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Operating System DIT Part 1

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PICT

Operating Systems

(DIT Part-I)

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Latest Course Outline

OVERVIEW OF AN OPERATING SYSTEM

1.1. What is Operating System?
1.2. Types of OS
    1.2.1. Desktop OS
        i. Batch OS (Batch Processing)
        ii. Multiprogramming Operating System
        iii. Multiprocessing Operating System
        iv. Multitasking Operating System
        v. Network Operating System
        vi. Real Time Operating System
        vii. Time Sharing Operating System
        viii. Distributed Operating System

    1.2.2. Mobile / Tablet OS
        i. Android
            a. What is android system
            b. Version & Upgrades
ii. IOS

FUNCTIONS OF AN OPERATING SYSTEM

2.1. Operating System Structures
    2.1.1. User Interface
2.2. Functions
    2.2.1. Memory Management
    2.2.2. Process Management
    2.2.3. Resources Management
    2.2.4. File Management
    2.2.5. Security
    2.2.6. Deadlock Prevention
    2.2.7. Coordination Between users and software's

PROCESSES

3.1. Definition
3.2. Process States (05 States)
3.3. Process structure
    3.3.1. PCB and components
3.4. Operations on Processes
3.5. Threads

INTRODUCTION TO WINDOWS 10

4.1. Installation Requirements
4.2. How to create Bootable USB / DVD / CD
    4.2.1. Rufus Software
4.3. Step-By Step Installation Process
4.4. Hard Disk Partition
4.5. GUI Basics / Desktop Basic
4.6. Start Menu
4.7. Task Bar
4.8. Settings
4.9. Driver / Hardware Installation
    4.9.1. VGA / SVGA / AGP / Gaming Card
    4.9.2. Sound Card
    4.9.3. Network Interface Card
        i. Wired ii. Wireless
4.10. Software Installation
4.11. User Creation
    4.11.1. Setting Properties
    4.11.2. Assigning Role & Permissions
4.12. Tablet Mode
4.13. Dual Desktop
4.14. Network Settings
    4.14.1. Join Workgroup
    4.14.2. Connecting with DSL MODEM
    4.14.3. Connecting with Hotspot
4.15. Updates & Security
4.16. Mouse & Keyboard Settings
4.17. Adding Urdu Keyboards
4.18. Installing & Configuring Printers & Scanner

NETWORK CONNECTIVITY (NETWORKING)

5.1. Creating Workgroup
5.2. Assigning IP Address to NIC / HOST / Computer
5.3. File Sharing
5.4. Printer Sharing
5.5. Assigning Permissions to users
5.6. Practically demonstrate the data sharing between computers

WINDOWS SERVER 2019 / 2016

6.1. Definition
6.2. Difference between client and Server

6.3. Role & Services

6.3.1. Print & Document Services

6.3.2. Active Directory

6.3.3. DHCP

6.3.4. DNS

6.3.5. WINS

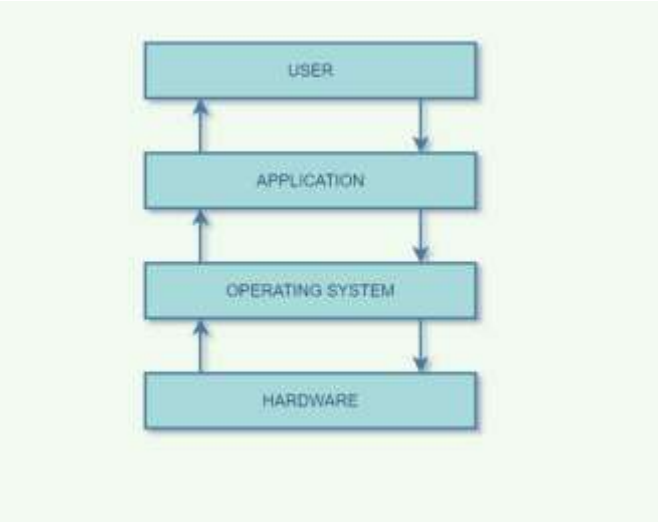
Practical Portion

1. Identify the basic components of computer i.e. CPU-MOUSE-KEYBOARD-MONITOR
2. Introduction to BIOS
    a. Setting System Date & Time
    b. Setting Boot-Devices Priority
        i. HD
        ii. USB Drive / Hard Disk iii. Network
3. Create bootable USB / DVD / CD
4. Windows 10 Installation
5. HD Partition during Installation
6. Setting username & computer name during installation
7. Changing Taskbar & Desktop settings
8. Device Drivers Installation
    a. Via Settings
    b. Without settings (Direct installation)
9. Un-installing a software via settings
10. Converting windows from computer to tablet mode 11. Creating & using dual desktops
12. How to join a workgroup?
13. Configure & connect DSL Modem
14. Using Internet via Hotspot
15. How to add Urdu Keyboard & fonts
16. Printer Installation
17. Printer sharing on LAN
18. Scanner Installation
19. Demonstrate the scanning document process
20. Assign IP address to your computer
21. Share your files & folder
22. Assign Permissions
23. Password Recovery
24. Backup & Restore
25. Defender
26. Windows Server 2019/2016 Installation

27. Install & Configure Active Directory
28. Install & Configure DNS
29. Install & Configure DHCP

Topic # 1: What is and Operating System

An Operating System (OS) is an interface between a computer user and computer hardware. An operating system is a software which performs all the basic tasks like file management, memory management, process management, handling input and output, and controlling peripheral devices such as disk drives and printers.



An operating system is software that enables applications to interact with a computer's hardware. The software that contains the core components of the operating system is called the kernel.

The primary purposes of an Operating System are to enable applications (software's) to interact with a computer's hardware and to manage a system's hardware and software resources.

Some popular Operating Systems include Linux Operating System, Windows Operating System, VMS, OS/400, AIX, z/OS, etc. Today, Operating systems is found almost in every device like mobile phones, personal computers, mainframe computers, automobiles, TV, Toys etc.

Definitions

We can have a number of definitions of an Operating System. Let's go through few of them:

An Operating System is the low-level software that supports a computer's basic functions, such as scheduling tasks and controlling peripherals.

We can refine this definition as follows:

An operating system is a program that acts as an interface between the user and the computer hardware and controls the execution of all kinds of programs.

Following is another definition taken from Wikipedia:

An operating system (OS) is system software that manages computer hardware, software resources, and provides common services for computer programs.

Operating system functions

Basic functions of an operating system include:

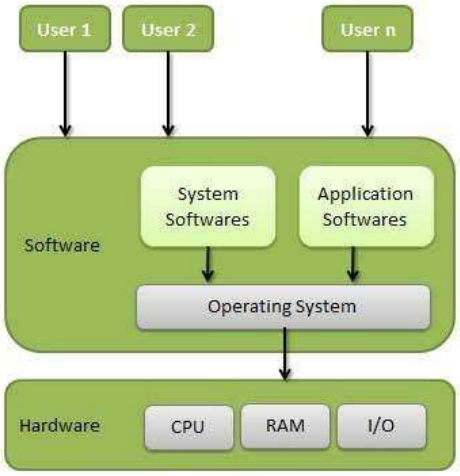
- Booting: An operating system manages the startup of a device.

- Memory management: An operating system coordinates computer applications and allocates space to different programs installed in the computer.
- Data security: An operating system protects your data from cyberattacks.
- Loading and execution: An operating system starts and executes a program.
- Drive/disk management: An operating system manages computer drives and divides disks.
- Device control: An operating system enables you to allow or block access to devices.
- User interface: This part of an operating system, also known as UI, allows users to enter and receive information.
- Process management: The operating system allocates space to enable computer processes, such as storing and sharing information.

Most operating systems come pre-installed on the device. However, users can change their OS or upgrade to a newer version of the operating system for better device performance.

Architecture Of An Operating System

We can draw a generic architecture diagram of an Operating System which is as follows:



1. Command line interface (CLI)

The command-line interface is an interface whenever the user needs to have different commands regarding the input and output and then a task is performed so this is called the command-line argument and it is used to execute the output and create, delete, print, copy, paste, etc.

All these operations are performed with the help of the command-line interface.

The command line interface is necessary because all the basic operations in the computer are performed with the help of the OS and it is responsible for memory management. By using this we can divide the memory and we can use the memory.

Command Line Interface advantages –

- Controls OS or application
- faster management
- ability to store scripts which helps in automating regular tasks.
- Troubleshoot network connection issues.

Command Line Interface disadvantages –

- The steeper learning curve is associated with memorizing commands and a complex syntax.
- Different commands are used in different shells.

2. Graphical user interface (GUI)

The graphical user interface is used for playing games, watching videos, etc. these are done with the help of GUI because all these applications require graphics.

The GUI is one of the necessary interfaces because only by using the user can clearly see the picture, play videos.

So we need GUI for computers and this can be done only with the help of an operating system.

When a task is performed in the computer then the OS checks the task and defines the interface which is necessary for the task. So, we need GUI in the OS.

The basic components of GUIs are –

- Start menu with program groups
- Taskbar which showing running programs
- Desktop screen
- Different icons and shortcuts.

Now to perform the functions mentioned above, the operating system has two components:

- Shell
- Kernel

Shell handles user interactions. It is the outermost layer of the OS and manages the interaction between user and operating system by:

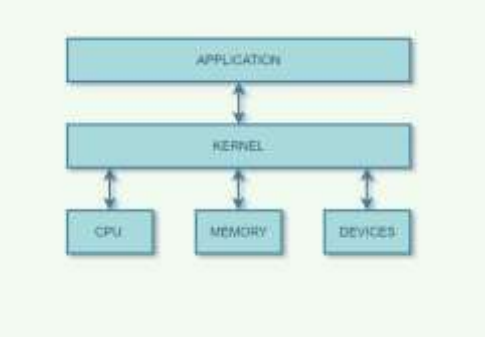
- Prompting the user to give input
- Interpreting the input for the operating system
- Handling the output from the operating system.

- **MDI Menu Driven Interface**

List Of Commands is called menu

What is Kernel?

The kernel is the core component of an operating system for a computer (OS). All other components of the OS rely on the core to supply them with essential services. It serves as the primary interface between the OS and the hardware and aids in the control of devices, networking, file systems, and process and memory management.



Functions of kernel

The kernel is responsible for performing the following tasks:

- Input-Output management
- Memory Management
- Process Management for application execution.
- Device Management
- System calls control

Hardware Abstraction Layer

A hardware abstraction layer is included in many OSs to avoid modifying the OS kernel to run the program on computers with varying hardware architecture. A PC may include the HAL in the OS kernel or in the form of device drivers that provide a consistent interface for applications to interact with the hardware peripherals.

The HAL provides the following benefits:

- Allowing applications to extract as much performance out of the hardware devices as possible
- Enabling the OS to perform regardless of the hardware architecture
- Enabling device drivers to provide direct access to each hardware device, which allows programs to be device-independent
- Allowing software programs to communicate with the hardware devices at a general level

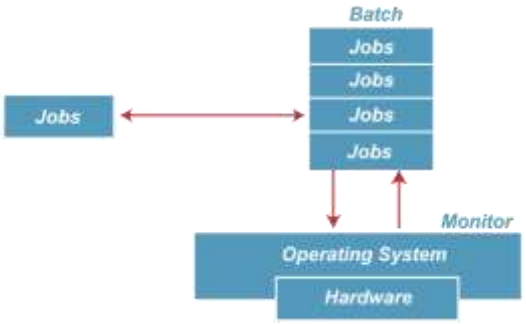
Topic # 2: Types of Operating Systems (OS)

An operating system is a well-organized collection of programs that manages the computer hardware. It is a type of system software that is responsible for the smooth functioning of the computer system.

1. Batch Operating System

In the 1970s, Batch processing was very popular. In this technique, similar types of jobs were batched together and executed in time. People were used to having a single computer which was called a mainframe.

In Batch operating system, access is given to more than one person; they submit their respective jobs to the system for the execution.



The system put all of the jobs in a queue on the basis of first come first serve and then executes the jobs one by one. The users collect their respective output when all the jobs get executed.

The purpose of this operating system was mainly to transfer control from one job to another as soon as the job was completed. It contained a small set of programs called the resident monitor that always resided in one part of the main memory. The remaining part is used for servicing jobs.

Advantages of Batch OS

The use of a resident monitor improves computer efficiency as it eliminates CPU time between two jobs.

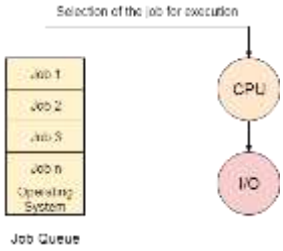
Disadvantages of Batch OS

1. Starvation

Batch processing suffers from starvation.

For Example:

There are five jobs J1, J2, J3, J4, and J5, present in the batch. If the execution time of J1 is very high, then the other four jobs will never be executed, or they will have to wait for a very long time. Hence the other processes get starved.



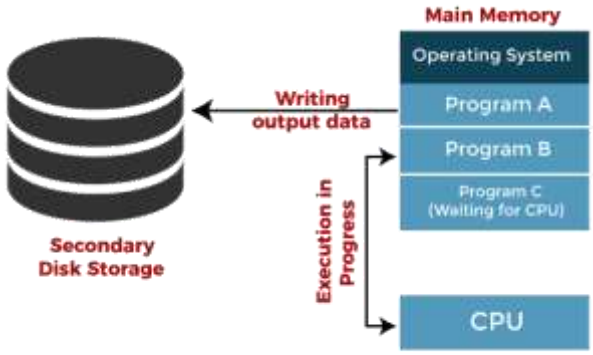
2. Not Interactive

Batch Processing is not suitable for jobs that are dependent on the user's input. If a job requires the input of two numbers from the console, then it will never get it in the batch processing scenario since the user is not present at the time of execution.

2. Multiprogramming Operating System

Multiprogramming is an extension to batch processing where the CPU is always kept busy. Each process needs two types of system time: CPU time and IO time.

In a multiprogramming environment, when a process does its I/O, The CPU can start the execution of other processes. Therefore, multiprogramming improves the efficiency of the system.



Jobs in multiprogramming system

Advantages of Multiprogramming OS

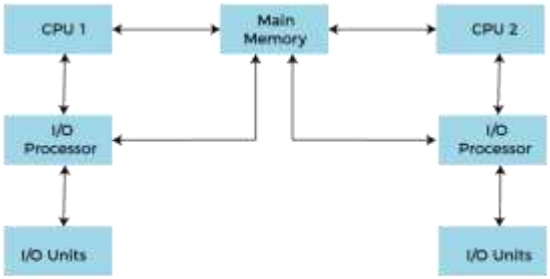
- Throughout the system, it increased as the CPU always had one program to execute.
- Response time can also be reduced.

Disadvantages of Multiprogramming OS

- Multiprogramming systems provide an environment in which various systems resources are used efficiently, but they do not provide any user interaction with the computer system.

3. Multiprocessing Operating System

In Multiprocessing, Parallel computing is achieved. There is more than one processor present in the system which can execute more than one process at the same time. This will increase the throughput of the system.



Working of Multiprocessor System

In Multiprocessing, Parallel computing is achieved. More than one processor present in the system can execute more than one process simultaneously, which will increase the throughput of the system.

Types of Multiprocessing systems

Advantages of Multiprocessing operating system:

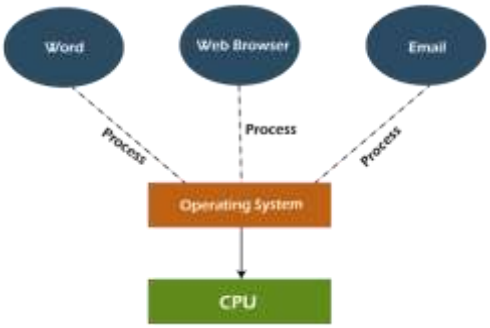
- Increased reliability: Due to the multiprocessing system, processing tasks can be distributed among several processors. This increases reliability as if one processor fails, the task can be given to another processor for completion.
- Increased throughout: As several processors increase, more work can be done in less.

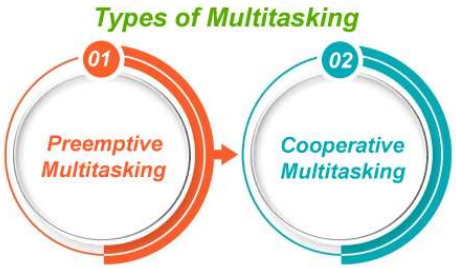
Disadvantages of Multiprocessing operating System

- Multiprocessing operating system is more complex and sophisticated as it takes care of multiple CPUs simultaneously.

4. Multitasking Operating System

The multitasking operating system is a logical extension of a multiprogramming system that enables multiple programs simultaneously. It allows a user to perform more than one computer task at the same time.





Advantages of Multitasking operating system

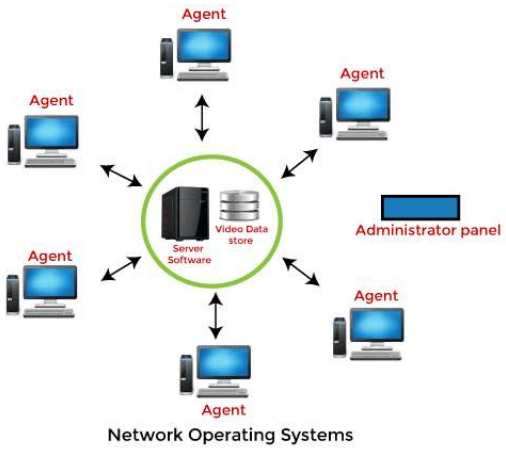
- This operating system is more suited to supporting multiple users simultaneously.
- The multitasking operating systems have well-defined memory management.

Disadvantages of Multitasking operating system

- The multiple processors are busier at the same time to complete any task in a multitasking environment, so the CPU generates more heat.

5. Network Operating System

An Operating system, which includes software and associated protocols to communicate with other computers via a network conveniently and cost-effectively, is called Network Operating System.



Network Operating Systems

Advantages of Network Operating System

- In this type of operating system, network traffic reduces due to the division between clients and the server.
- This type of system is less expensive to set up and maintain.

Disadvantages of Network Operating System

- In this type of operating system, the failure of any node in a system affects the whole system.
- Security and performance are important issues. So trained network administrators are required for network administration.

6. Real Time Operating System

In Real-Time Systems, each job carries a certain deadline within which the job is supposed to be completed, otherwise, the huge loss will be there, or

even if the result is produced, it will be completely useless.

The Application of a Real-Time system exists in the case of military applications, if you want to drop a missile, then the missile is supposed to be dropped with a certain precision.

Advantages of Real-time operating system:

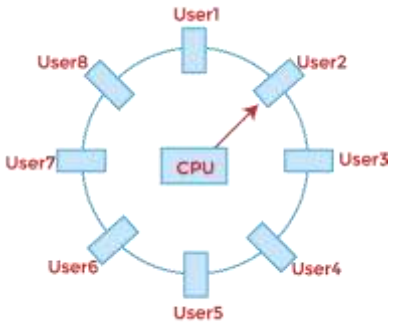
- Easy to layout, develop and execute real-time applications under the real-time operating system.
- In a Real-time operating system, the maximum utilization of devices and systems.

Disadvantages of Real-time operating system:

- Real-time operating systems are very costly to develop.
- Real-time operating systems are very complex and can consume critical CPU cycles.

7. Time-Sharing Operating System

In the Time-Sharing operating system, computer resources are allocated in a time-dependent fashion to several programs simultaneously. Thus, it helps to provide a large number of user's direct access to the main computer. It is a logical extension of multiprogramming. In time-sharing, the CPU is switched among multiple programs given by different users on a scheduled basis.



Timesharing in case of 8 users

A time-sharing operating system allows many users to be served simultaneously, so sophisticated CPU scheduling schemes and Input/output management are required.

Time-sharing operating systems are very difficult and expensive to build.

Advantages of Time-Sharing Operating System

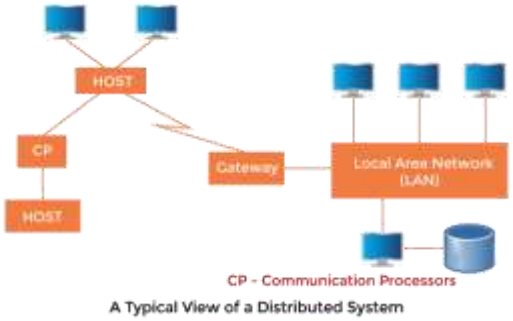
- The time-sharing operating system provides effective utilization and sharing of resources.
- This system reduces CPU idle and response time.

Disadvantages of Time-Sharing Operating System

- Data transmission rates are very high in comparison to other methods.
- Security and integrity of user programs loaded in memory and data need to be maintained as many users access the system at the same time.

8. Distributed Operating System

The Distributed Operating system is not installed on a single machine, it is divided into parts, and these parts are loaded on different machines. A part of the distributed Operating system is installed on each machine to make their communication possible. Distributed Operating systems are much more complex, large, and sophisticated.



A Typical View of a Distributed System

Advantages of Distributed Operating System

- The distributed operating system provides sharing of resources.
- This type of system is fault-tolerant.

Disadvantages of Distributed Operating System

- Protocol overhead can dominate computation cost.

9. Embedded Operating System

An embedded operating system is a computer operating system designed for use in embedded computer systems. These operating systems are designed to be small, resource-efficient, dependable, and reduce many features that aren't required by specialized applications.

The hardware that runs an embedded operating system is usually quite resource-constrained. Embedded hardware systems are typically quite specific, and it means that these systems are designed to cover certain tasks due to limited resources.

Topic # 3 Functions of An Operating System

Following are some of important functions of an operating System.

- Memory Management
- Processor Management
- Device Management
- File Management
- Network Management
- Security
- Control over system performance
- Job accounting
- Error detecting aids
- Coordination between other software and users

1. Memory Management

Memory management refers to management of Primary Memory or Main Memory. Main memory is a large array of words or bytes where each word or byte has its own address.

Main memory provides a fast storage that can be accessed directly by the CPU. For a program to be executed, it must in the main memory. An Operating System does the following activities for memory management –

- Keeps tracks of primary memory, i.e., what part of it are in use by whom, what part are not in use.
- In multiprogramming, the OS decides which process will get memory when and how much.
- Allocates the memory when a process requests it to do so.
- De-allocates the memory when a process no longer needs it or has been terminated.

2. Processor Management

In multiprogramming environment, the OS decides which process gets the processor when and for how much time. This function is called process scheduling. An Operating System does the following activities for processor management –

- Keeps tracks of processor and status of process. The program responsible for this task is known as traffic controller.
- Allocates the processor (CPU) to a process.
- De-allocates processor when a process is no longer required.

3. Device Management

An Operating System manages device communication via their respective drivers. It does the following activities for device management –

- Keeps tracks of all devices. Program responsible for this task is known as the I/O controller.
- Decides which process gets the device when and for how much time.
- Allocates the device in the efficient way.
- De-allocates devices.

4. File Management

A file system is normally organized into directories for easy navigation and usage. These directories may contain files and other directions.

An Operating System does the following activities for file management –

- Keeps track of information, location, uses, status etc. The collective facilities are often known as file system.
- Decides who gets the resources.
- Allocates the resources.
- De-allocates the resources.

5. Other Important Activities

- Security – By means of password and similar other techniques, it prevents unauthorized access to programs and data.
- Control over system performance – Recording delays between request for a service and response from the system.
- Job accounting – Keeping track of time and resources used by various jobs and users.
- Error detecting aids – Production of dumps, traces, error messages, and other debugging and error detecting aids.
- Coordination between other software's and users – Coordination and assignment of compilers, interpreters, assemblers and other software to the various users of the computer systems.

Topic No 4 : Mobile Operating System

A mobile operating system allows the user to run other different application software on the mobile, tablets, etc. Moreover, we can say that it is a type of operating system which is specially designed for mobiles, tablets, smartwatches, etc. Furthermore, they are a mixture of computer OS with some additional features for mobiles. Also, they are comparatively light and simple.

Types of Popular Mobile Operating System

1. Android OS

The Android OS is the most common operating system among the mobile operating system.
Furthermore, Google is the developer of Android. Moreover, it is an open source and free operating system. This OS is based on the Linux kernel. The name for every new version of update is based on 'desserts' for example Cupcake, Donut, Eclair, Oreo, KitKat, etc.

2. Bada

Samsung is the launcher of this operating system. It came into market in 2010. Moreover, it includes features like 3-D graphics, application installation, multipoint touch etc.

3. Blackberry OS

The developer of this operating system is Research in Motion (RIM). It was specifically designed for blackberry devices. Furthermore, it is useful for corporate users.

4. Apple iOS

After android, it is one of the most popular OS. It is designed to run on Apple devices such as iPhones, iPad tablets, etc. Moreover, like the android devices have the play store for apps download. Likewise, apple iOS contains the app store. Also, it has very strong security features.

5. Windows Mobile Operating System

The developer of this OS is Microsoft. It is basically designed for pocket PCs and smartphones. Moreover, it has the features of computer-based Windows OS and additional features for mobile phones.

6. Symbian OS

Symbian Ltd. is the developer of this OS. Moreover, Nokia was the first to use this OS on its mobile phones. Furthermore, it provides high level integration with communication. This OS is based on java language.

7. Harmony OS

It is a latest OS moreover; Huawei is its developer. It is specifically designed for use in IoT devices.

8. Palm OS

Its other name is Garnet OS. Furthermore, Palm Ltd. is its developer which developed this OS for use in Personal Digital Assistants (PADs).

9. WebOS

Palm Ltd is its developer. Moreover, it is based on Linux kernel and HP uses it in its mobile devices and touchpads.

Features of Mobile Operating System

1. Easy to use

The graphics should be attractive.

The buttons and features should be easy to use. moreover, the functionalities should not be very complicated.

Features should be powerful and useful.

2. Good app store

An app is one of the basic parts of an OS.

Good and useful apps form an important part of an OS.

The apps should be simple and interactive.

3. Good battery life

Power is one of the main requirements of a smartphone.

They require power for processors sensors etc. Therefore, the battery holds a very important role.

Smartphones power usage keeps on increasing therefore, a good battery backup is very essential.

4. Data usage and organization

An operating system should focus on controlling the data and network usage. It should keep the limit and requirement in focus.

Secondly, the organization of data related to to-do lists, calendars, alarms, reminders etc. is very important. A good OS should keep this data in a very organized and safe manner. Moreover, the data should be readily and easily available.

Topic No 6 : Android Operating System

Android is a mobile operating system based on a modified version of the Linux kernel and other open-source software, designed primarily for touchscreen mobile devices such as smartphones and tablets. Android is developed by a partnership of developers known as the Open Handset Alliance and commercially sponsored by Google. It was disclosed in November 2007, with the first commercial Android device, the HTC Dream, launched in September 2008.

It is free and open-source software. Its source code is Android Open-Source Project (AOSP), primarily licensed under the Apache License.

- About 70% of Android Smartphone runs Google's ecosystem, some with vendor-customized user interface and some with software suite, such as *TouchWiz* and later *One UI* by Samsung, and *HTC Sense*.
- Competing Android ecosystems and forks include Fire OS (developed by Amazon) or LineageOS. However, the "Android" name and logo are trademarks of Google which impose standards to restrict "uncertified" devices outside their ecosystem to use android branding.

Features of Android Operating System

Below are the following unique features and characteristics of the android operating system, such as:

1. Near Field Communication (NFC)

Most Android devices support NFC, which allows electronic devices to interact across short distances easily. The main goal here is to create a payment option that is simpler than carrying cash or credit cards, and while the market hasn't exploded as many experts had predicted, there may be an alternative in the works, in the form of Bluetooth Low Energy (BLE).

2. Infrared Transmission

The Android operating system supports a built-in infrared transmitter that allows you to use your phone or tablet as a remote control.

3. Automation

The *Tasker* app allows control of app permissions and also automates them.

4. Wireless App Downloads

You can download apps on your PC by using the Android Market or third-party options like *AppBrain*. Then it automatically syncs them to your Droid, and no plugging is required.

5. Storage and Battery Swap

Android phones also have unique hardware capabilities. Google's OS makes it possible to upgrade, replace, and remove your battery that no longer holds a charge. In addition, Android phones come with SD card slots for expandable storage.

6. Custom Home Screens

While it's possible to hack certain phones to customize the home screen, Android comes with this capability from the get-go. Download a third-party launcher like *Apex, Nova*, and you can add gestures, new shortcuts, or even performance enhancements for older-model devices.

7. Widgets

Apps are versatile, but sometimes you want information at a glance instead of having to open an app and wait for it to load. Android widgets let you display just about any feature you choose on the home screen, including weather apps, music widgets, or productivity tools that helpfully remind you of upcoming meetings or approaching deadlines.

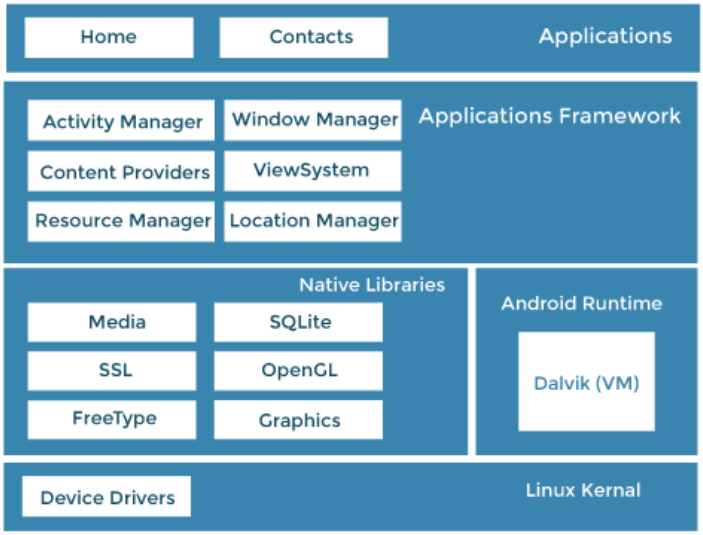
8. Custom ROMs

Because the Android operating system is open-source, developers can twist the current OS and build their versions, which users can download and install in place of the stock OS. Some are filled with features, while others change the look and feel of a device. Chances are, if there's a feature you want, someone has already built a custom ROM for it.

Architecture of Android OS

The android architecture contains a different number of components to support any android device needs. Android software contains an open-source Linux Kernel with many C/C++ libraries exposed through application framework services.

Among all the components, Linux Kernel provides the main operating system functions to Smartphone and Dalvik Virtual Machine (DVM) to provide a platform for running an android application. An android operating system is a stack of software components roughly divided into five sections and four main layers, as shown in the below architecture diagram.



- Applications
- Application Framework
- Android Runtime
- Platform Libraries
- Linux Kernel

1. Applications

An application is the top layer of the android architecture. The pre-installed applications like camera, gallery, home, contacts, etc., and third-party applications downloaded from the play store like games, chat applications, etc., will be installed on this layer.

It runs within the Android run time with the help of the classes and services provided by the application framework.

2. Application framework

Application Framework provides several important classes used to create an Android application. It provides a generic abstraction for hardware access and helps in managing the user interface with application resources. Generally, it provides the services with the help of which we can create a particular class and make that class helpful for the Applications creation.

The Android framework includes the following key services:

- Activity Manager: Controls all aspects of the application lifecycle and activity stack.
- Content Providers: Allows applications to publish and share data with other applications.
- Resource Manager: Provides access to non-code embedded resources such as strings, colour settings and user interface layouts.

- Notifications Manager: Allows applications to display alerts and notifications to the user.
- View System: An extensible set of views used to create application user interfaces.

3. Application runtime

Android Runtime environment contains components like core libraries and the Dalvik virtual machine (DVM). It provides the base for the application framework and powers our application with the help of the core libraries.

Like *Java Virtual Machine* (JVM), *Dalvik Virtual Machine* (DVM) is a register-based virtual machine designed and optimized for Android to ensure that a device can run multiple instances efficiently.

It depends on the layer Linux kernel for threading and low-level memory management. The core libraries enable us to implement android applications using the standard *JAVA* or *Kotlin* programming languages.

4. Platform libraries

The Platform Libraries include various C/C++ core libraries and Java-based libraries such as Media, Graphics, Surface Manager, OpenGL, etc., to support Android development.

- app: Provides access to the application model and is the cornerstone of all Android applications.
- content: Facilitates content access, publishing and messaging between applications and application components.
- database: Used to access data published by content providers and includes SQLite database, management classes.
- OpenGL: A Java interface to the OpenGL ES 3D graphics rendering API.
- os: Provides applications with access to standard operating system services, including messages, system services and inter-process communication.
- text: Used to render and manipulate text on a device display.
- view: The fundamental building blocks of application user interfaces.
- widget: A rich collection of pre-built user interface components such as buttons, labels, list views, layout managers, radio buttons etc.
- WebKit: A set of classes intended to allow web-browsing capabilities to be built into applications.
- media: Media library provides support to play and record an audio and video format.
- surface manager: It is responsible for managing access to the display subsystem.
- SQLite: It provides database support, and FreeType provides font support.

- SSL: Secure Sockets Layer is a security technology to establish an encrypted link between a web server and a web browser.

5. Linux Kernel

Linux Kernel is the heart of the android architecture. It manages all the available drivers such as display, camera, Bluetooth, audio, memory, etc., required during the runtime.

The Linux Kernel will provide an abstraction layer between the device hardware and the other android architecture components. It is responsible for the management of memory, power, devices etc. The features of the Linux kernel are:

- Security: The Linux kernel handles the security between the application and the system.
- Memory Management: It efficiently handles memory management, thereby providing the freedom to develop our apps.
- Process Management: It manages the process well, allocates resources to processes whenever they need them.
- Network Stack: It effectively handles network communication.
- Driver Model: It ensures that the application works properly on the device and hardware manufacturers responsible for building their drivers into the Linux build.

Advantages of Android Operating System

- Android Google Developer: The greatest favourable position of Android is Google. Google claims an android operating system. Google is a standout amongst the most trusted and rumoured item on the web. The name Google gives trust to the clients to purchase Android gadgets.
- Android Users: Android is the most utilized versatile operating system. More than a billion individuals clients utilize it. Android is likewise the quickest developing operating system in the world. Various clients increment the number of applications and programming under the name of Android.
- Android Multitasking: The vast majority of us admire this component of Android. Clients can do heaps of undertakings on the double. Clients can open a few applications on the double and oversee them very. Android has incredible UI, which makes it simple for clients to do multitasking.
- Google Play Store App: The best part of Android is the accessibility of many applications. Google Play store is accounted for as the world's largest mobile store. It has practically everything from motion pictures to amusements and significantly more. These things can be effortlessly downloaded and gotten to through an Android phone.

- Android Notification and Easy Access: Without much of a stretch, one can access their notice of any SMS, messages, or approaches their home screen or the notice board of the android phone. The client can view all the notifications on the top bar. Its UI makes it simple for the client to view more than 5 Android notices immediately.
- Android Widget: Android operating system has a lot of widgets. This gadget improves the client encounter much and helps in doing multitasking. You can include any gadget relying on the component you need on your home screen. You can see warnings, messages, and a great deal more use without opening applications.

Disadvantages of Android Operating System

- Android Advertisement pop-ups: Applications are openly accessible in the Google play store. Yet, these applications begin demonstrating tons of advertisements on the notification bar and over the application. This promotion is extremely difficult and makes a massive issue in dealing with your Android phone.
- Android require Gmail ID: You can't get to an Android gadget without your email ID or password. Google ID is exceptionally valuable in opening Android phone bolts as well.
- Android Battery Drain: Android handset is considered a standout amongst the most battery devouring operating systems. In the android operating system, many processes are running out of sight, which brings about the draining of the battery. It is difficult to stop these applications as the lion's share of them is system applications.
- Android Malware/Virus/Security: Android gadget is not viewed as protected when contrasted with different applications. Hackers continue attempting to take your data. It is anything but difficult to target any Android phone, and each day millions of attempts are done on Android phones.

Android versions: history from 1.0 to 14

The development of the Android operating system was started in 2003 by Android, Inc. Later on, it was purchased by Google in 2005. The beta version of Android OS was released on November 5, 2007, while the software development kit (SDK) was released on November 12, 2007.

Android Version 1.0 to 1.1: No codename

Android officially publish its Android version 1.0 in September 2008. It is the initial version of Android operating system. It supports Web browser to show HTML and XHTML web pages, camera, access web email server (POP3, IMAP4, and SMTP). This version contains Google Calendar, Google Maps, Google Sync, Google Search, Google Talk, Instant messaging, Media player, Notifications appear in the status bar, wallpaper, YouTube video player, Alarm Clock, Calculator, Dialer, Pictures (Gallery), Wi-Fi and Bluetooth support.

Things were pretty basic back then, but the software did include a suite of early Google apps like Gmail, Maps, Calendar, and YouTube, all of which were integrated into the operating system — a stark contrast to the more easily updatable standalone-app model employed today.

T-Mobile

The Android 1.0 home screen and its rudimentary web browser (not yet called Chrome).

Android version 1.5: Cupcake

On April 27, 2009, the Android updated to 1.5 with the codename of the dessert item (Cupcake). It has Linux kernel 2.6.27. It supports third-party virtual keyboard, Video recording and playback in MPEG-4, Copy and paste feature, Animated screen translations, auto-rotation option, ability to upload a video to YouTube, upload photos to Picasa, check phone usage history.

Cupcake also brought about the framework for third-party app widgets, which would quickly turn into one of Android's most distinguishing elements, and it provided the platform's first-ever option for video recording.

Android version 1.6: Donut

On September 15, 2009, Android 1.6 was released with the name Donut. It contains numerous new features such as voice and text entry search, bookmark history, contacts, web, "speak" a string of text, faster camera access, user can select multiple photos for deletion, support text-to-speech engine, WVGA screen resolutions.

It also added support for CDMA networks like Verizon, which would play a key role in Android's imminent explosion.

Google

Android's universal search box made its first appearance in Android 1.6.

Android version 2.0 to 2.1: Eclair

On October 26, 2009, Android 2.0 was released, whose codename was Eclair. It was based on Linux kernel 2.6.29. It contains the several new features as expanded account sync, Microsoft Exchange email support, Bluetooth 2.1, ability to tap a Contact photo and select to call, SMS, ability to search all saved SMS, MMS messages, delete the oldest message automatically when the defined limit is reached, Minor API, bug fixes.

And it made waves for injecting the once-iOS-exclusive pinch-to-zoom capability into Android — a move often seen as the spark that ignited Apple's long-lasting "thermonuclear war" against Google.

Google

The first versions of turn-by-turn navigation and speech-to-text, in Eclair.

Android version 2.2 to 2.2.3: Froyo

On May 20, 2010, Android 2.2 (Froyo) was released based on Linux kernel 2.6.32. It contains several features as speed, memory, performance optimization. JIT compilation, Integration of Chrome's V8, JavaScript engine into the Browser application, support Android Cloud to Device Messaging service, Adobe Flash support, security updates, and performance improvement.

Froyo did deliver some important front-facing features, though, including the addition of the now-standard dock at the bottom of the home screen as well as the first incarnation of Voice Actions, which allowed you to perform basic functions like getting directions and making notes by tapping an icon and then speaking a command.

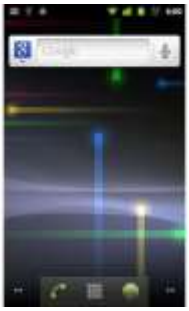
Google

Google's first real attempt at voice control, in Froyo.

Notably, Froyo also brought support for Flash to Android's web browser — an option that was significant both because of the widespread use of Flash at the time and because of Apple's adamant stance against supporting it on its own mobile devices.

Android version 2.3 to 2.3.7: Gingerbread

On December 6, 2010, the Android 2.3 (Gingerbread) was released based on Linux kernel 2.6.35. It includes the following changes: support for extra-large screen size and resolutions, updated user interface design with increased simplicity and speed, enhanced copy/paste functionality, select a word by press-holding, support Near Field Communication (NFC), headphone virtualization, new Download Manager.



It has improved bug fixes for Nexus S, voice or video chat using Google Talk, network performance for Nexus S 4G, Gmail application, battery efficiency, fixed a voice search bug, Google Wallet support for Nexus S 4G.

Black and green seeped all over the UI as Android started its slow march toward distinctive design.

JR Raphael / IDG
It was easy being green back in the Gingerbread days.

Android version 3.0 to 3.2.6: Honeycomb

On February 22, 2011, Android 3.0 (Honeycomb) was launched for the first tablet for Android-based on Linux kernel 2.6.36. It contains the features like "holographic" user interface for tablet, added system Bar, simplified multitasking tapping Recent Application in system Bar, redesign the keyboard making fast typing, quick access to camera exposure, hardware acceleration, support for multi-core processor, UI refinements, connectivity for USB accessories, support for joysticks and gamepads, high-performance Wi-Fi lock, improved hardware support, Google Books, fixed data connectivity issues when coming out of Airplane mode.

Under the guidance of newly arrived design chief Matias Duarte, Honeycomb introduced a dramatically reimagined UI for Android. It had a space-like "holographic" design that traded the platform's trademark green for blue and placed an emphasis on making the most of a tablet's screen space.

Honeycomb: When Android got a case of the holographic blues.

Android version 4.0 to 4.0.4: Ice Cream Sandwich

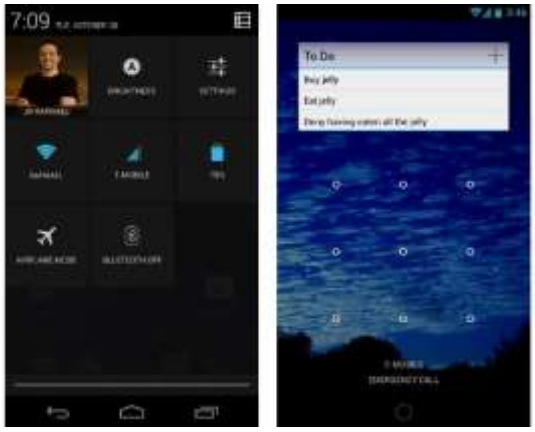
On October 19, 2011, Android 4.0.1 (Ice Cream Sandwich) was launched, which was based on Linux kernel 3.0.1. It was the last version of officially support Adobe System Flash player. It introduces the numerous new features: refinements to "Holo" interface with new Roboto font family, separation of widgets in a new tab, integrated screenshot capture, improved error correction on the keyboard, improved copy and paste functionality, build-in photo editor, fixed minor bugs, improvement to graphics, spell-checking, better camera performance.

ICS dropped much of Honeycomb's "holographic" appearance but kept its use of blue as a system-wide highlight. And it carried over core system elements like on-screen buttons and a card-like appearance for app-switching.

The ICS home screen and app-switching interface.

Android version 4.1 to 4.3.1: Jelly Bean

On June 27, 2012, Google announced Android 4.1(Jelly Bean) in the Google I/O conference. It is based on Linux kernel 3.0.31. It updates to following features: smoother user interface, enhance accessibility, expandable notification, fixed bug on Nexus 7, one-finger gestures to expand/collapse notifications, lock screen improvement, multiple user accounts (tablets only), new clock application, Bluetooth low energy support, volume for incoming call, 4K resolution support, native emoji support, bug fixes for the Nexus 7 LTE.



Multiuser support also came into play, albeit on tablets only at this point, and an early version of Android's Quick Settings panel made its first appearance. Jelly Bean ushered in a heavily hyped system for placing widgets on your lock screen, too — one that, like so many Android features over the years, quietly disappeared a couple years later.

Jelly Bean's Quick Settings panel and short-lived lock screen widget feature.

Android version 4.4 to 4.4.4: KitKat

On September 3, 2013, Google announced Android 4.4 (KitKat). Initially, its code name was "Key Lime Pie". Google started on Google's Nexus 5 on October 31, 2013. The minimum required amount of RAM should available to Android is 340 MB. The other devices with less than 512 MB of RAM must report themselves as "low RAM" devices. It includes several new features as clock no longer display bold hours, wireless printing capability, WebViews are based on Chromium engine, sensor batching, built-in screen recording feature, better application compatibility, camera application loads Google+ Photo instead of Gallery.

android 4.4 also saw the first version of "OK, Google" support — but in KitKat, the hands-free activation prompt worked only when your screen was already on *and* you were either at your home screen or inside the Google app.

The release was Google's first foray into claiming a full panel of the home screen for its services, too — at least, for users of its own Nexus phones and those who chose to download its first-ever standalone launcher.

JR Raphael / IDG

The lightened KitKat home screen and its dedicated Google Now panel.

Android version 5.0 to 5.1.1: Lollipop

Android 5.0 "Lollipop" was initially named "Android L" on June 25, 2014. It was officially introduced on November 12, 2014. Lollipop provides several features like redesigned user interface, support for 64-bit CPUs, support for print previews, material design, Project Volta for battery life improvement, multiple user accounts, audio input, and output through USB devices, join Wi-Fi networks, support for multiple SIM cards, device protection, high-definition voice calls, native Wi-Fi calling support.

The card-based concept that had been scattered throughout Android became a core UI pattern — one that would guide the appearance of everything from notifications, which now showed up on the lock screen for at-a-glance access, to the Recent Apps list, which took on an unabashedly card-based appearance.

JR Raphael / IDG

Lollipop and the onset of Material Design.

Android version 6.0 - 6.0.1: Marshmallow

Android 6.0 "Marshmallow" was disclosed under the codename "Android M" on May 28, 2015, for Nexus 5 and Nexus 6 phones, Nexus 9 tablet.

On October 5, 2015, Android lunches "Marshmallow" for all android devices. It contains the various new features as App Standby feature, introduce the Doze mode to save battery life, native fingerprint reader support, run-time permission requests, USB-C support, Unicode 7.0 & 8.0 emoji support.

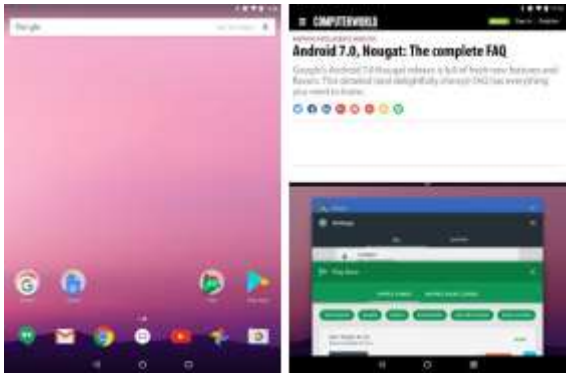
Marshmallow's most attention-grabbing element was a screen-search feature called Now On Tap — something that, as I said at the time, had tons of potential that wasn't fully tapped. Google never quite perfected the system and ended up quietly retiring its brand and moving it out of the forefront the following year.

JR Raphael / IDG

Marshmallow and the almost-brilliance of Google Now on Tap.

Android version 7.0 to 7.1.2: Nougat

Android 7.0 "Nougat" was the major release for the Android operating system. Its initial codename was "Android N". It was first released as a developer preview on March 9, 2016, with factory images for the Nexus device.



On August 22, 2016, the final preview built was released with following features: file-based encryption, zoom in the screen, multi-window support, new Data Saver mode, JIT compiler makes 75 percent faster app installation, picture-in-picture support, support manager APIs, circular app icons support, send GIFs directly from the default keyboard, battery usage alerts.

Nougat added some smaller but still significant features, too, like an Alt-Tab-like shortcut for snapping between apps.

Android 7.0 Nougat and its new native split-screen mode.
Perhaps most pivotal among Nougat's enhancements, however, was the launch of the Google Assistant — which came alongside the announcement of Google's first fully self-made phone, the

Pixel, about two months after Nougat's debut. The Assistant would go on to become a critical component of Android and most other Google products and is arguably the company's foremost effort today.

Android version 8.0 to 8.1: Oreo

Android 8.0 "Oreo" was the 8th major release of the Android operating system. It was first released for developer preview on March 21, 2017. The final developer preview was released on July 24, 2017.

On August 21, 2017, its stable version was released with several features: picture-in-picture support, support for Unicode 10.0 emoji (5.0), restructured settings, adoptive icons, notification channels, notification dots, 2 times faster boot time, Google Play Protect, Integrated printing support, Neural network API, shared memory API, Android Oreo Go Edition, autofill framework, automatic light, and dark themes.

Android Oreo added a variety of niceties to the platform, including a native picture-in-picture mode, a notification snoozing option, and notification channels that offer fine control over how apps can alert you.

JR Raphael / IDG

Oreo added several significant features to the operating system, including a new picture-in-picture mode.

Android version 9.0: Pie

Android 9.0 "Pie" was the ninth major version of the Android operating system. It was first announced and preview launched by Google on March 7, 2018. It was officially released on August 6, 2018. It has the following features: the clock has moved to the left of the notification bar, the "screenshot" button has been added, battery percentage always shown on display.

The freshly baked scent of Android Pie, a.k.a. Android 9, wafted into the Android ecosystem in August of 2018. Pie's most transformative change was its hybrid gesture/button navigation system, which traded Android's traditional Back, Home, and Overview

keys for a large, multifunctional Home button and a small Back button that appeared alongside it as needed.

JR Raphael/IDG

Android 9 introduced a short-lived setup for getting around phones with a mix of both gestures and buttons.

Android version 10:

Android 10 is the tenth extensive version of the Android operating system. Android 10 has developed under the codename "Android Q". It was initially announced by Google on March 13, 2019 and its first beta version was released on same day and its second beta was released on April 3, 2019.

The stable version of Android 10 was released on September 3, 2019. It contains features like new permissions to access location in the background, floating setting panel, support for an AV1 video codec, support for biometric authentication, support the WPA3 Wi-Fi security.

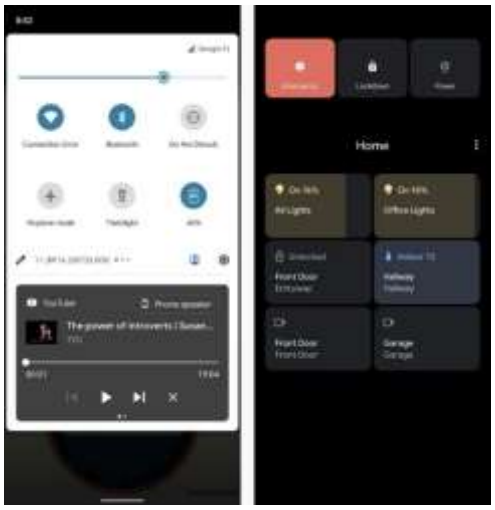
Android 10 packed plenty of other quietly important improvements, including an updated permissions system with more granular control over location data along with a new system-wide dark theme, a new distraction-limiting Focus Mode, and a new on-demand live captioning system for any actively playing media.

Android 10's new privacy permissions model added some much-needed nuance into the realm of location data.

Android 11

Android 11 operating system is the eleventh big release of Android. It is the 18th version of Android mobile OS, which was released on 8 September 2020. The alphabetic naming system of Android, based on deserts, was stopped since Android 10. So therefore, this operating system has branded with "Android 11".

Features included in Android 11



- Conversations: Get all your message in one place.
- Accessibility: Perceptive apps help us to control and navigate our phone using voice command.
- Device controls: Android 11 allows us to control all our connected devices (IOT) from a single point.
- Content capture: Android 11 comes with a screen recording feature that captures our phone's current screen activity.
- Predictive tools: By predicting our habits and patterns of working, it suggests accordingly.
- Privacy & security: Android 11 gives more security and privacy fixes to our smartphone straight from Google Play.
- Media: We can play music from other devices connected to our phones.
- Notification History section, a native screen-recording feature, and a system-level menu of connected-device controls.
- Android 11's new media player brought audio controls into the Quick Settings panel, while the new connected-device controls appeared within the system-level power menu.

Android version 12

Google officially launched the final version of Android 12 in October 2021, alongside the launch of its Pixel 6 and Pixel 6 Pro phones.

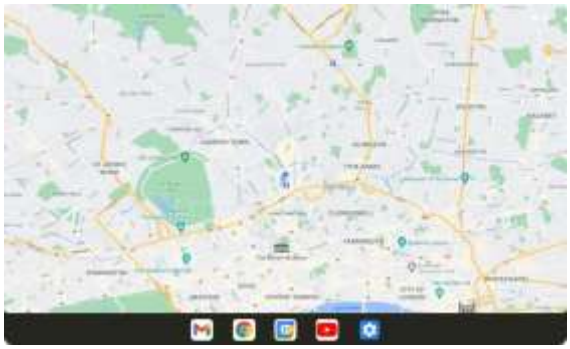
In a twist from the previous several Android versions, the most significant progressions with Android 12 were mostly on the surface. Android 12 featured the biggest reimagining of Android's interface since 2014's Android 5.0 (Lollipop) version, with an updated design standard known as Material You — which revolves around the idea of *you* customizing the appearance of your device with dynamically generated themes based on your current wallpaper colors. Those themes automatically change anytime your wallpaper changes, and they extend throughout the entire operating system interface and even into the interfaces of apps that support the standard.

Android 12 ushered in a whole new look and feel for the operating system, with an emphasis on simple color customization. (Click image to enlarge it.)
Surface-level elements aside, Android 12 brought a (long overdue) renewed focus to Android's widget system along with a host of important foundational enhancements in the areas of performance, security, and privacy. The update provided more powerful and accessible controls over how different apps are using your data and how much information you allow apps to access,

for instance, and it included a new isolated section of the operating system that allows AI features to operate entirely on a device, without any potential for network access or data exposure.

Android version 13

Android 13, launched in August 2022, is one of Google's strangest Android versions yet. The software is simultaneously one of the most ambitious updates in Android history *and* one of the most subtle version changes to date. It's an unusual duality, and it ultimately all comes down to what type of device you're using to experience the software.



On the former front, Android 13 introduces a whole new interface design for both tablets and foldable phones, with a renewed focus on creating an exceptional large-screen experience in the operating system itself and within apps (as first observed and reported by Computerworld in January). The enhancements in that area include a fresh framework and series of guidelines for app optimizations along with a more capable split-screen mode for multitasking and a ChromeOS-like desktop-style taskbar that makes it easy to access frequently used apps from anywhere — enhancements we now know were aimed initially at Google's Pixel Fold and Pixel Tablet devices, though their impact and effects have certainly stretched beyond those two products.

Android 13 introduces a more desktop-like multitasking setup for tablets and foldable phones.
On the latter front, Android 13 also laid the groundwork for the Pixel Tablet to function as a stationary Smart Display and then allow you to detach its screen and use it as a tablet. The software introduced support for a whole new series of shared-surface widgets and screensavers along with an expanded multiuser profile system for that purpose.

On regular phones, Android 13 is much less significant — and in fact, most people probably won't even notice its arrival. Along with some minor visual refinements, the software introduces an expanded clipboard system that allows you to see and edit text as it's copied, a native QR code scanning function within the Android Quick Settings area, and a smattering of under-the-hood improvements connected to privacy, security, and performance.

Android version 14

Following a full eight months of out-in-the-open refinement, Google's 14th Android version landed at the start of October 2023 in the midst of the company's Pixel 8 and Pixel 8 Pro launch event.

Like the version before it, Android 14 doesn't look like much on the surface. That's in part because of the trend of Google moving more and more toward a development cycle that revolves around smaller ongoing updates to individual system-level elements year-round — something that's actually a significant advantage for Android users, even if it does have an awkward effect on people's perception of progress.

But despite the subtle nature of its first impression, Android 14 includes a fair amount of noteworthy new stuff. The software introduces a new system for dragging and dropping text between apps, for instance, as well as a new series of native customization options for the Android lock screen.

Android 14 includes options for completely changing the appearance of the lock screen as well as for customizing which shortcuts show up on it.
Android 14 provides a number of new improvements to privacy and security, too, including a new settings-integrated dashboard for managing all your health and fitness data and controlling which apps and devices can access it. And it adds in a more info-rich and context-requiring system for seeing exactly *why* apps want access to your location when they request such a permission.

The software also sports a series of significant accessibility additions, such as an enhanced on-demand magnifier, an easier way to increase font size in any app, improved support for hearing aid connections, and a built-in option to have your phone flash its camera light anytime a new notification arrives.

Beyond that, Android 14 features a first taste of Google's AI-generated custom wallpaper creator, though that's available only on the Pixel 8 and Pixel 8 Pro to start.

Topic No 7: What is the iOS?

iOS is an abbreviation for the *iPhone operating system*. iOS is the operating system that runs on many of Apple's mobile devices, including the iPhone and iPod Touch. It is the world's second most popular mobile OS, trailing only Android. It is the basis for three other Apple operating systems: *iPadOS, tvOS*, and *watchOS*. It is a part of proprietary software. Some are open source under the *Apple Public Source License* and other licenses.

The iOS os was first released in *2007* for the first-generation iPhone and has since been updated to support more Apple devices, including the iPod Touch and iPad. Apple's App Store had *over 2.1 million* iOS apps as of *March 2018*, with 1 million unique to iPads. *Over 130 billion* times, these mobile applications have been downloaded.

Apple releases a new major version of iOS every year. On *September 20, 2021*, the current stable version, *iOS 15*, was released to the public.

Features of the iOS

There are various features of iOS. Some main features of the iOS are as follows:

1. The iPhone OS has multitasking capabilities. It all started with the *iPhone 4* and *iPhone 3GS*. You may quickly switch from one app to another by using the multitasking function on an iOS device or a multi-finger motion on an iPad.
2. Apple's iCloud service is a cloud-based data storage service. It works on all Apple devices, has some Windows compatibility, and manages most operations in the background. It is quite secure. It includes a backup feature to ensure that the user's data is not lost.
3. Apple offers an online mapping service that may be utilized as the default map system for iOS devices. It offers various features, including a flyover mode. Apple's MapKit may be used to construct map-based applications.
4. Apple also provides the Core Bluetooth framework, and it offers classes for connecting to Bluetooth-enabled low-energy wireless technology.
5. A gyroscope is a device that measures the rate at which a device rotates around a spatial axis. Many iOS devices include a three-axis gyroscope that delivers rotation data in all three axes.
6. Notification Center is an iOS feature that displays all of your app alerts in one location. It displays notifications rather than requiring immediate resolution until the user completes an associated action. However, we may change the notification settings.
7. Apple includes the AV Foundation Capture Subsystem in iOS, which is a high-level architecture for audio, image, and video capture.

Facts about iOS Operating System

There are many interesting facts about the iPhone Operating System. Some important facts about the iPhone Operating System are as follows:

1. The app store is one of the most advanced features of the iOS platform. iPhone owners and gamers can download their favorite games through the app store. Most notably, it allows users to download games and programs legally.
2. iOS is powered by the most powerful mobile processors available, such as the *A10 Fusion* and *A9X Fusion* in the *iPhone* and *iPad* and the *Kaby Lake-X* in Macs.
3. iOS 10 introduced the new Photos app, which replaced the Photos app in prior iOS versions.
4. iOS 11 adds a new Home screen design, Memoji-cartoon characters that you can create and share with other users, and provides a new way to handle HomeKit devices.

5. iOS boasts the largest app store, with more than *2 million* applications and games available.
6. The iPhone was released in the *USA* on *June 29, 2007*. At the time, there were two iPhone models available. The internal storage and price differences between the two variants were significant. The 4 GB model costs *$499*, while the *8 GB* variant costs *$599*.
7. The iPhone may not be known for its customization as Android. Its optimization is well-known in the software industry. Apple's principal goal is to provide the best customer experience.
8. It is well-known not only for its photographic quality but also for its design and hardware. Apple strives to provide a simple, minimalistic, yet appealing design on all of its products.
9. The million-dollar question is next on our list of fascinating iPhone facts. Every Apple product has the letter *'i'* in its name. But do you understand what this *'i'* means? When Steve Jobs unveiled the iMac to the world in *1998*, he explained the significance of this letter. As a result, I stand for *"Internet"*. The internet was a new concept to the general public at the time. The iMac was a device that made it simple for the general public to connect to the internet. Later, he explained what the *'i'* stands for inspiring, instructing, individual, informing, etc.
10. Although the iPhone debuted in *2007*, Apple has been working on it since 2005. However, it was a top-secret project. This initiative was codenamed '*Project Purple 2*'. Only a few of the engineers and personnel were aware of the project.
11. In *2019*, Apple announced three iPhone models: the iPhone 11, 11 Pro, and 11 Pro Max. However, none of these devices was enough to be the most popular iPhone in *2019*. Interestingly, the iPhone XR was the most selling iPhone in *2019*. However, when it comes to global popularity, the iPhone 7 remains the most popular iPhone worldwide.
12. There are currently approximately *900 million* iPhone users globally. Most iPhone users are from China. The United States is ranked second. There are currently over *110 million* iPhone users in the United States. It accounts for roughly half of all smartphone users in the United States.
13. Since the iPhone was released in *2007*, it has filled over *200 patents* relating to the iPhone's technology. Many of these patents, such as Force Touch and over-the-air updates, directly lead to new and improved methods for publishers and developers to communicate with users.
14. Apple's products include the iPad, iPod, Mac, watch, and others. However, the iPhone is the most common of all. They reported that iPhone sales generated approximately *99 billion USD* in revenue for the third quarter of *2019*.
15. Almost every smartphone currently comes with the pre-installed app store. On the other hand, Apple was the trend's initiator. They were the first to legalize downloading and installing apps from the *'App Store'*. Apple's App Store had over *2 million* iPhone applications in *January 2017*.

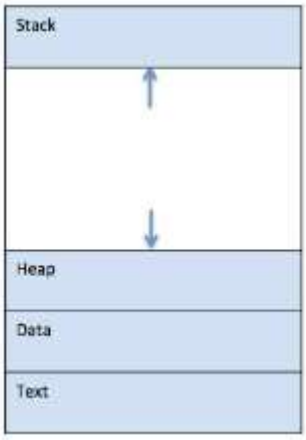
16. In *2007*, the iPhone was awarded the covered with the prestigious title of *"Invention of the Year"*. Fans and professionals were pleasantly surprised by the superb design, strong operating system, and amazing performance.
17. When Steve Jobs made his first iPhone call in *2007*, he called a nearby Starbucks and ordered *4,000 lattes* as a prank. He immediately canceled it, which was probably a good thing for the unfortunate barista who had taken the call.
18. In the smartphone sector, Apple faces several competitors. However, without question, the most visible among them is Samsung. But, behind the scenes, Apple and Samsung have a terrific connection. In truth, Samsung used to manufacture chips for Apple's iPhones. However, TSMC is currently producing processors for Apple's iPhones.
19. Apple unveiled the iPhone 6s and iPhone 6s Plus on *September 25, 2015*. Apple claims that over *13 million* iPhone 6s and 6s Plus handsets were sold during the launch weekend. They sold nearly 50 phones every second during the first weekend after these models were released.
20. Apple also tries to feature the best hardware possible at each iPhone release. Many of the hardware components found in iPhones are shared with other smartphones, while some are exclusive to iPhones, such as the *Taptic Engine* and *3D Touch screen*.
21. Cisco possessed the rights to a VOIP device that allowed Skype calls to be made without using a computer. Both companies agreed and now hold full ownership of the name.
22. Some Apple-developed apps come with the iPhone, and some other third-party apps may be downloaded via the App Store.
23. *Steve Jobs* launched the iPhone for the first time at *42 a.m.* in *San Francisco, California*. The organization decided that the iPhone would be presented at *9.42 a.m*. Thus the slideshow was scheduled for *9.42 a.m.* When the iPad was introduced later, the time was set for *9.41 a.m*. It has not altered since then. As a result, all iPhone commercials will always have the time set to *9:41 a.m*.
24. Apple approached Verizon with the idea of working together on the iPhone. Verizon had a couple of stipulations that they didn't agree with it. As a result, Apple requested a proposal from Cingular Wireless (*AT&T Mobility*). All of the terms and conditions were accepted.
25. In *January 2007*, Steve Jobs unveiled the iPhone with a *5-inch (9-cm)* polycarbonate display. However, Apple disclosed the switch from plastic to glass just 11 days before the phone was released.
26. After spending more than two and a half years developing the secret project, Apple released the iPhone, which cost around *$150 million* to produce.
27. Apple was not the only company to name a phone iPhone. The InfoGear iPhone was the first to be released in *1998* by *InfoGear Technology Corporation*.

28. It includes proximity, ambient light, gyroscopic, a facial-recognition sensor, a fingerprint sensor, magnetometers, accelerometers, and a barometer, among other sensors.
29. A device that measures changes in velocity along a single axis is known as an accelerometer. Every iOS device has a three-axis accelerometer that provides acceleration readings on each of the three axes. The LIS302DL 3-axis MEMS-based accelerometer is used in the first-generation iPhone and iPod touch.
30. iPhone consumers are more dedicated than other cellphone users, with *4%* of iPhone users saying their next gadget would be an iPhone, compared to *64.2%* who say their next device will be a Samsung.

Topic No 8: Process In Operating System

A process is basically a program in execution. The execution of a process must progress in a sequential fashion.

A process is defined as an entity which represents the basic unit of work to be implemented in the system.



To put it in simple terms, we write our computer programs in a text file and when we execute this program, it becomes a process which performs all the tasks mentioned in the program.

When a program is loaded into the memory and it becomes a process, it can be divided into four sections — stack, heap, text and data. The following image shows a simplified layout of a process inside main memory –

S.N.	Component & Description
1	Stack The process Stack contains the temporary data such as method/function parameters, return address and local variables.
2	Heap This is dynamically allocated memory to a process during its run time.
3	Text This includes the current activity represented by the value of Program Counter and the contents of the processor's registers.

4	Data This section contains the global and static variables.

Topic No 9: Program

A program is a piece of code which may be a single line or millions of lines. A computer program is usually written by a computer programmer in a programming language. For example, here is a simple program written in C programming language –

```
#include <stdio.h>

int main() {
   printf("Hello, World! \n");
   return 0;
}
```

A computer program is a collection of instructions that performs a specific task when executed by a computer. When we compare a program with a process, we can conclude that a process is a dynamic instance of a computer program.

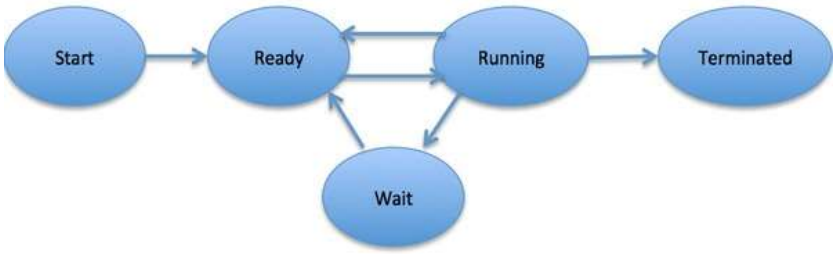
A part of a computer program that performs a well-defined task is known as an algorithm. A collection of computer programs, libraries and related data are referred to as a software.

Topic No 10: Process Life Cycle

When a process executes, it passes through different states. These stages may differ in different operating systems, and the names of these states are also not standardized.

In general, a process can have one of the following five states at a time.

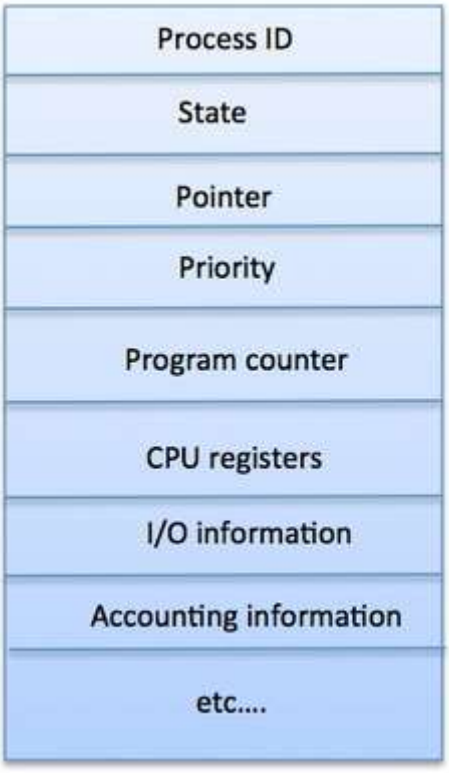
S.N.	State & Description
1	Start This is the initial state when a process is first started/created.



2	Ready The process is waiting to be assigned to a processor. Ready processes are waiting to have the processor allocated to them by the operating system so that they can run. Process may come into this state after Start state or while running it by but interrupted by the scheduler to assign CPU to some other process.
3	Running Once the process has been assigned to a processor by the OS scheduler, the process state is set to running and the processor executes its instructions.
4	Waiting Process moves into the waiting state if it needs to wait for a resource, such as waiting for user input, or waiting for a file to become available.
5	Terminated or Exit Once the process finishes its execution, or it is terminated by the operating system, it is moved to the terminated state where it waits to be removed from main memory.

Topic No 11: Process Control Block (PCB)

A Process Control Block is a data structure maintained by the Operating System for every process. The PCB is identified by an integer process ID (PID). A PCB keeps all the information needed to keep track of a process as listed below in the table –



S.N.	Information & Description
1	Process State The current state of the process i.e., whether it is ready, running, waiting, or whatever.
2	Process privileges This is required to allow/disallow access to system resources.
3	Process ID Unique identification for each of the process in the operating system.
4	Pointer A pointer to parent process.
5	Program Counter Program Counter is a pointer to the address of the next instruction to be executed for this process.
6	CPU registers Various CPU registers where process need to be stored for execution for running state.
7	CPU Scheduling Information Process priority and other scheduling information which is required to schedule the process.
8	Memory management information This includes the information of page table, memory limits, Segment table depending on memory used by the operating system.
9	Accounting information This includes the amount of CPU used for process execution, time limits, execution ID etc.
10	IO status information This includes a list of I/O devices allocated to the process.

The architecture of a PCB is completely dependent on Operating System and may contain different information in different operating systems. Here is a simplified diagram of a PCB –

The PCB is maintained for a process throughout its lifetime, and is deleted once the process terminates.

Topic No 12: 5 State Process Model in Operating System

The Five-State Process Model is developed from the Two-State Model. If all processes in the Not-running state are ready to run, the two-stage model is efficient; however, it is not always true. Some processes in the Not-running state may be waiting for an event or performing an I/O activity. A process must be created for each program to run a program. The process can or cannot run, but if a process is running, it has to be supported by the operating system for the right progress of the process to be gained.

The best way to fix this issue is to divide the Not-running state into two states: Ready and Blocked state.

Reason for New State

The main memory in previous models was considered to be large enough to accommodate all programs, but this is not the case. The size of today's programs is very large. It is not possible to load all processes into the main memory.

The program does not load into the main memory for the new process when creating a new process. In the main memory, the operating system only saves a little amount of information about the process. When enough space is available, the long-term scheduler sends the program to the main memory. Such a process is said to be in a new state.

Reason for Terminated State

When a process completes execution in the previous models, its resources are instantly released. However, another process may require this data in the future.

The child process is considered to be at an end-of-life condition. The child's process is still in memory but cannot be executed. For example, when a child process completes execution, the operating system saves its data till the parent call waits () function.

Five-state process model states

The five states that are being used in this process model are as follows:

1. New

It refers to a new process that has been created but has not yet been approved for execution by the operating system. Although a new process has not been loaded into the main memory, its process control block has been created.

2. Ready

After a new state process, a process moves from a new to a ready state. When a process is in the ready state, it signifies it has been loaded into the main memory and is ready to run. In the ready state, the process must wait for the processor to respond; once the processor responds, the process advances to the processor for execution. It's worth noting that several processes in a multi-programming environment can remain in the ready state.

3. Running

All of the processes that are executing on the CPU are in the running state.The running state indicates that the procedure is starting from a new and ready state. If the process is in its critical section, other processes must wait in the Ready state.

4. Blocked/Waiting

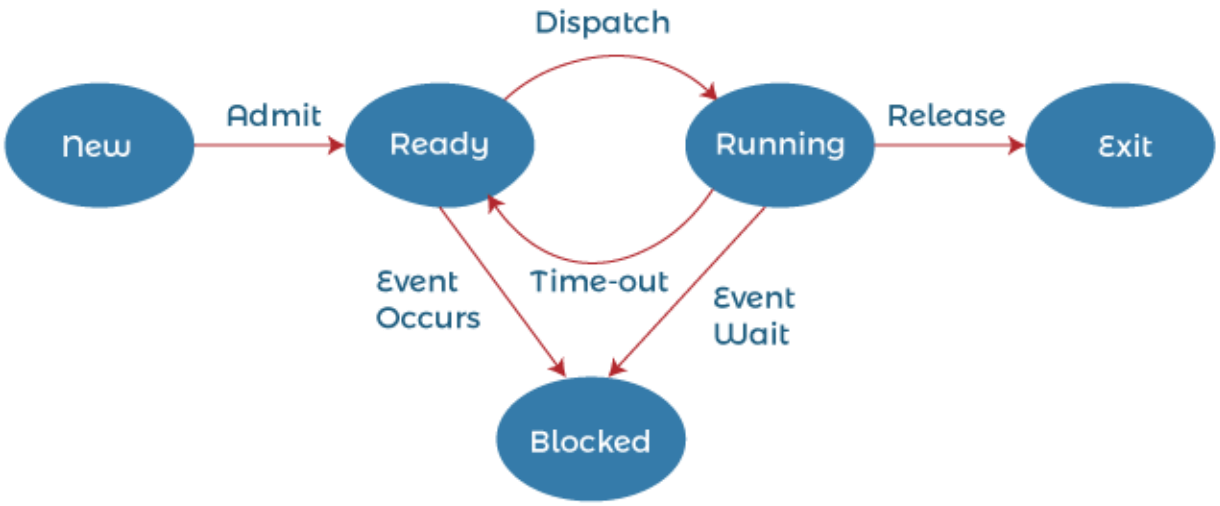
The blocked state applies to all processes that quit the CPU and enter the waiting state. When the CPU becomes available, processes in the blocked state are moved to the ready state and then to the running state.

5. Exit/Terminated

The exit state refers to a process that has been terminated from the CPU and the main memory.

Execution of Five-state process in Two-state Model

This model has five states: new, ready, running, blocked, and exit. When a new job/process arrives in the queue, it is first accepted to the queue and then moves to the ready state. The process is now in the running state while in the Ready state. A process in the running state has two conditions: it either proceeds to the event wait, or it times out.



Fire State Process Model

If the process has timed out, it moves to the ready state because the process has not finished its execution. If a process has an event wait condition, it enters the blocked state and the ready state. If both conditions are true, the process enters a running state after dispatching, and following which, it is freed and finally terminated.

Advantages and Disadvantages of the five-state process model

There are various advantages and disadvantages of the five-state process model. Some advantages and disadvantages of the five-state process model are as follows:

Advantages

1. The New and Exit states are very useful components for process management.

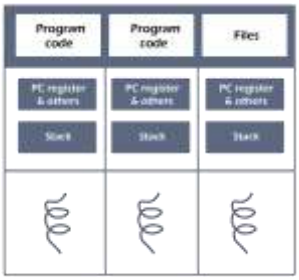
2. It is a more efficient implementation of the preceding two-state process concept.

Disadvantages

1. The data of a process that is terminated or exited from the OS is not saved by the OS.
2. When each process enters a blocked state, the processor remains idle until at least one process exits the waiting state, which might cause a performance issue.

Topic No 13: Threads in Operating System (OS)

A thread is a single sequential flow of execution of tasks of a process so it is also known as thread of execution or thread of control. There is a way of thread execution inside the process of any operating system. Apart from this, there can be more than one thread inside a process. Each thread of the same process makes use of a separate program counter and a stack of activation records and control blocks. Thread is often referred to as a lightweight process.



Three threads of same process

The process can be split down into so many threads. For example, in a browser, many tabs can be viewed as threads. MS Word uses many threads - formatting text from one thread, processing input from another thread, etc.

Need of Thread:

- It takes far less time to create a new thread in an existing process than to create a new process.
- Threads can share the common data; they do not need to use Inter- Process communication.
- Context switching is faster when working with threads.
- It takes less time to terminate a thread than a process.

Types of Threads

In the operating system, there are two types of threads.

1. Kernel level thread.
2. User-level thread.

Components of Threads

Any thread has the following components.

1. Program counter
2. Register set

3. Stack space

Section 2
INTRODUCTION TO WINDOWS 10

Windows 10 - Introduction

Windows 10 is the most recent version of the operating system from Microsoft. Officially it was released in 2015 and was initially offered free of charge to legitimate users of Windows 7 and Windows 8.1. This new version combines features from those two previous installments to suit the users in a better way for both desktop/laptop computers as well as mobile devices.

The most notable change in Windows 10 is that Microsoft replaced the Start screen tiles from Windows 8, and brought back the Start Menu. They also removed the vertical toolbars (or "charms") that appeared from the sides of the screen. These changes make this Windows version easier to use for users of both desktop/laptops and mobile devices.

Windows 10 - Installation

System Requirements

Although most computers nowadays probably have the necessary requirements for Windows 10. It will certainly be useful to know them in case you want to upgrade from an older system.

The main requirements are –

- A processor (CPU) with a clock rate of at least 3GHz.
- At least 1 to 2GB of memory (RAM), but Microsoft recommends 4GB.
- At least 16GB space in your hard disk.

Upgrade Existing Window's e.g. Win7 or Win8

If your computer qualifies for a Windows 10 upgrade, then you can follow these steps to perform the upgrade –

Step 1 – Look for the Windows 10 notification in the lower-right corner of the screen. This is a one-year-only offer that Microsoft is extending to valid users of Windows 7 and Windows 8.1.

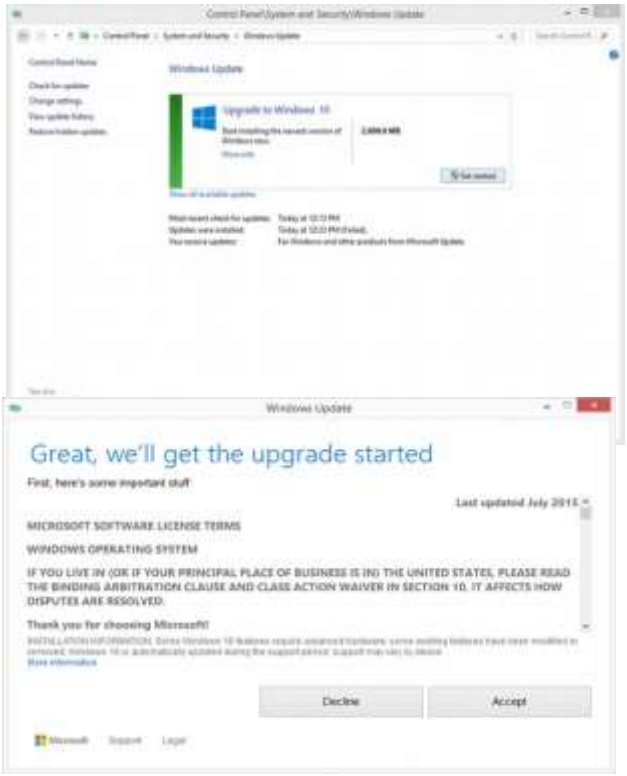
Step 2 – By clicking on the notification, it will start the download and installation process of Windows 10 in your system.

The download required for the upgrade is quite large, so make sure you have a stable Internet connection and continuous power for your computer to avoid interruptions during the process.

Step 3 – After the download is complete, it will prompt you to accept Microsoft's license terms.

Step 4 – After agreeing to the terms, it will ask if you want to install the upgrade at that moment or schedule it for later.

Step 5 – Once the upgrade starts, the system will perform a series of tasks, during which you will see the following screen.



During this time, your computer will reboot a couple of times, so don't worry. The process itself will take you through the steps to complete the upgrade.

Step 6 – As the upgrade approaches its end, it will ask you to configure some basic Windows settings. You can choose to use Express settings, which will apply the most common or recommended settings, or you can choose to customize the settings as you please.

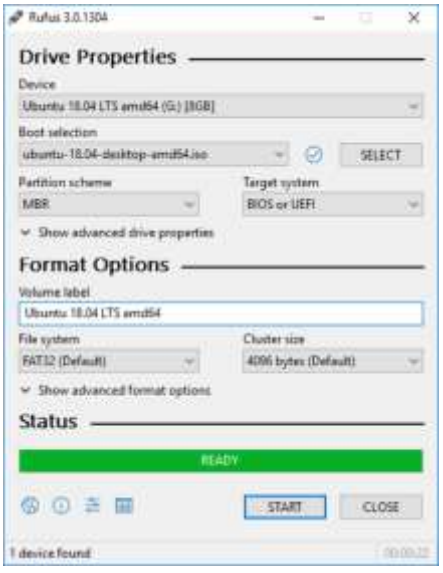
Step 7 – After the upgrade finishes, you'll see the Windows welcome screen.

Windows 10 - Bootable USB Using Rufus

Creating a bootable USB for Windows 7 or 10 using Rufus is a straightforward process. Here's a step-by-step guide:

Requirements:

1. USB Drive: At least 8 GB of storage (all data will be erased).
2. Windows ISO File: Download the Windows 7 or 10 ISO from the official Microsoft website.
3. Rufus: Download the latest version of Rufus from the official site.



Step-by-Step Process:

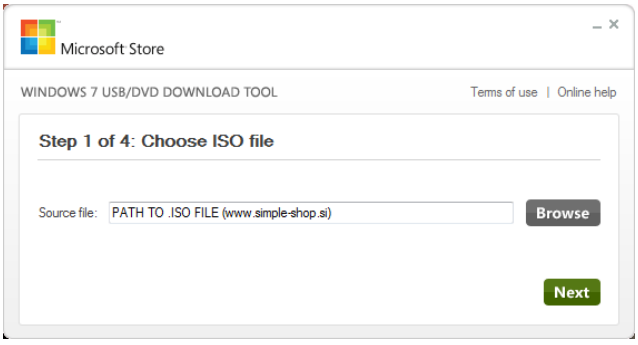
1. Download and Open Rufus:
   - Go to the Rufus website and download the latest version.
   - Open Rufus (no installation is needed; it runs as a portable application).
2. Insert USB Drive:
   - Plug your USB drive into your computer. Ensure its empty or that you have backed up any important data on it, as it will be formatted.
3. Select the USB Drive:
   - In Rufus, under the "Device" dropdown, select your USB drive. Be careful to choose the correct device.

4. Select the ISO File:
   - Click on the "SELECT" button next to "Boot selection."
   - Browse to the location of your Windows ISO file and select it.
5. Configure Partition Scheme:
   - Partition scheme: Choose MBR for older BIOS systems or GPT for UEFI systems. Most modern systems use UEFI, so select GPT if unsure.
   - File system: Leave it as NTFS for Windows installations.
6. Volume Label:
   - You can give your USB drive a name in the "Volume label" field, but it's optional.
7. Start the Process:
   - Click on the "START" button. A warning will appear indicating that all data on the USB drive will be destroyed.
   - Confirm to proceed.
8. Wait for Completion:
   - Rufus will format the USB drive and copy the necessary files from the ISO. This may take several minutes.
9. Finalization:
   - Once Rufus completes the process, you'll see a message indicating that the operation is done. Click "CLOSE" to exit Rufus.

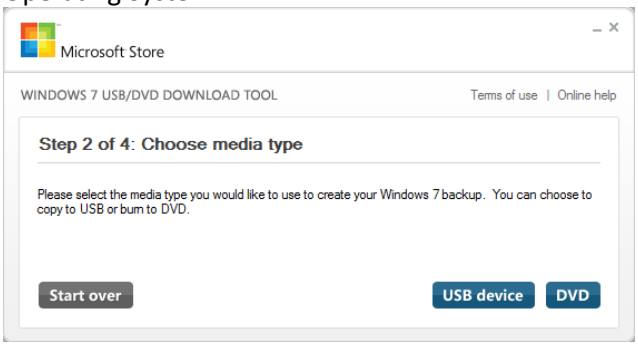
Windows 10 - Bootable USB Using Windows 7 USB / DVD Tool

Note: You need a USB flash drive with a minimum of 8 GB of free space. And also, please backup your data from USB first.

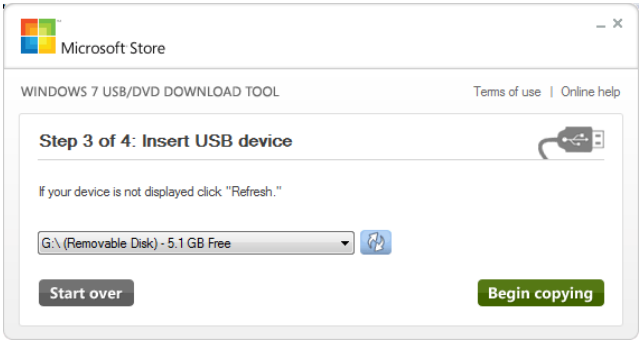
1. Download Windows 7 USB/DVD Tool and install it.
2. Run the program, browse to your Windows 10 ISO image using the Browse button.



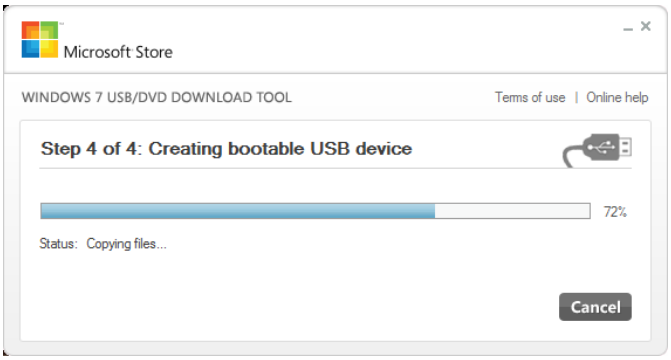
3. In this step, you need to select your media type. As we are here to create a bootable USB, simply click on USB device button (if you don't know which is right check for drive letter via Windows Explorer or other file browsers).



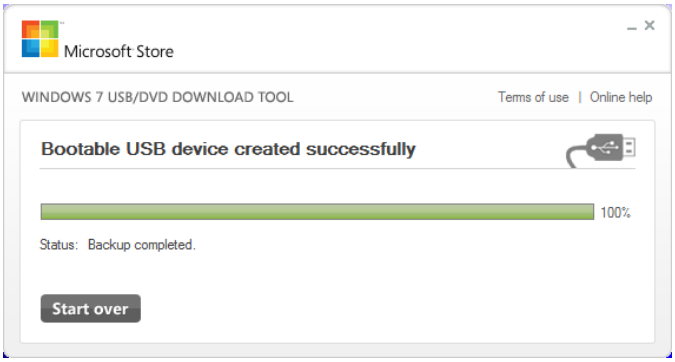
4. Select your USB flash drive from the drop-down box and click on Begin copying button.



5. The Windows 7 USB/DVD tool will take a few minutes to complete the procedure.



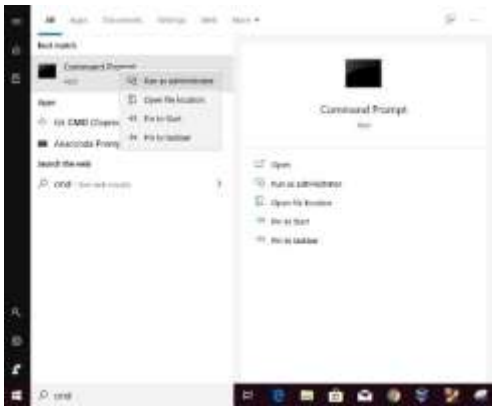
6. You are done. Reboot your machine and start installing Windows 10



Windows 10 - Bootable USB Using CMD

here are a total of 12 steps to Create a Bootable USB Flash drive, follow these steps:-

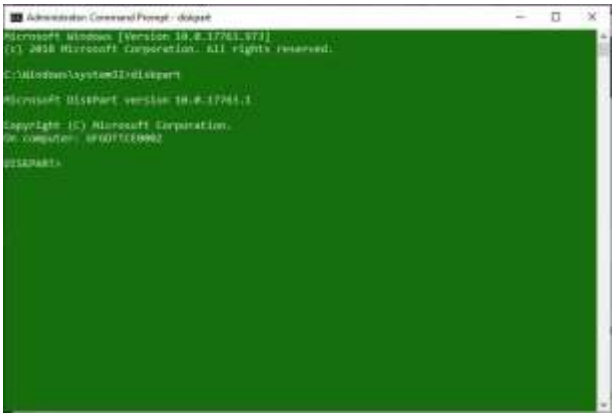
Step 1: Run the Command Prompt in Administrator mode. There are two ways to do the same:



- Search for CMD in the Start menu, right-click on the command prompt, and click on Run as Administrator.
- Open Task Manager, go to File -> Run new task, search for CMD and press enter.

Step 2: Connect the USB Device to the computer that is to be made bootable.

Step 3: Type the command diskpart and then press Enter.



Step 4: Type the command list disk to display a list of all the available storage devices on your system. Press Enter to continue.

Step 5: Select the disk that is your pen drive. To choose the disk, type the command select disk X in this case, select disk 1 and press Enter.

Note: Generally, it is marked as Disk 1, it might vary from system to system. Make sure not to select any other available disk as it will get formatted.

Step 6: To make a pendrive bootable, there is a need to format it to clean the existing data. This can be done by the use of clean commands.

Step 7: Type the command create partition primary and press Enter. This will make the disk primary and ready to be made bootable.

Step 8: To choose the partition created as primary, type the command select partition 1, and press Enter.

Step 9: Before making the disk bootable, you need to format it as NTFS if you are using legacy BIOS. This can be done with the use of a command format fs=ntfs quick and press Enter.

Note: If you are using Unified Extensible Firmware Interface or in simple words UEFI BIOS then you must type in the following command instead. Most modern systems are UEFI systems, you can check your system manufacturer's website to know whether your system is legacy BIOS or UEFI BIOS.

format fs=fat32 quick

Step 10: Type the command active and press Enter. This will mark the primary bootable partition as Active.

Step 11: Type the command exit to exit DISKPART and press Enter. Now close the command prompt window.

Step 12: Now copy all the data from the OS(Windows/Linux/etc.) installation disk to your USB drive that is just been made bootable.

Windows 10 - Installation

To install Microsoft Windows 10 using a bootable USB drive or DVD, follow these steps. The instructions below will guide you through the process:

Option 1: Installation Using a Bootable USB Drive

Step 1: Create a Bootable USB Drive

1. Download the Windows 10 Installation Media:
    - Go to the Windows 10 download page.
    - Under "Create Windows 10 installation media," click Download tool now to get the Media Creation Tool.
2. Prepare the USB Drive:
    - Insert a USB drive with at least 8 GB of free space into your computer.
    - The USB drive will be formatted, so back up any important data before proceeding.
3. Run the Media Creation Tool:
    - Open the Media Creation Tool and accept the license agreement.
    - Choose Create installation media (USB flash drive, DVD, or ISO file), then click Next.
    - Select your language, edition, and architecture (either 32-bit or 64-bit) for Windows 10. You can choose to keep the default settings (recommended for most users).
    - Select USB flash drive, and click Next.
    - Choose your USB drive from the list, and click Next to start the download and creation of the bootable USB drive.

Step 2: Boot From the USB Drive

1. Shut down your PC.
2. Insert the Bootable USB Drive into a USB port on your PC.
3. Turn on your PC and enter the BIOS/UEFI:
    - To access the BIOS/UEFI, press the appropriate key during the startup sequence (commonly F2, F12, DEL, or ESC).
    - Check your motherboard or laptop manual for the specific key if you're unsure.

4. Change the Boot Order:
    - Once in the BIOS/UEFI menu, find the Boot Options or Boot Order setting.
    - Set the USB drive as the first boot device.
    - Save and exit the BIOS/UEFI (usually F10).
5. Restart Your PC and boot from the USB drive. Your PC will now boot into the Windows 10 installation setup.

Step 3: Install Windows 10

1. After booting from the USB, you'll see the Windows Setup screen.
2. Select your language, time, and keyboard preferences, then click Next.
3. Click Install now.
4. Enter your Windows 10 product key if prompted (if you don't have a product key, you can choose to activate Windows later).
5. Select the installation type:
    - Custom: If you're doing a fresh installation, choose Custom.
    - Upgrade: If you are upgrading from an older version of Windows, choose Upgrade (this is rare with fresh installs).
6. Select the drive where you want to install Windows 10 and click Next. If needed, format the partition, but make sure you have backed up your data first.
7. Windows will begin installing. Your PC may restart several times during the process.
8. After installation, follow the on-screen prompts to complete the setup (region, keyboard layout, Microsoft account, etc.).

Option 2: Installation Using a Bootable DVD

Step 1: Create a Bootable DVD

1. Download the Windows 10 ISO file:
    - Go to the Windows 10 download page.
    - Under "Download Windows 10 Disk Image (ISO)", select Windows 10, and click Confirm.
    - Choose the appropriate language and edition, then download the ISO file.
2. Burn the ISO to a DVD:
    - Insert a blank DVD into your computer's DVD drive.
    - Use a DVD burning tool (like ImgBurn, Windows Disc Image Burner, or CDBurnerXP) to burn the ISO file to the DVD. If you're using Windows 10 or 11, you can simply right-click the ISO file and select Burn disc image.
    - Make sure you select Write speed as lowest or medium to avoid burning errors.

Step 2: Boot From the DVD

1. Shut down your PC.

2. Insert the Bootable DVD into your PC's DVD drive.
3. Turn on your PC and enter the BIOS/UEFI.
    - Access the BIOS/UEFI by pressing the correct key during startup (commonly F2, F12, DEL, or ESC).
4. Change the Boot Order to boot from the DVD drive first.
    - In BIOS/UEFI, go to Boot Options and set the DVD drive as the primary boot device.
5. Save changes and exit the BIOS/UEFI.
6. Your PC will boot from the DVD, and the Windows Setup screen will appear.

Step 3: Install Windows 10

1. Once the setup starts, select your language, time, and keyboard preferences, then click Next.
2. Click Install now.
3. Enter your product key (you can skip this step and enter it later if you don't have it).
4. Choose Custom installation.
5. Select the partition where you want to install Windows 10, then click Next. You may need to format the drive before selecting it for installation.
6. Windows will begin installing. Your computer will restart several times.
7. After installation, follow the on-screen prompts to set up your user account and complete the installation.

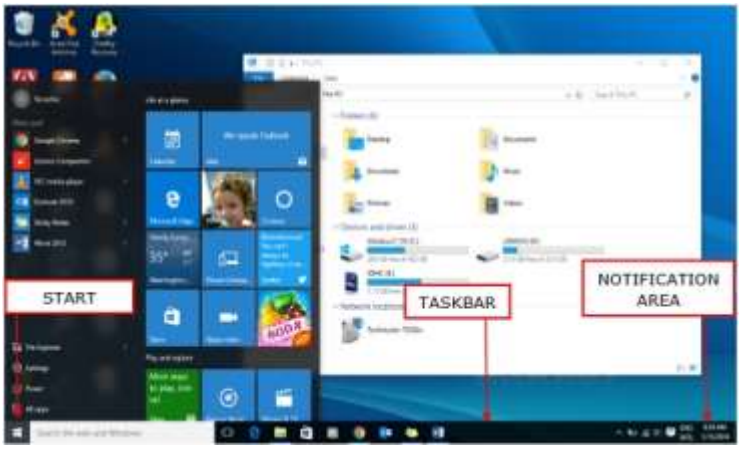
Post-Installation:

1. Activate Windows 10:
    - If you didn't enter a product key during installation, you can do so after installation by going to Settings > Update & Security > Activation and entering the key.
2. Install Drivers:
    - After installation, Windows 10 should automatically detect and install most drivers. However, you might want to visit your hardware manufacturer's website for the latest drivers (e.g., graphics, sound, network).
3. Install Windows Updates:
    - Go to Settings > Update & Security > Windows Update to ensure your system is fully up-to-date.

Windows 10 – GUI Basics

Once you get to the Windows Desktop screen, here are some basic features you will see.

One of the most important parts of your Desktop is the Taskbar. By default, it sits at the bottom of your screen giving you access to the Start Menu, several application icons, and the Notification Area.



Windows

In Windows 10, if an application is active or opened, you will see a green line below its icon. Clicking the icon will bring the application window up.

Every open window features three buttons in the upper-right corner. These are used to minimize, maximize, or close the window –

- Minimizing means that the window will hide in the Taskbar.
- Maximizing will bring the window to a full-screen size.

Windows can be moved around or resized as you please –

- To move a window, just click on its Title Bar on the upper side of the window and drag it.
- To resize a window, move your mouse to any corner until you see a double-sided arrow. Then click and drag until you reach the desired size.

Icons

Most Windows versions will feature different icons on the background. An icon is simply a graphic representation of an application or a file. To open or access an icon, just double click on it.

Although the amount and type of icons will vary, depending on the computer, you can add more icons by following these steps –

Step 1 – Right-click on the Desktop Background.

Step 2 – Choose “New” and “Shortcut”.

Step 3 – Browse for the application or file you want to create a shortcut to.

Step 4 – Assign a name to the shortcut and click “Finish”.

Icons can also be moved around by clicking on them and dragging them to another place in the screen.

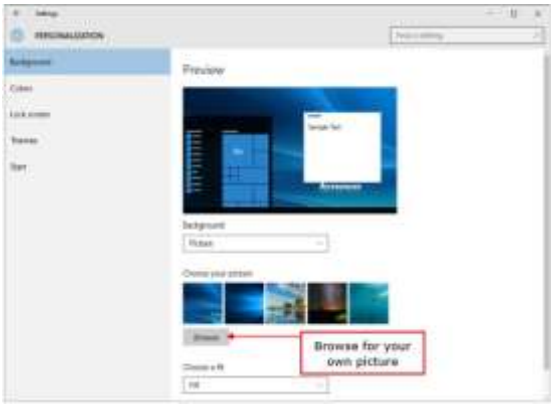
Desktop Background

Another component of your Desktop is the Background. This is simply an image that appears at the back of your screen. Most computers come with a pre-selected background, but you can change it to any image you want.

To change the background, follow these steps –

Step 1 – Right-click on the background and choose "Personalize".

Step 2 – From the Personalization window, choose from a series of pre-selected pictures or browse for your own.



After choosing a picture, the Background will change automatically.

Windows 10 – Navigation Methods

To navigate your Windows, you can simply type what you are looking for on the Taskbar search. It can be the name of a document or application, or just any information you are looking for.

Start Menu

If you are looking for a specific application, you can also open the Start Menu and click "All Applications". This will open an alphabetical list of all the applications installed on your computer.

File Explorer

If you are looking for a specific document, another alternative is to use the File Explorer by clicking on the Folder icon on the Taskbar.

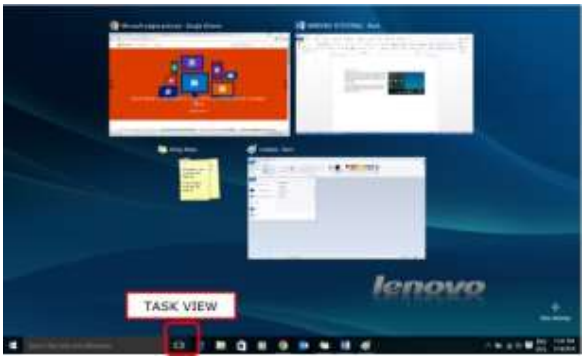
In the File Explorer window, you can browse all your folders and documents.

Virtual Desktops

One of the new features of Windows 10 is the addition of Virtual Desktops. This allows you to have multiple desktop screens where you can keep open windows organized.

To add a virtual desktop, follow these steps –

Step 1 – Click Task View on the Taskbar.

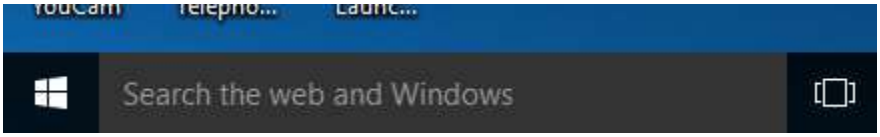


Step 2 – Click the "New desktop" option on the lower-right corner. You can access or delete the new Desktop by clicking Task View again.

The Start Menu is the main point of access to your applications.

There are two main ways to open it –

Step 1 – Use your mouse to click Windows icon in the lower-left corner of the taskbar.



Step 2 – Press the Windows key on your keyboard.

The Windows 10 Start Menu features two panes.

The left pane resembles the traditional Start Menu from Windows 7 and earlier, while the right pane features live tiles that were used in Windows 8.

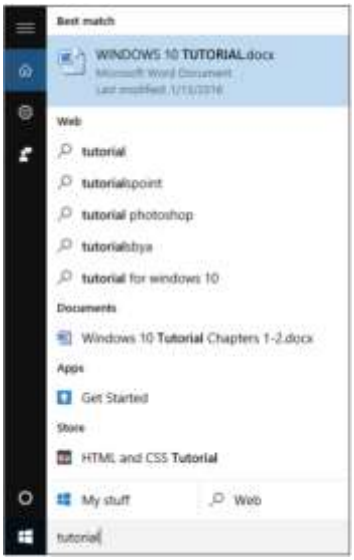
Left Pane

Among the things you can do in the left pane are –

- Click the username at the top of the menu to change account settings or log in with another user.
- Access the applications you use more frequently.
- A small arrow next to an application will open a sub-menu with a list of recent documents opened with that application.
- Open the "File Explorer" to navigate your folders and files.
- Change the settings of your computer like your Internet connection or changing your background.
- See different options to shut down your computer.
- See a list of all the applications installed in your computer.

Search Box

The "Search box" on the Taskbar will allow you to search within your documents and files or on the Web for anything you write. The initial results will appear within the Start Menu itself.



The results will be grouped according to the closest match (or matches) labeled "Best match" at the top of the list.

The remaining results will be grouped according to what they are or their location –

- Web results
- Documents or folders
- Apps
- System settings

The icons on the left side of the menu do the following –

 The Gear icon will allow you to configure the settings of your Search.

 This icon will let you send Feedback to Microsoft on what you like or dislike about Windows.

 The Cortana icon will activate Windows' new personal assistant.

Clicking "My stuff" or "Web" at the bottom will expand the Start Menu and limit your results to the location you choose, as well as streamlining the search.

Right Pane

The right pane features a varied array of tiles, similar to the ones that were seen on the Start Screen of Windows 8.

These tiles can be moved and dragged to different places by holding the mouse button.

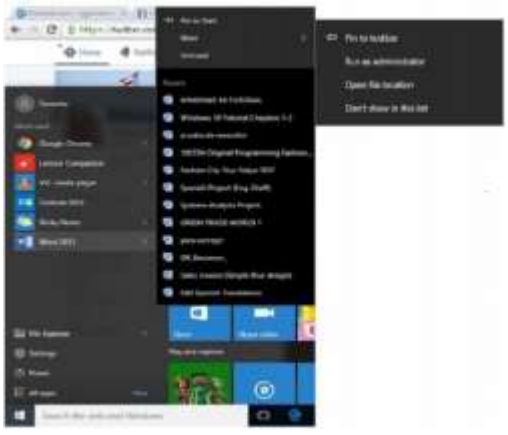
You can also configure them by right-clicking on them to see options to resize them or "unpin" them (remove them) from the Menu.

The whole Start Menu can also be resized by dragging the borders with the mouse to the desired size.

The Windows 10 taskbar

sits at the bottom of the screen giving the user access to the Start Menu, as well as the icons of frequently used applications. On the right-side, the Taskbar features the Notification Area which informs the user of different things like the state of the Internet connection or the charge of the laptop battery.

The icons in the middle of the Taskbar are "pinned" applications, which is a way to have a quick access to applications you use frequently. "Pinned" applications will stay in the Taskbar until you "unpin" them.



Pin an Application to the Taskbar

Step 1 – Search for the application you want to pin in the Start Menu.

Step 2 – Right-click on the application.

Step 3 – Select "More" option at the top of the menu.

Step 4 – Select the "Pin to taskbar" option.

This will attach or "pin" the application icon to your Windows Taskbar.

Unpin an Application from the Taskbar

To "unpin" it, just right-click the icon in the Taskbar and select "Unpin from taskbar". You can "pin" it back again any time you want.

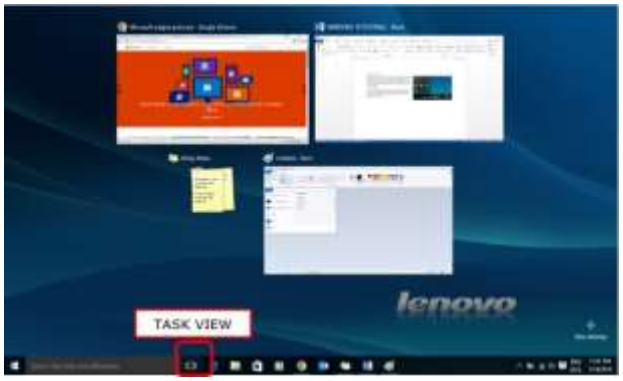
Notification Area

The Notification Area is located at the right side of the Taskbar. It shows different types of notifications from your computer like your Internet connection, or the volume level.

At first, the Notification Area shows a limited amount of icons. But you can click the upward arrow on its left-side to see other icons as well.

Task View

Task View allows you to quickly move within your open windows and applications. You can access it by clicking the "Task View" button from the Taskbar.



You can also press and hold the Windows key, and then press Tab to achieve the same result.

By pressing the Alt+Tab keyboard shortcut also serves a similar purpose

Windows 10 – Tablet Mode

The Tablet Mode is a new feature in Windows 10, which allows the user to switch the system interface, whenever a tablet is detached from a base or dock. When the Tablet Mode activates, the Start Menu goes full-screen. During Tablet Mode, many other windows like the File Explorer or the Settings window also open at full screen.

How to Activate the Tablet Mode?

Step 1 – Open the Start Menu and select "Settings".

Step 2 – Select the "System" option.

Step 3 – Turn the Tablet Mode switch from "Off" to "On".

Windows 10 – Multiple Desktop's

One of the innovative features of Windows 10 operating system is the addition of Virtual Desktops. This allows you to have multiple desktop screens, where you can keep open windows organized.

To add a virtual desktop, follow these steps –

Step 1 – Click Task View icon on the Taskbar.

Step 2 – Click "New Desktop" option on the lower-right corner. You can access or delete the new Desktop by clicking Task View icon again.

Windows 10 – Security

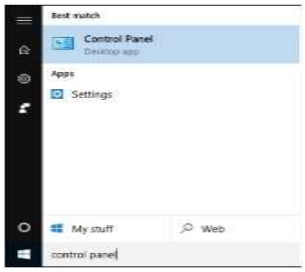
Windows 10 features a series of tools to help you protect your computer from threats like viruses and other malware. The three main security tools are –

- User Account Control
- Windows Defender
- Windows Firewall

User Account Control

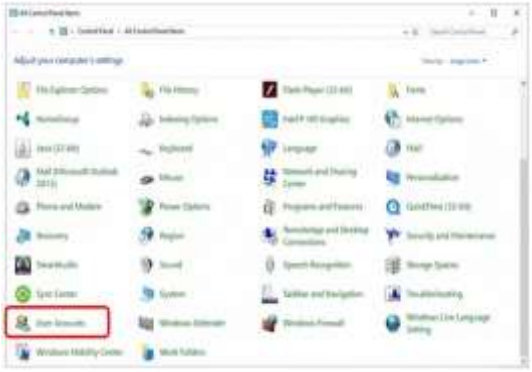
The Windows User Account Control is a tool that warns you when someone or something attempts to change your computer system settings. When this happens, the screen will alert you until an Administrator can confirm the change. This helps protect your computer against accidental changes or malicious software altering your settings.

Initially, this User Account Control is set at a moderate to high level, which means it will notify you only when an application tries to make changes to your computer. However, you can change this setting to your desired level by following these steps –



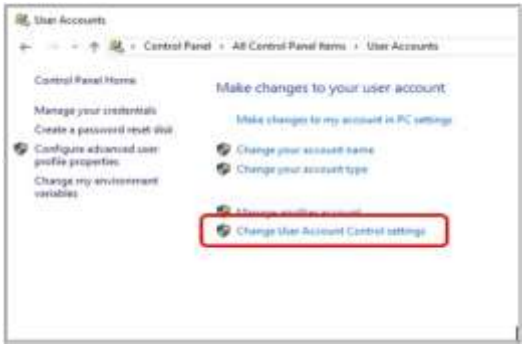
Step 1 – Open the Control Panel by searching for it in the Search bar.

Step 2 – After the Control Panel is open, choose User Accounts.



After choosing User Accounts, click on "Change User Account Control settings".

In the User Account Control Settings, you can move the slider to the desired position. Windows 10 will give you a summary of how your system will behave under that level.



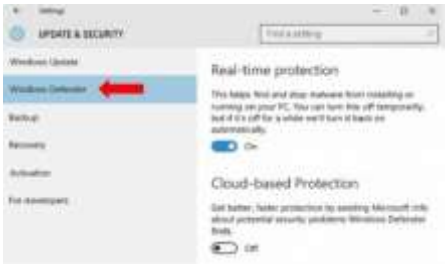
Windows Defender

Windows Defender is an antivirus and malware protection included in your operating system. It allows you to scan your computer for malicious software, while also checking each file or program you open.

To configure Windows Defender, follow these steps –

Step 1 – Go to SETTINGS and select Update & security.

Step 2 – In the UPDATE & SECURITY window, select Windows Defender.



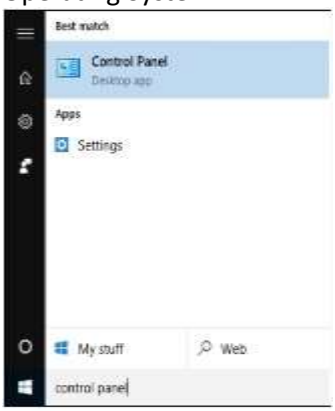
Here you can customize settings like turning off real-time protection or activating cloudbased protection, which allows Defender to send Microsoft information about security threats it finds.

Windows Firewall

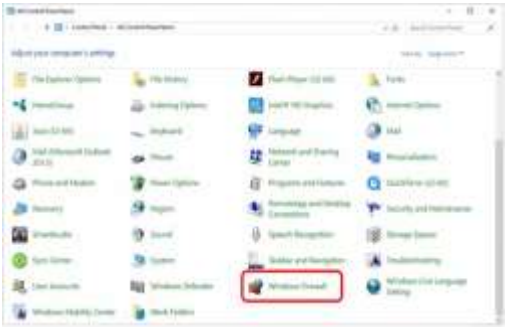
Windows Firewall prevents unauthorized access from outside to get into your computer. By default, it is turned on to protect your computer and your network.

If you want to customize your Firewall, follow these steps –

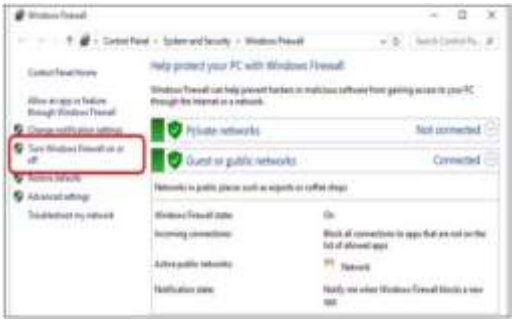
Step 1 – Open the Control Panel by searching for it in the Search bar.



Step 2 – When the Control Panel is open, choose Windows Firewall.



Step 3 – In the Windows Firewall window, you can customize the settings of it by turning it on or off or choosing when to protect your computer.



Windows 10 – Networking

PRACTICAL #1: INSTALLING AND CONFIGURING MODEM

Modem overview

Telephone lines that are used in a conventional phone system are designed to transmit human speech with analog signals. Analog signals vary continuously, like waves, along their length. Computers store and process data in digital format and communicate both internally and with each other in binary digits.

When two computers communicate with each other over a conventional phone line, a modem translates the binary information from the computer at the sending end to an analog signal that can pass over the phone line. At the receiving end, another modem translates the analog signal back to binary information that can be used by the computer. The conversion from binary to analog information is called *modulation* and the conversion back from analog to binary is called

demodulation. The word *modem*, short for modulator/demodulator, is the name for the device that performs these conversions.

The most recent developments with the fastest transmissions are broadband technologies such as cable or DSL (Digital Subscriber Line) that transmit over cable or phone lines as waves similar to radio or television.

Installing a modem

To install the modem hardware on your computer, refer to the manufacturer's documentation. Generally, the following instructions apply:

- Install an internal modem in an empty slot. Attach an external serial modem to an unused COM port.
- If you have an external modem, ensure that it is attached to the computer, plugged into the power source, and turned on before you turn on the computer and start Windows.
- Ensure that your modem is properly connected to the phone line and to your computer.

Most modems manufactured now are compatible with Plug and Play and installed automatically after they are connected to the computer. However, older modems and external serial modems may not be detected. If your modem is not installed automatically, then use Phone and Modem Options in Control Panel to install it manually.

Setting hardware connections

A modem has to be connected to the telephone system and to a power source.

Telephone connections

Both internal and external modems use a modular phone cord, called an RJ-11 coupler. Usually, a new modem includes the coupler. If you have an older, four-pronged jack, you may also need an adapter to connect to your phone line.

Power connections

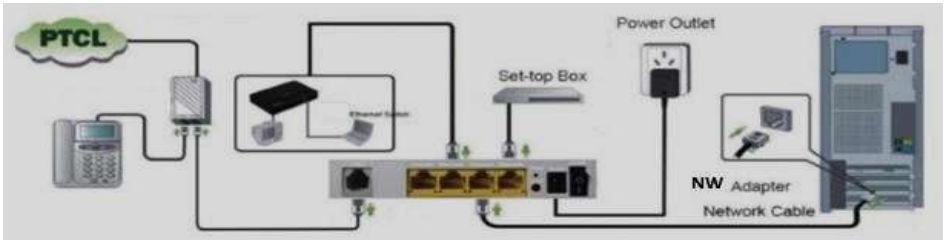
Internal modems are powered directly by the computer. External modems usually come with a power adapter, but are sometimes powered by the computer.

Cabling Connections

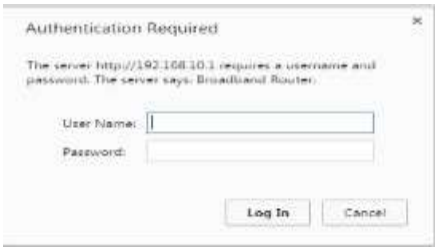
External serial modems connect to the computer with a serial cable, also called an RS232 cable.

Practical #2: DSL CONFIGURATION

1. Connect the Modem as shown in the following diagram



2. Open web browser and type “192.168.10.1” to get the access of the modem. Following window will pop up; input user name “admin” and password in printed at sticker on the bottom panel of modem(default password is last 5 digits of MAC address).



If the connections are Ok, you will be directed to following page.

3. Click “Easy Installation” and you will be prompted for username and password as can be seen in following snapshot. Please enter username and password as provided by the PTCL representative and click “Apply/Save”

4. You can also configure the modem manually by clicking on the “Advance installation” as shown in following snapshot.

5. Click “Edit” as highlighted in red in above snapshot and you will be redirected to following page.

6. Enter the username and password as provided by the PTCL representative and check the options as shown in the above snapshot and click “Next” , following page will be displayed, Finally click “Save” , to save the configuration.

Configuration for WLAN

1. Go to browser and type “192.168.10.1”, you will be directed to main page.
2. Click on Wireless and you will be redirected to following page, put check on “Enable Wireless” and “WMF” , by default the SSID is “PTCL-BB” you can change the SSID as per your requirement.

3. Click on Security to set the password for WLAN, click on “Security Tab” to direct to following page. Kindly change the parameters as per your requirement and press “Save”

Practical # 3: How to Set Up a LAN Network?

Step 1: - Physical Configuration of LAN Network

LAN (Local Area Network) is a data communication network that locally connects network devices such as workstations, servers, routers, etc. to share the resources within a small area such as a building or campus. Physical or wireless connections are set up between workstations to share the resources.

Requirements to set up LAN Network:

1. **Workstation/Personal devices:** laptop, computer, mobile phones, etc.
2. **Network devices:** router, switch, modem (if not already present in the router)
3. **Sharing resources:** printers, disk drives, etc.
4. **Cables:** Ethernet cables, wires for connecting other devices (in case of wired LAN)
5. **Internet connection:** Wi-Fi (in case of wireless LAN)

Following steps should be followed to set up a LAN network:

- **Identify services:** Identify the network services such as printers, disk drives, data, etc. that will be shared among workstations.
- **Identify devices:** Identify devices such as computers, mobile phones, laptops, etc. with a unique address that will be connected to the network.
- **Plan connections:** Design the network by laying out cable wires between network devices or by making wireless connections. Wired LAN is set up using Ethernet cables while wireless LAN is set up using Wi-Fi that connects network devices without making any

physical connection. A wired LAN network is more secure than a wireless LAN network but it is difficult to relocate.

- **Select networking device:** Select switch or router with enough ports to connect all workstations within the network. The choice of networking device is based on the requirements of the network.
- **Make connections:** Connect all the devices using wires to configure a LAN network. Standard Ethernet cables are used to connect workstations and servers while Ethernet crossover cable is used to connect the switch to cable routers by connecting the standard port of the switch with router's LAN port. For wireless LAN, connect all the devices to Wi-Fi with SSID (Service Set Identifier) provided by the router or switch to configure the LAN network.
- **Test the network:** Test each of the workstation connected to the network and ensure every workstation have access to network services.

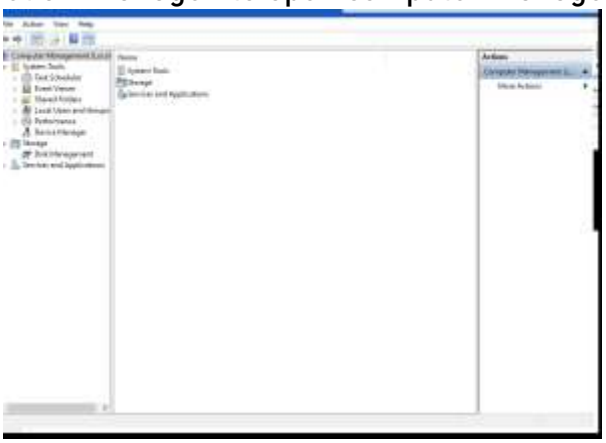
Step 2: - Computer name for LAN Network

Enable administrator account in Windows 10

Using a command prompt

1. Click Start ==➔ type "Run" Or Press [Windows] + [R].
2. Type "cmd" choose "Run As Administrator"
3. Type the following Command "net user administrator /active:yes".
4. The administrator account is now activated.

5. Now right click "My Computer"
6. Click "Manage" to open computer management



7. Now Double Click "Local Users and Groups"
8. Again Double Click "Users" folder.
9. Right Click "Administrator"
10. Click "Set Password"
11. Click "Proceed"

12. Provide Administrator Password e.g. “Mcse2024”
13. Confirm Sam Password
14. Click “Apply” then “Ok”

Provide Appropriate Name to Each Pc

1. Login as “Administrator”
2. Right Click “My Computer” / “This PC”
3. Click “Properties”
4. Click “advanced system settings”
5. Click “Computer Name” tab.
6. Click “change” Button.
7. Provide proper name to pc’s like
   Pc1, Pc2, Pc3 …… Pc10
   Lab1, Lab2, Lab3……Lab10
   Office 1, Office 2…… Office 10 Name prefix should be same
8. Click “Apply”
9. Click “Ok”
10. Click “Restart This PC”

Step 3 : - IPv4 Settings for LAN Network

Setting static IP addresses can help to avoid network conflicts which could cause certain devices to stop working correctly. However, in most installation scenarios, users will use a regular network and will not need to use a static IP. Setting a static IP address is an advanced networking function, and a basic, fundamental knowledge of TCP/IP is needed.

1. Access the Control Panel
In the Windows search bar, type in “ncpa.cpl” and then press enter.

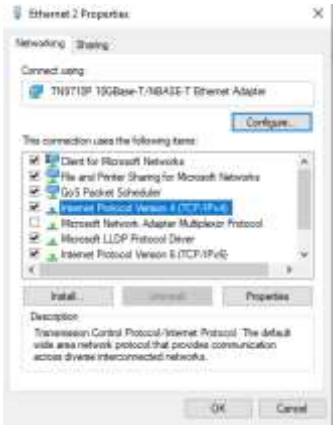
Or

A. Click Lan icon on the task bar
B. Click “Network and Internet settings”

2. Select the Network Adapter
Right click on the network adapter that is currently connected to the device that you are trying to configure. Usually, it will be the adapter with the word “Ethernet” in the name.

3. Select Properties
Select “Properties” from the drop-down menu.

4. Select Internet Protocol Version 4 (TCP/IPv4)
Double-click on “Internet Protocol Version 4 (TCP/IPv4)”.



5. Manually enter IP address and subnet mask
Select “Use the following IP Address” and then input the following information in the corresponding fields:

IP address: Check the device that you are connected to in order to locate the IP address. The first three sets of digits should match.

e.g. IP address 192.168.1.10, 192.168.1.11, 192.168.1.12, 192.168.1.13, 192.168.1.14 etc.

Subnet mask: The subnet mask between the device that you are trying to connect to needs to be the same as your PC. For this tutorial, we will use

subnet mask 255.255.255.0

Default Gateway 192.168.1.1(e.g. DSL Server IP)

Preferred DNS 127.0.0.1

Alternate DNS 192.168.1.1(Same as Default Gateway)

6. Save Settings
Click the OK button on “Internet Protocol Version 4 (TCP/IPv4) Properties” window, and also click the OK button on “Ethernet Properties” window.

7. Revert Back to DHCP

1. To set your computer back to DHCP➔repeat steps 1-4 again.
2. When you get to the ➔“Internet Protocol Version 4 (TCP/IPv4) Properties”
3. Window

   ➔ click

4. ➔“Obtain an IP address automatically”

   ➔“Obtain DNS Automatically”

5. Click➔ “Apply “

6. Click ➔"OK"

Practical # 4: Access any PC on LAN?

Method No 1 Using Network Icon On Desktop

1. Log in as ➔Administrator
2. Double Click ➔Network Icon On the Desktop
3. Double Click ➔Available PC name on the network
4. Or type ➔\\pcname\drive name $ e.g. ➔\\pc1\d$ in the address bar
5. Press ➔Enter to Access the PC

Method No 2 Using Search Bar

1. Log in as ➔Administrator
2. Start ➔Search ➔type \\ Pc Name \ Drive Name $ as
3. ➔\\pc1\d$
4. Press ➔Enter to Access the PC

Method No 3 Using Browser

1. Log in as ➔Administrator
2. Start ➔Any Browser Program (google chrome, Mozella firefox,opera,Microsoft Edge)
3. ➔type \\ Pc Name \ Drive Name $ in the address bar as
4. ➔\\pc1\d$
5. Press ➔Enter to Access the PC

Method No 4 Using the Windows explorer

1. Log in as ➔Administrator
2. Start ➔Any Windows Explorer (This Pc, My Documents, Folder etc)
3. ➔type \\ Pc Name \ Drive Name $ in the address bar as
4. ➔\\pc1\d$
5. Press ➔Enter to Access the PC

Practical #5: Sharing Of Resources on LAN Network

Verify that the sharing component is installed

To verify that File and Printer Sharing is on your computer (typically installed by default):

1. Navigate to the "Network and Sharing Center".
2. Click "Change adapter settings".
3. Right-click the "local connection icon" and select "Properties".

4. In the area below "This connection uses the following items:"

   look for File and Printer Sharing for Microsoft Networks.

   - If this component is not available:

     1. Click Install. Select Service, and then click Add....
     2. Select File and Printer Sharing for Microsoft Networks, and then click OK.
     3. Click Close. If a dialog window appears telling you to restart your computer, do so.

   - If the component is available, make sure it is checked.

Share a folder, drive, or printer

Once File and Printer Sharing is installed, to share a folder or drive:

1. Right-click the folder or drive you want to share.
2. Click "Properties". From the "Sharing tab", click "Advanced Sharing".
3. Click "Share this folder".
4. Click "Apply"
5. If you would like to grant access to particular groups or individuals, click "Permissions" to add the appropriate groups or usernames.
6. If you are using NTFS, check the permissions in the Security tab to ensure that they are properly set to allow access to the share. Because Security settings override Share permissions, it is possible for people on the Permissions list to be denied access to the share because they either are not specified or are denied specifically in the Security list.
7. Click OK.

To share a printer:

1. From the Control Panel, open "Devices and Printers."
2. Right-click the printer you want to share. Click "Printer Properties", and then select the "Sharing" tab.
3. Check "Share this Printer". Under Share name, select a shared name to identify the printer. Click OK.

Access a shared folder or printer

To find and access a shared folder or printer:

1. Access the desired pc as

1. Start ➔ serach.
2. \\ PC Name e.g. \\ PC1

2. Press “Enter” button form the keyboard.

3. Now Double Click any shared resource to access the resource

Practical # 6 Local User Accounts on LAN Network

A user account is a collection of settings and permissions, specific to each user, that determine what the user can and cannot do on the computer. There are three levels of user accounts, each designed to enable or restrict changes to a computer's settings and programs.

Administrator, Standard, and Managed accounts

Before you create new user accounts, it's important to understand the different types.

Administrator:

Administrator accounts are special accounts that are used for making changes to system settings or managing other people's accounts. They have full access to every setting on the computer. Every computer will have at least one Administrator account, and if you're the owner you should already have a password to this account.

Standard:

Standard accounts are the basic accounts you use for normal everyday tasks. As a Standard user, you can do just about anything you would need to do, such as running software or personalizing your desktop.

Standard with Family Safety:

These are the only accounts that can have parental controls. You can create a Standard account for each child, then go to the Family Safety settings in your Control Panel to set website restrictions, time limits, and more.

Types Of User Accounts

1. Local user accounts

A local user account is an offline account that you can use to log in to your Windows PC. All the account-related information is stored locally on your computer rather than being shared with Microsoft. Unlike the online account, you have more control over the Microsoft services you want to access on your computer. These accounts can either be an administrator or a standard user.

In general, when we're talking about anything "local," we're referring in context to an individual computer right in front of you — this local box exclusively.

A local user account can be used on this particular machine and no others … with some practical exceptions. If you tried to log in with this particular login and password anywhere that those credentials hadn't been explicitly set up, it would bounce back and say that isn't a valid username and password combination.

Local user accounts can be divided into two broad categories: users and administrators. Normal users can log into the system, run most programs, print and perform a wide variety of tasks. What they can't do, however, is make system-level changes. Most of the time, they cannot install new applications.

2. Domain user accounts

As mentioned above, local user accounts are designed for single-system or very small networks. Once you get beyond this, however, you're going to want to move up to an Active Directory-based domain network.

This allows you to set up a very large number of users with as many machines and devices as you require, with the ability to allow a user to move from device to device and continuously access their network resources without hassles. Depending on what the user needs to do on an individual workstation, it is possible to assign local administrative privileges to a domain user account. This essentially gives the best of both worlds in very specific situations.

As with local user accounts, we have standard domain users and domain admins to start with.

One of the biggest benefits to a domain user account is the ease of password resets. Knowledge of the current password is not required, as Active Directory handles all of the heavy lifting. This one feature turns what could potentially be an ultra-panicky situation into a normal Tuesday morning.

Creating A Local User Account

1. Create a Local User Account in Windows 10 From Settings

To set up a new local user account on your computer.

➔Start > Settings > Accounts.

Next, head over to Family & other users from the left pane. Now, click Add someone else to this PC, located under Other Users.

you will be prompted to use an online account. Select I don't have this person's sign-in information instead of entering an email address.

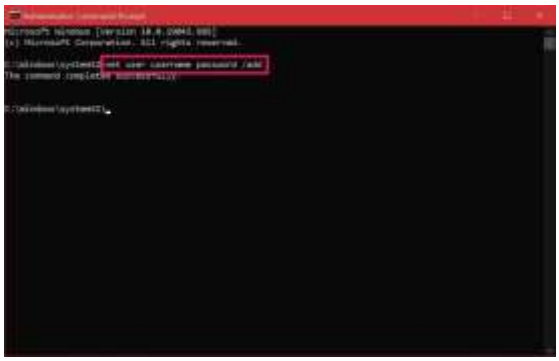
Windows will continue to try and get you to create a new Microsoft account. You need to click on Add a user without a Microsoft account instead.

This will bring up the account setup screen, where you'll be able to fill out all the details for your local account, including security questions that can be used for recovery if you forget the password. Once you're done, click Next.

You've successfully created a local account at this point.

2. Set Up a Local User Account in Windows 10 With Netplwiz

Netplwiz is basically a control panel for managing all the user accounts on a computer. In legacy versions of Windows, users relied on it to add a new user account to their PCs since a streamlined settings menu wasn't available back then. This method is still available as an option. You can use it to add or remove accounts, reset the password, change the account type, and more. To set up a local user account, follow these steps:



Type Netplwiz in the Start menu search field. Hit the Enter key to open the panel. Here, you'll see your primary administrator account at the top. Click on Add to continue.

You'll now see the onscreen instructions that help you set up a new user account. Here, you need to click on Sign in without a Microsoft account located at the bottom.

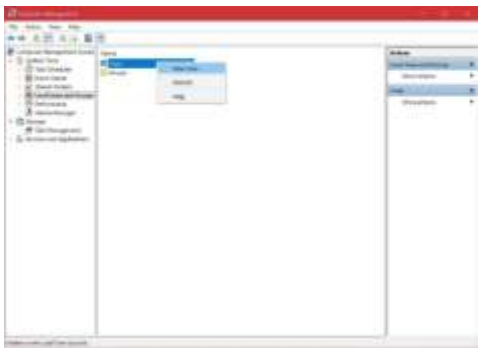
Next, you'll be able to select the account type. Click on Local account to proceed further.

Fill in the login details for your new account, give the desired password hint, and click on Next to finish setting up the account.

Instead of security questions, you're asked to enter a password hint in this method. This will be the only help you'll get if you ever forget your login information down the line.

3. Make a Local User Account in Windows 10 With Computer Management

Computer Management is a built-in program that lets you access all the Windows 10 administration tools in one place. From storage management to task scheduling, you can perform many advanced operations on your PC with this app.



If you own Windows 10 Pro instead of the regular home edition, you can use it to configure a new local user account too in two simple steps:

Find and open the Computer Management app using Windows Search. Head over to the Local Users and Groups section from the left pane. Here, you'll see a folder named Users. Right-click on this folder and choose New User from the context menu.

You know what to do next, right? Fill in your account login information and click on Create.

Be careful with the password you choose because there's no option to even enter a password hint here. If you forget it, there's nothing you can do other than deleting it using an administrator account.

4. Use Command Prompt to Create a Local User Account

For those who don't know, CMD or Command Prompt is a command-line interpreter that's used by tons of coders and other advanced users to perform crucial tasks on their PCs. Using CMD is arguably the fastest way to make a new local user account since all you need to do here is enter a proper line of code. You don't have to fill out too much information. Let's get started:

Type CMD in the Start menu search bar, and select Command Prompt as the Best match. Now, make sure to choose Run as administrator. If you fail to do this, you won't be allowed to make a new account.

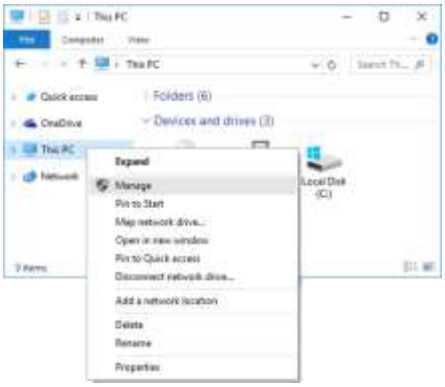
Now, type in the following line of code, replacing username and password in the command line to match your account requirements. Hit the Enter key.

net user username password /add

If you get a response that "The command completed successfully," it means that the account has been created.

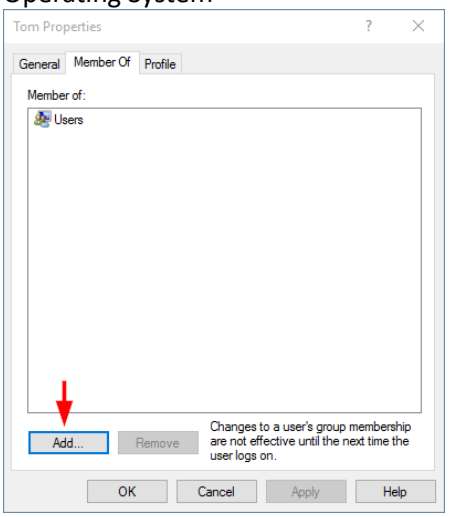
Practical # 7 Assign Rights to a Local User Accounts on LAN Network

There are different ways of opening the Computer Management console. In File Explorer, right-click on "This PC" (or "My Computer") on the left pane and select Manage.



When the Computer Management console opens, expand to System Tools -> Local Users and Groups -> Users. Find the standard user in the list on the right that you wish to grant Administrator access, right-click on it and select Properties.

In the User Properties window, click the Member Of tab. You can see the standard account is not a member of Administrators group, so you have to add it.



Once you've clicked the Add button and a "Select Groups" window will pop up. Click on Advanced.

Click on Find Now to list available users and groups. Select the Administrators group from the search results, and click OK.

When come back to the User Properties window, click OK. Now you've successfully changed a standard user to administrator.

Practical # 8 : - How to Configure NTFS Permissions on Windows 10/11

NTFS permissions are a set of permissions used to protect your files and folders stored on the partition with NTFS file system. These permissions can determine who can access certain files/folders such as user profiles. They can be assigned to groups or individual users. There are different types of NTFS permissions for files and folders which you can configure for.

Full control: If you select this option, a user or group has all available permissions for files and folders, including add, modify, move, and delete. Besides, you can change NTFS permission for all files and subdirectories.

Modify: This permission means that a user or group can modify a file or the contents in a folder.

Read & execute: It allows a user or group to view and run executable files in a folder.

List folder contents: It is an NTFS folder permission that determines if a user or group can list the content of a folder.

Read: It means that a user or group can read the data in a file or folder but can't read an executable file or open the folder where the files are stored if only assigning this permission.

Write: It means that a user or group can change the content in a file, create files/folders, or write data and attributes for a folder.

Method 1. Set NTFS permissions in File Explorer

The first and most common way on how to set NTFS permissions for a folder is to use Windows File Explorer. Here are detailed steps:

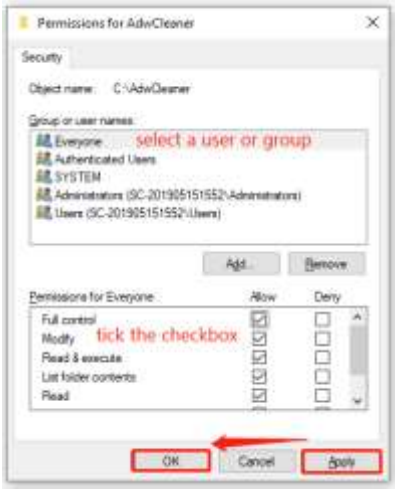
Step 1. Press ➔Win + E keys to open the File Explorer, or open my computer and select desired drive of folder and then ➔right-click the directory that you want to set NTFS permissions Windows 10/11 for and select ➔Properties.

Step 2. In the Properties window, navigate to the ➔Security tab and click on ➔Edit to change NTFS permissions.

Step 3. Select your desired group or user names from the list Add➔Advanced➔Find Now and choose a ➔User Account To Apply Permissions, and then tick the checkbox of ➔Allow or Deny next to the Permissions that you want to set, and click on ➔Apply and then OK to save the change.

Tips:

If you want to add a new user or group, you can click on Add and enter the desired name, and follow the on-screen prompts to complete the process.



Method 2. Set NTFS permissions PowerShell

Another advanced way is to let PowerShell set NTFS permissions. To do this work, you can follow the detailed steps below:

Step 1. Type ➔PowerShell in the Search box, and then➔ right-click Windows ➔PowerShell from the top result and select➔ Run as administrator.

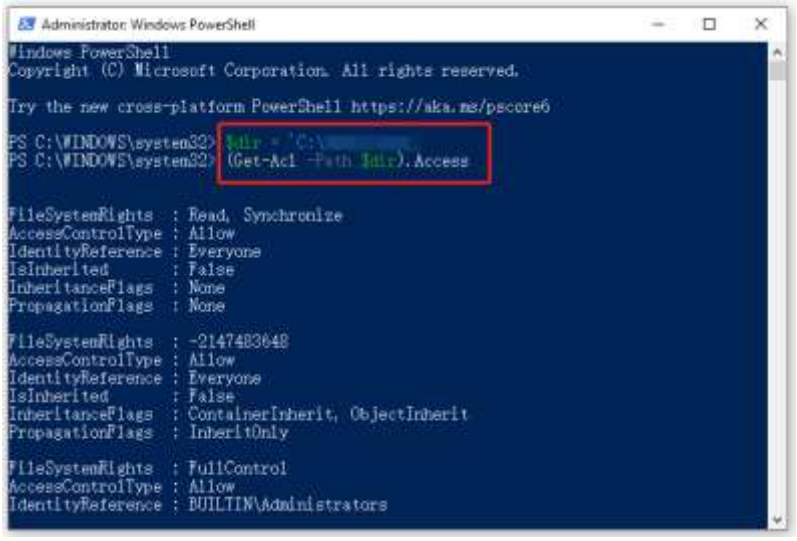
Step 2. In the elevated PowerShell window, type the following commands and hit Enter after each one to assign the path to your desired directory and view its permissions.

Note:

Here you need to replace the path with your actual directory. Also, you can run the (Get-Acl -Path $dir).Access | Format-Table -AutoSize command to view permissions in a more readable format.

$dir = 'C:Pathtodirectory'

(Get-Acl -Path $dir).Access



Step 3. Run the following commands in order and hit Enter after each one to create variables for permissions.

➔$identity = 'domainuser'
➔$rights = 'FullControl'

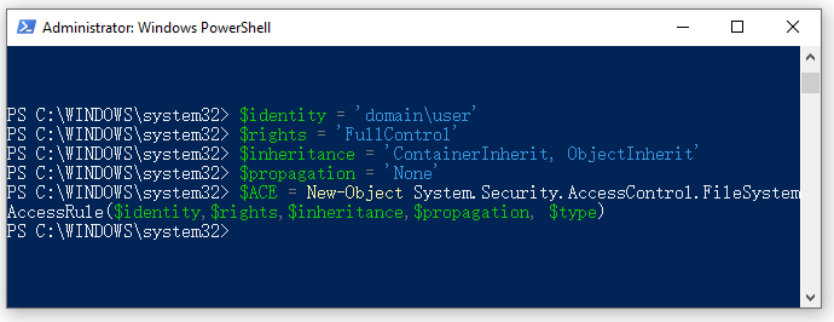
➔$inheritance = 'ContainerInherit, ObjectInherit'

➔$propagation = 'None'

➔$type = 'Allow'

Step 4. Run the following command to combine all variables into a single object.

➔$ACE = New-Object System.Security.AccessControl.FileSystemAccessRule($identity,$rights,$inheritance,$propagation, $type)



Step 5. Run the following command to get access rights from the selected directory and store them in a variable.

➔$Acl = Get-Acl -Path $dir

Step 6. Type the following commands and hit Enter after each one to add the access rule and set the rule.

➔$Acl.AddAccessRule($ACE)

➔Set-Acl -Path $dir -AclObject $Acl

Now, you should set NTFS permissions PowerShell completely. If you want to remove NTFS permissions using PowerShell someday, you can run the following commands.

➔$Acl = Get-Acl -Path $dir

➔$Ace = $Acl.Access | Where-Object {($_.IdentityReference -eq 'domainuser') -and -not ($_.IsInherited)}

➔$Acl.RemoveAccessRule($Ace)

➔Set-Acl -Path $dir -AclObject $Acl

Reset NTFS Permissions to Default Using NTFS ACCESS 2.2

If you're using Windows system and you lost the access to your files or folders (for example, after system reinstallation), use NTFS Access to regain it. The program sets permissions recursively, so you don't have to repeat the process for each file or folder separately.

NTFS Access can do the following

➔set folder/file owner,

➔set full access rights to a given folder/file,

➔give permissions recursively.

Practical

➔Open NTFS access 2.2

➔To gain full access to a folder and its contents, select folder which you are interested in by clicking 'Browse' button.

➔Make sure 'Set folder owner' and 'Set folder access rights' fields are checked.

➔Click 'Grant' to begin the process.

Practical # 9: - Disk Management Tool

Disk Management is a built-in tool in Windows 10 that is widely known by PC users. It is able to help you manage hard disk partitions without rebooting the system and any interruption. It is a convenient tool for Windows 10 users.

As a Windows 10 user, you must know how to use Disk Management to manage your hard disk partition, or to solve some common problems such as initializing a new drive, extending a basic volume, shrinking a basic volume, etc. Here is what Disk Management in Windows 10 can help:

How to open Disk Management in Windows 10?

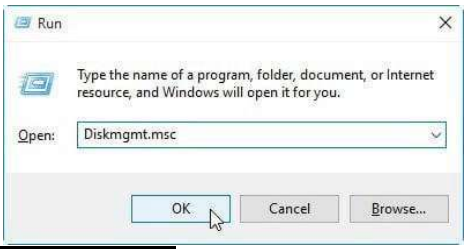
Method 1 Open Disk Management via "This PC"

Right-click➔ "This PC" on the desktop
choose ➔"Manage" in the context menu. Then, you will get into the Computer Management window.
➔Select and click ➔Disk Management on the left.

Method 2. Open Disk Management via "Run"

Press the ➔Windows key and ➔R key simultaneously to open the "Run" window.

Type ➔"Diskmgmt.msc" in the empty box and press ➔Enter key (or tap OK).



Method 3. Open Disk Management via "Search"

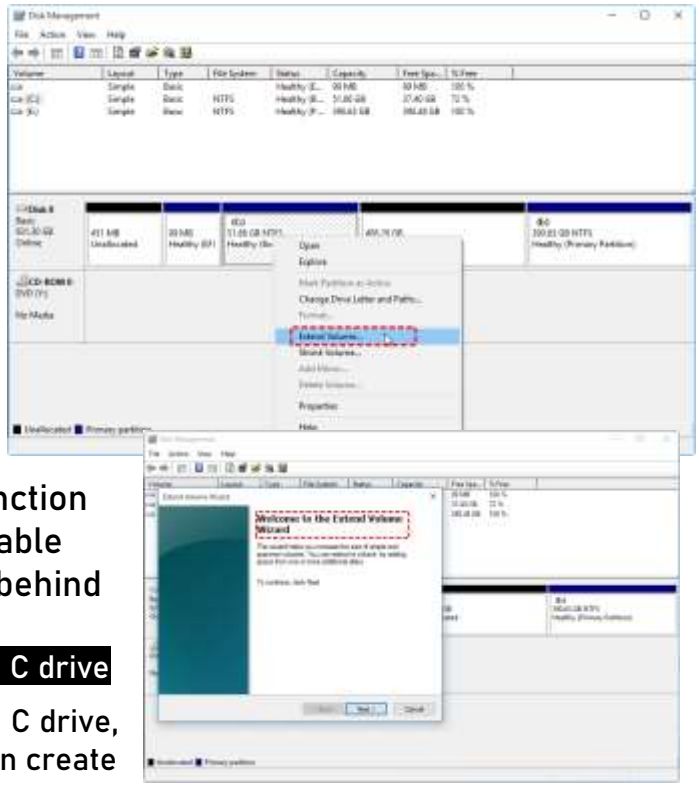
➔Click Search, and type ➔"disk management" in the search box and select "Disk Management" in the list.

How to Use Disk Management in Windows 10

Since we already know about Disk Management, then, we will talk about how to use it to solve the real problem. Most Windows 10 desktop and laptop users have encountered the problem of low disk space warning, especially for the system partition. To solve such kind of problems, extending volume would be the most effective way.
Some users may want to create a new partition since now most disk only has a big C drive. In this part, we'll show you how to extend volume and how to shrink the volume to create a new drive.

1. Extend C drive via Disk Management with adjacent unallocated space

If there is an adjacent unallocated space behind C drive, you can extend it in Disk Management. Here are detailed steps:

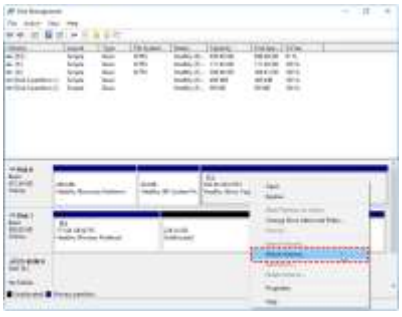


Step 1. Press ➔Windows + R at the same time to open Run dialogue.
Step 2. Input ➔diskmgmt.msc and hit Enter to open Disk Management.
Step 3. Right-click C drive and choose ➔"Extend Volume".
Step 4. Follow the prompts that will appear to complete this operation.

Note: If the Extend Volume greyed out and cannot be clickable, the reason is that the function of Extend Volume in Windows 10 is only available when there is contiguous unallocated space behind the partition you would like to extend.

2. Create a new partition in Disk Management from C drive

To use Disk Management to create a partition from C drive, you need to create unallocated space first, and then create a new partition based on it.



Step 1. Press the ➔"Windows + X" and select ➔"Disk Management" from the menu.
Step 2. Locate the C drive in the list of available disks and right-click it.
Step 3. Select ➔"Shrink Volume" from the context menu that appears.

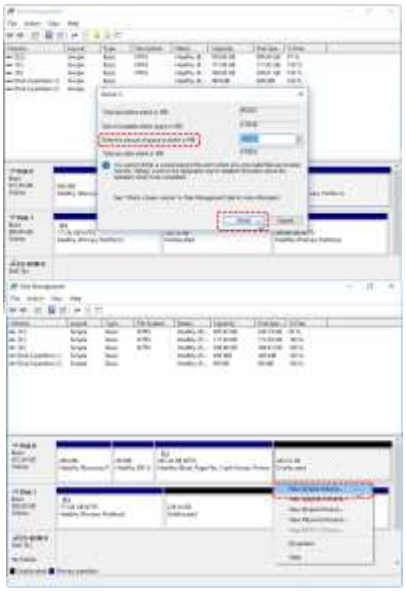
Step 4. In the ➔Shrink window, enter the amount of space you want to allocate to the new partition in megabytes (MB), then click "Shrink".

Step 5. Once Disk Management has completed the shrinking process, you'll see a black area labeled➔ "Unallocated."

Step 6. Right-click the ➔unallocated space and select ➔"New Simple Volume" from the context menu that appears.

Step 7. Follow the prompts in the New Simple Volume Wizard to assign a drive letter, format the new partition, and complete the creation process.

Is it easy? Yes, and using Disk Management to initialize disk, delete volume, and format volume is as same easy as extend volume- Select the disk or partition➔ right click it➔ choose the operation you want to execute and follow the hints step by step.



3. Perform these steps to shrink an existing partition in order to create a new partition:

1. In the Disk Management Console, right-click on the partition which you want to resize. The system displays the capacity of the drive and the option to enter an amount you'd like to —shrink‖ your partition by. Click *Shrink*.
2. You can now see the unallocated space on your hard drive in the capacity you specified, situated just after your now resized original partition.
3. Right-click the unallocated volume, select *New Simple Volume*, assign a drive letter, and quick format the volume using the NTFS file system and default allocation unit size.

4. Extending a partition:

1. In the Disk Management Console, right-click the partition that you want to extend and select *Extend Volume*.
2. Click *Next*. The system displays the capacity of the drive and the option to enter an amount you'd like to extend your partition by. Click *Next*.
3. Click *Finish*.

5. Deleting a partition:

1. In the Disk Management Console, right-click the partition that you want to delete and select *Delete Volume*.
2. Click *Yes* to continue the deletion process.
3. Click *Yes* to delete the partition.

6. Changing the drive letter:

1. In the Disk Management Console, right-click on a partition and select *Change drive letters and paths*.
2. The current drive letter will display. The *Add* button typically allows the partition to be placed inside an existing NTFS folder.

3. Click *Change* to assign a new drive letter.

7. To convert from an MBR partition to a GPT partition, or vice versa

Back up or move the data on the basic MBR disk you want to convert.

1. Open Computer Management (Local).
2. In the console tree, click *Computer Management* (Local), click *Storage*, and then click *Disk Management*.
3. The disk must not contain any partitions or volumes. If these exist, right-click any volumes on the disk and then click *Delete Partition* or Delete Volume.
4. Right-click the MBR disk that you want to change into a GPT disk, and then click *Convert to GPT Disk*.

8. Converting a basic disk to a dynamic disk:

1. In the Disk Management Console, simply right-click the disk you want to convert and click *Convert To Dynamic Disk*. If you want to convert from a dynamic disk to a basic disk, you must first delete all volumes, hence all data, on the disk.

Practical # 11: - Disk Maintenance Tools

Disk management tools are utility software that is used to manage data on disk by performing various functions on it. Moreover, they perform functions like partitioning devices, manage drives, disk checking, disk formatting, etc. Furthermore, there are various types of disk management tools like disk checkers, disk cleaners, and disk analyzers. Some basic functions that these tools perform are as follows:

- Partitioning of the disk
- Formatting the disk
- Changing disk's name
- Shrinking a disk partition
- Extending a disk partition
- Deleting a disk partition
- Changing the file system of a driver

Types of Disk Management Tools

1. Disk Cleanup Tools

These tools clean up the unnecessary and unwanted files on the system. Furthermore, this deletion of files thus helps to clean up the disk space. Moreover, it prevents unnecessary clutter and protects privacy.

Temporary files, web caches, old backups, etc. are the files that make up the unwanted clutter on the disk. Privacy risk happens due to files that have information about files opened by each computer program. For example log files, HTTP cookies, etc. Examples of disk cleanup tools are Razer Cortex, Piriform CCleaner, etc.

Disk Cleanup Tool

2. Disk Compression Tools

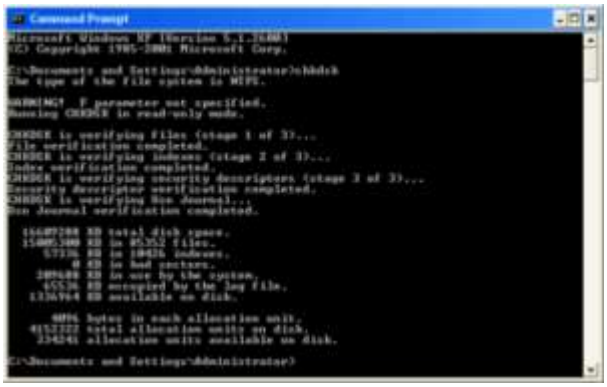
The disk compression tools or disk compression utility increases the amount of space on a disk by decreasing the size of information. The utility compresses the information while storing it on this disk. On the other hand, the information decompresses when we have to read it. Examples of disk compression utility are as follows:

- Microsft Windows: DriveSpace
- Macintosh: DiskDoubler

3. Disk Checkers

These tools scan the hard disk and remove any such areas which are corrupted or not saved properly. Furthermore, they perform this process so that the hard disk can operate more efficiently. Some tools perform the full surface scan while some others check only logical structures of the files.

Examples are CHKDSK, fsck, etc.



Disk Checker

4. Disk Formatters

They prepare a data storage device for the initial use. For example devices like hard disk, floppy disk, USB flash drive, etc. Moreover, they can also permanently erase a drive.

The formatting has three levels:

- Low-level formatting
- Partitioning
- High-level formatting

5. Disk Partitioning Tools

These tools divide the disk into more than one region. Furthermore, it does this so that each region can be managed separately and hence, more efficiently. These regions are the partitions. A partition table is also maintained which contains information about the location and size of each partition. Examples are GParted, diskpart, GNU Parted, etc.

GParted

6. Disk Space Analyzers

These tools indicate the space usage on the disk. Furthermore, they perform this task by analyzing the size of each file and folders and also, the subfolders. Usually, this information is indicated through graphical charts according to the folders' size or other criteria. We can also call them as disk usage analysis software. Examples are DiskReport, KDE Filelight, GNOME Disk Usage Analyzer, etc.

GNOME Disk Analyzer

7. Disk Defragmenter

This utility software helps to reduce the fragmentation and hence, reduces the access speed. Defragmenting refers to rearranging files and storing them in contiguous memory locations. This means that when the contents of some files are scattered here and there it rearranges them and stores them in a contiguous memory area. These scattered parts are fragments. Moreover, saves time in reading from files and writing files to disk. Examples of disk defragmenters are Perfect disk, Deflaggler, etc.

8. Backup Software

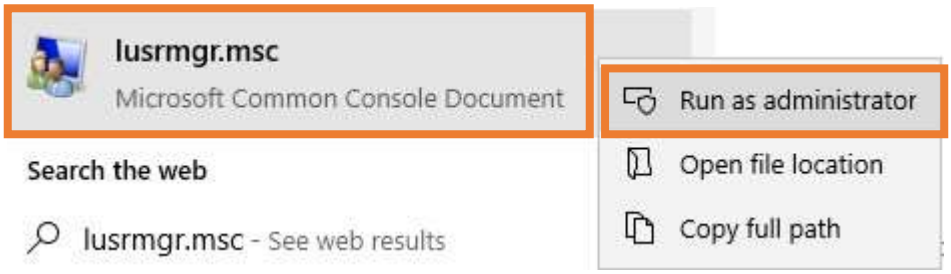
This keeps a copy of all the information on a disk. Whenever some disk failure occurs or files are deleted accidentally, it restores the files. Restoring the whole disk is called disk cloning.

Practical # 11: - Using Remote Desktop Utility

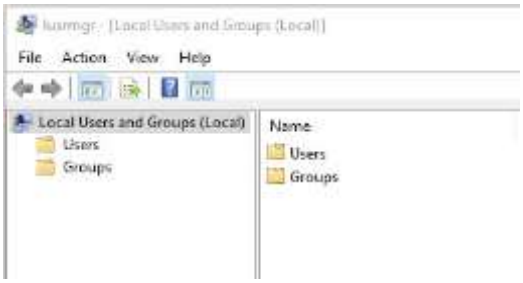
Remote Desktop is a Windows OS feature that allows you to connect to your Office PC from home. You will be able to access your Office PC as though you are sitting in front of it. Hence, this method is suitable for you if you have work data or software installed on your Office PC that you need to use.

Set up Office PC for Remote Desktop Access (one-time setup)

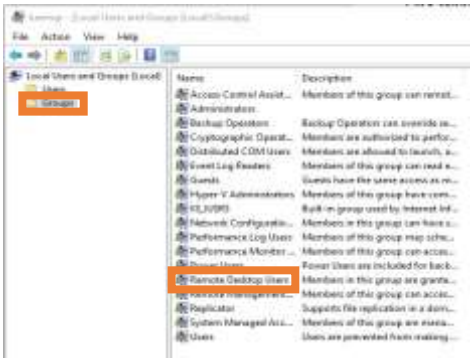
1. Click Windows ➔Start button and type ➔lusrmgr.msc.
   Right click on ➔lusrmgr.msc and select ➔Run as administrator.



2. You should see the following window.

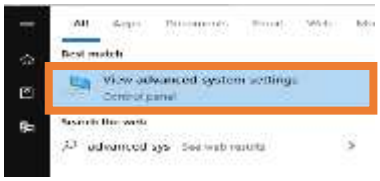


3. Click on ➔Groups and double-click ➔Remote Desktop Users.

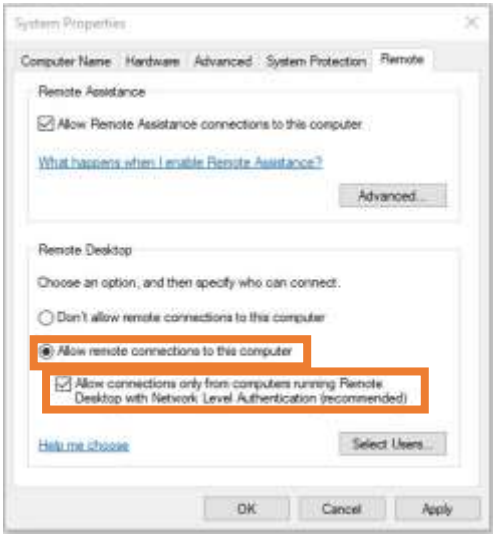


4. Click ➔Add button and type your ➔User ID in the box. Click ➔OK to close.

5. Click Windows➔ Start button and type ➔advanced sys. Click ➔View advanced system settings.



6. Click on Remote tab. Select Allow remote connections to this computer and Allow connections only from computers running Remote Desktop with Network Level Authentication (recommended). Click OK to close.



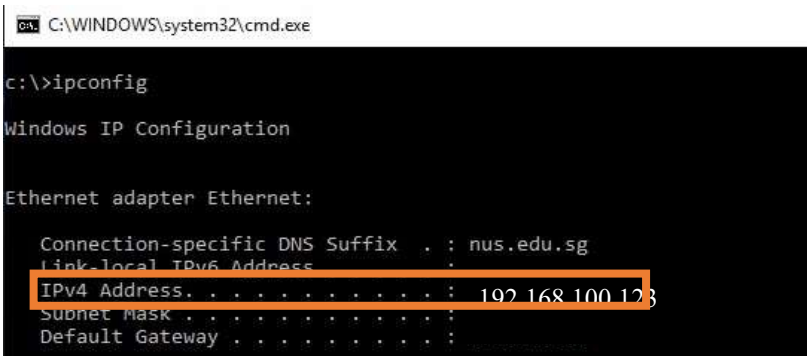
You might get the following pop-up message. Refer to next step.

7. You will need to disable the sleep/hibernation mode because the Office PC must not be in sleep/hibernation mode when you connect to it.
8. button and select ➔System.
9. Note down the ➔Device name or equivalent as you will need this name to connect to Office PC.

In the window, type the command ➔ipconfig and press enter.

Take note of the ➔IPv4 Address. (e.g.192.168.100.123)

This IP address is dynamic (except those using Fixed IP) and is assigned when your PC connects to the network therefore it may change over time.



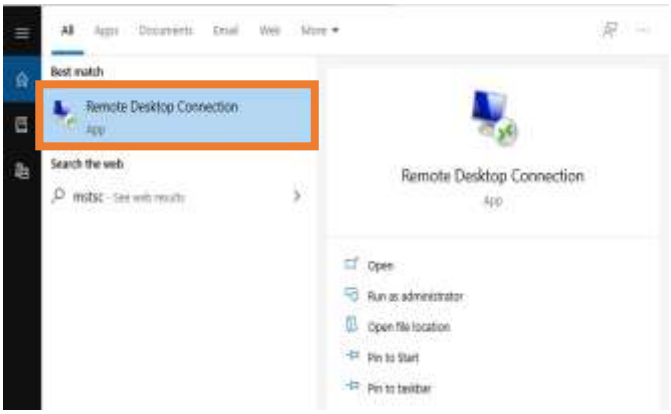
12. If you are using your Office PC to generate security code for 2FA, you need to change the 2FA token to a mobile device so that you can access 2FA from home. You need to make this change from your Office PC. Sign into VIP Self Service Portal and follow the on-screen instructions.

Connect from Home PC to Office PC

1. Before connecting to your Office PC remotely, ensure the following pre-requisites are met:
   i Your Home PC is connected to NUS network through VPN connection.

   ii Your Office PC is turned on

2. Click Windows➔ Start button and type ➔mstsc.msc
   Select ➔Remote Desktop Connection.
   If you do not have Remote Desktop Connection, you will need to download Windows Desktop Client from here.



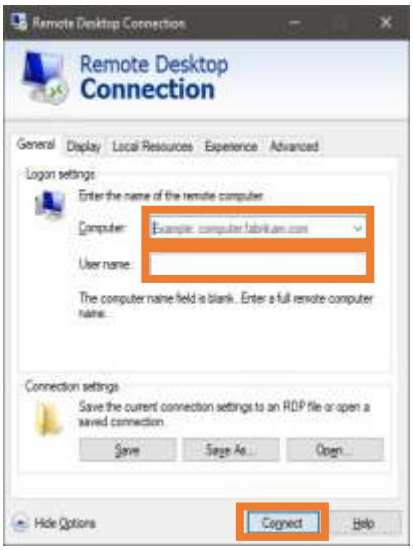
3 Click **Show Options**

4. Enter the Office PC name at the computer box.

   Enter your User ID Administrator and provide password.

   Click Connect.

   You should be able to access your Office Windows 10 PC remotely.



Note: In case you cannot connect using the Device/PC name, type the IPv4 Address instead.

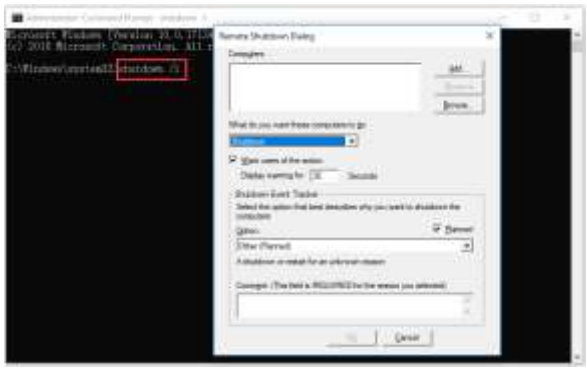
Practical # 12: - How to Remotely Shut Down or Restart a Windows 10 Computer with CMD

You can even use Command Prompt to remotely restart or shut down a Windows 10 computer over the Internet. The Windows PCs should be connected to the same network.

After you enter into Command Prompt, you can type shutdown /m \\computername /r /f command line, and hit Enter. This will remotely restart the target Windows 10 computer and force close all running programs on it.

You can also remotely shutdown PC via Shutdown dialog.

- Click ➔Start➔Search➔type cmd➔right click cmd ➔Run As Administrator
- You can type ➔shutdown / i command in CMD, and press ➔Enter to open Remote Shutdown Dialog.
- Click ➔Add or ➔Browse button to add the target computers to the list. You can type the computer network name in \\computername e.g. ➔ \\pc1 format or just type the computer name.



- Then you can set the shutdown options: ➔restart or shutdown. You can also set the shutdown settings like displaying a warning.

- Then you can run the corresponding Windows shutdown commands to shut down or restart a batch of computers in the same network.

Practical # 13: - Network Trouble Shooting Commands

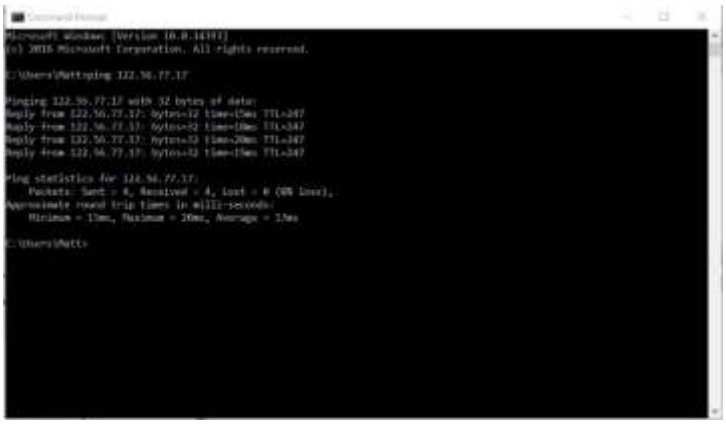
Users can send a ping command through a Windows, Mac, or Linux computer. It is used to check the network connectivity between two PC's.

How to run a ping network test

Goto ➔Start ➔Search in the taskbar and:

1. Type ➔"cmd" to bring up the Command Prompt.
2. Open the ➔Command Prompt.
3. Type ➔"ping" in the black box and hit the space bar.
4. Type the IP address you'd like to ping (e.g., 192.168.1.10).
5. Review the ping results displayed

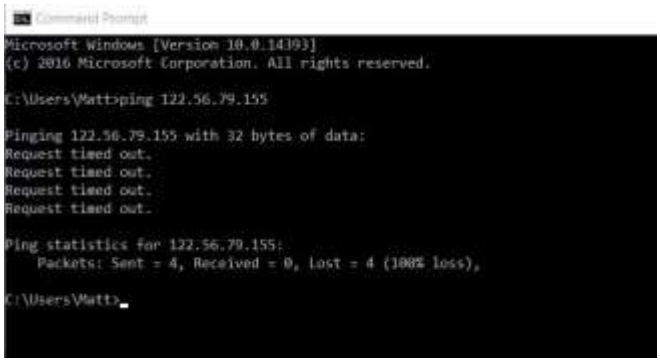
Interpreting the Results



A normal reply looks like:

Reply from 192.168.1.10
: bytes=32 time=15ms TTL=247
The ping command has received a response from the IP address, which took 15 milliseconds.

If the connection is down or the device you are pinging does not accept the ping, the ping command prints:



Request timed out.

Infinite ping in Windows, Linux, and MacOS

Ping is available in Windows, Linux, and MacOS as a diagnostics tool for network connections.

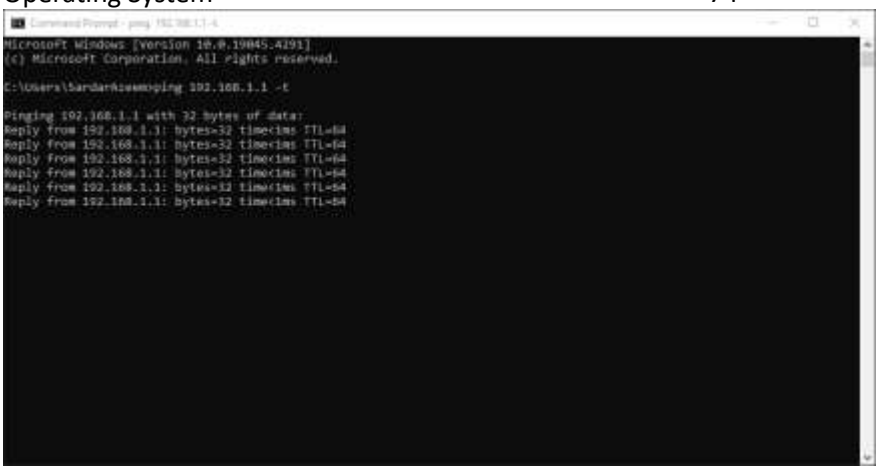
Continuous ping in Windows 7, 8, and 10

In Windows, the ping sends four data packets in its default setting to the target computer you specified by IP address or host name. If you would like to test the network connection between two computers on an ongoing basis, the “continuous ping” option is available.

Step 1: Open the Windows command prompt. One way of doing this is by entering the key combination Windows + R and enter the command CMD.

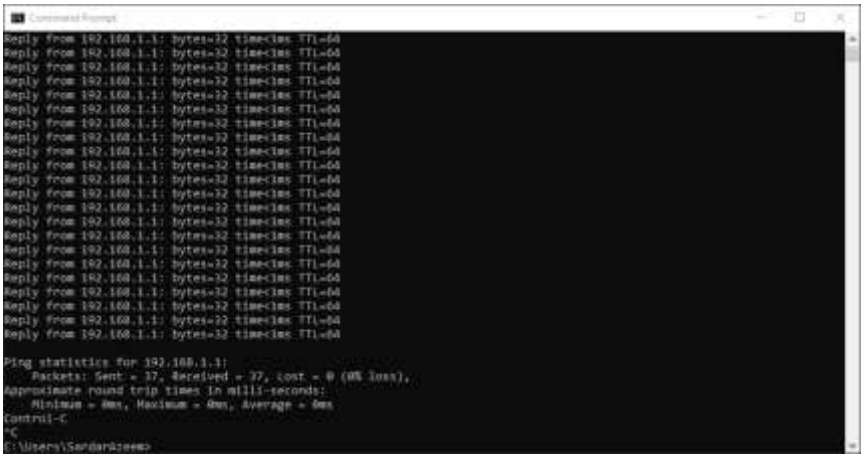
Step 2: Enter the command line *ping* with the *-t* option and any address and confirm by clicking [Enter].

➔Ping 192.168.1.1 -t



The echo queries are dispatched every second to the target computer until you end the command line program with [Ctrl] + [C].

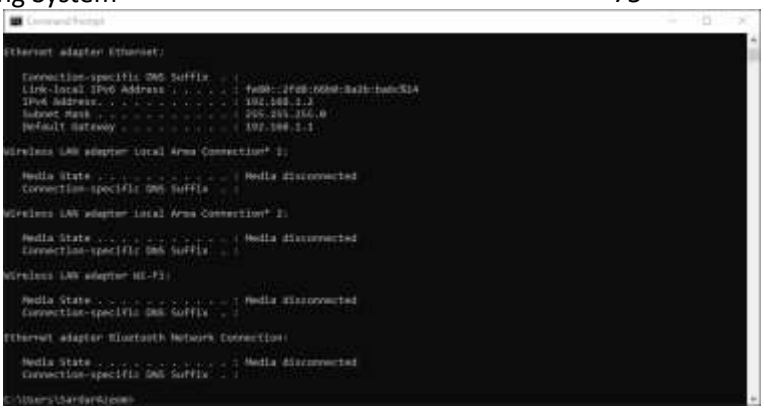
If you stop the ping, the program displays a statistical summary (ping statistics) at its conclusion.



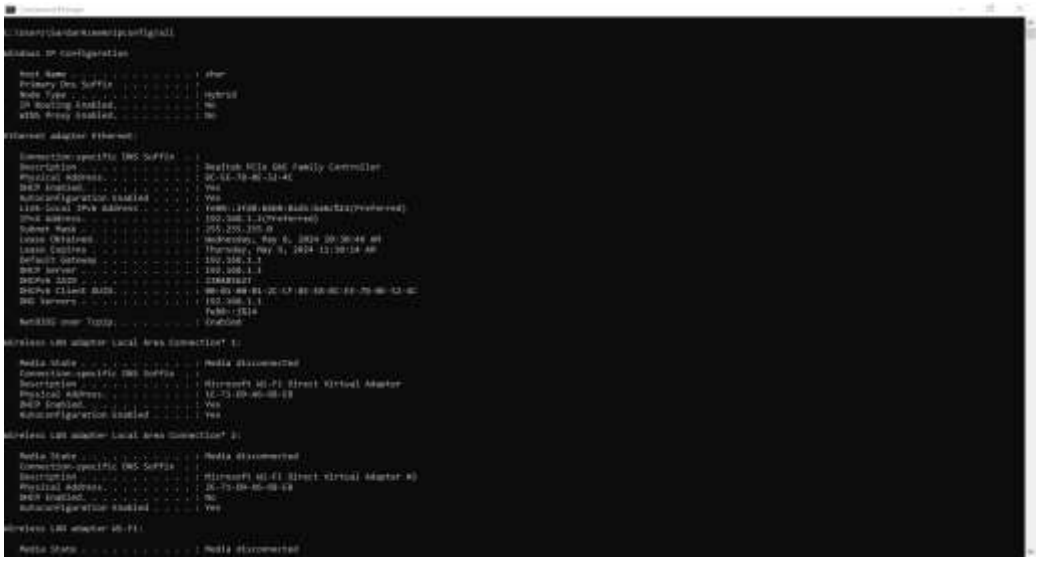
How Do I Use Ipconfig in the Command Prompt

The ipconfig command is used to display information about your network configuration and refresh DHCP and DNS Settings. By default, the ipconfig command displays your IP Address, Subnet Mask, and default gateway. But with the correct parameters, you can get a lot more information out of it. Below are steps on how to use it.

1. To run the command, open the ➔Command prompt
2. Type ➔ipconfig and press ➔Enter. This will display information about each network adapter on your computer, including a VPN client.



3. Type ➔ipconfig /all and press ➔Enter. This will show all the information about your network adapter:
    - Physical Address: This is the MAC address of your network adapter.
    - DHCP Enabled: Indicates if the network connection is using DHCP or Static IP Address
    - IPv4 Address: The IP Address of your computer
    - Default Gateway: The router to which your computer is connected
    - DHCP Server: Router/server that hands out IP Addresses in your network
    - DNS Servers: Servers used to translate domain names to IP Addresses
    - Link-Local IPv6 Address: IPv6 address of your computer (often not used)
    - Lease Obtained: Date-time when your computer received the IP Address



4. When you have DHCP enabled on your network card, you can request a new IP Address from the DHCP server. To do this:
    1. Type ➔ipconfig /release adapter_name where adapter_name must be specified as it appears when you use ipconfig without parameters.

2. Then type ➔ipconfig /renew adapter_name where adapter_name must be specified as it appears when you use ipconfig without parameters.

5. Your computer keeps a local cache of DNS records of websites it has visited. This cache is used to quickly translate the domain names to the correct IP Address.
6. Type ➔ipconfig /displayDNS and press ➔Enter. This will display the content of the DNS cache on your computer.

Traceroute Command

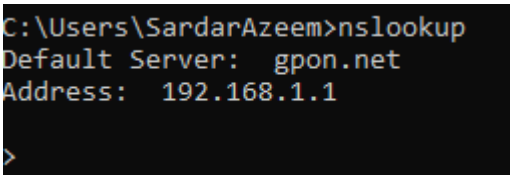
Traceroute is a utility that records the Internet route (gateway computers at each hop) between your computer and a specified destination computer. It also calculates and displays the amount of time for each hop. This utility helps you find where high transfer times are occurring in your internal network and the Internet. Before using Traceroute, you can use the Ping utility to identify whether a host is present on the network. For more information, see Running and Reading a Ping.

1. Press ➔Windows key + R to open the ➔Run window.
2. Enter ➔cmd and press ➔Enter to open a ➔Command Prompt.
3. Enter ➔tracert, a space, then the IP address or web address for the destination site (for example: ➔tracert https://pictacademy.com).
4. Press Enter.

NSLOOKUP Command

Microsoft Windows includes a tool called NSLOOKUP that you can use via the command prompt. This tool can be used to check DNS records propagation and resolution using different servers and perform other troubleshooting steps.

1. Open ➔Command prompt..
2. Type ➔nslookup and hit Enter. The displayed information will be your local DNS server and its IP address. You can specify the DNS server (IP address), type of record, and domain name.



3. Type ➔nslookup domain_name and the command will return the A record for the domain you ran a query for.

```
> nslookup pictacademy.com
Server:  pictacademy.com
Address:  65.109.37.144

DNS request timed out.
    timeout was 2 seconds.
*** pictacademy.com can't find nslookup: Query refused
```

4. Type ➔nslookup -q=XX google.com where XX is a type of a DNS record and ➔domain_name is the domain you want to look up the record for. Some of the available types of records are MX, A, CNAME, and TXT. The records are then displayed.

```
c:\>nslookup -q=MX google.com
Server:  UnKnown
Address:  10.200.18.22

Non-authoritative answer:
google.com      MX preference = 10, mail exchanger = aspmx.l.google.com
google.com      MX preference = 20, mail exchanger = alt1.aspmx.l.google.com
google.com      MX preference = 30, mail exchanger = alt2.aspmx.l.google.com
google.com      MX preference = 40, mail exchanger = alt3.aspmx.l.google.com
google.com      MX preference = 50, mail exchanger = alt4.aspmx.l.google.com
```

5. To look up the specific type of record for a domain use the ➔nslookup -type=record_type domain_name where record_type is A, CNAME, MX, PTR, NS, ANY and domain_name is the domain you want to look up the record for.

```
c:\>nslookup -type=ns wikipedia.org
Server:  UnKnown
Address:  10.200.18.22

Non-authoritative answer:
wikipedia.org   nameserver = ns0.wikimedia.org
wikipedia.org   nameserver = ns1.wikimedia.org
wikipedia.org   nameserver = ns2.wikimedia.org
```

ARP Command

The ARP commands to view, display, or modify the details/information in an ARP table/cache.

The ARP cache or table has the dynamic list of IP and MAC addresses of those devices to which your computer has communicated recently in a local network.

- ➔arp -a: This command is used to display the ARP table for a particular IP address. It also shows all the entries of the ARP cache or table.

```
C:\Users\SardarAzeem>arp -a

Interface: 192.168.1.2 --- 0xe
  Internet Address      Physical Address      Type
  192.168.1.1           e8-43-68-09-ff-b8     dynamic
  192.168.1.255         ff-ff-ff-ff-ff-ff     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
  224.0.0.252           01-00-5e-00-00-fc     static
  239.255.255.250       01-00-5e-7f-ff-fa     static
  255.255.255.255       ff-ff-ff-ff-ff-ff     static
```

- ➔arp -g: This command works the same as the arp -a command.
- ➔arp -d: This command is used when you want to delete an entry from the ARP table for a particular interface. To delete an entry, write arp -d command along with the IP address in a command prompt you want to delete.
- Syntax: arp -d 192.168.43.255
- ➔arp -d *: You can also delete all the entries from the ARP table. This command will remove or flush all the entries from the table.
- ➔arp -s: This command is used to add the static entry in the ARP table, which resolves the InetAddr (IP address) to the EtherAddr (physical address). To add a static entry in an ARP table, write arp -s command along with the IP address and MAC address of the device in a command prompt.

Practical # 14 :- Use Disk Quota Management

On a shared desktop it is very easy to fill the entire hard disk space with all types of files, but a hard disk supports storage limits for each user, so a single user can be limited and cannot fill the entire disk if a certain procedure is followed correctly.

Disk quotas can be used to monitor and control hard disk space usage for each user. This feature exists in Windows 7, 8 and Windows 10 still retains it.

a. Organization Level

b. Group Level

c. User Level

Step 1 :- Organization Level Quota Management

In organization level all users can see data i.e. folders and files of each other.

1. Logon as ➔Administrator Create a folder name org in ➔E: drive
2. Right-Click ➔Org folder ➔Select ➔Sharing and Security
3. Click ➔Share this folder Click ➔Permissions ➔Check Full Control (for Everyone) – Ok
4. Click ➔Security Tab ➔Add➔Advanced➔ Find Now➔Select Everyone➔Ok➔Ok

5. Check ➔Full Control (for Everyone) ➔Apply➔Ok
6. Right click on ➔E: drive➔Properties ➔Click on Quota Tab ➔Check Enable quota management
7. Check ➔Deny disk space to users exceeding quota limit
8. Click ➔Limit disk space to 300 MB
9. Set➔ warning level to 280 MB
10. Check ➔Log event when a user exceeds their quota limit
11. Check ➔Log event when a user exceeds their warning level➔ Apply ➔ Ok
12. Disk Quota Message ➔Ok
13. Wait for the green light and ➔Ok

Step 2 :- Now create at least 5 users

1. Right-click on ➔My Computer➔ Manage ➔Local Users and Groups➔Users
2. Right-click on ➔users➔ Select New User
3. Type User name: user1➔Password: ➔Pict2024➔Confirm password: Pict2024
4. Uncheck ➔User must change password at next logon
5. Check ➔User cannot change password
6. Check ➔Password never expires
7. Click ➔Create ➔Close

(Repeat for other 4 users i.e. user2, user3, user4 and user5)

Step 3 :- Application of Quota on Users

1. Click ➔Profile tab
2. Click ➔Connect
3. Select ➔Z drive from combo box
4. Set path To:➔ \\pc1\org Apply Ok

(Repeat above a to g step and set the path \\server\org for other 4 users i.e. user2, user3, user4 and user5)

Step 4 :- Checking Quota Application

1. Double Click ➔My Computer
2. Now you can see ➔Z drive org on 'PC' (Z:)
3. Double-click on ➔Z: drive -- e. Right-click➔Select New Select Folder➔Rename folder to user1
4. Double-click ➔user1 folder➔Right-click➔Select New➔ Select Text Document➔Rename Text Document to user1

(Logoff user1 and Logon as user2 and repeat above steps for user2, user3, user4 & user5)

Group Level Quota Management

In group level users can see each other data in group but they can't see data of another group.

1. Logon as ➔Administrator Double-click ➔My Computer ➔ Double-click E: drive➔Double-click Org folder➔ Create 2 folder named g1 and g1 (for group level)

2. Right-click ➔My Computer ➔ Manage➔Local Users and Groups➔Select Users➔Double-click user1➔ Set path To: \\Sher\org\g1 ➔Apply➔ Ok
3. Do the Same for other users.

User Level Quota Management

In user level only the logon user can see data of his own other user can't see.

Logon as Administrator

Double-click➔ My Computer

1. Double➔click E: drive➔Double-click Org folder
2. Create 3 folder named ➔MKT, SALES & ACC
3. Right-click ➔My Computer➔Manage ➔Local Users and Groups ➔Users
4. Double-click ➔user1➔Profile➔ Set path to: \\Sher\org\mkt\%username% -- "\%username%" ➔Apply ➔Ok
5. Do the same for all other users

Check the implementation

1. Logoff Administrator and Logon as user1
2. Click ➔My Computer➔Double-click on Z: drive ➔ Right-click➔Select New ➔
3. Select Text Document ➔ Rename Text Document to user1

(Logoff user1 and Logon as user2 and repeat above steps user2, user3 and users4

Section #3 : Windows Server 2016/2019

Introduction To Microsoft Windows Server - Its Types and Features

Windows Server is a line of operating systems that Microsoft specifically created for use in a normal version of Windows to suit business requirements. In almost all cases, normal users don't need the complexity of Windows Server. You won't even find it in stores and you can't mistakenly download it for Microsoft when you meant to get the standard version (Windows). Basically, the standard version of Windows is for normal users while the Windows Server is for business.

Another way to understand this is that Microsoft designed Windows for use with a desktop you sit in front of, while Windows server is a server that runs services across a network and other systems. The Windows server is designed to share services with multiple users and provide administrative control of data storage and applications.

Types and Features of Windows Servers

1. Windows Server 2003

Microsoft word introduced the Windows server brand with the release of Windows server 2003. This was the first time a .net environment was included with the Windows Server operating system.

The 2003 version of Windows Server was featured with server roles that allowed the operating system to be tailored to specialized tasks such as a DNS (Domain Name System) server.

This version also featured Volume Shadow Copy Services (VSSC). Microsoft VSSC is a Microsoft Windows Server feature that takes snapshots of files for shared folders and backups.

Other features are:

- Expanded Encryption functionality
- Built-in firewall
- Greater NAT network access translation

2. Windows Server 2003 R2

This version came out in 2005. At this time (2005) all Windows Server 2003 sales from the release of this version were actually Windows server 2003 R2.

This means that the R2 only used the CALs (Client Access Licenses) of the immediately preceding server version (in this case Windows Server 2003) to avoid upgrading those licenses.

The key new features are:

- Active directory federation services enable administrators to broaden single sign-on access to applications and systems beyond the corporate firewall.
- The R2 package also featured Active Directory (AD) application mode, which creates arm's length relationships with third-party applications. This feature stores data for applications that may be considered not secure enough to use in the Active Directory system.

3. Windows Server 2008

Windows Server 2008, the next version which took three years to evolve had another upgrade to AD (Active Directory).

Some vital changes were made to how network services interacted with the software support features of the operating system.

Its features include:

- Hyper-V virtualization software- this was introduced to enhance the company's competitiveness in IT management. The idea was that, if system administrators already have a Hyper-V installed, there will be no need to bring in a rival VM virtual machine system.
- Server Core- this increasingly important product of Microsoft was the bare version of Windows Server that allowed command-line access.

Other new features into the Windows Server 2008 were Event Viewer and Server Manager which were system administration tools that permitted administrators to have better control over the activities of the server.

4. Windows Server 2008 R2

First made available in 2009, Windows Server 2008 R2 is still in use today.

Microsoft kind of used its Windows 7 basic and modified its scalability and availability features to a 64-bit operating environment from a 32-bit operating system.

There were more changes in Active Directory (AD) to enhance group policy implementation.

The terminal services were also repackaged to the remote desktop services RDS

New features in this series (2008 R2) include Brand Cache and Direct Access which were both aimed at improving access to the server from users at remote locations.

5. Windows Server 2012

By 2012, Microsoft added features to Windows Server to enable better interaction with 'off-sites' so much so that the company marketed Windows Server 2013 as "Cloud OS". This was probably why the VM was initially introduced in the Windows Server 2008 version.

Imperial updates were also made to the storage infrastructure of the operating system and Hyper-V virtualization platform to make cloud resources as easy to integrate into on-site delivery as local hosts.

New features were:

- Hyper-V virtual switch
- Hyper-V replica
- Storage spaces

Also, the Server Core and PowerShell became significant with this release Microsoft switched the default installation option to Server Core which requires administrators to use PowerShell.

Windows Server 2012 came in 4 editions: Essentials, Foundation, Standard and Datacenter.

6. Windows Server 2012 R2

This version, a revised 2012 was released in 2013. The massive changes that were singing this version included enhanced virtualization, information, security, and web services.

The ability to serve mobile devices with software from the server was also improved.

New features included are:

- Desired State Configuration was built on PowerShell to prevent configuration drift and maintain consistency across the organization's machines.
- Storage tethering was added to storage spaces to boost performance by automatically moving frequently called blocks of data to solid-state storage.
- Work folders allow users to retrieve and save company files on work and personal devices through replication to servers in the organization's data center.

7. Windows Server 2016

Here, VM (Virtual Machine) systems were also added with an encryption system for Hyper-V and the new ability to interact with Dockers.

Microsoft introduced the Nano Server along with the inclusion of Server Core with the intention of boosting security through the light-weight server implementation that made it harder to attack.

Another plus to security is shown in the new Hyper-V shielded VM feature which uses encryption to prevent data inside a VM from being compromised.

Microsoft included the network controller as a key feature that permits administrators to manage both physical and virtual network devices from one console.

Windows Server 2016 came in Standards and data center versions.

8. Windows Server 2019

Behold! The latest version of the Microsoft server operating system- Windows Server 2019 -was released in October 2018.

Windows Server 2019 features were consistent with numerous innovations: hybrid, security, application platform, and Hyper-Converged Infrastructure (HCI).

The HCI features of Windows Server 2019 are aimed at service to consumers. The system is capable of supporting software-defined data centers as well as their customers. The HCI is able to adjust virtualized services without taking the system down.

Users of Windows Server 2019 get access to the full front end administration tools in the GUI interface.

A highly vital security addition, Windows Defender Advanced Threat Protection (ATP) has also been featured in this version.

Installing Windows Server 2016

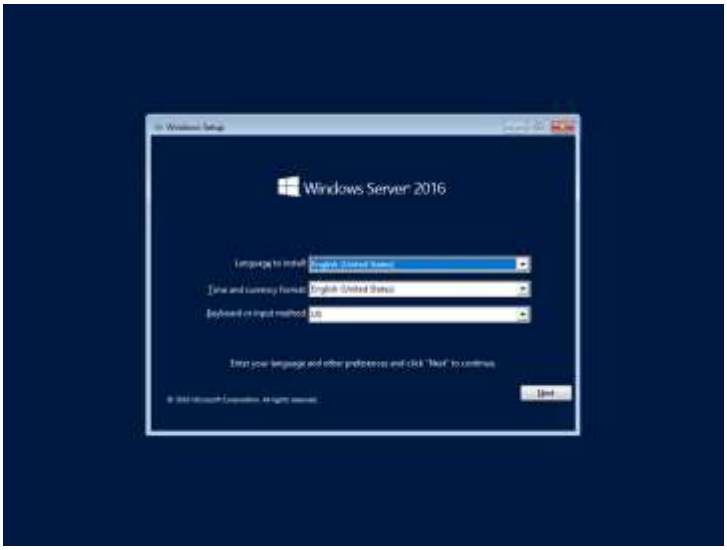
Prerequisites

Before starting with this guide, you will need to boot into installation media. For a physical server, insert the disc or USB drive and choose it in your boot options if necessary. For a virtual server, configure it to mount the ISO or pass though the server's optical drive or usb slot. Then change the boot order or one-time boot options.

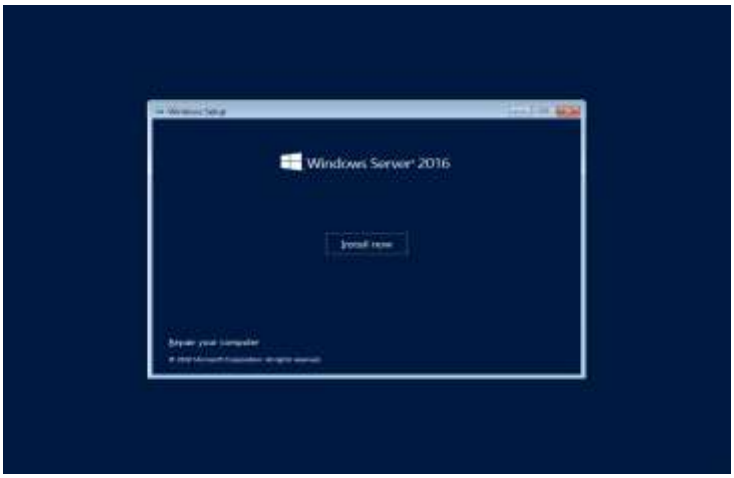
1) Boot into the installation media

If you have booted off the installation media, you have see the screen below

Choose your Language, Time and currency format, and Keyboard or input method and hit Next



2) Click Install Now

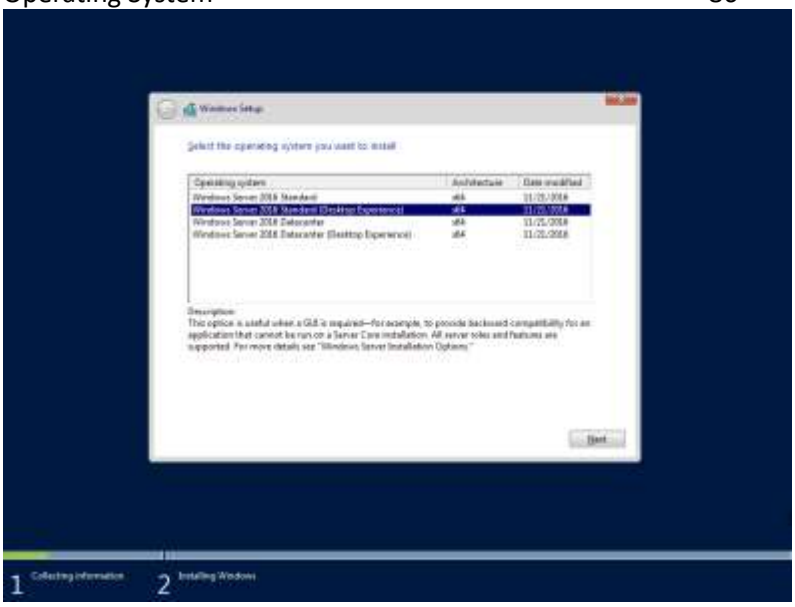


3) Choose the version

Choose the version that fits your license and your needs then click Enter

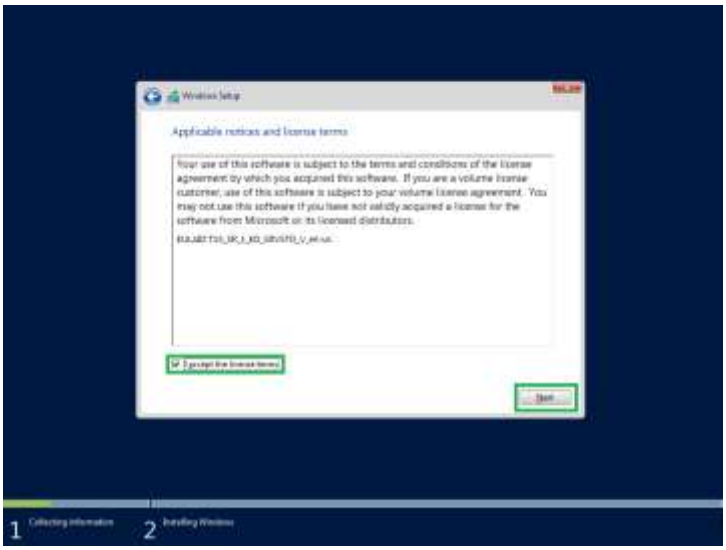
Please Note:

Choosing Windows Server 2016 Standard or Windows Server 2016 Datacenter will install without a desktop experience. This was previously known as Server Core. If you would like the GUI, make sure to choose one of the options with (Desktop Experience).



4) Accept the license terms

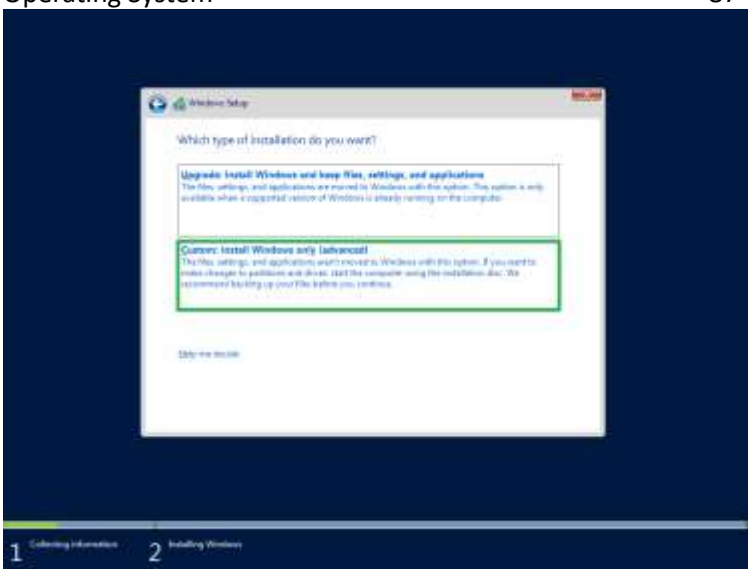
Click the I accept the license terms checkbox and click Next



5) Choose your installation type

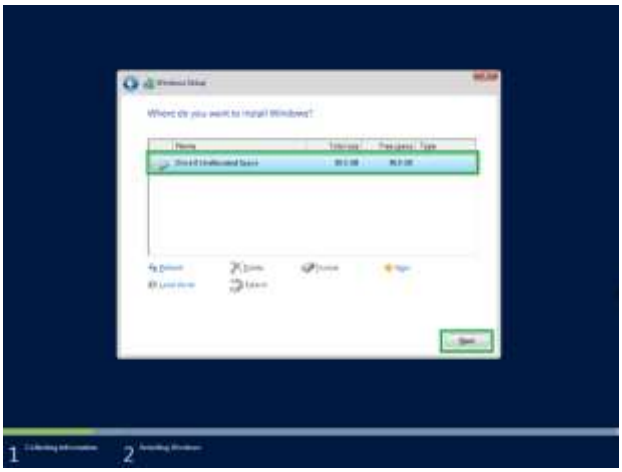
We are assuming Windows Server is not installed on this machine

Choose Custom: Install Windows only (advanced)



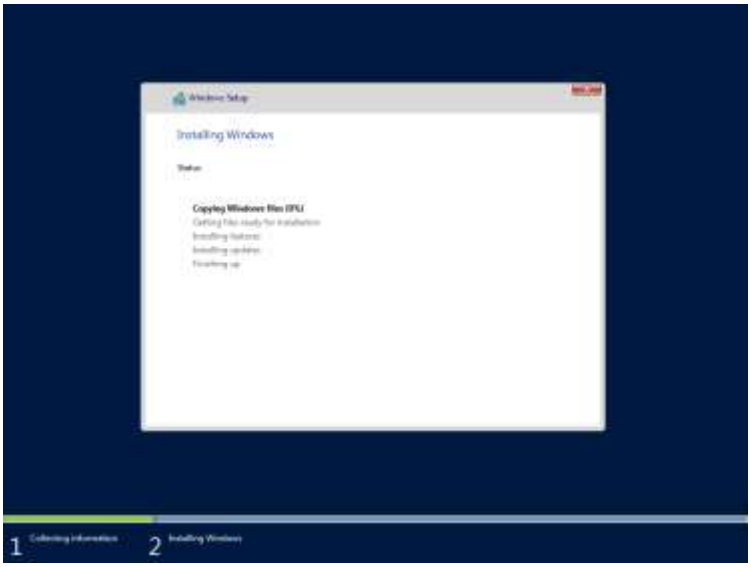
6) Choose the drive

Select the drive you would like to install to and click Next



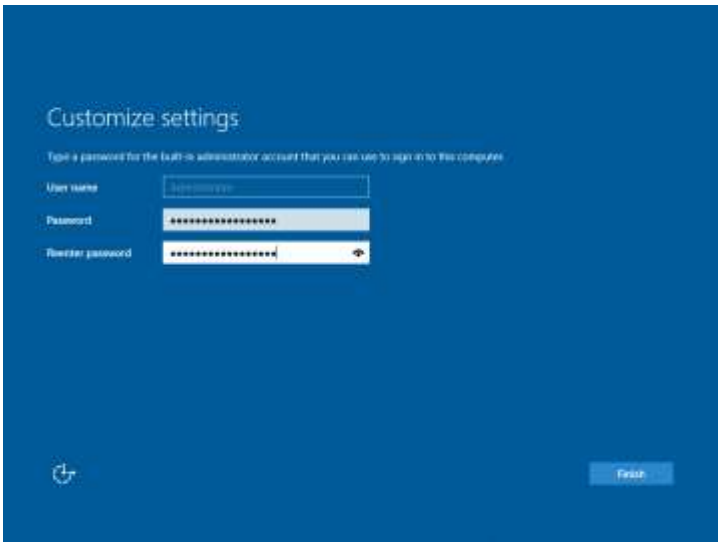
7) Let the install complete

See examples of the progress below



8) Enter the administrator password

Enter the password you would like to use for the administrator account then click Finish or hit Enter



9) Installation is now complete!

You are now at the login screen

Installing and Configuring Active Directory – Windows Server 2016

What is Active Directory and how does it work?

Active Directory (AD) is Microsoft's proprietary directory service. It runs on Windows Server and enables administrators to manage permissions and access to network resources.

Active Directory stores data as objects. An object is a single element, such as a user, group, application or device such as a printer. Objects are normally defined as either resources, such as printers or computers, or security principals, such as users or groups.

Active Directory services

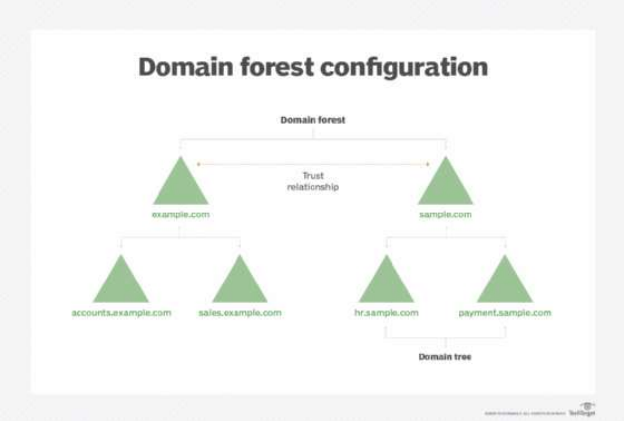
Several different services comprise Active Directory. The main service is Domain Services, but Active Directory also includes Lightweight Directory Services (AD LDS), Lightweight Directory Access Protocol (LDAP), Certificate Services, or AD CS, Federation Services (AD FS) and Rights Management Services (AD RMS). Each of these other services expands the product's directory management capabilities.

- Lightweight Directory Services has the same codebase as AD DS, sharing similar functionalities, such as the application program interface. AD LDS, however, can run in multiple instances on one server and holds directory data in a data store using Lightweight Directory Access Protocol.
- Lightweight Directory Access Protocol is an application protocol used to access and maintain directory services over a network. LDAP stores objects, such as usernames and passwords, in directory services, such as Active Directory, and shares that object data across the network.

- Certificate Services generates, manages and shares certificates. A certificate uses encryption to enable a user to exchange information over the internet securely with a public key.
- Active Directory Federation Services authenticates user access to multiple applications -- even on different networks -- using single sign-on (SSO). As the name indicates, SSO only requires the user to sign on once, rather than use multiple dedicated authentication keys for each service.
- Rights Management Services control information rights and management. AD RMS encrypts content, such as email or Microsoft Word documents, on a server to limit access.

Major features in Active Directory Domain Services

Active Directory Domain Services uses a tiered layout structure consisting of domains, trees and forests to coordinate networked elements.



Domains are the smallest of the main tiers, while forests are the largest. Different objects, such as users and devices, that share the same database will be on the same domain. A tree is one or more domains grouped together with hierarchical trust relationships. A forest is a group of multiple trees. Forests provide security boundaries, while domains -- which share a common database -- can be managed for settings such as authentication and encryption.

- A domain is a group of objects, such as users or devices, that share the same AD database. Domains have a domain name system
- A tree is one or more domains grouped together. The tree structure uses a contiguous namespace to gather the collection of domains in a logical hierarchy. Trees can be viewed as trust relationships where a secure connection, or trust, is shared between two domains. Multiple domains can be trusted where one domain can trust a second, and the second domain can trust a third. Because of the hierarchical nature of this setup, the first domain can implicitly trust the third domain without needing explicit trust.
- A forest is a group of multiple trees. A forest consists of shared catalogs, directory schemas, application information and domain configurations. The schema defines an object's class and attributes in a forest. In addition, global catalog servers provide a listing of all the objects in a forest. According to Microsoft, the forest is Active Directory's security boundary.
- Organizational Units (OUs) organize users, groups and devices. Each domain can contain its own OU. However, OUs cannot have separate namespaces, as each user or object in a domain must be unique. For example, a user account with the same username cannot be created.
- Containers are similar to OUs, but Group Policy Objects cannot be applied or linked to container objects.

Practical

Prerequisites

Before Starting, I recommend changing the server's name and setting a static IP. Attempting to change these after Active Directory installation can cause headaches. If you are unsure how to do this, please view one of the following articles.

Configure Server Using Sconfig

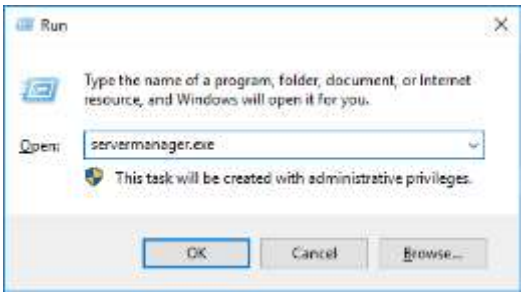
Configure Server Using Server Manager

1) Open Server Manager

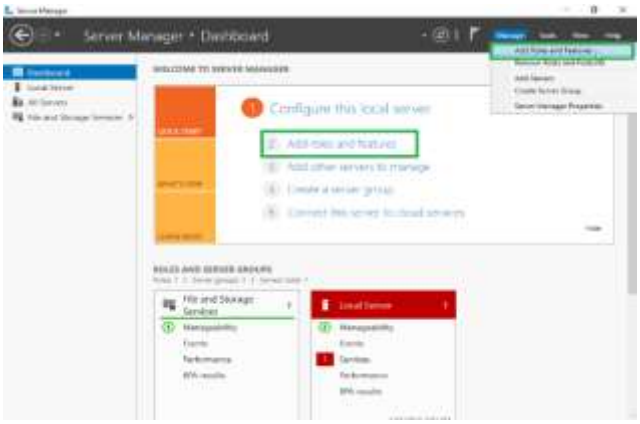
Open the Run box using Win+R, type servermanager.exe, and click

or

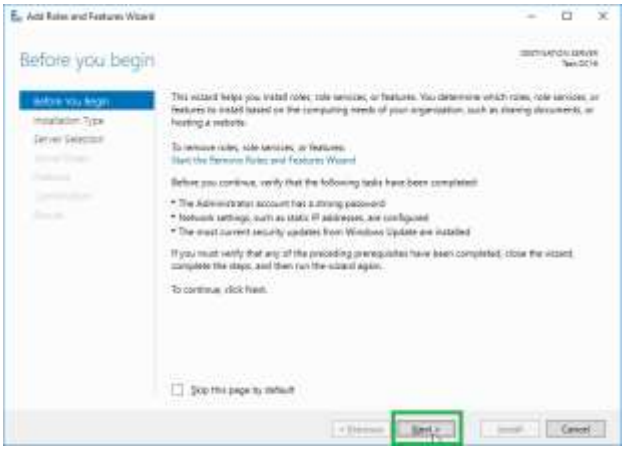
Search Server Manager in the Start Menu and click it



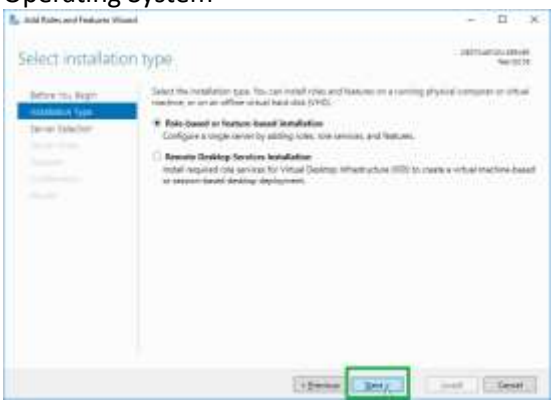
2) Choose either "Add Roles and Features" Option



3) Click Next

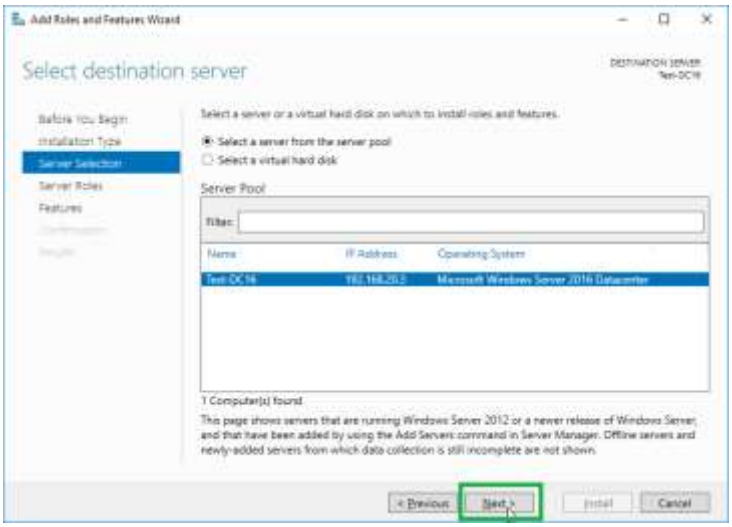


4) Click Next

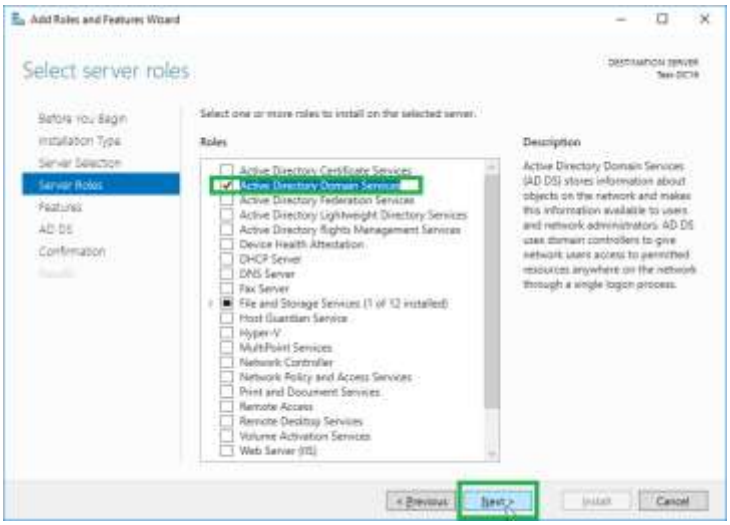


5) Select the server

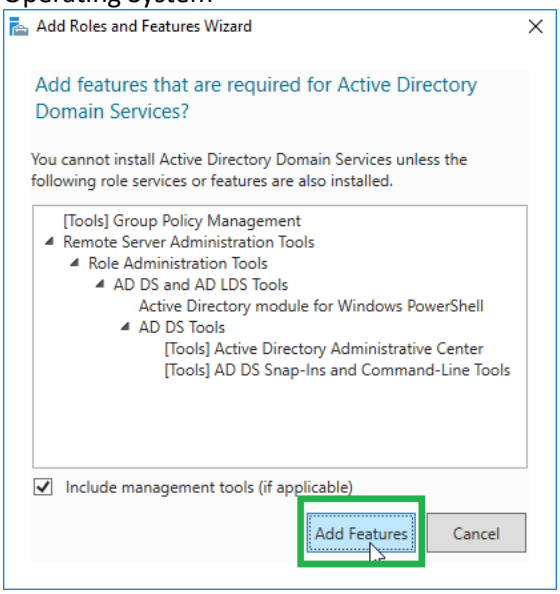
If installing to the local machine, simply click next



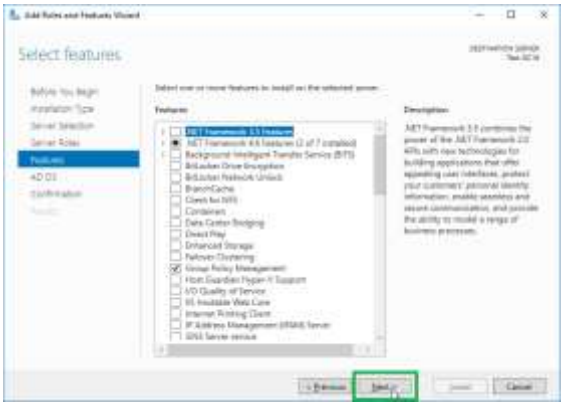
6) Check “Active Directory Domain Services” and click Next



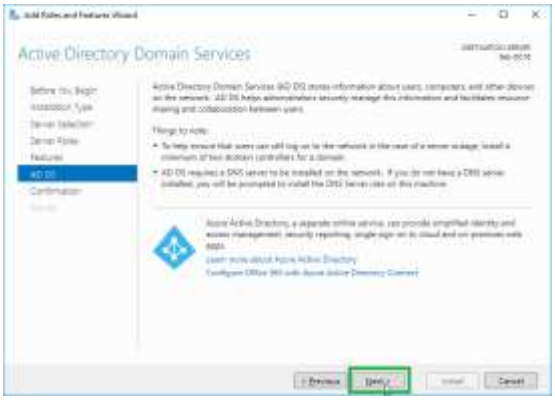
7) Click Add Features



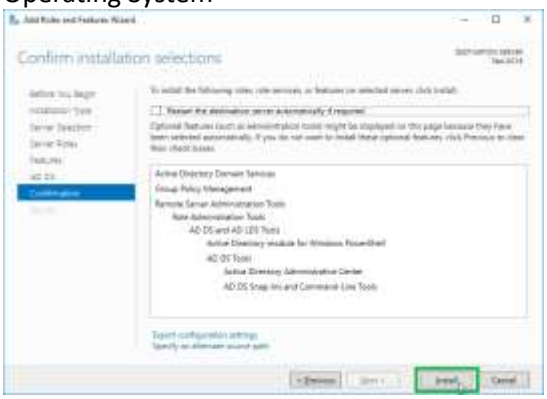
8) Click Next



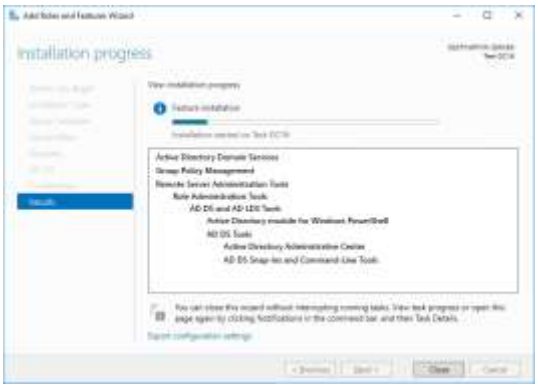
9) Click Next

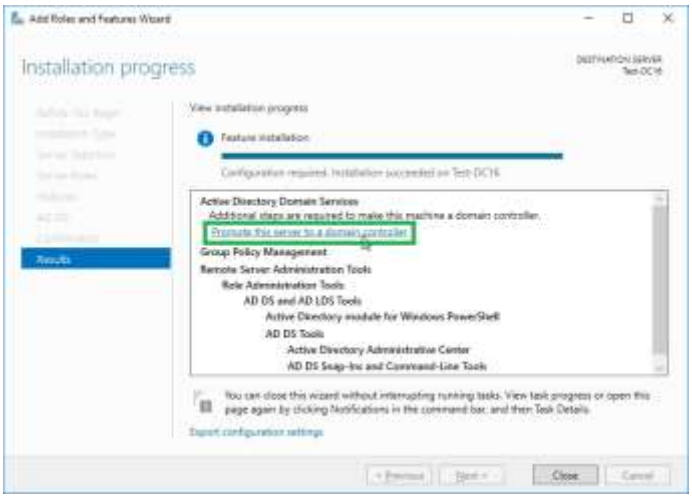


10) Click Install



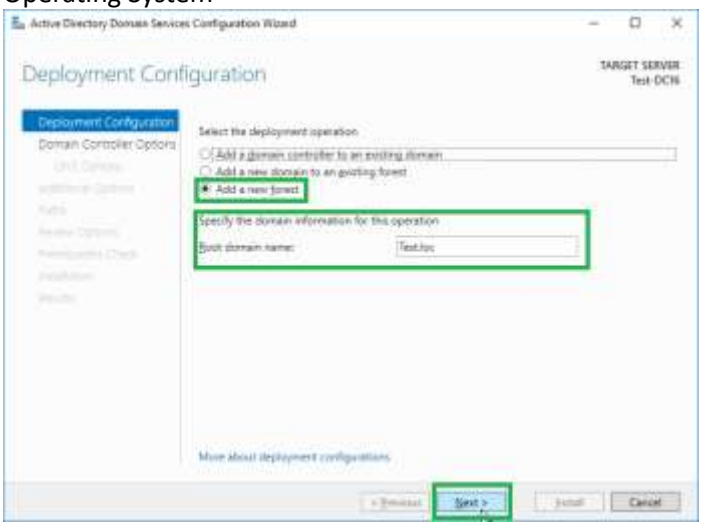
11) Wait for the install to finish and click “Promote this server to a domain controller”





12) Choose “Add a new forest”, enter a Domain Name, and Click Next

This is assuming that the server is not going to be part of a pre-existing domain and the new domain is not going to be added to a pre-existing forest.



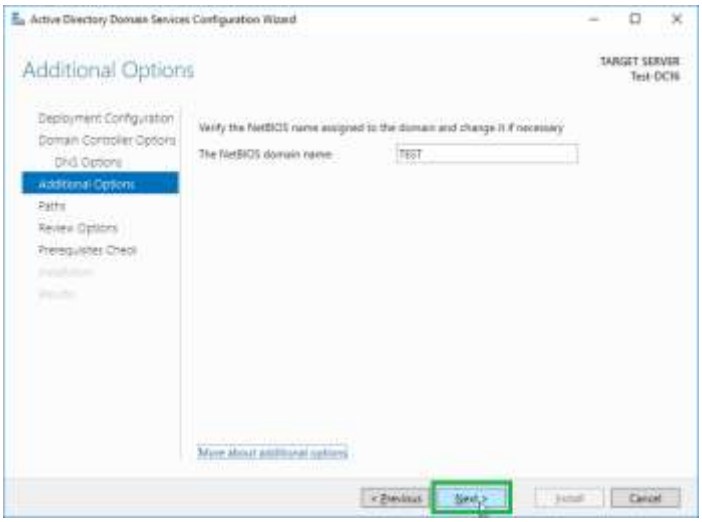
13) Enter a password for DSRM and click next

Again, this is assuming that the server is a new, stand-alone, Domain Controller. If it will be joining a pre-existing forest and/or domain, the functional levels may need to be changed to match the function levels currently in place.

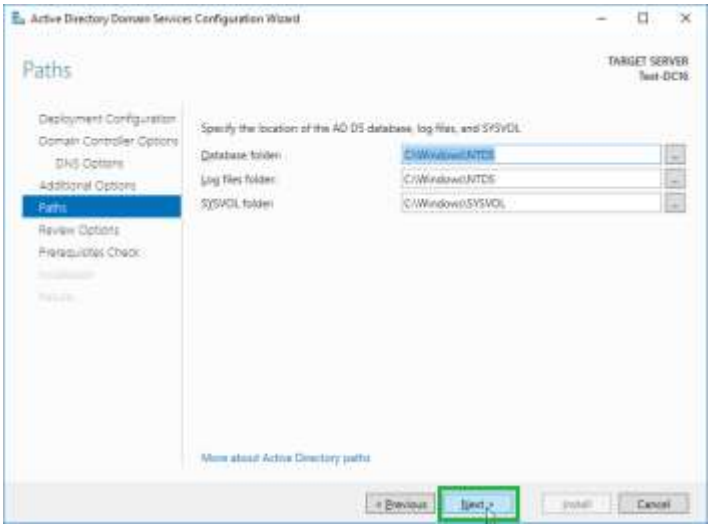
14) Click Next

This is assuming you do not have existing DNS servers for which delegation may be required.

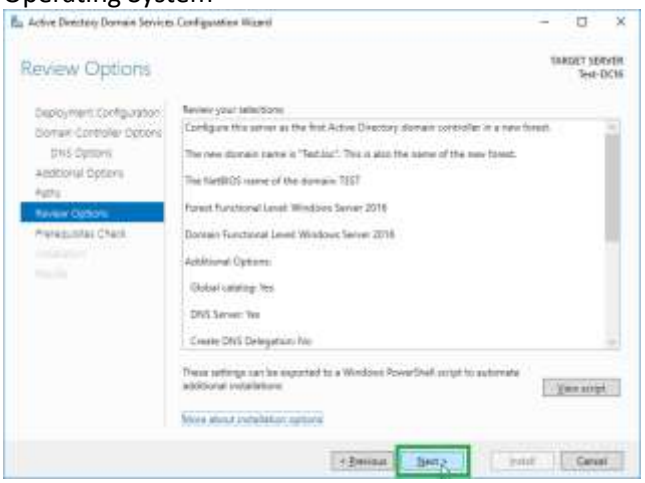
15) Click Next



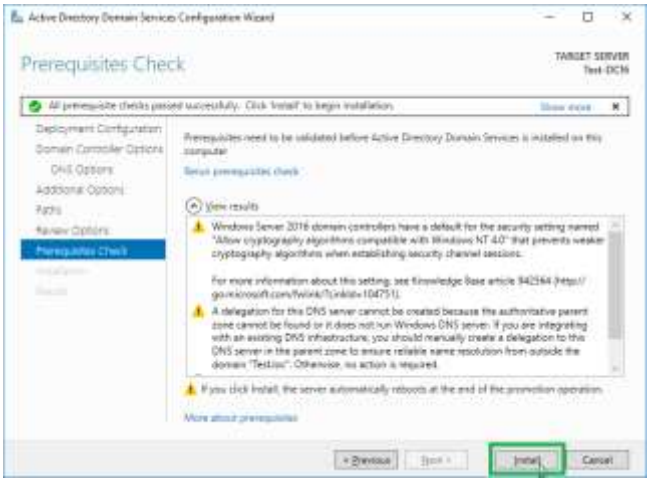
16) Click Next



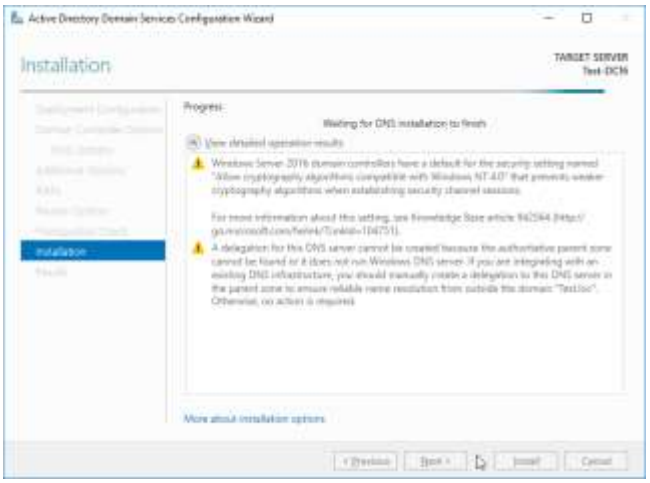
17) Click Next



18) Click Install



19) Wait for Install to Finish



20) The Active Directory and DNS roles are now installed

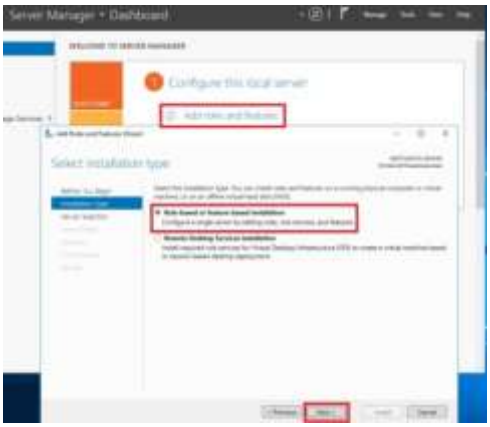
See Windows Administrative Tools to find the management applications

How to configure a DHCP server in Windows Server 2016

DHCP is a dynamic host configuration protocol that allows automating the configuration of client network parameters, such as IP address, gateway, DNS, subnet mask. The DHCP server controls the issuance of IP addresses, prevents duplication and frees unused addresses.

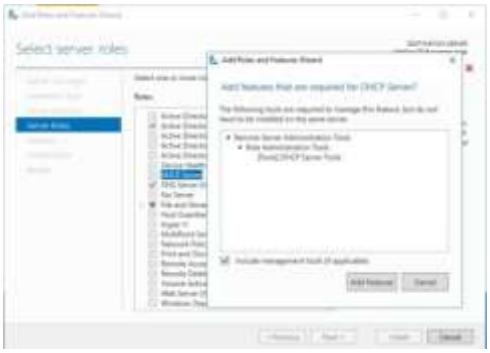
Installation process

- Launch Server Manager and select “Add roles and features”. Choose the first item "Role-based or feature-based installation":

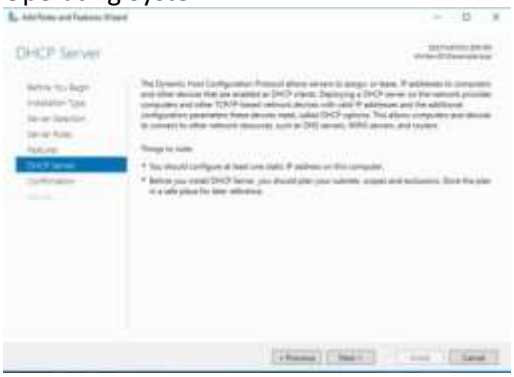


- Specify the server on which we will install the DHCP role:

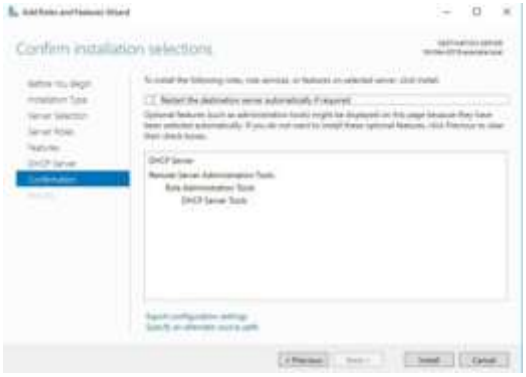
- Next, you need to find and select the DHCP role in the list. We agree to add the components required for the DHCP service to work properly. Since the components were added at the “Server Roles” step, we skip the “Features” step:



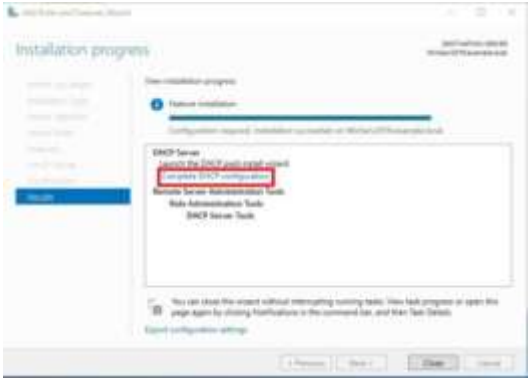
- The wizard reminds you to plan your subnets, areas, and exceptions:



- We check the installed components and click "Install":



- After the installation is complete, you can begin the initial configuration of DHCP. We follow the link "Complete DHCP configuration":

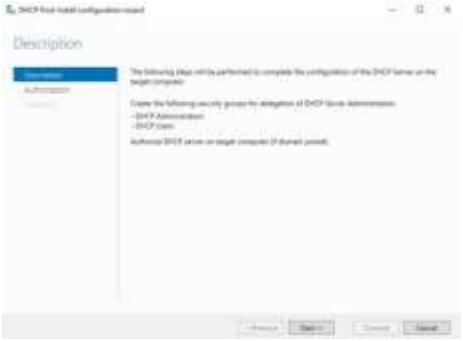


The initial setup process takes place in two stages:

1. Create a “Security Group” to manage this DHCP server. There are two of them:

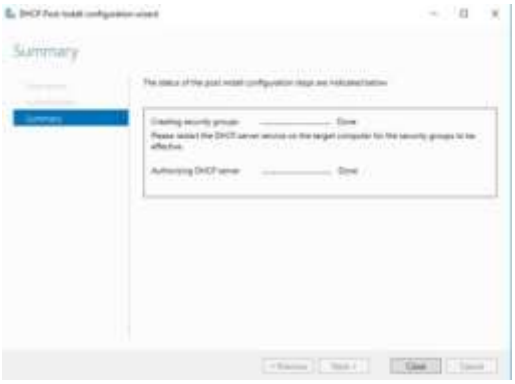
- DHCP Administrators - group members have full rights to manage the DHCP server;
- DHCP Users - members of the group can view server settings and a list of connected devices.

2. Authorization of a DHCP server in Active Directory (if it is joined to a domain). This setting is necessary to avoid the appearance of extraneous DHCP servers on the network. The server must be authorized for the DHCP service to start:



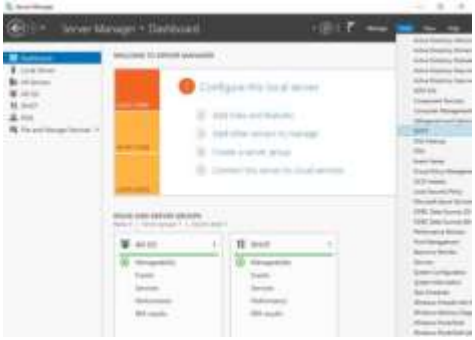
- Enter the administrator credentials and click on the “Commit” button. If the server is not joined to the domain, then select the last item:

- If everything is done correctly, the wizard notifies that the configuration was successful:

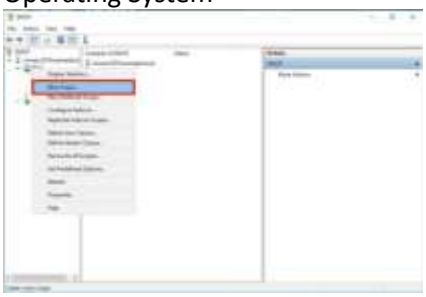


Setup process

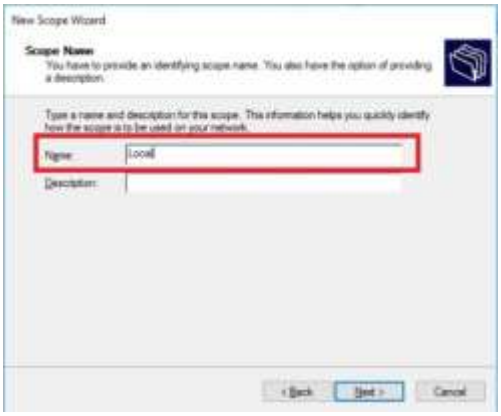
Launch the "Server Manager". We find the DHCP item in the "Tools" drop-down list:



In our version, we are considering issuing IPv4 addresses, so we need to create a new area (Scope) - a pool of IP addresses issued to clients. Right-click on IPv4 and select “New Scope ...”:

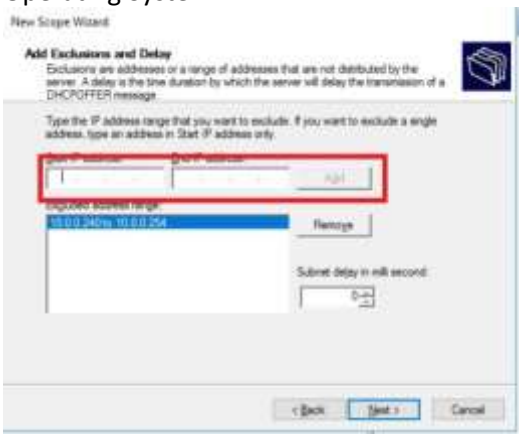


The Create Area Wizard opens, where we enter the name of the pool. If necessary, you can enter a description:



We determine the boundaries of our pool by setting the start and end IP addresses. Also, enter the subnet mask:

If necessary, you can add one or more IP addresses from the created pool to the exceptions. This range may include network devices that are already assigned a static IP. There is also a parameter for delaying the response of the server before sending data to the request from the host:



Next, you can specify the lease time of the IP address. The default is 8 days:

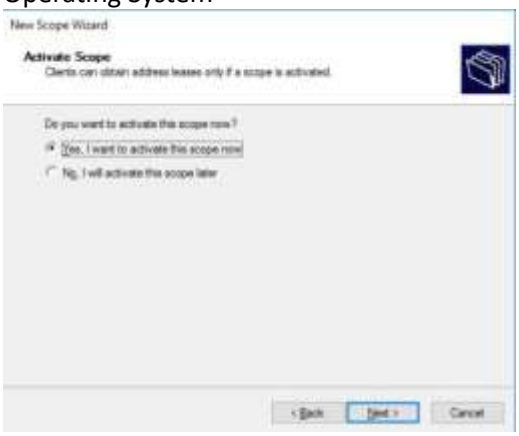
Now the Wizard will offer to specify the network parameters (Gateway, DNS, WINS) issued to clients on the network:

Specify the address of the network gateway:

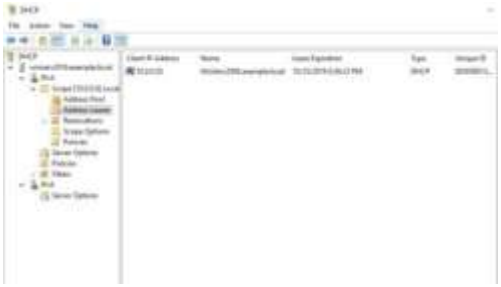
Next, enter the domain name and DNS server. DNS can be found either by server name or by specifying an IP address:

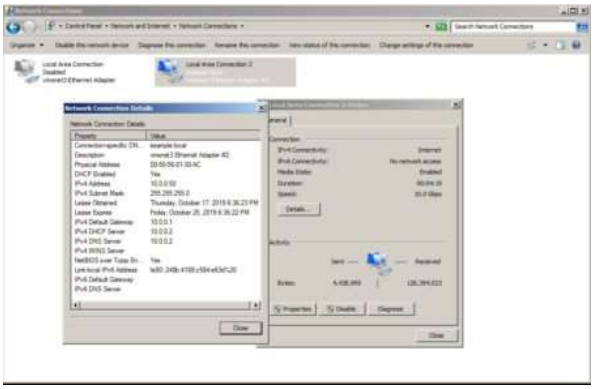
The next step allows to add a WINS server:

Select "Activate" the area we specified now:



After setting up the pool, you can check if the server is working. You can see connected clients by going to the Address Leases section. In our case, we see that one device is connected:

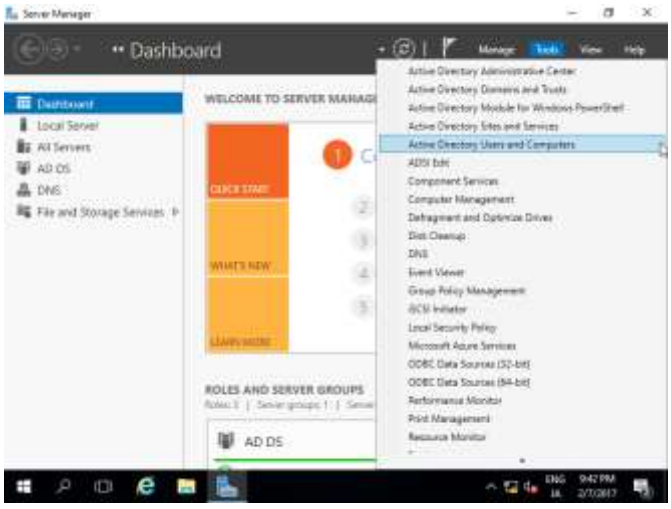




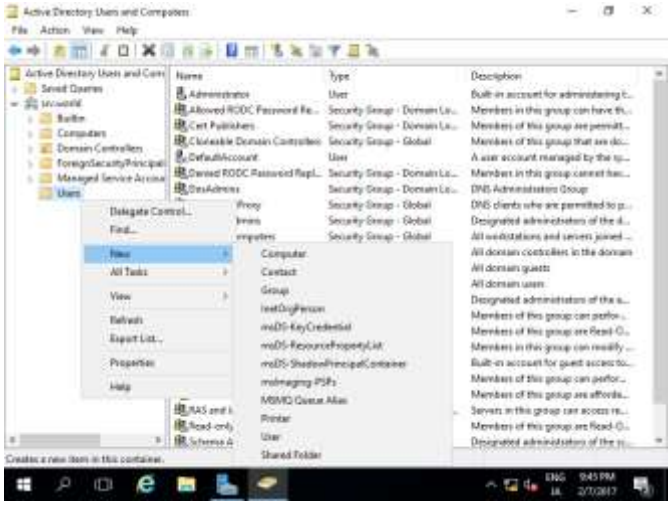
If we go to the client machine, we can check the correctness of the received settings:

Add Domain User Accounts on Active Directory.

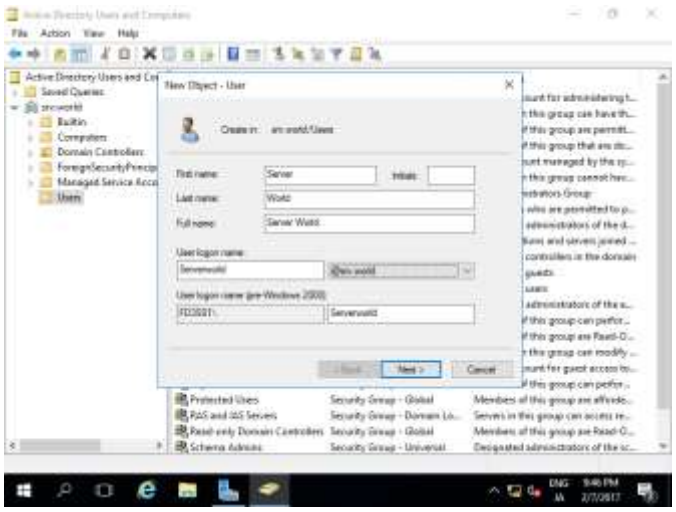
[1] Log into server as administrator.



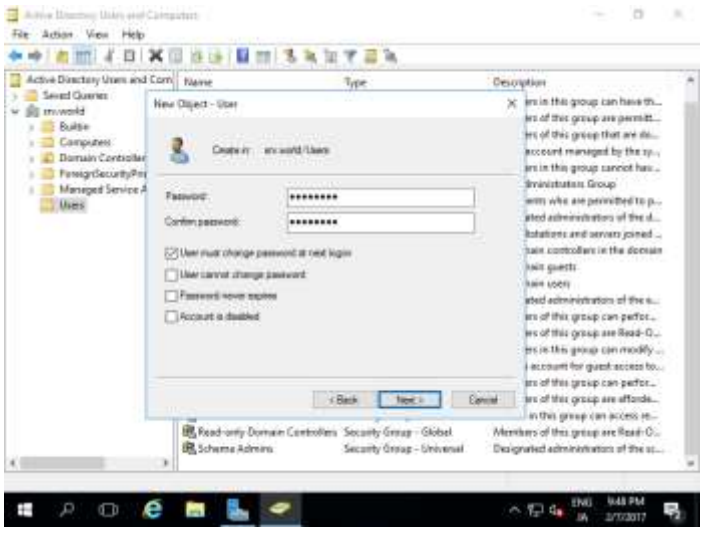
[2] Right-Click ➔ [Users] on left tree and ➔select [New]➔ [User].



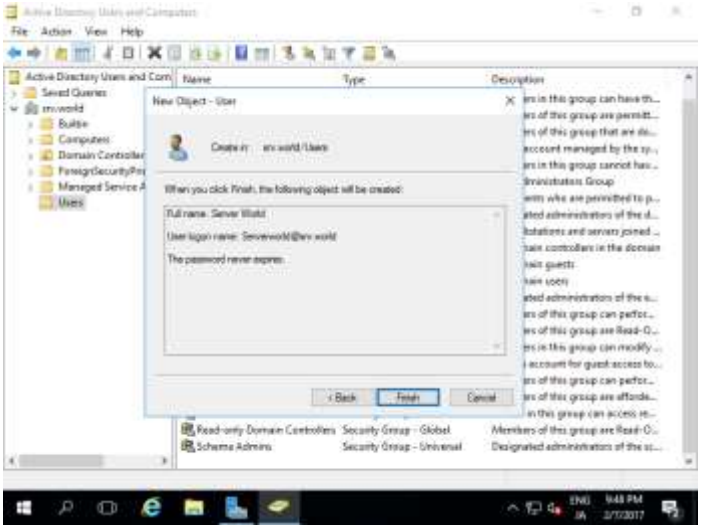
[3] Input Username and Logon name for a new user.



[4] Set initial password for a new User.



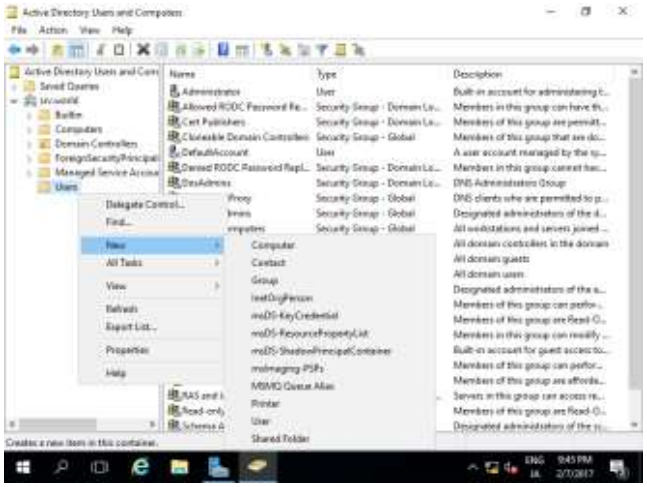
[5] Check contents you set and click [Finish] button.



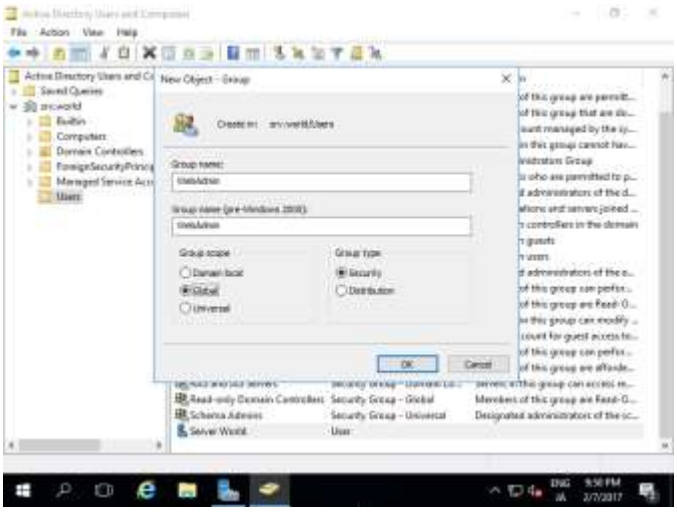
[6] A new user is just added.

Add Group Accounts on Active Directory.

[1] Run ➔[Server Manager] and open ➔[Tools] ➔ [Active Directory Users and Conputers], next, Click with right button➔ [Users] on left tree and select ➔[New] ➔[Group].



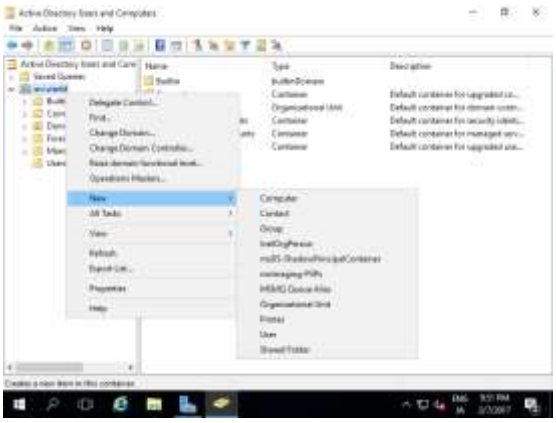
[2] Input a Group name you'd like to add.



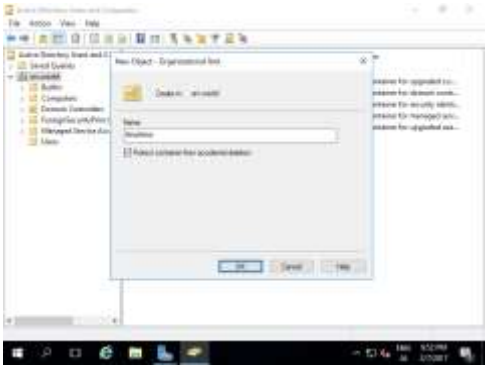
[3] A new Group is just added.

Add Organizational Unit on Active Directory.

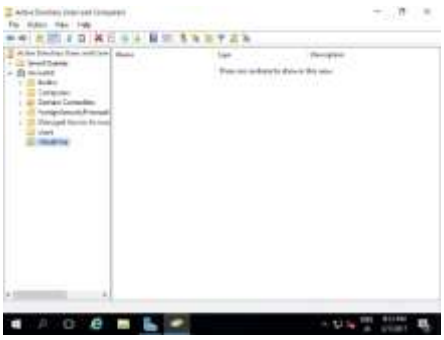
[1] Run [Server Manager] and open [Tools] ➔ [Active Directory Users and Computers], next, right-Click your domain name on the left tree and select [New] ➔ [Organizational Unit].



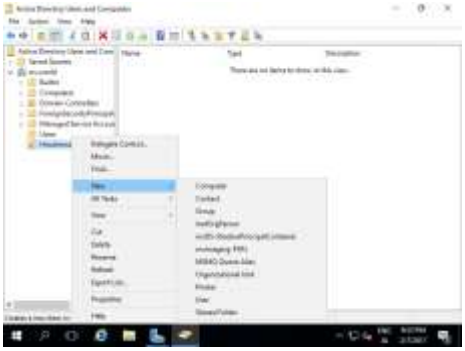
[2] Set any name you like.



[3] A new Organizational Unit is just created.



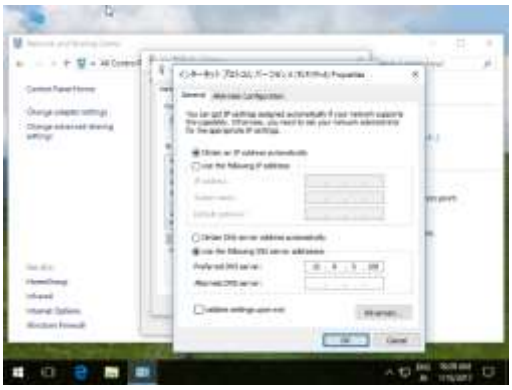
[4] It's possible to configure hierarchical design for Organizational Unit.



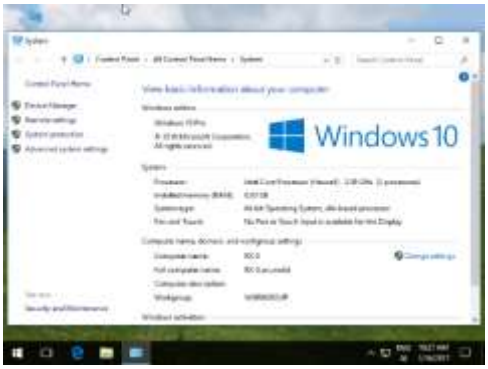
[5] A new Organizational Unit "development01" is created under the OU "Hiroshima" as an example

Join in Active Directory Domain from Other Windows Clients. This example is based on Windows 10.

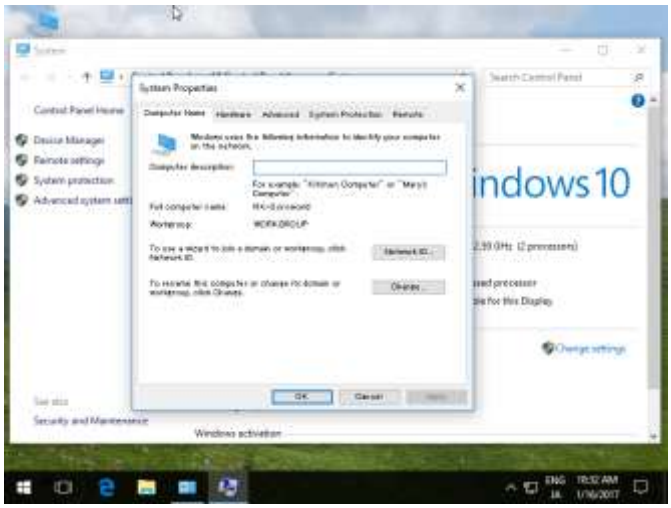
[1] Before setting, change to DNS settings to refer Active Directory Host.



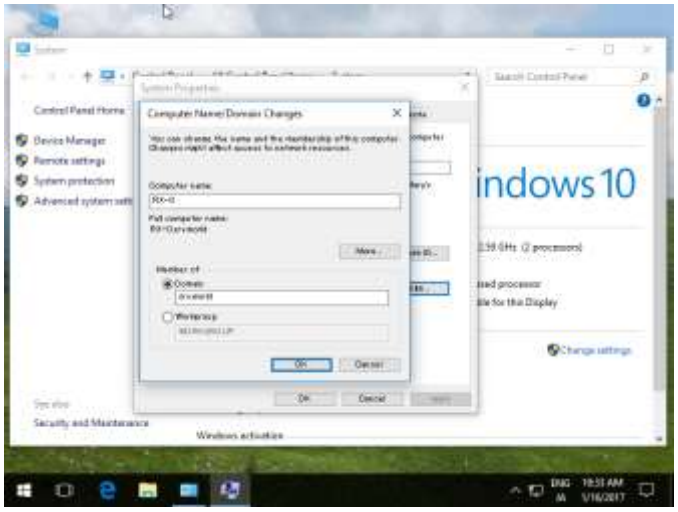
[2] Open [System] and click [Change settings] link which is lower-right.



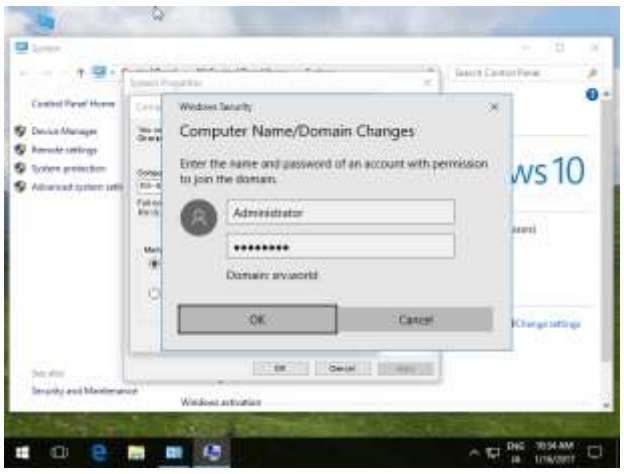
[3] Move to [Computer Name] tab and click [Change] button.



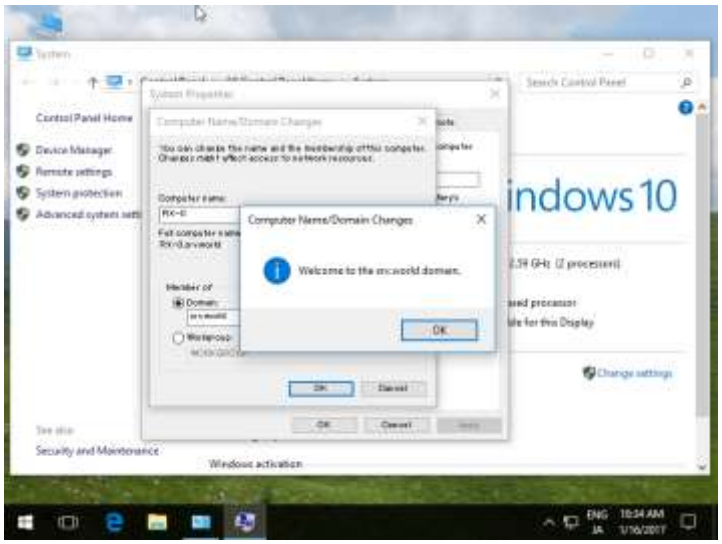
[4] Check a box [Domain] and input domain name and next, click [OK] button.



[5] Authentication is required, authenticate with a domain User in AD.



[6] After successful authentication, Welcome message is shown like follows. Restart the Computer once.



[7] On the logon screen after restarting Computer, click "another user" to switch Domain user to logon.

[8] Authenticate with a Domain user you added.

[9] Just Logon to Active Directory Domain.

Configure DNS Server to resolve Hostname or IP Address.

DNS Definition

The Domain Name System (DNS) turns domain names into IP addresses, which browsers use to load internet pages. Every device connected to the internet has its own IP address, which is used by other devices to locate the device. DNS servers make it possible for people to input normal words into their browsers, such as Fortinet.com, without having to keep track of the IP address for every website.

What Is A DNS Server?

A DNS server is a computer with a database containing the public IP addresses associated with the names of the websites an IP address brings a user to. DNS acts like a phonebook for the internet. Whenever people type domain names, like Fortinet.com or Yahoo.com, into the address bar of web browsers, the DNS finds the right IP address. The site's IP address is what directs the device to go to the correct place to access the site's data.

Once the DNS server finds the correct IP address, browsers take the address and use it to send data to content delivery network (CDN) edge servers or origin servers. Once this is done, the information on the website can be accessed by the user. The DNS server starts the process by finding the corresponding IP address for a website's uniform resource locator (URL).

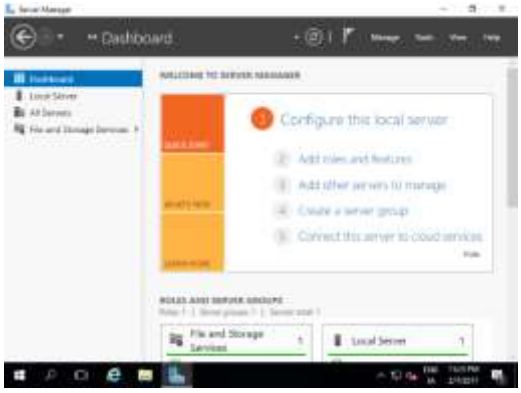
How Does DNS Work?

In a usual DNS query, the URL typed in by the user has to go through four servers for the IP address to be provided. The four servers work with each other to get the correct IP address to the client, and they include:

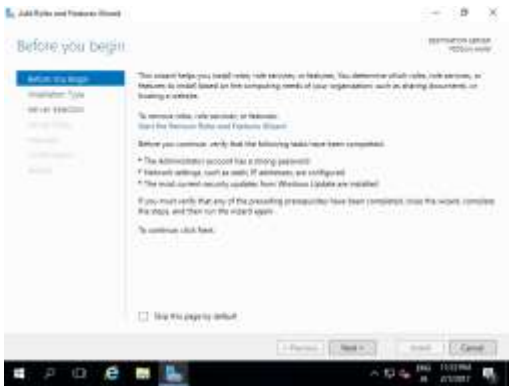
1. DNS recursor: The DNS recursor, which is also referred to as a DNS resolver, receives the query from the DNS client. Then it communicates with other DNS servers to find the right IP address. After the resolver retrieves the request from the client, the resolver acts like a client itself. As it does this, it makes queries that get sent to the other three DNS servers: root nameservers, top-level domain (TLD) nameservers, and authoritative nameservers.
2. Root nameservers: The root nameserver is designated for the internet's DNS root zone. Its job is to answer requests sent to it for records in the root zone. It answers requests by sending back a list of the authoritative nameservers that go with the correct TLD.
3. TLD nameservers: A TLD nameserver keeps the IP address of the second-level domain contained within the TLD name. It then releases the website's IP address and sends the query to the domain's nameserver.
4. Authoritative nameservers: An authoritative nameserver is what gives you the real answer to your DNS query. There are two types of authoritative nameservers: a master server or primary nameserver and a slave server or secondary nameserver. The master server keeps the original copies of the zone records, while the slave server is an exact copy of the master server. It shares the DNS server load and acts as a backup if the master server fails.

Practical

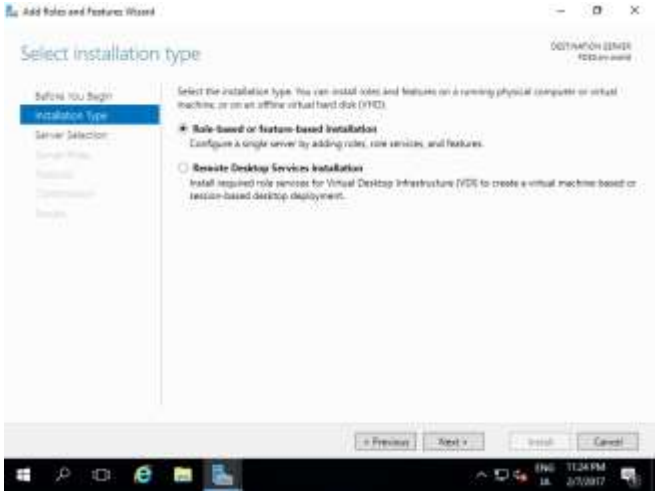
[1] Run Server Manager and Click [Add roles and features].



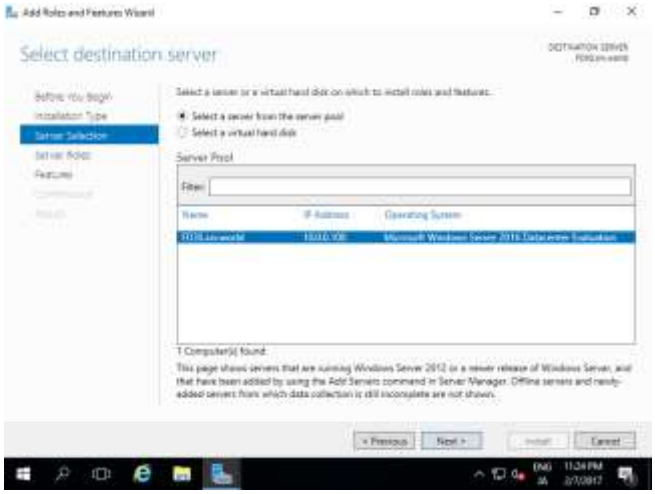
[2] Click [Next] button.



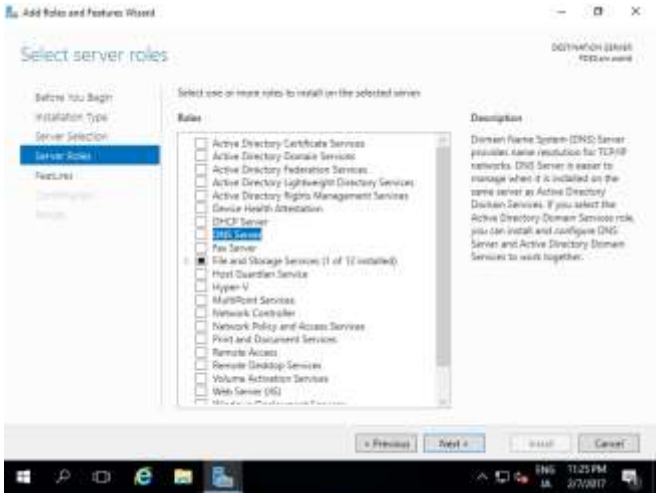
[3] Select [Role-based or feature-based installation].



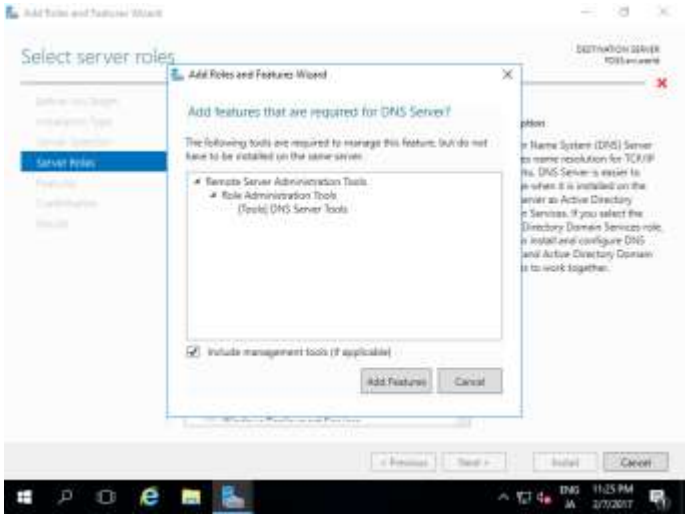
[4] Select a Host which you'd like to add services.



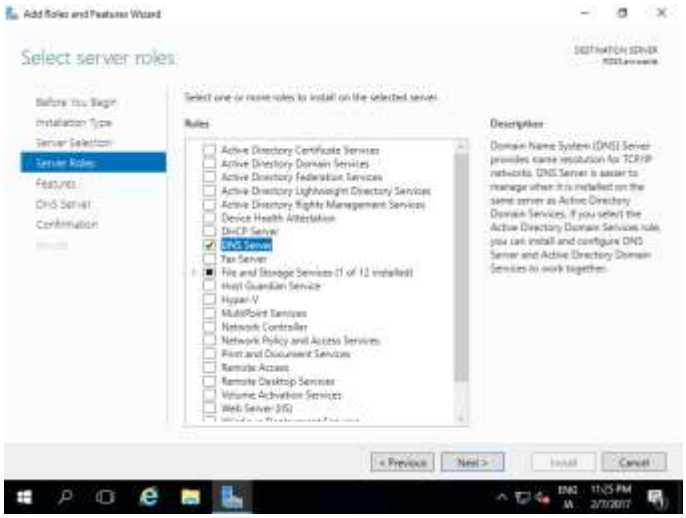
[5] Check a box [DNS Server].



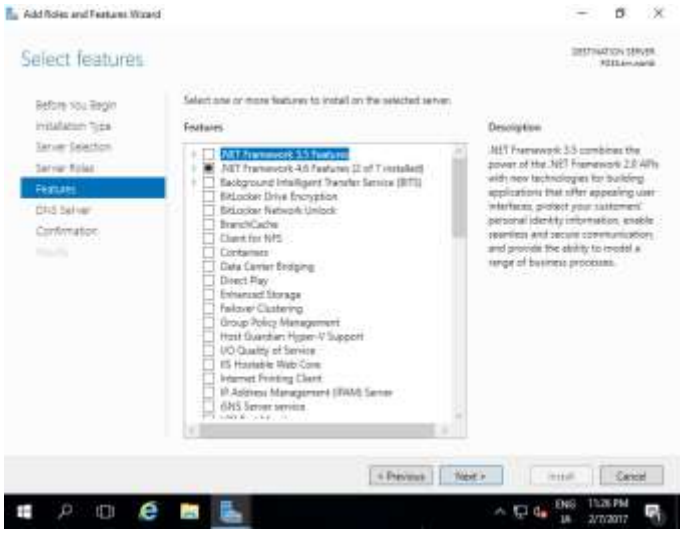
[6] Addtional features are required to add DNS Server. Click [Add Features] button.



[7] Click [Next] button.

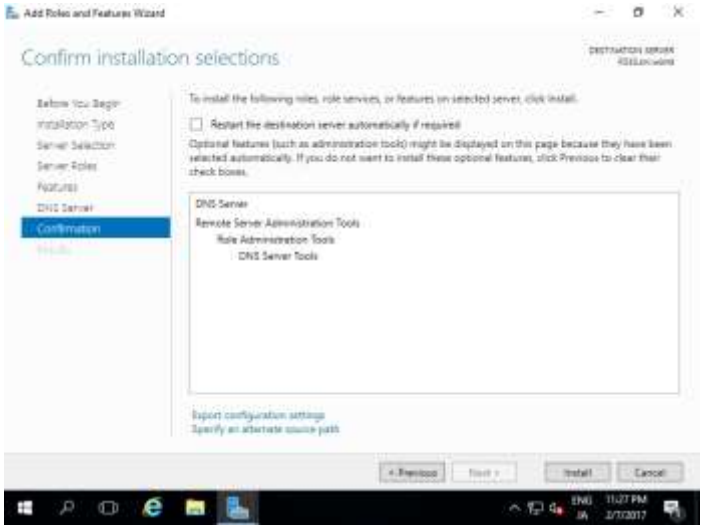


[8] Click [Next] button.



[9] Click [Next] button.

[10] Click [Install] button.



[11] After finishing Installation, click [Close] button.

Install DHCP (Dynamic Host Configuration Protocol) Server.

Dynamic Host Configuration Protocol (DHCP)

Dynamic Host Configuration Protocol is a network protocol used to automate the process of assigning IP addresses and other network configuration parameters to devices (such as computers, smartphones, and printers) on a network. Instead of manually configuring each device with an IP address, DHCP allows devices to connect to a network and receive all necessary network information, like IP address, subnet mask, default gateway, and DNS server addresses, automatically from a DHCP server.

What is DHCP?

DHCP stands for Dynamic Host Configuration Protocol. It is the critical feature on which the users of an enterprise network communicate. DHCP helps enterprises to smoothly manage the allocation of IP addresses to the end-user clients' devices such as desktops, laptops, cellphones, etc. is an application layer protocol that is used to provide.

Why Do We Use DHCP?

DHCP helps in managing the entire process automatically and centrally. DHCP helps in maintaining a unique IP Address for a host using the server. DHCP servers maintain information on TCP/IP configuration and provide configuration of address to DHCP-enabled clients in the form of a lease offer.

Components of DHCP

The main components of DHCP include:

- DHCP Server: DHCP Server is a server that holds IP Addresses and other information related to configuration.
- DHCP Client: It is a device that receives configuration information from the server. It can be a mobile, laptop, computer, or any other electronic device that requires a connection.
- DHCP Relay: DHCP relays basically work as a communication channel between DHCP Client and Server.
- IP Address Pool: It is the pool or container of IP Addresses possessed by the DHCP Server. It has a range of addresses that can be allocated to devices.
- Subnets: Subnets are smaller portions of the IP network partitioned to keep networks under control.
- Lease: It is simply the time that how long the information received from the server is valid, in case of expiration of the lease, the tenant must have to re-assign the lease.
- DNS Servers: DHCP servers can also provide DNS (Domain Name System) server information to DHCP clients, allowing them to resolve domain names to IP addresses.
- Default Gateway: DHCP servers can also provide information about the default gateway, which is the device that packets are sent to when the destination is outside the local network.
- Options: DHCP servers can provide additional configuration options to clients, such as the subnet mask, domain name, and time server information.
- Renewal: DHCP clients can request to renew their lease before it expires to ensure that they continue to have a valid IP address and configuration information.
- Failover: DHCP servers can be configured for failover, where two servers work together to provide redundancy and ensure that clients can always obtain an IP address and configuration information, even if one server goes down.
- Dynamic Updates: DHCP servers can also be configured to dynamically update DNS records with the IP address of DHCP clients, allowing for easier management of network resources.

- Audit Logging: DHCP servers can keep audit logs of all DHCP transactions, providing administrators with visibility into which devices are using which IP addresses and when leases are being assigned or renewed.

DHCP Packet Format

DHCP Packet Format

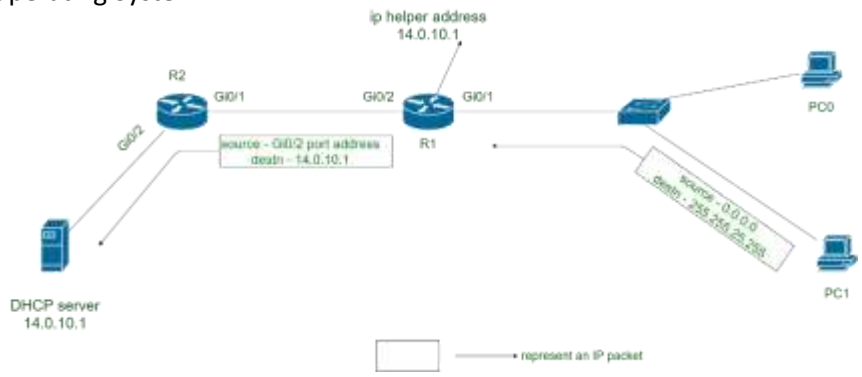
- Hardware Length: This is an 8-bit field defining the length of the physical address in bytes. e.g for Ethernet the value is 6.
- Hop count: This is an 8-bit field defining the maximum number of hops the packet can travel.
- Transaction ID: This is a 4-byte field carrying an integer. The transcation identification is set by the client and is used to match a reply with the request. The server returns the same value in its reply.

- Number of Seconds: This is a 16-bit field that indicates the number of seconds elapsed since the time the client started to boot.
- Flag: This is a 16-bit field in which only the leftmost bit is used and the rest of the bit should be set to os. A leftmost bit specifies a forced broadcast reply from the server. If the reply were to be unicast to the client, the destination. IP address of the IP packet is the address assigned to the client.
- Client IP Address: This is a 4-byte field that contains the client IP address . If the client does not have this information this field has a value of 0.
- Your IP Address: This is a 4-byte field that contains the client IP address. It is filled by the server at the request of the client.
- Server IP Address: This is a 4-byte field containing the server IP address. It is filled by the server in a reply message.
- Gateway IP Address: This is a 4-byte field containing the IP address of a routers. IT is filled by the server in a reply message.
- Client Hardware Address: This is the physical address of the client .Although the server can retrieve this address from the frame sent by the client it is more efficient if the address is supplied explicity by the client in the request message.
- Server Name: This is a 64-byte field that is optionally filled by the server in a reply packet. It contains a null-terminated string consisting of the domain name of the server. If the server does not want to fill this filed with data, the server must fill it with all 0s.
- Boot Filename: This is a 128-byte field that can be optionally filled by the server in a reply packet. It contains a null- terminated string consisting of the full pathname of the boot file. The client can use this path to retrieve other booting information. If the server does not want to fill this field with data, the server must fill it with all 0s.
- Options: This is a 64-byte field with a dual purpose. IT can carry either additional information or some specific vendor information. The field is used only in a reply message. The server uses a number, called a magic cookie, in the format of an IP address with the value of 99.130.83.99. When the client finishes reading the message, it looks for this magic cookie. If present the next 60 bytes are options.

Working of DHCP

DHCP works on the Application layer of the UDP Protocol. The main task of DHCP is to dynamically assigns IP Addresses to the Clients and allocate information on TCP/IP configuration to Clients. For more, you can refer to the Article Working of DHCP.

The DHCP port number for the server is 67 and for the client is 68. It is a client-server protocol that uses UDP services. An IP address is assigned from a pool of addresses. In DHCP, the client and the server exchange mainly 4 DHCP messages in order to make a connection, also called the DORA process, but there are 8 DHCP messages in the process.



Working of DHCP

The 8 DHCP Messages

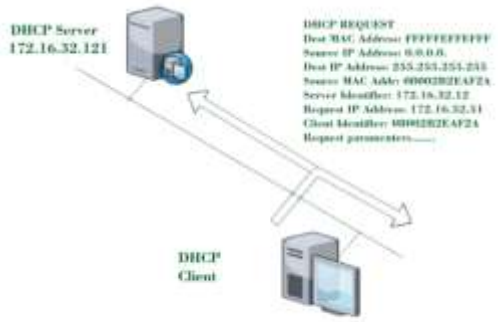
1. DHCP Discover Message: This is the first message generated in the communication process between the server and the client. This message is generated by the Client host in order to discover if there is any DHCP server/servers are present in a network or not. This message is broadcasted to all devices present in a network to find the DHCP server. This message is 342 or 576 bytes long.

DHCP Discover Message

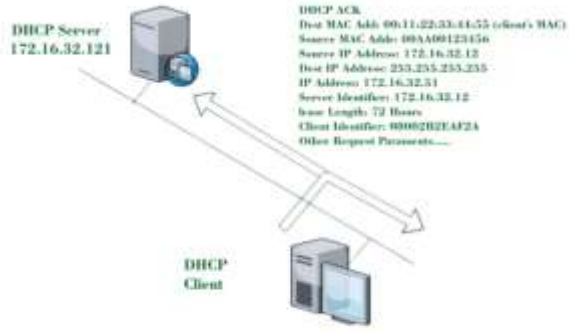
2. DHCP Offers A Message: The server will respond to the host in this message specifying the unleased IP address and other TCP configuration information. This message is broadcasted by the server. The size of the message is 342 bytes. If there is more than one DHCP server present in the network then the client host will accept the first DHCP OFFER message it receives. Also, a server ID is specified in the packet in order to identify the server.

DHCP Offer Message

3. DHCP Request Message: When a client receives an offer message, it responds by broadcasting a DHCP request message. The client will produce a gratuitous ARP in order to find if there is any other host present in the network with the same IP address. If there is no reply from another host, then there is no host with the same TCP configuration in the network and the message is broadcasted to the server showing the acceptance of the IP address. A Client ID is also added to this message.



4. DHCP Acknowledgment Message: In response to the request message received, the server will make an entry with a specified client ID and bind the IP address offered with lease time. Now, the client will have the IP address provided by the server.



5. DHCP Negative Acknowledgment Message: Whenever a DHCP server receives a request for an IP address that is invalid according to the scopes that are configured, it sends a DHCP Nak message to the client. Eg-when the server has no IP address unused or the pool is empty, then this message is sent by the server to the client.

6. DHCP Decline: If the DHCP client determines the offered configuration parameters are different or invalid, it sends a DHCP decline message to the server. When there is a reply to the gratuitous ARP by any host to the client, the client sends a DHCP decline message to the server showing the offered IP address is already in use.

7. DHCP Release: A DHCP client sends a DHCP release packet to the server to release the IP address and cancel any remaining lease time.

8. DHCP Inform: If a client address has obtained an IP address manually then the client uses DHCP information to obtain other local configuration parameters, such as domain name. In reply to the DHCP inform message, the DHCP server generates a DHCP ack message with a local configuration suitable for the client without allocating a new IP address. This DHCP ack message is unicast to the client.

Note – All the messages can be unicast also by the DHCP relay agent if the server is present in a different network.

Security Considerations for Using DHCP

To make sure your DHCP servers are safe, consider these DHCP security issues:

- Limited IP Addresses : A DHCP server can only offer a set number of IP addresses. This means attackers could flood the server with requests, causing essential devices to lose their connection.
- Fake DHCP Servers : Attackers might set up fake DHCP servers to give out fake IP addresses to devices on your network.
- DNS Access : When users get an IP address from DHCP, they also get DNS server details. This could potentially allow them to access more data than they should. It's important to restrict network access, use firewalls, and secure connections with VPNs to protect against this.

Protection Against DHCP Starvation Attack

A DHCP starvation attack happens when a hacker floods a DHCP server with requests for IP addresses. This overwhelms the server, making it unable to assign addresses to legitimate users. The hacker can then block access for authorized users and potentially set up a fake DHCP server to intercept and manipulate network traffic, which could lead to a man-in-the-middle attack.

Reasons Why Enterprises Must Automate DHCP?

Automating your DHCP system is crucial for businesses because it reduces the time and effort your IT team spends on manual tasks. For instance, DHCP-related issues like printers not connecting or subnets not working with the main network can be avoided automatically.

Automated DHCP also allows your operations to grow smoothly. Instead of hiring more staff to handle tasks that automation can manage, your team can focus on other important areas of business growth.

Advantages

- Centralized management of IP addresses.
- Centralized and automatedTCP/IP configuration .
- Ease of adding new clients to a network.
- Reuse of IP addresses reduces the total number of IP addresses that are required.
- The efficient handling of IP address changes for clients that must be updated frequently, such as those for portable devices that move to different locations on a wireless network.
- Simple reconfiguration of the IP address space on the DHCP server without needing to reconfigure each client.
- The DHCP protocol gives the network administrator a method to configure the network from a centralized area.
- With the help of DHCP, easy handling of new users and the reuse of IP addresses can be achieved.

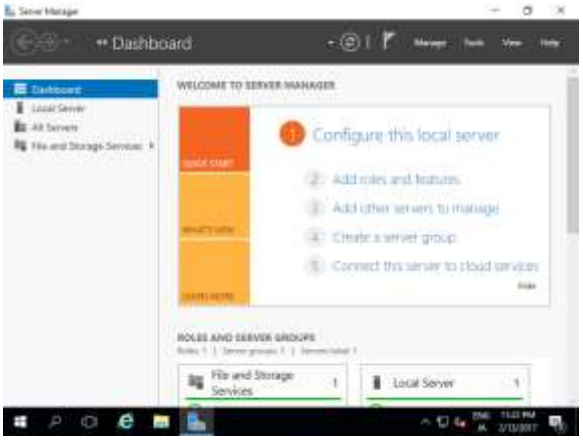
Disadvantages

- IP conflict can occur.
- The problem with DHCP is that clients accept any server. Accordingly, when another server is in the vicinity, the client may connect with this server, and this server may possibly send invalid data to the client.
- The client is not able to access the network in absence of a DHCP Server.
- The name of the machine will not be changed in a case when a new IP Address is assigned.

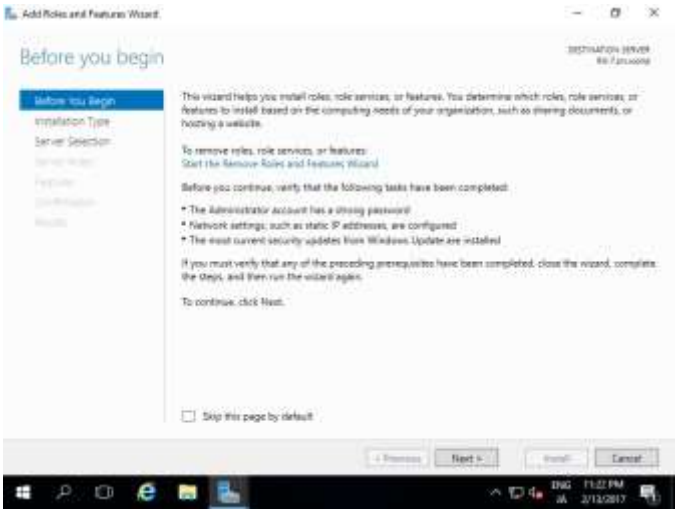
Practical

[1] Before settings DHCP, Configure AD DS in your LAN and make the DHCP Host join the Domain first.

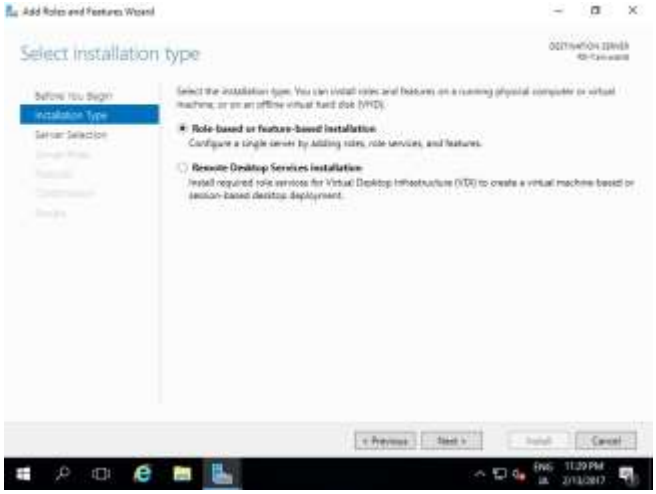
[2] Run Server Manager and Click [Add roles and features].



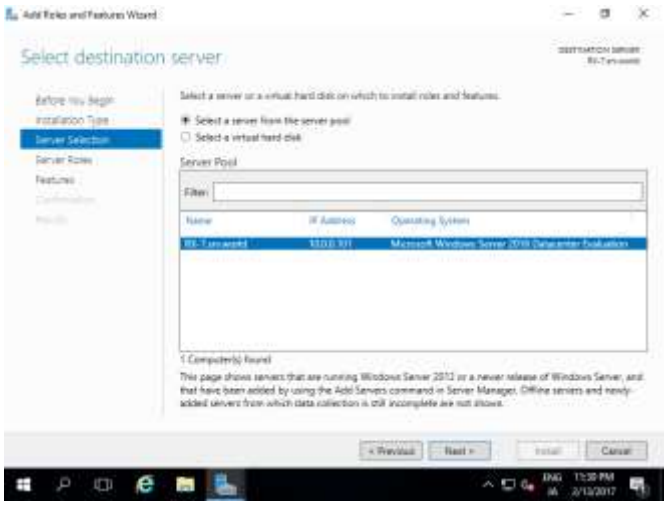
[3] Click [Next] button.



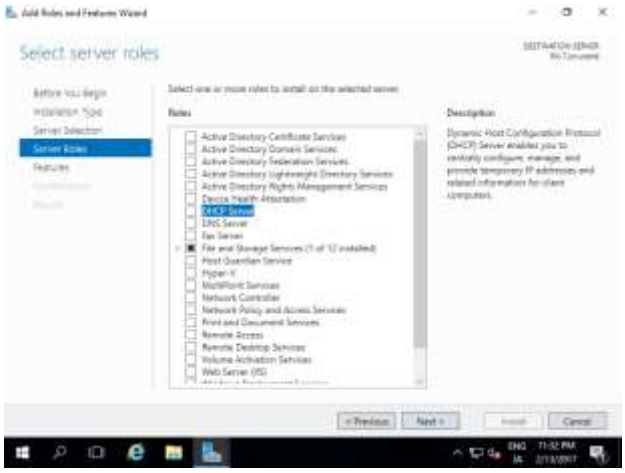
[4] Select [Role-based or feature-based installation].



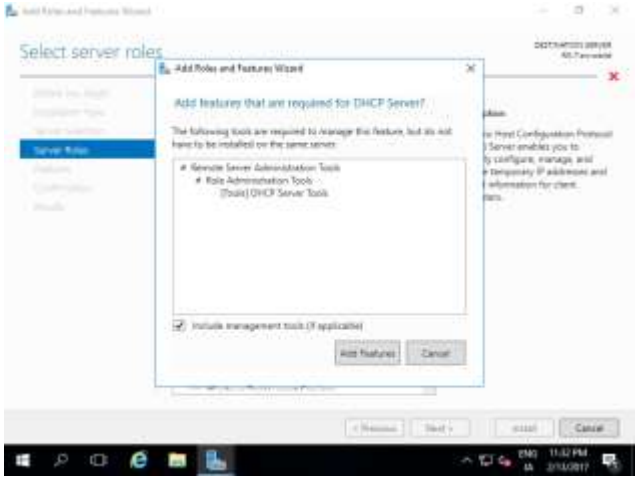
[5] Select a Host which you'd like to add services.



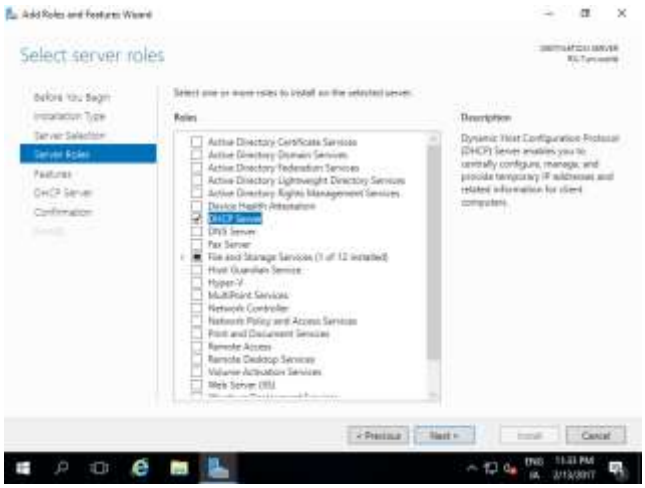
[6] Check a box [DHCP Server].



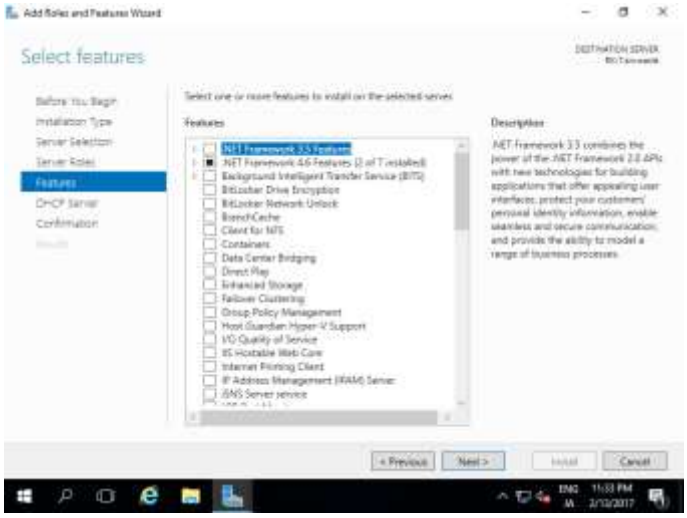
[7] Addtional features are required to add DHCP Server. Click [Add Features] button.



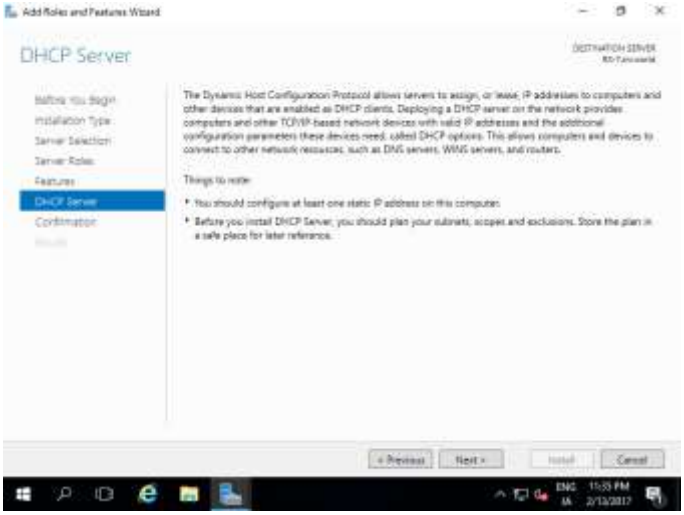
[8] Click [Next] button.



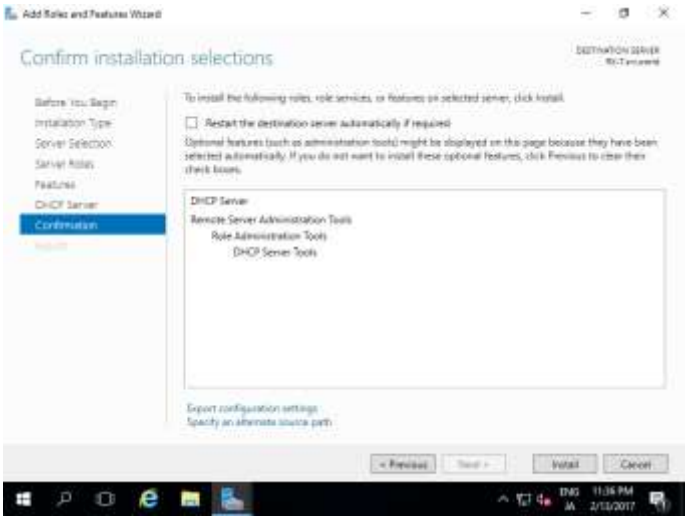
[9] Click [Next] button.



[10] Click [Next] button.



[11] Click [Install] button.



[12] After finishing Installation, click [Close] button.