

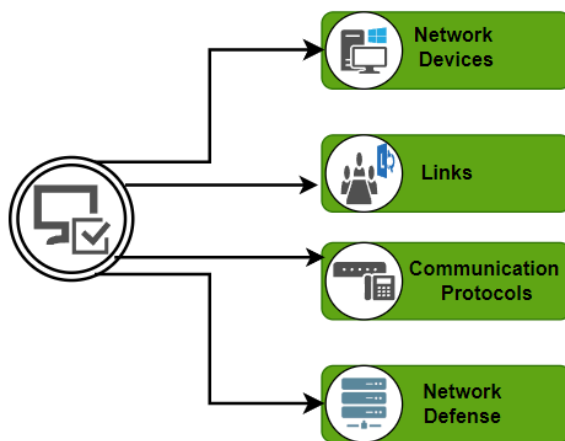
# Chapter1 Fundamentals of Computer Network

## What is a Computer Network?

A computer network is a system that connects many independent computers to share information (data) and resources. The integration of computers and other different devices allows users to communicate more easily. A computer network is a collection of two or more computer systems that are linked together. A network connection can be established using either cable or wireless media. Hardware and software are used to connect computers and tools in any network.

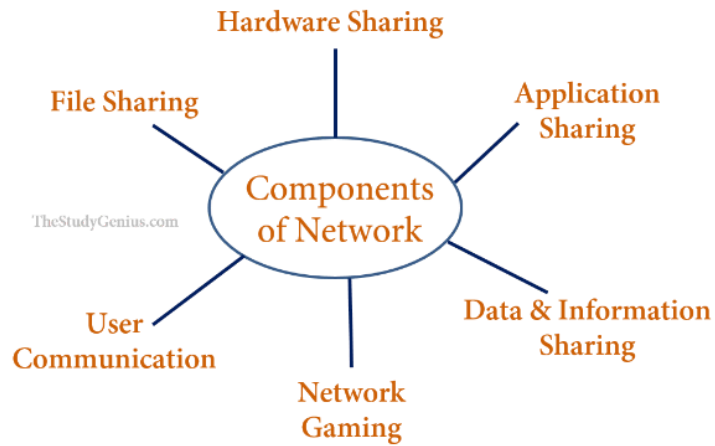
A computer network consists of various kinds of nodes. Servers, networking hardware, personal computers, and other specialized or general-purpose hosts can all be nodes in a computer network. Hostnames and network addresses are used to identify them. In this article, we are going to discuss computer networking in detail.

### KEY COMPONENTS OF A COMPUTER NETWORK



## Uses of Computer Networks

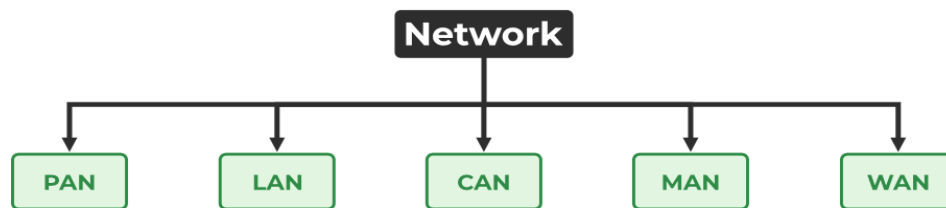
- Communicating using email, video, instant messaging, etc.
- Sharing devices such as printers, scanners, etc.
- Sharing files.
- Sharing software and operating programs on remote systems.
- Allowing network users to easily access and maintain information.



### **Types of Computer Networks**

There are mainly five types of Computer Networks

1. Personal Area Network (PAN)
2. Local Area Network (LAN)
3. Campus Area Network (CAN)
4. Metropolitan Area Network (MAN)
5. Wide Area Network (WAN)



### *Types of Computer Networks*

#### **1. Personal Area Network (PAN)**

PAN is the most basic type of computer network. It is a type of network designed to connect devices within a short range, typically around one person. It allows your personal devices, like smartphones, tablets, laptops, and wearables, to communicate and share data with each other. PAN offers a network range of 1 to 100 meters from person to device providing communication. Its transmission speed is very high with very easy maintenance and very low cost. This uses Bluetooth, IrDA, and Zigbee as technology. Examples of PAN are USB, computer, phone, tablet, printer, PDA, etc.



#### **Types of PAN**

- **Wireless Personal Area Networks:** Wireless Personal Area Networks are created by simply utilising wireless technologies such as WiFi and Bluetooth. It is a low-range network.
- **Wired Personal Area Network:** A wired personal area network is constructed using a USB.

#### **Advantages of PAN**

- PAN is relatively flexible and provides high efficiency for short network ranges.
- It needs easy setup and relatively low cost.

- It does not require frequent installations and maintenance
- It is easy and portable.
- Needs fewer technical skills to use.

### **Disadvantages of PAN**

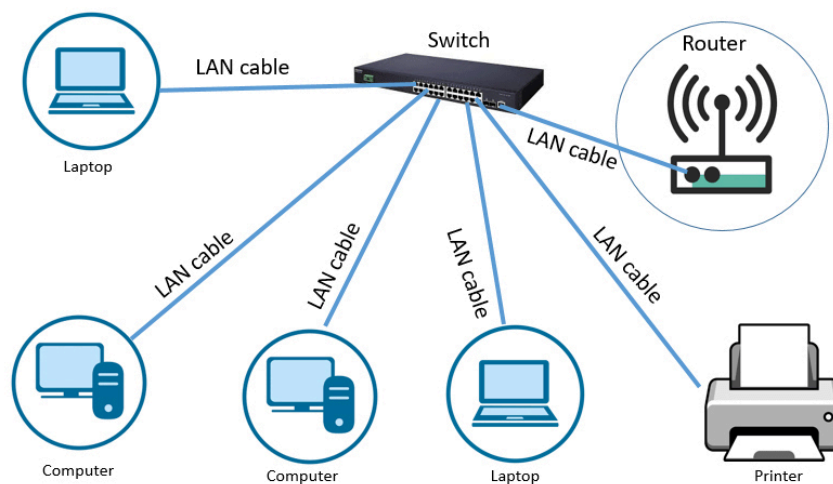
- Low network coverage area/range.
- Limited to relatively low data rates.
- Devices are not compatible with each other.
- Inbuilt WPAN devices are a little bit costly.

### **Applications of PAN**

- Home and Offices
- Organizations and the Business sector
- Medical and Hospital
- School and College Education
- Military and Defense

## **2. Local Area Network (LAN)**

LAN is the most frequently used network. A LAN is a computer network that connects computers through a common communication path, contained within a limited area, that is, locally. A LAN encompasses two or more computers connected over a server. The two important technologies involved in this network are Ethernet and Wi-fi. It ranges up to 2km & transmission speed is very high with easy maintenance and low cost. Examples of LAN are networking in a home, school, library, laboratory, college, office, etc.



# Local Area Network

### Advantages of a LAN

- **Privacy:** LAN is a private network; thus, no outside regulatory body controls it, giving it a privacy.
- **High Speed:** LAN offers a much higher speed (around 100 Mbps) and data transfer rate comparatively to WAN.
- **Supports different transmission mediums:** LAN support a variety of communications transmission medium such as an Ethernet cable (thin cable, thick cable, and twisted pair), fiber and wireless transmission.
- **Inexpensive and Simple:** A LAN usually has low cost, installation, expansion and maintenance and LAN installation is relatively easy to use, good scalability.

### Disadvantages of LAN

- The initial setup costs of installing Local Area Networks are high because there is special software required to make a server.
- Communication devices like an ethernet cable, switches, hubs, routers, cables are costly.
- LAN administrator can see and check personal data files as well as Internet history of every LAN user. Hence, the privacy of the users is violated
- LANs are restricted in size and cover only a limited area
- Since all the data is stored in a single server computer, if it can be accessed by an unauthorized user, can cause a serious data security threat.

### 3. Campus Area Network (CAN)

CAN is bigger than a LAN but smaller than a MAN. This is a type of computer network that is usually used in places like a school or colleges. This network covers a limited geographical area that is, it spreads across several buildings within the campus. CAN mainly use Ethernet technology with a range from **1km to 5km**. Its transmission speed is very high with a moderate maintenance cost and moderate cost. Examples of CAN are networks that cover schools, colleges, buildings, etc.



**CAMPUS AREA NETWORK (CAN)**

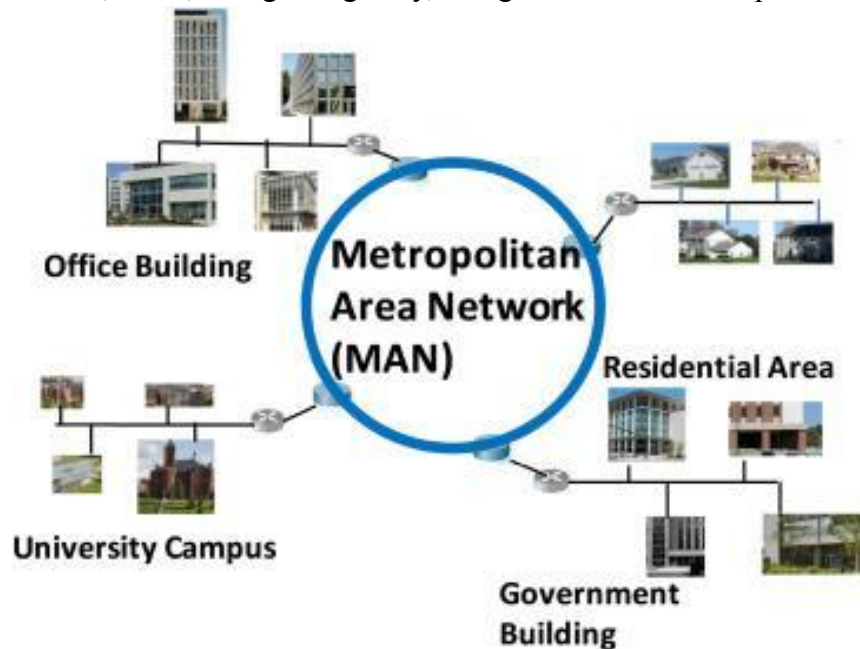
### Advantages of CAN

- **Speed:** Communication within a CAN takes place over Local Area Network (LAN) so data transfer rate between systems is little bit fast than Internet.

- **Security:** Network administrators of campus take care of network by continuous monitoring, tracking and limiting access. To protect network from unauthorized access firewall is placed between network and internet.
- **Cost effective:** With a little effort and maintenance, network works well by providing fast data transfer rate with multi-departmental network access. It can be enabled wirelessly, where wiring and cabling costs can be managed. So, to work with in a campus using CAN is cost-effective in view of performance

#### 4. Metropolitan Area Network (MAN)

A MAN is larger than a LAN but smaller than a WAN. This is the type of computer network that connects computers over a geographical distance through a shared communication path over a city, town, or metropolitan area. This network mainly uses FDDI (Fiber Distributed Data Interface), CDDI (Copper Distributed Data Interface), and ATM(Automated Teller Machine)as the technology with a range from 5km to 50km. Its transmission speed is average. It is difficult to maintain, and it comes with a high cost. Examples of MAN are networking in towns, cities, a single large city, a large area within multiple buildings, etc.



#### Advantages of MAN

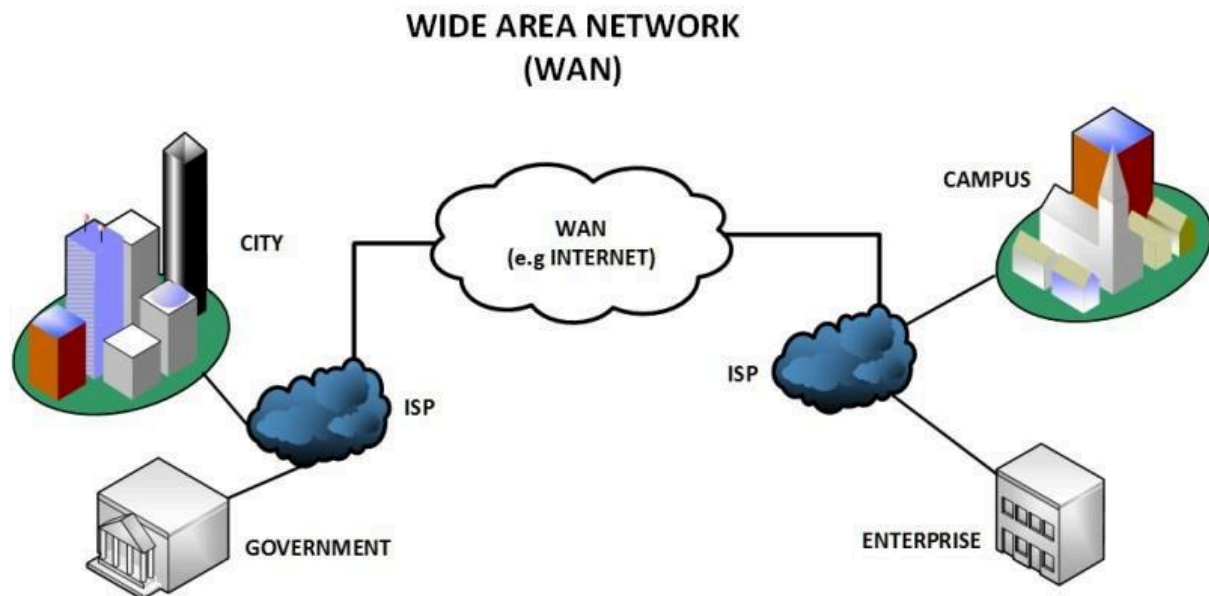
- MAN offers high-speed connectivity in which the speed ranges from 10-100 Mbps.
- The security level in MAN is high and strict as compared to WAN.
- It supports to transmit data in both directions concurrently because of dual bus architecture.
- MAN can serve multiple users at a time with the same high-speed internet to all the users.
- MAN allows for centralized management and control of the network, making it easier to monitor and manage network resources and security.

#### Disadvantages of MAN

- The architecture of MAN is quite complicated hence, it is hard to design and maintain.
- This network is highly expensive because it required the high cost to set up fibre optics.
- It provides less fault tolerance.
- The Data transfer rate in MAN is low when compared to LANs.

#### 5. Wide Area Network (WAN)

WAN is a type of computer network that connects computers over a large geographical distance through a shared communication path. It is not restrained to a single location but extends over many locations. WAN can also be defined as a group of local area networks that communicate with each other with a range above 50km. Here we use Leased-Line & Dial-up technology. Its transmission speed is very low, and it comes with very high maintenance and very high cost. The most common example of WAN is the Internet.



### **Advantages of WAN**

- It covers large geographical area which enhances the reach of organisation to transmit data quickly and cheaply.
- The data can be stored in centralised manner because of remote access to data provided by WAN.
- The travel charges that are needed to cover the geographical area of work can be minimised.
- WAN enables a user or organisation to connect with the world very easily and allows to exchange data and do business at global level.

### **Disadvantages of WAN**

- Traffic congestion in Wide Area Network is very high.
- The fault tolerance ability of WAN is very less.
- Noise and error are present in large amount due to multiple connection point.
- The data transfer rate is slow in comparison to LAN because of large distances and high number of connected systems within the network.

### **Wireless Network**

The term wireless networking comes with the combination of two words i.e. Wireless + Networking. The word wireless is defined as “having no wires” or ‘without cable’ while networking is defined as the interaction of devices with one other to exchange information and develop professional or social contacts. In wireless networking terminology, wireless is the term that used to explain about any computer network where there is no physical cable



connection between information sender and receiver, but rather the network is connected by radio waves and/or microwaves to maintain communications in between sender and receiver. Hence a wireless networking is a computer networking technology which enables users to communicate and access applications and information without connected by wires of any kinds.



### **Advantages of Wireless Communication:**

- Heavy data transform: Huge amount of data and information can be transmitted faster with a high speed.
- Economical setup installation: A Unified Wireless network is often more cost effective than installing dedicated cable drops and is less costly than you think.
- Save Time: By providing wireless network services when and where they are needed most, without adding additional staff resources.
- Maintenance is less cost for these networks.
- The internet can be accessed from anywhere wirelessly.
- High amount user access wireless network.
- Very helpful for workers, doctors working in remote areas as they can be in touch with medical centres.

### **Disadvantages of Wireless Communication:**



- **Unauthorized user:** An unauthorized person can easily capture the wireless signals which spread through the air.
- **Security:** It is very important to secure the wireless network so that the information cannot be misused by unauthorized users.

### **Application of Wireless networking:**

Wireless networking technology is widely available across worldwide. High amount of wireless networking application involves security systems, television remote control, Wi-Fi, Cell phones, wireless power transfer, computer interface devices and various wireless communication-based projects (like; Android based smart phone communication, smart phone-controlled traffic signal etc.).

### **Advantages of Computer Network**

- **Central Storage of Data:** Files are stored on a central storage database which helps to easily access and available to everyone.
- **Connectivity:** A single connection can be routed to connect multiple computing devices.
- **Sharing of Files:** Files and data can be easily shared among multiple devices which helps in easily communicating among the organization.
- **Security through Authorization:** Computer Networking provides additional security and protection of information in the system.

### **Disadvantages of Computer Network**

- **Virus and Malware:** A virus is a program that can infect other programs by modifying them. Viruses and Malware can corrupt the whole network.
- **High Cost of Setup:** The initial setup of Computer Networking is expensive because it consists of a lot of wires and cables along with the device.
- **loss of Information:** In case of a System Failure, might lead to some loss of data.
- **Management of Network:** Management of a Network is somehow complex for a person, it requires training for its proper use.

## **10 Social Issues Computers Have Created**

The growth in the availability of affordable computing technology has caused a number of major shifts in the way that society operates. The majority of these have been for the better, with home computers and the internet providing unlimited access to all of the information ever created and discovered by humanity.

There are, however, some less positive social issues generated as a direct result of technological advances. In the interests of balance, it is important to analyse these and assess the severity of their impact so that steps can be taken to better understand and combat the negative effects.

## **1. Communication Breakdown**

Socialising within a family unit has always been important, as it strengthens the bonds between us and ensures cohesion within the group. But with more and more households owning several computers and numerous portable devices granting access to information and entertainment, some argue that this is leading to a lack of family communication.

If each member is engrossed in their laptop, smartphone or tablet each evening, even communal things like watching television are compromised. Meanwhile, you can see whole families who are out to dinner and still staring into a touchscreen rather than talking to one another.

And if you're the one driving to that family dinner and texting while driving, you're a distracted driver, increasing your risk of crashing, and potentially causing death and injury.

Increase your digital wellbeing by allowing technology to improve your life and not to become a distraction to your life and others. Your life and others are more important than technology.

## **2. Defamation of Character**

The only means of getting in touch with major corporations or famous people in the public eye prior to the advent of digital communication was via a stiffly written letter. This was, of course, accessible only to the intended recipient and thus a very private way for the disgruntled to vent their spleen. But first message boards and now social media services like Facebook and Twitter are being used to defame people and businesses in an intrinsically public manner.

This has led to arrests, lawsuits and the threat of placing stricter controls over what can and cannot be posted to such services. It has also caused heartache and woe for many individuals, helping to perpetuate a massive, international rumour mill which pays little heed to facts or the threat of legal action.

## **3. Identity Theft**

Fraud is another spurious activity that has been able to evolve in the wake of easily accessible computers and the internet.

Perhaps most problematic and prevalent of the various fraudulent activities is identity theft, in which personal details of innocent people are harvested by a third party so that they can be used for malicious purposes. This includes carrying out illicit online transactions and other damaging activities that can have serious ramifications.

#### **4. Cyber Bullying**

As with the defamation of public figures, the internet and computers have also made it easier for spiteful people to attack people they know personally as well as perfect strangers via the anonymous platforms that are available to them.

This has led to serious incidents of cyber bullying involving both children and adults, sometimes with tragic consequences. The problem with these techniques is that they tend to go under the radar to an even greater degree than traditional bullying, which makes it harder to detect and correct.

#### **5. Gaming Addiction**

Whilst computers and the internet have made it easier for gambling addicts to get their fix, a new type of addiction has also arisen, in the form of addiction to videogames. This is something that can impact people of all ages and leads inevitably to a number of problems, from the social to the financial.

Professionals are beginning to take gaming addiction seriously and combat it in the same way as other diseases.

#### **6. Privacy**

Whilst high profile cases of online identity theft and fraud should have caused people to become more careful about how they use their personal information, issues of privacy and a lack of appreciation for the risks are still widespread.

This extends beyond simply giving away private data via chat rooms, message boards and e-commerce sites and extends into the compromising world of social media.

Employers are now combing Facebook and Twitter to effectively do background checks on potential employees, paying particular attention to those that have not chosen to use privacy settings to prevent anyone from getting a look at their details.

#### **7. Health & Fitness**

We are living increasingly sedentary lifestyles, because computers are removing the need for us to physically carry out many tasks, as well as keeping us rooted to one spot throughout our working days and during our leisure time.

This is leading to an epidemic of childhood and adult obesity throughout the developed world, with the UK possessing one of the worst records in this respect of any of its Western neighbours.

## 8. Education

The educational properties of computers are well known and universally lauded, but having all the information in existence on tap has its own issues.

In particular, the practice of plagiarism has become a major problem, as students can simply copy and paste whole chunks of text from online sources without attributing the work to anyone else. This has become the bane of educational institutions, which tend to come down hard on detected plagiarists in order to discourage similar activities from others.

## 9. Terrorism & Crime

Computers have been a positive force in allowing for the creation of global movements and righteous activism in a number of forms. However, the other side of the coin is that terrorists and organised criminals also exploit the web for their own nefarious purposes.

Businesses, governments and individuals are all at risk of cyber attack and the perpetrators can often act anonymously from a country with no extradition agreements.

## 10. Sexuality

This is a less clear cut topic, but there are fears that unmitigated access to pornography for adolescents is shaping the sexual proclivities and expectations of young people in problematic ways.

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## Network

A computer network is a collection of two or more computer systems that are linked together. A network connection can be established using either cable or wireless media. Hardware and software are used to connect computers and tools in any network. A computer network consists of various kinds of nodes. Servers, networking hardware, Personal computers, and other specialized or general-purpose hosts can all be nodes in a computer network.

### Wired/Wireless Networking

On basis of physical medium, there are 2 types of networks:

**(a) Wired Network:** As we all know, “wired” refers to any physical medium made up of cables. Copper wire, twisted pair, or fiber optic cables are all options. A wired network employs wires to link devices to the Internet or another network, such as laptops or desktop PCs.

**(b) Wireless Network:** “Wireless” means without wire, media that is made up of electromagnetic waves (EM Waves) or infrared waves. Antennas or sensors will be present on all wireless devices. Cellular phones, wireless sensors, TV remotes, satellite disc receivers, and laptops with WLAN cards are all examples of wireless devices. For data or voice communication, a wireless network uses radiofrequency waves rather than wires.



### **Examples of Wireless Networking**

Wireless networking is an essential part of today's communications, and its new forms will be a central part of robots, drones, self-driving cars, and other emerging technologies. Some common examples of wireless networking include:

- Television and Radio Broadcasting
- Satellite Communication
- Radar
- AM radio
- Bluetooth
- Paging
- Terrestrial microwave networks
- FM radio
- HD radio
- SiriusXM satellite radio
- Cordless Phones
- Radio Frequency Identification (RFID)
- Cell phone networks
- Wireless sensor networks

### **Working of Wireless Network**

Radio frequency technology is connected to radio wave propagation within the electromagnetic spectrum and is used to power wireless networks. When an RF current is applied to an antenna, an electromagnetic field is created that can spread throughout space.

A wireless network's core is a system known as an access point (AP). The primary function of an access point is to broadcast a wireless signal that computers detect and tune into. As wireless networks generally connect to wired networks, access points frequently serve as a gateway to the resources of a wired network, such as an Internet connection.

To connect to an access point and join a wireless network, computers must have wireless network adapters. Generally, computers have these adapters built into the device. Still, if not,

almost any computer or notebook can be made wireless-capable by attaching an add-on adapter to an empty expansion slot, USB port, PC card slot, etc.

Wireless LAN (WLAN)	Wireless PAN (WPAN)	Wireless MAN (WMAN)	Wireless WAN (WWAN)
Local area network	Personal area network	Metropolitan area network	Wide area network
Provide internet access within a building or limited outdoor area	Transmit signals between devices in limited areas, typically 100 meters	Provide access outside office and home networks, typically regional	Provide access outside the range of WLANs and WMANs
Cellular	Bluetooth, Zigbee and infrared	IEEE 802.16 WiMax	LTE

### Advantages of Wireless Networking

There are various advantages of wireless networking, such as:

- **Increased efficiency:** Improved data communications facilitate faster information transfer between partners and customers. While on a sales call, for example, sales representatives can remotely confirm stock levels and prices.
- **Connectivity and availability:** Because wireless technology allows users to communicate on the go, you are rarely disconnected.
- **Flexibility:** Office workers can continue to do productive work while away from the office. This has resulted in new working styles, such as work-from-home (WFH).
- **Savings:** Wireless networks can be easier and less expensive to install, as the use of cables is minimum. It comes in handy, especially in buildings where the landlord does not allow you to install cables.
- **Adding devices:** You can easily connect a new device to the existing setup since the connection doesn't rely on wires or cables. You can also add or remove the number of equipment without worry since there is no cable capacity limit.

### Disadvantages of Wireless Networking

Despite the numerous advantages that wireless networks have over wired networks, there are some drawbacks to consider, such as:

- **Security:** Because wireless transmission is more vulnerable to attacks by unauthorized users, you must pay special attention to security.
- **Coverage:** Obtaining consistent coverage in some buildings can be difficult, resulting in 'black spots' where the signal is unavailable.
- **Transmission speeds:** Wireless networking transmission speeds can be slower and more inefficient than wired.
- **Installation issues:** If others in the same building use wireless technology or other electromagnetic (radio) interference sources exist, you may experience interference.

S.No	Wired Network	Wireless Network
1.	A wired network employs wires to link devices to the Internet or another network, such as laptops or desktop PCs.	“Wireless” means without wire, media that is made up of electromagnetic waves (EM Waves) or infrared waves. Antennas or sensors will be present on all wireless devices
2.	Faster transmission speed	Slow transmission speed
3.	Propagation delay is Low	Propagation delay is high
4.	More Secure & hence Reliable	Less Secure & hence less Reliable
5.	Devices must be hard-wired	Installation is Quick
6.	Less Expensive	More Expensive
7.	High installation & maintenance cost	Low installation & maintenance cost
8.	Hub, Switch, etc. devices are used	Wireless routers, access points, etc. are used.

### Classification of Computer Network on basis of Architecture

Network architecture generally refers to the design of a computer network or communications network. It simply describes the allocation task between all of the computers in the network. It is simply a way in which all network devices and services are organized and managed to connect clients like laptops, tablets, servers, etc., and also how tasks are allocated to computers.

It is defined as the physical and logical design of software, hardware, protocols, and media of data transmission. In this article, we are going to discuss Network Architecture in detail along with its type, the skills required to become a network architect, and many more.

### What is a Computer Network Architect?

A computer network architect sets up the computer and communication systems for a company. “Network architecture” means the rules, tools, and software that help people in the company stay connected without any problems.

### Network Architect vs Network Administrator vs Network Engineer

- **Network Administrator:** They take care of a network that’s already set up. They handle day-to-day tasks like fixing problems, adding users, and making sure everything runs smoothly.

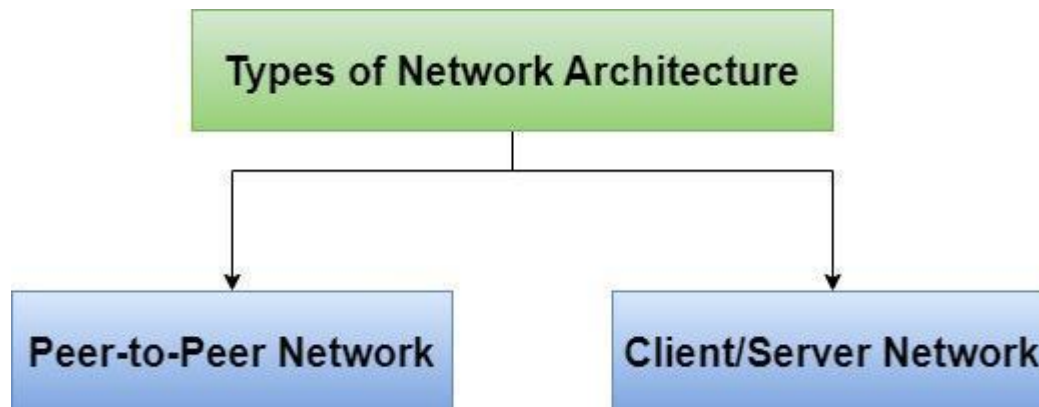


- **Network Engineer:** They're like the builders and fixers. They create networks based on designs, make changes when needed, and troubleshoot any issues that pop up.
- **Network Architect:** They're the big planners. They design how a network should look and work. They create the blueprint that the engineers follow to build the network

### Types of Network Architecture

Computer networks can be classified based on architecture into two primary types:

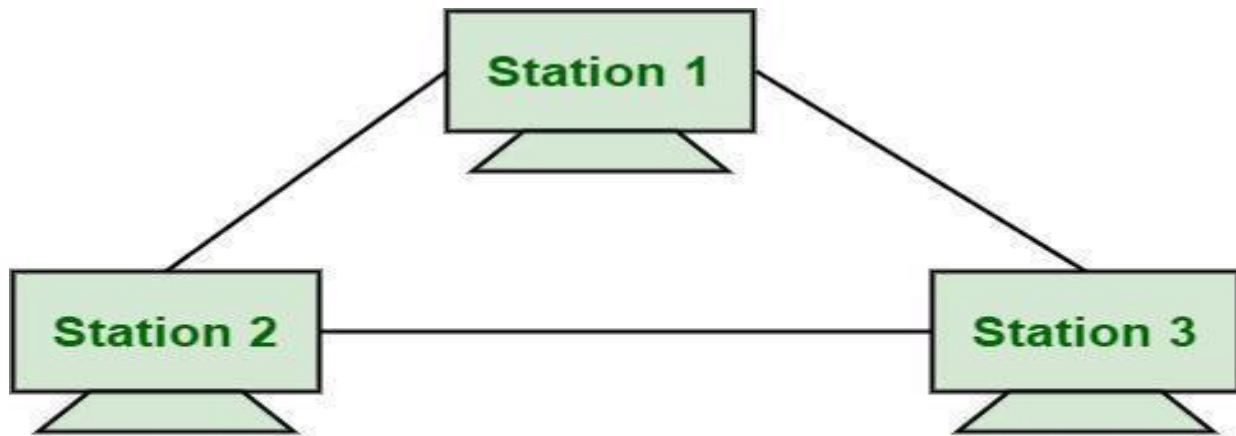
- Peer-to-Peer Architecture
- Client/Server Architecture



### What is Peer-to-Peer Architecture?

In the P2P (Peer-to-Peer) network, “peers” generally represent computer system. These peers are connected to each other with help of Internet. Files might be shared directly without requirement of central server among these systems on the network. It can be said that each of computers on P2P network usually becomes file server even as client also.

In this architecture, system is generally decomposed into various computational nodes that contain the same and equivalent capabilities, abilities, and responsibilities. In this network, tasks are allocated at each device available on network. This network is very essential and important for small environments, usually up to at least 10 computers. There is also no separate division as clients and servers. Each computer in this network are treated same and equally and might send even receive message directly. This P2P network is generally useful in various fields such as business, education, military, etc.



## Peer-to-Peer Architecture

### Advantages of Peer-to-Peer Architecture

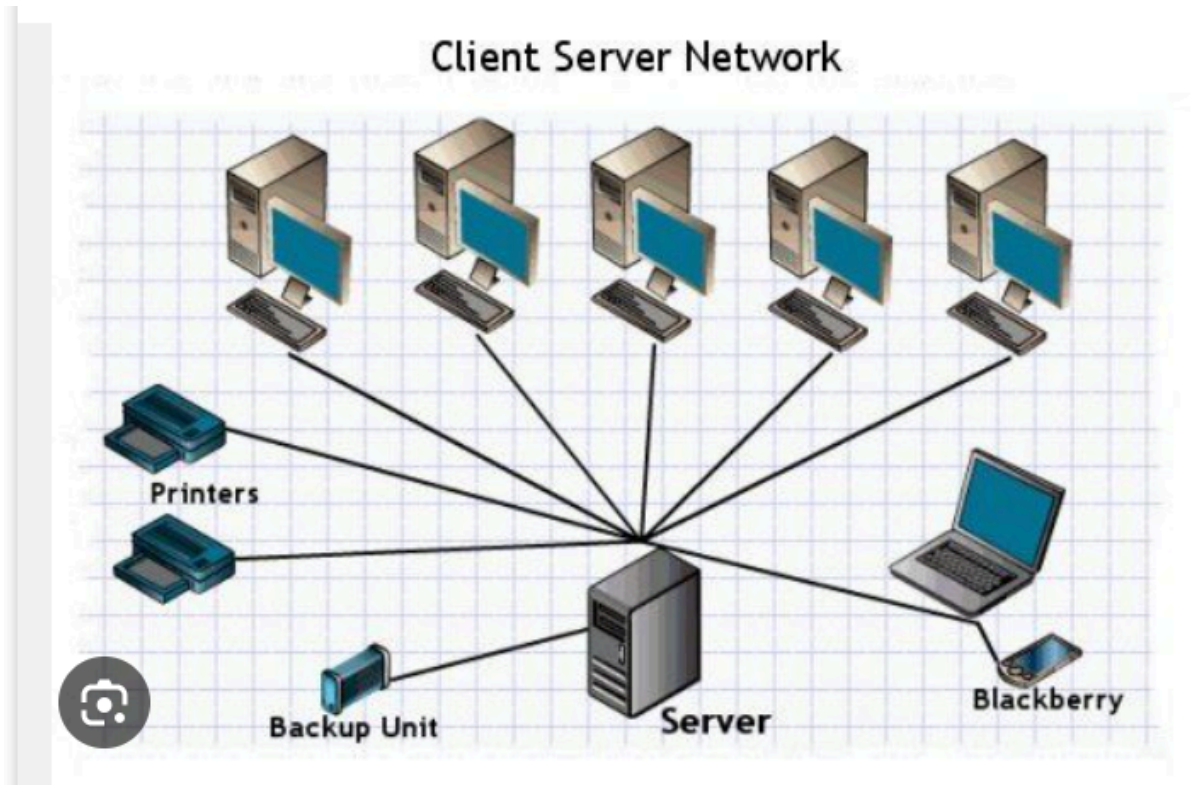
- P2P network is less costly and cheaper. It is affordable.
- P2P is very simple and not complex. This is because all computers that are connected in network communication in an efficient and well-mannered with each other.
- It is very easy and simple to set up and manage as installation and setup is less painful and computer manages itself. This is because of built-in support in modern operating systems.
- Security is one of major issues in this type of network.
- If computer working with some of resources is down and sharing of resources might become major problem.
- Performance, security, and access can also become major problem with an increase in number of computers on this network.

### Disadvantages of Peer-to-Peer Architecture

- It is more difficult to manage security policies consistently.
- Each peer demands individual care and control.
- As the network expands in size, it may become inefficient.

### What is Client/Server Architecture?

CSN (Client/Server Network) is type of computer network in which one of centralized and powerful computers (commonly called as server) is hub to which many of personal computers that are less powerful or workstations (commonly known as clients) are connected. It is type of system where clients are connected to server to just share or use resources. These servers are generally considered as heart of system. This type of network is more stable and scalable as compared to P2P network. In this architecture, system is generally decomposed into client and server processor or processes.



#### Advantages of Client/Server Architecture

- A special Network Operating System (NOS) is provided by server to provide resources to many users that request them.
- It is also very easy and simple to set up and manage data updates. This is because data is generally stored in centralized manner on server.
- The server usually controls resources and data security.
- This network also boosts speed of sharing resources.
- If anyhow server goes down or crashes, entire will be affected by this.
- It is very expensive as compared to P2P. This is due to need for server with more memory as well as need for many networking devices such as hubs, routers, switches, etc.
- Cost of NOS being provided is very high.

#### Disadvantages of Client/Server Architecture

- If the server fails, clients may lose access to services.
- Setting up servers requires a higher investment in hardware and software.
- Managing servers requires skilled personnel.