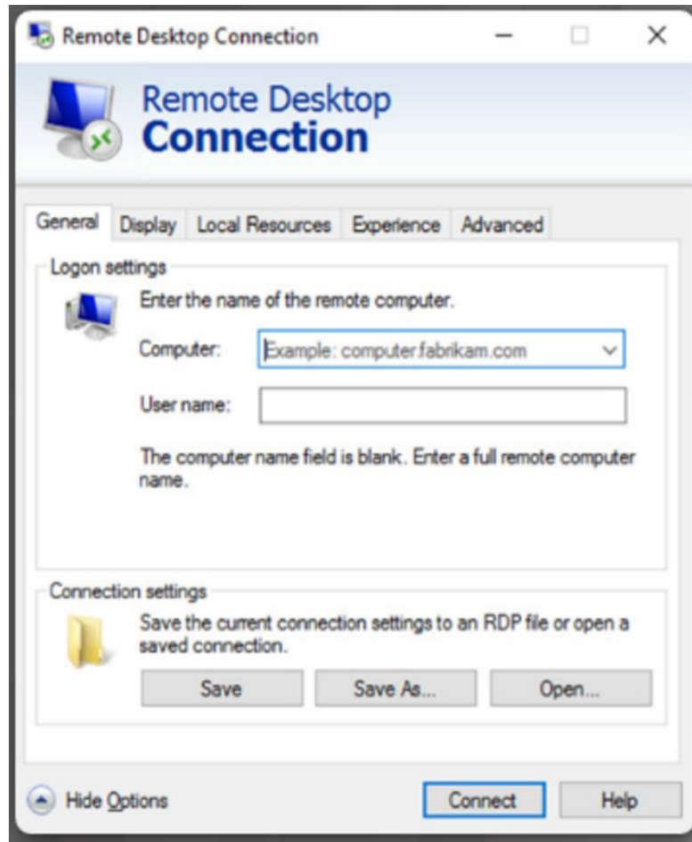


Networking

- To configure Windows networking properties and test networking settings, the Network and Sharing Center is used.
- Use the **netsh.exe** tool to configure networking parameters from a command prompt.
- To test the network adapter, type **ping 127.0.0.1** at the command prompt.
- Domain Name System (DNS) should also be tested using **nslookup** command.
- Use **netstat** at the command line to see details of active network connections.



Accessing Network Resources



- Server Message Block (SMB) protocol is used to share network resources.
- Universal Naming Convention (UNC) format is used to connect to resources.
- An administrative share is identified by the dollar sign (\$) that comes after the share name.
- Remote Desktop Protocol (RDP) can be used to log onto a remote host and make configuration changes, install software, or troubleshoot.

Windows Server

- There is another edition of Windows that is mainly used in data centers called Windows Server.
- Services that Windows Server hosts include:
 - Network Services
 - File Services
 - Web Services
 - Management



Lab – Create User Accounts



Lab - Create User Accounts

Introduction

In this lab, you will create and modify user accounts in Windows.

Part 1: Creating a New Local User Account

Part 2: Reviewing User Account Properties

Part 3: Modifying Local User Accounts

Required Resources

- A Windows PC

Part 1: Creating a New Local User Account

Step 1: Open the User Account Tool.

- Log on to the computer with an Administrator account. The account **CyberOpsUser** is used in this example.
- Click **Start** > search **Control Panel**. Select **User Accounts** in the Small icons view. To change the view, select **Small icons** in the View by drop down list.

Lab – Using Windows PowerShell



Lab – Using Windows PowerShell

Objectives

The objective of the lab is to explore some of the functions of PowerShell.

Background / Scenario

PowerShell is a powerful automation tool. It is both a command console and a scripting language. In this lab, you will use the console to execute some of the commands that are available in both the command prompt and PowerShell. PowerShell also has functions that can create scripts to automate tasks and work together with the Windows Operating System.

Required Resources

- 1 Windows PC with PowerShell installed and Internet access

Step 1: Access PowerShell console.

- a. Click **Start**. Search and select **powershell**.

Lab – Windows Task Manager



Lab – Windows Task Manager

Introduction

In this lab, you will explore Task Manager and manage processes from within Task Manager.

Part 1: Working in the Processes tab

Part 2: Working in the Services tab

Part 3: Working in the Performance tab

Background / Scenario

The Task Manager is a system monitor program that provides information about the processes and programs running on a computer. It also allows the termination of processes and programs and modification of process priority.

Required Resources

- A Windows PC with Internet access

Part 1: Working in the Processes tab

- a. Open a command prompt and a web browser.

Microsoft Edge is used in this lab; however, any web browser will work. Just substitute your browser name whenever you see Microsoft Edge.

- b. Right-click the Task bar to open **Task Manager**. Another way to open the Task Manager is to press **Ctrl-Alt-Delete** to access the Windows Security screen and select **Task Manager**.

Lab – Monitoring and Manage System Resources in Windows



Lab - Monitor and Manage System Resources in Windows

Introduction

In this lab, you will use administrative tools to monitor and manage Windows system resources.

Recommended Equipment

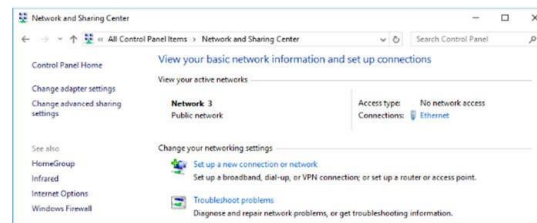
- A Windows PC with Internet access

Part 1: Starting and Stopping the Routing and Remote Access service

You will explore what happens when a service is stopped and then started. In this part, you will use routing and remote access service as the example service. This service allows the local device to become a router or a remote access server.

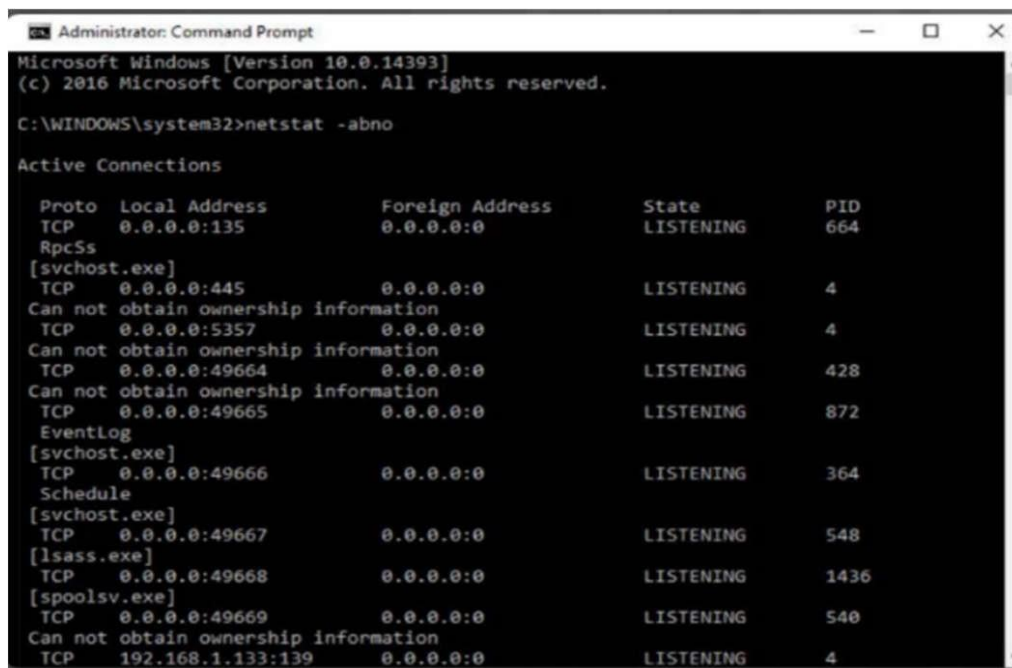
- a. Click **Start** > Search and select **Control Panel** > Click **Network and Sharing Center**.

Note: If your Control Panel is set to **View by: Category**, change it to **View by: Large icons** or **View by: Small icons**. This lab assumes that you are using one of these settings.



The netstat Command

- The **netstat** command can be used to look for inbound or outbound connections that are not authorized.
- Link the connections to the running processes in the Task Manager by using **netstat -abno**
- To display the Process IDs for the processes in the Task Manager, open the Task Manager, right-click the table heading and select PID.



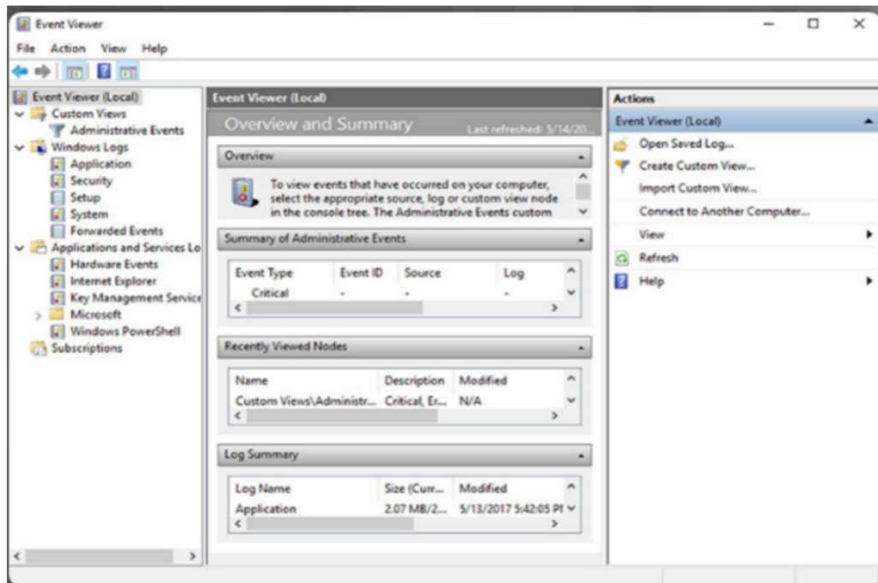
```
Administrator: Command Prompt
Microsoft Windows [Version 10.0.14393]
(c) 2016 Microsoft Corporation. All rights reserved.

C:\WINDOWS\system32>netstat -abno

Active Connections

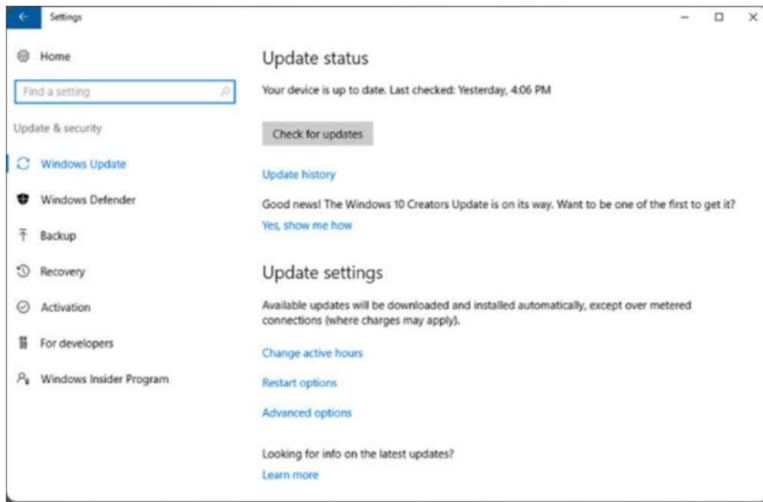
Proto Local Address           Foreign Address         State       PID
TCP   0.0.0.0:135              0.0.0.0:0               LISTENING   664
RpcSs
[svchost.exe]
TCP   0.0.0.0:445              0.0.0.0:0               LISTENING   4
Can not obtain ownership information
TCP   0.0.0.0:5357             0.0.0.0:0               LISTENING   4
Can not obtain ownership information
TCP   0.0.0.0:49664            0.0.0.0:0               LISTENING   428
Can not obtain ownership information
TCP   0.0.0.0:49665            0.0.0.0:0               LISTENING   872
EventLog
[svchost.exe]
TCP   0.0.0.0:49666            0.0.0.0:0               LISTENING   364
Schedule
[svchost.exe]
TCP   0.0.0.0:49667            0.0.0.0:0               LISTENING   548
[lsass.exe]
TCP   0.0.0.0:49668            0.0.0.0:0               LISTENING   1436
[spoolsv.exe]
TCP   0.0.0.0:49669            0.0.0.0:0               LISTENING   540
Can not obtain ownership information
TCP   192.168.1.133:139        0.0.0.0:0               LISTENING   4
```


The Event Viewer



- Windows Event Viewer logs the history of application, security, and system events.
- Windows includes two categories of event logs: Windows Logs, and Application and Services Logs.
- A built-in custom view called Administrative Events shows all critical, error, and warning events from all of the administrative logs.

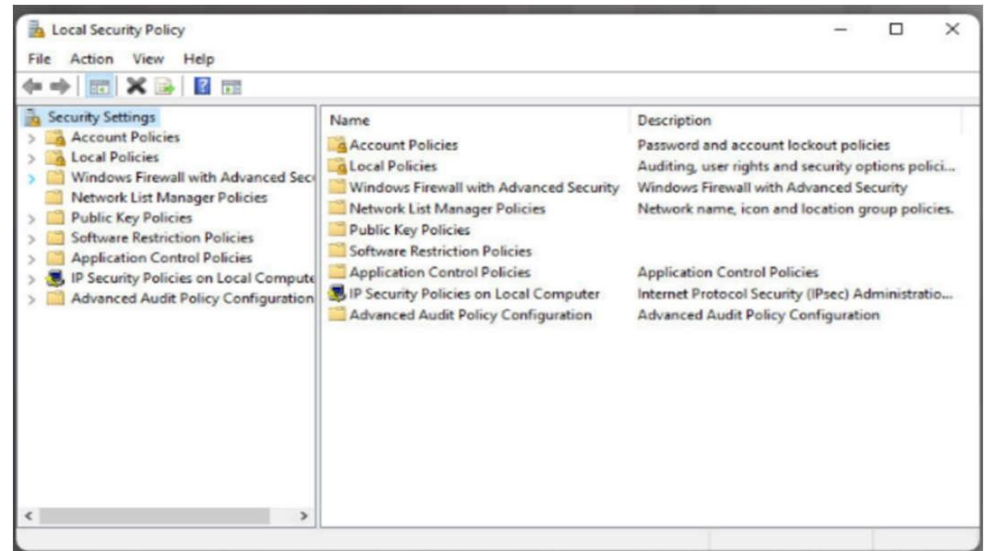
Windows Update Management



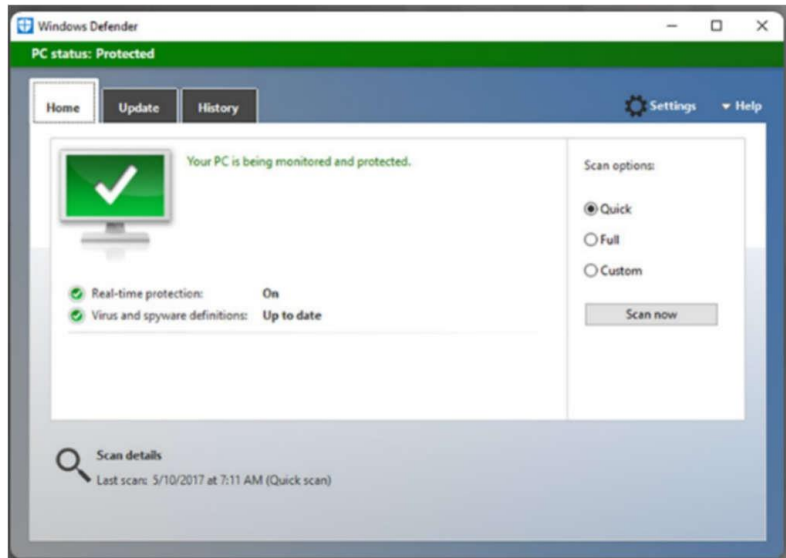
- To ensure the highest level of protection against attacks, always make sure Windows is up to date with the latest service packs and security patches.
- Windows routinely checks the Windows Update website for high-priority updates that can help protect a computer from the latest security threats.
- To configure the settings for Windows update, search for Windows Update and click the application.

Local Security policy

- Windows Local Security Policy can be used for stand-alone computers that are not part of an Active Directory domain.
- Password Policy is found under Account Policies, and defines the criteria for the passwords for all of the users on the local computer.
- Use the Account Lockout Policy in Account Policies to prevent brute-force login attempts.
- You can also configure User Rights and Firewall Rules.



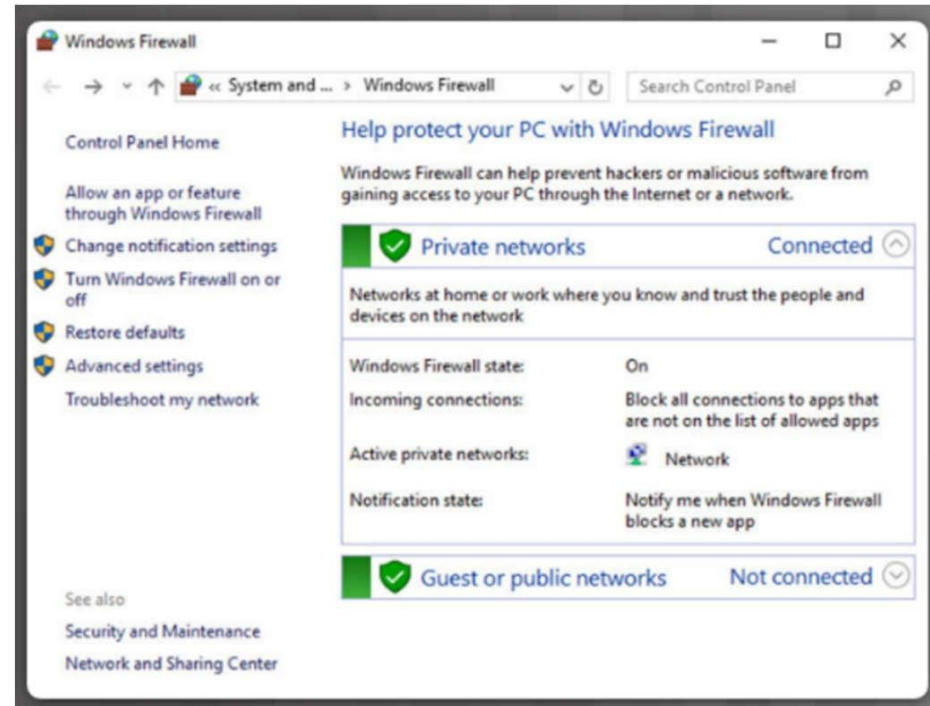
Local Security policy



- Windows has built-in virus and spyware protection called Windows Defender.
- Windows Defender allows you to perform manual scans of the computer and storage devices, and update the virus and spyware definitions in the Update tab

Windows Firewall

- Firewalls generally work by opening and closing the ports used by various applications.
- Opening only the required ports on a firewall implements a restrictive security policy.
- Most devices now ship with settings as restrictive as possible.



2.3 Chapter Summary

Chapter Summary

- In this chapter, you learned about the history and architecture of the Windows operating system. There have been over 40 versions of Windows desktop, Windows server, and Windows mobile operating systems.
- HAL handles all the communication between the hardware and the kernel. The CPU can operate in two separate modes: kernel mode and user mode. Applications that are installed are run in user mode, and operating system code runs in kernel mode.
- NTFS formats the disk into four important data structures:
 - Partition Boot Sector
 - Master File Table (MFT)
 - System Files
 - File Area

Chapter Summary

Summary (Cont.)

- Applications are generally made up of many processes. A process is any program that is currently executing. Each running process is made up of at least one thread. A thread is a part of the process that can be executed. Some of the processes that Windows runs are services. These are programs that run in the background to support the operating system and applications.
- Each process in a 32-bit Windows computer supports a virtual address space that enables addressing up to four gigabytes. Each process in a 64-bit Windows computer supports a virtual address space of up to eight terabytes.
- Windows stores all of the information about hardware, applications, users, and system settings in a large database known as the registry. The registry is a hierarchical database where the highest level is known as a hive. These are the five hives of the Windows registry:
 - HKEY_CURRENT_USER (HKCU)
 - HKEY_USERS (HKU)
 - HKEY_CLASSES_ROOT (HKCR)
 - HKEY_LOCAL_MACHINE (HKLM)
 - HKEY_CURRENT_CONFIG (HKCC)

Chapter Summary

Summary (Cont.)

- In this chapter, you also learned how to configure, monitor, and keep Windows secure. To do this normally requires that you run programs as Administrator. As administrator, you can create users and groups, disable access to the administrator and guest accounts, and use a variety of administrator tools including:
 - All commands available to CLI and PowerShell
 - Remote computer management using WMI and Remote Desktop
 - Task Manager and Resource Monitor
 - Networking configuration

Chapter Summary

Summary (Cont.)

- As administrator, you will also have the ability to use all of the Windows security tools including:
 - The netstat command to look for inbound and outbound connections that are not authorized
 - Event Viewer for access to logs that document the history of application, security, and system events
 - Windows Update configuration and scheduling
 - Windows Local Security Policy to secure stand-alone computers that are not part of an Active Directory domain
 - Windows Defender configuration for built-in virus and spyware protection
 - Windows Firewall configuration to fine-tune the default settings
- As a cybersecurity analyst, you need a basic understanding of how Windows operates and what tools are available to help keep Windows endpoints secure.

New Terms and Commands

- Alternative Data Stream (ADS)
- Basic Input-Output System (BIOS)
- Boot Configuration Database (BCD)
- command line interface (CLI)
- Disk Operating System (DOS)
- domain
- domain controller (DC)
- encryption
- Event Viewer
- Extended FAT (exFAT)
- Extended File System (EXT)
- File Allocation Table (FAT)
- firewall
- hardware abstraction layer (HAL)
- Hierarchical File System Plus (HFS+)
- kernel
- Kernel Mode Code Signing (KMCS)
- master boot record (MBR)
- Master File Table (MFT)
- MS-DOS
- netstat
- New Technology File System (NTFS)
- Partition Boot Sector
- PowerShell
- Process
- registry
- Resource Monitor
- Server Message Block (SMB)
- Services
- Session Manager Subsystem (SMSS)
- System Files
- Task Manager
- Threads
- Unified Extended Firmware Interface (UEFI)
- Windows Defender
- Windows Management Instrumentation (WMI)

Cybersecurity Operations Certification

This chapter covers the following areas in the Cybersecurity Operations

Certification: From 210-250 SECFND - Understanding Cisco

Cybersecurity Fundamentals:

- **Domain 4: Host Based Analysis**

- 4.1 Define the following terms as they pertain to Microsoft Windows:
 - Processes
 - Threads
 - Memory Allocation
 - Windows Registry
 - WMI
 - Handles
 - Services
- 4.3 Describe the functionality of the following endpoint technologies in regards to security monitoring:
 - AntiMalware and Antivirus
 - Host based firewall

Cybersecurity Operations Certification

This chapter covers the following areas in the Cybersecurity Operations Certification:

From 210-255 SECOPS - Implementing Cisco Cybersecurity Operations

- **Domain 1: Endpoint Threat Analysis & Computer Forensics**

- 1.4 Define the following items as they pertain to the Microsoft Windows file system:
 - FAT32
 - NTFS
 - Alternative Data Streams
 - Timestamps on a File System

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