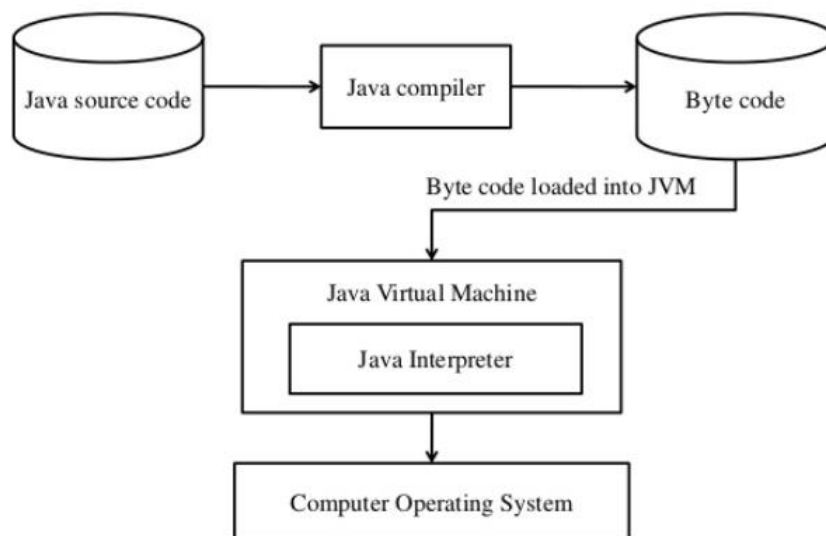


## Experiment: 01

### Aim: Case study on Java Virtual Machine (JVM)

A Java virtual machine (JVM) is an abstract computing machine that enables a computer to run a Java program. There are three notions of the JVM: specification, implementation, and instance. The specification is a document that formally describes what is required of a JVM implementation. Having a single specification ensures all implementations are interoperable. A JVM implementation is a computer program that meets the requirements of the JVM specification. An instance of a JVM is an implementation running in a process that executes a computer program compiled into Java bytecode.

Mostly in other Programming Languages, compiler produce code for a particular system but Java compiler produce Bytecode for a Java Virtual Machine. Bytecode is an intermediary language between Java source and the host system. It is the medium which compiles Java code to bytecode which gets interpreted on a different machine and hence it makes it Platform/Operating system independent.



JVM generates a “.class (Bytecode) ” file, and that file can be run in any OS, but JVM should have in OS because JVM is platform dependent.

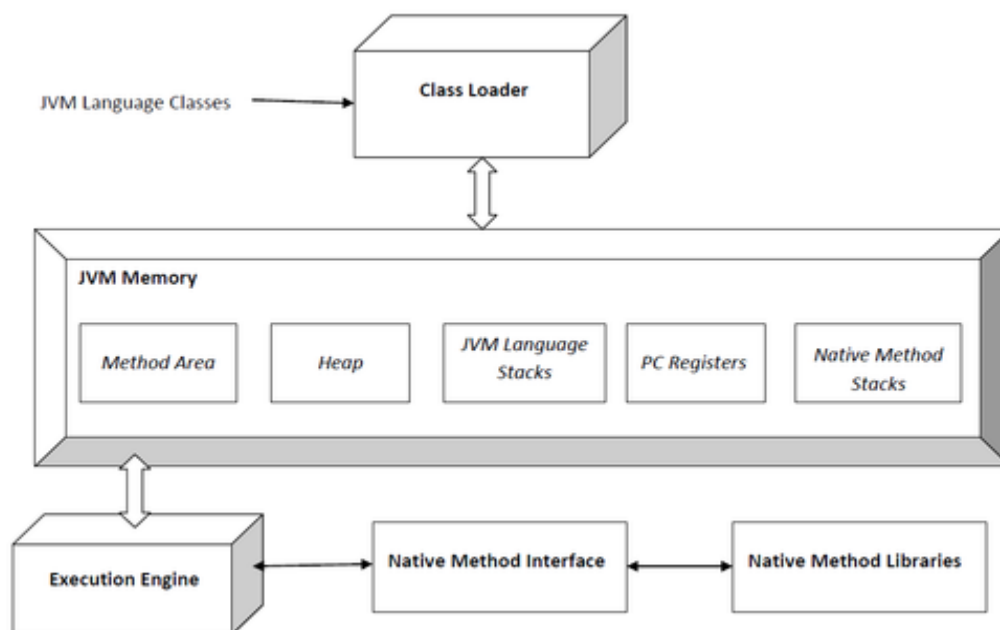
## Platform Independent:

Java is called platform independent because of Java Virtual Machine. As different computers with the different operating system have their own JVM, when we submit a .class file to any operating system, JVM interprets the bytecode into machine level language.

- JVM is the main component of Java architecture and it is the part of the JRE (Java Runtime Environment).
- Java Runtime Environment is used to provide an environment at runtime. It is the cause of implementation of JVM. It contains set of supporting libraries in combination with core classes and various other files that are used by JVM at runtime. JRE is a part of JDK (Java Development Toolkit).
- A program of JVM is written into "C Programming Language" and JVM is Operating System dependent.
- JVM is responsible to allocate the necessary memory needed by the Java program.
- JVM is responsible to deallocate memory space.

## Java Virtual Machine Architecture:

The architecture of the Java Virtual Machine is given below:



### 1) ClassLoader:

The class loader is a subsystem used for loading class files. It performs three major functions viz. Loading, Linking, and Initialization.

## **2) Method Area**

JVM Method Area stores class structures like metadata, the constant runtime pool, and the code for methods.

## **3) Heap**

All the Objects, their related instance variables, and arrays are stored in the heap. This memory is common and shared across multiple threads.

## **4) JVM language Stacks**

Java language Stacks store local variables, and it's partial results. Each thread has its own JVM stack, created simultaneously as the thread is created. A new frame is created whenever a method is invoked, and it is deleted when method invocation process is complete.

## **5) PC Registers**

PC register store the address of the Java virtual machine instruction which is currently executing. In Java, each thread has its separate PC register.

## **6) Native Method Stacks**

Native method stacks hold the instruction of native code depends on the native library. It is written in another language instead of Java.

## **7) Execution Engine**

It is a type of software used to test hardware, software, or complete systems. The test execution engine never carries any information about the tested product. This is the core of the JVM. Execution engine can communicate with various memory areas of JVM. Each thread of a running Java application is a distinct instance of the virtual machine's execution engine. The byte code that is assigned to the runtime data areas in the JVM via class loader is executed by the execution engine.

- a. Interpreter
- b. JIT Compiler
- c. Garbage Collector

#### **a. Interpreter**

Reads, interprets and executes the bytecode instructions one by one. As it interprets and executes instructions one by one, it can quickly interpret one bytecode, but slowly executes the interpreted result. This is the disadvantage of the interpret language. The 'language' called Bytecode basically runs like an interpreter.

#### **b. JIT Compiler**

The JIT compiler converts the bytecode to an intermediate-level expression, IR (Intermediate Representation), to execute optimization, and then converts the expression to native code. The JIT compiler has been introduced to compensate for the disadvantages of the interpreter. The main purpose of JIT compiler is to improve the performance. Internally JIT compiler maintains a separate count for every method. Whenever JVM across any method call, first that method will be interpreted normally by the interpreter and JIT compiler increments the corresponding count variable.

#### **c. Garbage Collector**

Garbage collection (GC) is the process that aims to free up occupied memory that is no longer referenced by any reachable Java object, and is an essential part of the Java virtual machine's (JVM's) dynamic memory management system. All Java objects automatically grab the memory that they need when they are created, and when the object is no longer need, the Java Garbage Collection process reclaim the memory. That means, the Garbage Collector tracked live objects and everything else designated garbage.

### **8) Native Method interface**

The Native Method Interface is a programming framework. It allows Java code which is running in a JVM to call by libraries and native applications.

### **9) Native Method Libraries**

Native Libraries is a collection of the Native Libraries(C, C++) which are needed by the Execution Engine.

## Case Study : 01

### Start-up: Dropbox



Dropbox is a file hosting service operated by American company Dropbox, Inc., headquartered in San Francisco, California, that offers cloud storage, file synchronization, personal cloud, and client software. Dropbox was founded in 2007, by MIT students Drew Houston and Arash Ferdowsi, as a startup company, with initial funding from seed accelerator Y Combinator.

Dropbox creates a special folder on the user's computer, the contents of which are then synchronized to Dropbox's servers and to other computers and devices that the user has installed Dropbox on, keeping the same files up-to-date on all devices. Dropbox uses a freemium business model, where users are offered a free account with a set storage size, with paid subscriptions available that offer more capacity and additional features. Dropbox Basic users are given 2 gigabytes of free storage space. Dropbox Plus users are given 1 terabyte of storage space, as well as additional features, including advanced sharing controls, remote wipe, and an optional Extended Version History add-on. Dropbox offers computer apps for Microsoft Windows, Apple macOS, and Linux computers, and mobile apps for iOS, Android, and Windows Phone smartphones and tablets. In March 2013, the company acquired Mailbox, a popular email app, and in April 2014, the company introduced Dropbox Carousel, a photo and video gallery app. Both Mailbox and Carousel were shut down in December 2015, with key features from both apps implemented into the regular Dropbox service. In October 2015, it officially announced Dropbox Paper, its collaborative document editor, in a reported effort to expand its operations towards businesses. As of March 2016, Dropbox has 500 million users.

## Founders Of Dropbox:

### 1) Drew Houston:

Andrew W. "Drew" Houston is an American Internet entrepreneur who is best known for being the founder and CEO of Dropbox, an online backup and storage service. According to Forbes magazine, his net worth is \$1.08 billion.

### 2) Arash Ferdowsi:

Arash Ferdowsi is an Iranian-American entrepreneur. He is a co-founder of Dropbox. Ferdowsi launched Dropbox in June 2007 with his business partner, Drew Houston, at Massachusetts Institute of Technology. In September 2007 Ferdowsi moved his company to San Francisco and raised venture capital from Sequoia Capital, Accel Partners, Y Combinator, and a handful of individual investors.

## History:

Dropbox founder Drew Houston conceived the Dropbox concept after repeatedly forgetting his USB flash drive while he was a student at MIT. In a 2009 "Meet the Team" post on the Dropbox blog, he wrote that existing services at the time "suffered problems with Internet latency, large files, bugs, or just made me think too much". He began making something for his personal use, but then realized that it could benefit others with the same problems. Houston founded Dropbox, Inc. in June 2007, and shortly thereafter secured seed funding from Y Combinator.

Dropbox officially launched at 2008's [TechCrunch](#) Disrupt, an annual technology conference. Owing to trademark disputes between Proxy, Inc. and Evenflow. Dropbox's official [domain name](#) was "getdropbox.com" until October 2009, when it acquired its current domain, "dropbox.com".

In an interview with [TechCrunch](#)'s "Founder Stories" in October 2011, Houston explained that a demo video was released during Dropbox's early days, with one viewer being Arash Ferdowsi. Ferdowsi was "so impressed" that they formed a partnership. In regards to competition, Houston stated that "It is easy for me to explain the idea, it is actually really hard to do it.

## **Growth in Dropbox:**

Dropbox has seen steady user growth since its inception. It surpassed the 1 million registered users milestone in April 2010, followed by 2 million in September, and 3 million in November. It passed 50 million users in October 2011, 100 million in November 2012, 200 million in November 2013, 400 million in June 2015, and 500 million in March 2016.

## **How Dropbox started:**

### **1) Building its network:**

Drew's origins at MIT, the prestigious Massachusetts Institute of Technology. While studying at the university, he was surrounded by talented individuals and the rigorous approach of the school. Through this network, he recruited another MIT student by 2007, Arash Ferdowsi, and set to furiously coding. Fearing that they'd be left out of the loop in Boston, they moved to the heart of tech entrepreneurship, San Francisco.

### **2) Investors:**

Dropbox received initial funding from seed accelerator Y Combinator. Dropbox also raised US\$1.2 million in Series A funding from Sequoia Capital in 2007, that "along with interest converted to equity as part of the Series A investment, which included a fresh slug of US\$6 million", bringing the total amount to US\$7.25 million, with the round closed in 2008 and documents filed in 2009.

TechCrunch reported in July 2011 that Dropbox had been looking to raise between US\$200 and US\$300 million, and had a valuation "to end up in the \$5 billion to \$10 billion range. quite a step up from its previous funding rounds which have totalled a tiny \$7.2 million". As noted in a Forbes article, Dropbox had "revenue on track to hit \$240 million in 2011".

In March 2017, Bloomberg reported that Dropbox had secured a US\$600 million credit line, with the company expected to file for its initial public offering (IPO) "as soon as this year".

## **Business Model:**

Dropbox uses a freemium business model, where users are offered a free account with a set storage size, with paid subscriptions available that offer more capacity and additional features.

Dropbox Basic users are given 2 [gigabytes](#) of free storage space. This can be expanded through referrals; users recommend the service to other people, and if those people start using the service, the user is awarded with additional 500 megabytes of storage space. Dropbox Basic users can earn up to 16 gigabytes through the referral program.

The Dropbox Plus subscription named Dropbox Pro prior to March 2017 gives users 1 terabyte of storage space, as well as additional features, including:

- Advanced sharing controls: When sharing a link to a file or folder, users can set passwords and expiration limits.
- Remote wipe: If a device is stolen or lost, users can remotely wipe the Dropbox folder from the device the next time it comes online.
- "Extended Version History": An available add-on, it makes Dropbox keep deleted and previous versions of files for one year, a significant extension of the default 30-day recovery time.

## **Company partnerships:**

In September 2012, Facebook and Dropbox integrated to allow users in Facebook Groups to share files using Dropbox. In November 2014, Dropbox announced a partnership with Microsoft to integrate Dropbox and Microsoft Office applications on iOS, Android and the Office 365 applications on the web.

## **Awards:**

Dropbox has received several awards, including the Crunchie Award in 2010 for Best Internet Application, and Macworld's 2009 Editor's Choice Award for Software. It was nominated for a 2010 Webby Award, and for the 2010 Mac Design Awards by Ars Technica.

In 2011, Business Insider named Dropbox the world's sixth most valuable startup, and in 2017, the publication ranked Dropbox as the eighth most valuable US startup, with a valuation of \$10 billion. It has been described as one of Y Combinator's most successful investments to date.

Founders Drew Houston and Arash Ferdowsi were named among the top 30 under 30 entrepreneurs by Inc. in 2011.



**Conclusion:**

The Dropbox is one of the successful start up of 21<sup>st</sup> century and having a huge amount of scope even after the great competition from Google Drive. The Dropbox is the one which first gives the idea is to store the data or documents on the servers so that it can access form anywhere at anytime through internet.

The Dropbox having interface and operations more efficient that the Google Drive as a result of which the Dropbox is greatly used by the organizations and other institutions. The Dropbox can become even more successful if it increases the number of file formats supported by the Dropbox.

## Experiment: 01

### Aim: Study on LAN, MAN, and WAN.

#### LAN (Local Area Network)

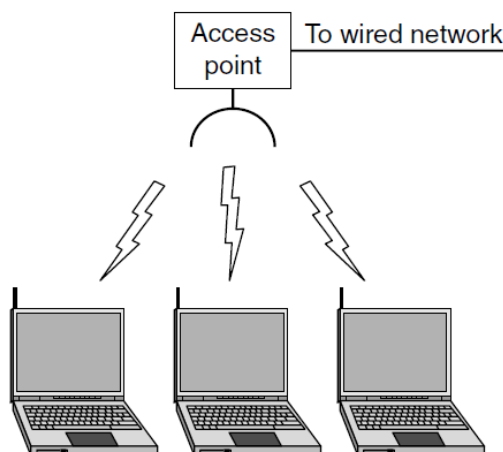
A local area network (LAN) is a computer network that interconnects computers within a limited area such as a residence, school, laboratory, university campus or office building. Ethernet and Wi-Fi are the two most common technologies in use for local area networks. Historical technologies include ARCNET, Token ring, and AppleTalk.

A local area network may serve as few as two or three users (for example, in a small-office network) or several hundred users in a larger office. LAN networking comprises cables, switches, routers and other components that let users connect to internal

A LAN is a privately owned network that operates within and nearby a single building like a home, office or factory. LANs are widely used to connect personal computers and consumer electronics to let them share resources and exchange information. When LAN's are used by companies, they are called enterprise networks.

A LAN may be wired, wireless, or a combination of the two. A standard wired LAN uses Ethernet to connect devices together. Wireless LANs are typically created using a Wi-Fi signal. If a router supports both Ethernet and Wi-Fi connections, it can be used to create a LAN with both wired and wireless devices.

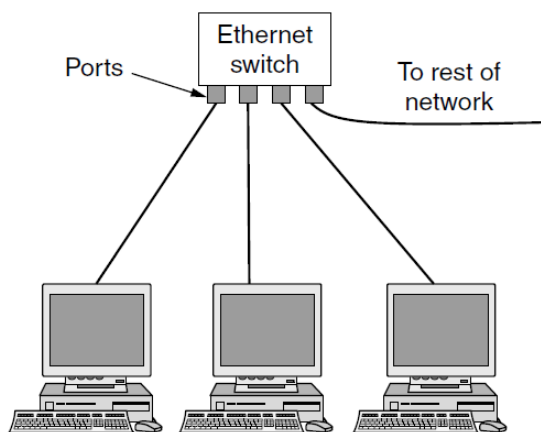
Wireless LANs are very popular these days, especially in homes, older office buildings, cafeterias, and other places where it is too much trouble to install cables. In these systems, every computer has a radio modem and an antenna that it uses to communicate with other computers. In most cases, each computer talks to a device as shown in the figure.



This device, called an **AP (Access Point)**, wireless router, or base station, relays packets between the wireless computers and also between them and the Internet. There is a standard for wireless LANs called **IEEE 802.11**, popularly known as WiFi, which has become very widespread. It runs at speeds anywhere from 11 to hundreds of Mbps.

Wired LANs use a range of different transmission technologies. Most of them use copper wires, but some use optical fiber. LANs are restricted in size, which means that the worst-case transmission time is bounded and known in advance. Knowing these bounds helps with the task of designing network protocols. Typically, wired LANs run at speeds of 100 Mbps to 1 Gbps, have low delay (microseconds or nanoseconds), and make very few errors. Newer LANs can operate at up to 10 Gbps. Compared to wireless networks, wired LANs exceed them in all dimensions of performance. It is just easier to send signals over a wire or through a fiber than through the air.

The topology of many wired LANs is built from point-to-point links. **IEEE 802.3**, popularly called Ethernet, is, by far, the most common type of wired LAN. The given below figure shows the switched Ethernet.



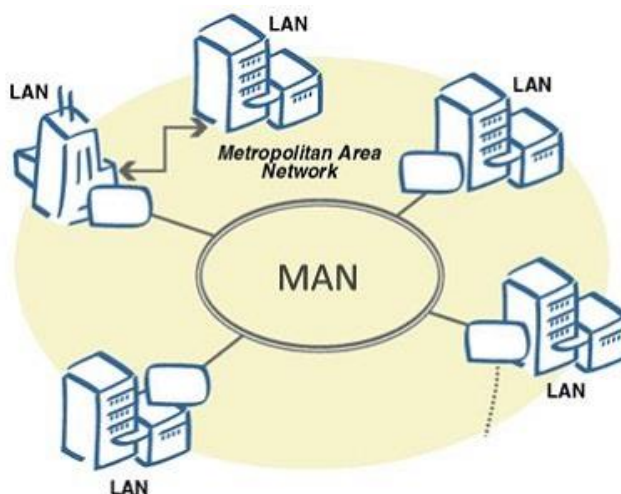
It is also possible to divide one large physical LAN into two smaller logical LANs. You might wonder why this would be useful. Sometimes, the layout of the network equipment does not match the organization's structure. For example, the engineering and finance departments of a company might have computers on the same physical LAN because they are in the same wing of the building but it might be easier to manage the system if engineering and finance logically each had its own network Virtual LAN or VLAN. In this design each port is tagged with a "color," say green for engineering and red for finance. The switch then forwards packets so that computers attached to the green ports are separated from the computers attached to the red ports. Broadcast packets sent on a red port, for example, will not be received on a green port, just as though there were two different LANs.

## MAN (Metropolitan Area Network)

A metropolitan area network (MAN) is a computer network that interconnects users with computer resources in a geographic area or region larger than that covered by even a large local area network (LAN) but smaller than the area covered by a wide area network (WAN). The term MAN is applied to the interconnection of networks in a city into a single larger network which may then also offer efficient connection to a wide area network. It is also used to mean the interconnection of several local area networks by bridging them with backbone lines.

A Metropolitan Area Networks bridges a number of 'Local Area Networks' with a fiber optical links which act as a backbone, and provides services similar to what Internet Service Provider (ISP) provide to Wide Area Networks and the Internet.

MAN is used to combine into a network group located in different buildings into a single network. The diameter of such a network can range from 5 to 50 kilometres. As a rule, MAN does not belong to any particular organization, in most cases, a group of users or a provider who takes charge for the service own its connecting elements and other equipment. Level of service is agreed in advance and some warranties are discussed.



MAN ( Metropolitan Area Network )

Major technologies used in MAN networks are 'Asynchronous Transfer Mode (ATM)', 'Fiber Distributed Data Interface (FDDI)' and 'Switched Multi-megabit Data Service (SMDS, a connectionless service)'. In most of the areas, these technologies are used to replace the simple 'Ethernet' based connections. MANs can bridge Local Area Networks without any cables by using microwave, radio wireless communication or infra-red laser which transmits data wirelessly.

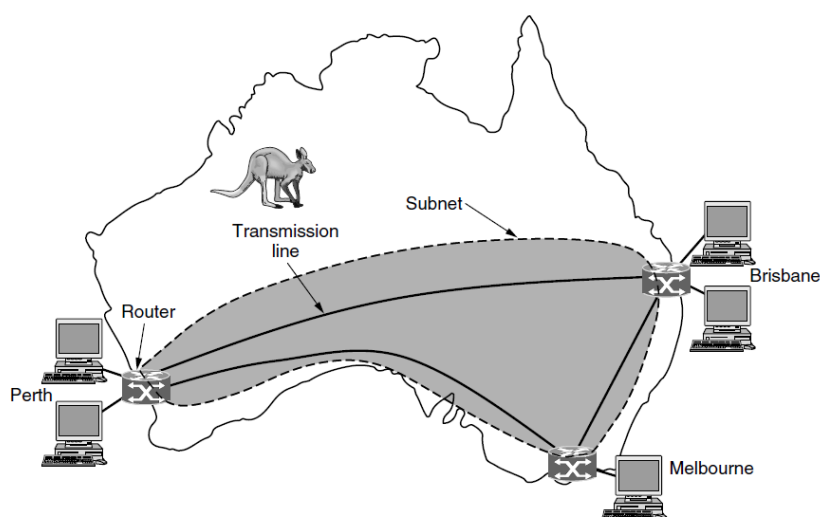
## WAN ( Wide Area Network )

A wide area network (WAN) is a telecommunications network or computer network that extends over a large geographical distance. Wide area networks are often established with leased telecommunication circuits (A leased line is a private bidirectional or symmetric telecommunications circuit between two or more locations provided in exchange for a monthly rent. Sometimes known as a private circuit or data line in the UK).

Business, education and government entities use wide area networks to relay data to staff, students, clients, buyers, and suppliers from various locations across the world. In essence, this mode of telecommunication allows a business to effectively carry out its daily function regardless of location. The Internet may be considered a WAN.

in terms of the application of computer networking protocols and concepts, it may be best to view WANs as computer networking technologies used to transmit data over long distances, and between different LANs, MANs and other localised computer networking architectures.

In 'Wide Area Network', Computers are connected through public networks, such as the telephone systems, fiber-optic cables, and satellite links or leased lines. The 'Internet' is the largest WAN in a world. WANs are mostly private and are built for a particular organization by 'Internet Service Providers (ISPs)' which connects the LAN of the organization to the internet. WANs are frequently built using expensive leased lines where with each end of the leased line a router is connected to extend the network capability across sites. For low cost solutions, WAN is also built using a 'circuit switching' or 'packet switching' methods.



The WAN in figure is a network that connects offices in Perth, Melbourne and Brisbane. Each of these offices contains computers intended for running user programs. We will follow traditional usage and call these machine hosts. The rest of the network that connects these hosts is then called the communication subnet, or just subnet for short. The job

of the subnet is to carry messages from host to host, just as the telephone system carries words from speaker to listener.

In most WANs, the subnet consists of two distinct components: transmission lines and switching elements. Transmission lines move bits between machines. Switching elements, or just switches, are specialized computers that connect two or more transmission lines. When data arrive on an incoming line, the switching element must choose an outgoing line on which to forward them.

## **Conclusion**

LAN is a private network used in small offices or homes usually within 1km range with high speed transfer data rate and fulltime service connectivity in low cost. WAN covers a large geographical area for example, a country or a continent. Its data transfer data is usually low as compared to LAN, but it is compatible with a variety of access lines and has an advanced security. MAN covers an area bigger than LAN within a city or town and serves as an ISP for larger LAN. It uses optical fibers or wireless infrastructure to link the LANs therefore, providing high speed regional resource sharing.

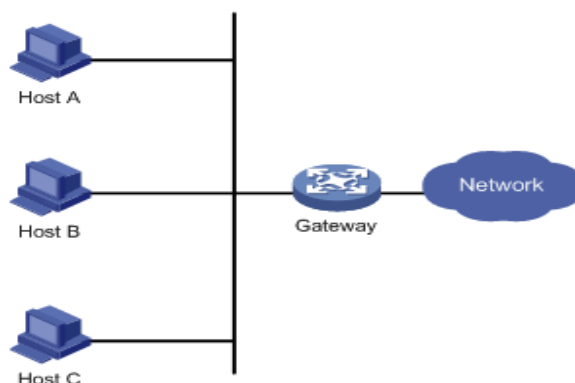
## Experiment: 02

### Aim: Study of various networking devices.

Networking hardware, also known as network equipment or computer networking devices, are physical devices which are required for communication and interaction between devices on a computer network. Specifically, they mediate data in a computer network. Typical core network devices include:

- **Gateway:**

A gateway is a hardware device that acts as a "gate" between two networks. It may be a router, firewall, server, or other device that enables traffic to flow in and out of the network. While a gateway protects the nodes within network, it also a node itself. The gateway node is considered to be on the "edge" of the network as all data must flow through it before coming in or going out of the network. It may also translate data received from outside networks into a format or protocol recognized by devices within the internal network.



Gateways, also called protocol converters, can operate at any network layer. The activities of a gateway are more complex than that of the router or switch as it communicates using more than one protocol.

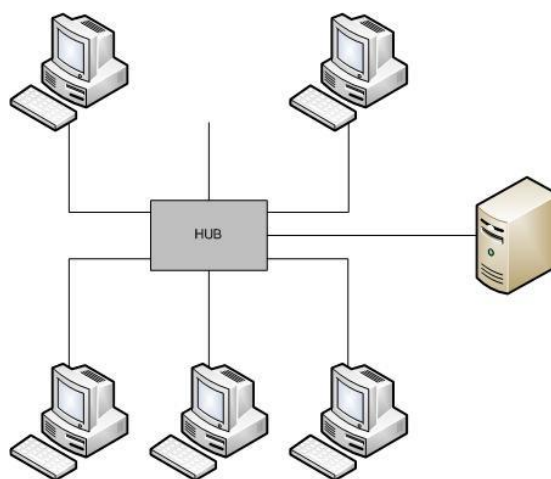
A router is a common type of gateway used in home networks. It allows computers within the local network to send and receive data over the Internet. A firewall is a more advanced type of gateway, which filters inbound and outbound traffic, disallowing incoming data from suspicious or unauthorized sources. A proxy server is another type of gateway that uses a combination of hardware and software to filter traffic between two networks.

In the network for an enterprise, a computer server acting as a gateway node is often also acting as a proxy server and a firewall server. A gateway is often associated with both a router, which knows where to direct a given packet of data that arrives at the gateway, and a switch, which furnishes the actual path in and out of the gateway for a given packet.

- **Hub**

A hub is the most basic networking device that connects multiple computers or other network devices together. Unlike a network switch or router, a network hub has no routing tables or intelligence on where to send information and broadcasts all network data across each connection. Most hubs can detect basic network errors such as collisions, but having all information broadcast to multiple ports can be a security risk and cause bottlenecks.

However, because of its working mechanism, a hub is not so secure and safe. Moreover, copying the data packets on all the interfaces or ports makes it slower and more congested which led to the use of network switch.



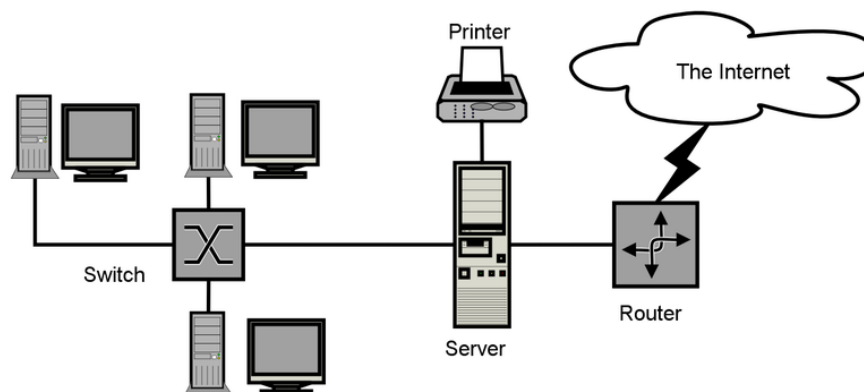
**Types:** On the basis of the mechanism the Hubs are of two types:

- **Active Hub:** As its name suggests, Active Hub is a hub which can amplify or regenerate the information signal. This type of bus has an advantage as it also amplifies the incoming signal as well as forward it to multiple devices. This Bus is also known as Multiport Repeater. It can upgrade the properties if incoming signal before sending them to destination.
- **Passive Hub:** Passive Hub works like a simple Bridge. It is used for just creating a connection between various devices. It does not have the ability to amplify or regenerate any incoming signal. It receives signal and then forward it to multiple devices.



- **Switch:**

A network switch also called switching hub, bridging hub, officially MAC bridge is a computer networking device that connects devices together on a computer network by using packet switching to receive, process, and forward data to the destination device.



A switch is a device that channels incoming data from any of multiple input ports to the specific output port that will take the data toward its intended destination.

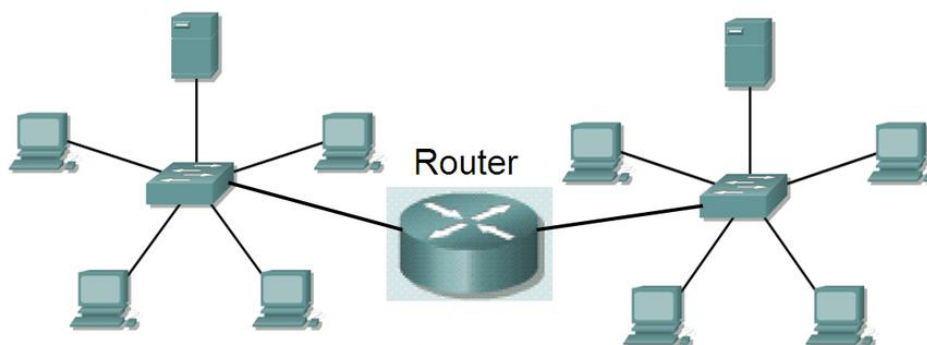
Switches operate at the data link layer (layer 2) and sometimes the network layer (layer 3) of the OSI Reference Model and therefore support any packet protocol. LANs that use switches to join segments are called switched LANs or, in the case of Ethernet networks, switched Ethernet LANs.

Switches are most commonly used as the network connection point for hosts at the edge of a network. In the hierarchical internetworking model and similar network architectures, switches are also used deeper in the network to provide connections between the switches at the edge.

- **Router:**

A router[a] is a networking device that forwards data packets between computer networks. Routers perform the traffic directing functions on the Internet. A data packet is typically forwarded from one router to another router through the networks that constitute an internetwork until it reaches its destination node.

Routers are network layer devices and are particularly identified as Layer- 3 devices of the OSI Model. They process logical addressing information in the Network header of a packet such as IP Addresses. Router is used to create larger complex networks by complex traffic routing. It has the ability to connect dissimilar LANs on the same protocol. It also has the ability to limit the flow of broadcasts. A router primarily comprises of a hardware device or a system of the computer which has more than one network interface and routing software.

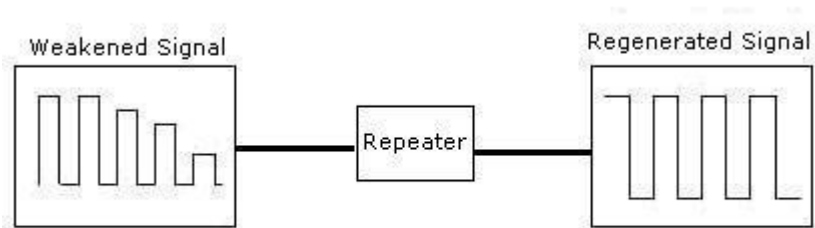


When a router receives the data, it determines the destination address by reading the header of the packet. Once the address is determined, it searches in its routing table to get know how to reach the destination and then forwards the packet to the higher hop on the route. The hop could be the final destination or another router. There are two types of routing mechanism which are employed by the routers:-

- **Static Routing:** In static routing, the routing information is fed into the routing tables manually. It does not only become a time-taking task but gets prone to errors as well. The manual updating is also required in case of statically configured routers when change in the topology of the network or in the layout takes place. Thus static routing is feasible for tinniest environments with minimum of one or two routers.
- **Dynamic Routing:** For larger environment dynamic routing proves to be the practical solution. The process involves use of peculiar routing protocols to hold communication. The purpose of these protocols is to enable the other routers to transfer information about to other routers, so that the other routers can build their own routing tables.

- **Repeaters:**

A repeater operates at the physical layer. Its job is to regenerate the signal over the same network before the signal becomes too weak or corrupted so as to extend the length to which the signal can be transmitted over the same network. An important point to be noted about repeaters is that they do no amplify the signal. When the signal becomes weak, they copy the signal bit by bit and regenerate it at the original strength. It is a 2 port device.



A Repeater enables signals to travel longer distances over a network. Repeaters work at the OSI's Physical layer. A repeater regenerates the received signals and then retransmits the regenerated (or conditioned) signals on other segments.