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# COMPUTER AND NETWORK ARCHITECTURE

## PHASE-II STUDY NOTES FOR NABARD GR. A IT OFFICER EXAM

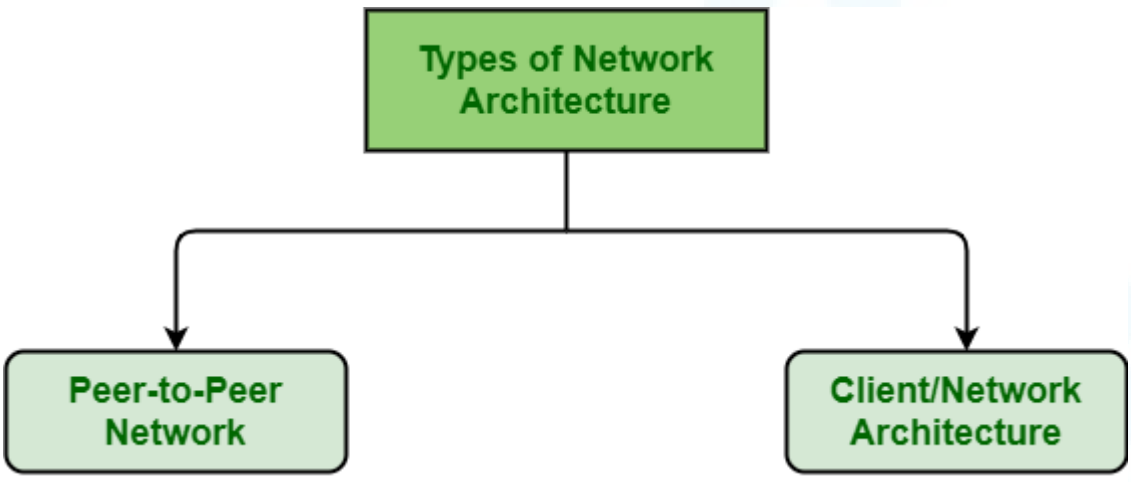
# Computer and Network Architecture

## Phase-II Study Notes for NABARD Gr. A IT Officer Exam

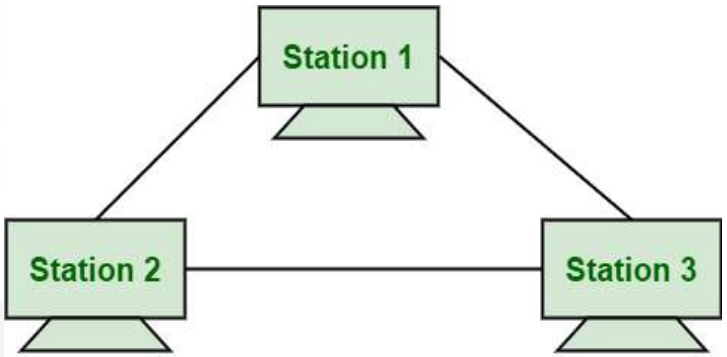
### Introduction

- Computer networks are usually developed **to fulfil the needs of their clients and users.**
- Network architecture generally refers **to the design of a computer network or communications network.**
- It simply describes allocation tasks 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 the computer.**
- It also facilitates system-level functionality **even robustness, extensibility, and evolvability.**
- It is basically defined and described as the physical and **logical design of software, hardware, protocols, and media of data transmission.**

### Classification of Networks Architecture - Based on the Use of Computer Nodes



1. **Peer-to-Peer Network**




Peer-to-Peer Architecture

- In the P2P (Peer-to-Peer) network, **"peers" generally represent a computer system. These peers are connected to each other with help of the Internet.**
- Files might be shared directly **without the requirement of a central server among these systems on the network**.
- It can be said that each computer **on a P2P network usually becomes a file server or even a client also.**
- In this architecture, the system is generally decomposed into various computational nodes that contain **the same and equivalent capabilities, abilities, and responsibilities**.
- In this network, tasks are allocated to each and **every device available on the network. This network is very essential and important for small environments, usually up to at least 10 computers**.
- There is also no separate division of **clients and servers. Each and every computer in this network are treated the same and equally and might send or even receive a message directly.**
- This P2P network is generally **useful in various fields such as business, education, military, etc.**
- A dedicated server or centralized **is not very essential, so a P2P network is less costly and is very cheaper.**
- **It is affordable.**

- **P2P is very simple and not complex.** This is because all computers that are connected in a network communicate **efficient and well-mannered with each other.**

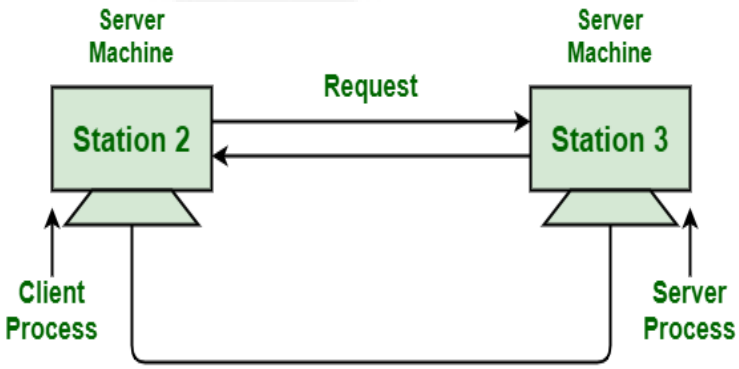
- It is very easy and simple **to set up and manage as installation and setup are less painless and the computer manages itself**. This is **because of built-in support in modern operating systems.**

- Security is one of the major issues in **this type of network**. This is because the message **that is sent flows freely among connected computers.**

- If the computer working with some of the resources is down and **sharing of resources might become a major problem.**

- Performance, security, and access can also become major problems and headaches **with an increase in the number of computers on this network.**

2. **Client/Server Network**




Client/Server Architecture

- **CSN (Client/Server Network) is a type of computer network in which one centralized and powerful computer** (commonly called a server) is a hub to which many personal computers that **are less powerful or workstations (commonly known as clients) are connected.**

- It is a type of system where **clients are connected to a server to just share or use resources**. These servers are generally considered the heart of the system. This type of network **is more stable and scalable compared to a P2P network.**

- In this architecture, the system is generally **decomposed into client and server processors or processes.** This architecture **supports the separation of functionality commonly based on the concept of service.**

**Advantages**

- A special Network Operating System (NOS) **is provided by the 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 a centralized manner on a server.**
- The server usually **controls resources and data security.**
- This network also **boosts the speed of sharing resources.**
- If anyhow the server goes **down or crashes, the entire will be affected by this.**
- It is very expensive as compared to a P2P. This is due to needing for servers with greater memory **as well as the need for many networking devices such as hubs, routers, switches, etc.**
- The cost of NOS **being provided is very high.**

## What is Network Architecture?

- **Network architecture** refers to a network's structural and logical layout.
- It describes how the network devices **are connected and the rules that govern data transfer between them.**
- There are many ways **to approach network architecture design**, which depend on the purpose and size of the network.
- Wide area networks (WAN), for example, refer **to a group of interconnected networks often spanning large distances.**
- Its network architecture will be vastly different from that **of a local area network (LAN) of a smaller office branch.**
- **Planning the network architecture** is vital because it either enhances or hinders the performance of the entire system.
- **Choosing the wrong transmission media or equipment for a particular expected server load**, for instance, can cause slowdowns on the network.
- **Network architecture can also facilitate security**, becoming increasingly important as more user devices connect to the network.

- **The design and protocols of the network need to support quick** and efficient user recognition and authorization.

- Most network architectures **adopt the Open Systems Interconnection Model or OSI.** This conceptual model separates the network tasks **into seven logical layers, from lowest to highest abstraction.**

- The Physical layer, **for instance, deals with the wire and cable connections of the network.** The highest layer, the Application layer, involves APIs that deal with application-specific functions **like chat and file sharing.**

- The OSI model makes it **easier to troubleshoot the network by isolating problem areas from each other.**

**Types of Networking Architecture**

- While there are myriads of ways to design your network architecture, you'll find that **most fall into one of two types.** These are the peer-to-peer and client/server architectures.

- **In a peer-to-peer model, all devices in a network have equal responsibilities and privileges** with each other. This means tasks are allocated equally throughout the network.

- Files in one computer can be shared with every other computer, essentially making every node a **network storage drive.**

- **Resources like a printer connected to one device** are also visible to every other device on the network.

- A **peer-to-peer architecture** is suitable for small networks, such as a branch office. **Your home network, by the way, often uses a peer-to-peer model.**

- In a client/server architecture, all devices in the network, called "clients," **are connected to a central hub, called a "server."**

- The server handles the bulk of the network operations – **data storage, processing of client requests, cybersecurity, and access control.**

- **Most large networks, such as WANs**, often use the client/server model. The web server you're accessing this **article on, for instance, is a perfect example.**

- In this case, your computer or smartphone is the **client device. Client/server is also the preferred enterprise network architecture.**

- There's also **a hybrid architecture called edge computing**, which is becoming more popular with the Internet of Things (IoT). **It's similar to a client/server architecture.**

- However, instead of the server is responsible for all storage and processing tasks, some of **it is delegated to computers located closer to the client machine, called edge devices.**

**Network Architecture Design**

- **The design of any digital network architecture involves optimizing its building blocks. These include:**

**Hardware**

- These are the equipment that forms the components of a network, **such as user devices (laptops, computers, mobile phones), routers, servers, and gateways.**

- So, in a way, the goal of any network architecture **is to find the most efficient way to get data from one hardware point to another**.

**Transmission Media**

- Transmission media refers to the physical **connections between the hardware devices on a network.**

- Different media have various properties **that determine how fast data travels from one point to another.**

- **They come in two forms: wired and wireless**. Wired media involve physical cables for connection.

- **Examples include coaxial and fibre optic**. Wireless media, on the other hand, relies on microwave or radio signals**. The most popular examples are WiFi and cellular**.

**Protocols**

- Protocols are the rules and models **that govern how data transfers between devices in a network.**

- It's also the common language that **allows different machines in a network to communicate with each other.**

- Without protocols, your iPhone couldn't access a **web page stored on a Linux server.**

- There are many network protocols, depending on the nature of the data. **Examples include the Transmission Control Protocol / Internet Protocol (TCP/IP) used by networks to connect to the Internet, the Ethernet protocol for connecting one**

**computer to another, and the File Transfer Protocol** for sending and receiving files to and from a server.

**Topology**

- **Topology is the structure of the network**. This is important because factors like distance between network devices **will affect how fast data can reach its destination, impacting performance.** There are various network topologies, each with strengths and weaknesses.
- **A star topology, for example, describes a layout where all devices in the network are connected to a central hub.**
- The advantage of this layout is that it's easy **to connect devices to the network. However, if the central hub fails, the whole network goes down.**
- On the other hand**, bus topology is where all network devices are connected to a single pathway, called the bus**.
- **The bus acts like a highway that carries data from one part of the network to the other. While cheap and easy to implement**, its performance tends to slow down as more devices are added to the network.
- Today, **most network architectures use a hybrid topology**, combining different topologies to compensate for each individual's weakness.

**Advantages and Disadvantages of Network Architecture**

- Different network architectures have **their pros and cons and knowing them is the key to picking out the right one for your needs.**
- **Peer-to-peer models are often inexpensive** and easy to put up because you don't need to invest in a powerful server.
- Theoretically, **all you need are network cables or a router**, and you're good to go. It's also quite robust; if one computer goes down, the network stays up.
- The distributed nature also lessens or **at least spreads out the network load to prevent congestion.**
- However**, peer-to-peer models are harder to manage.** Since there's no centralized hub, you'd need **to configure each computer individually to set up, for example, security software.**
- Thus**, peer-to-peer networks are also less secure. One hacked computer is all it takes to hijack the network.**

- **Client/server models, on the other hand**, are easier to manage because they take on a centralized approach.

- You can set up access privileges, firewalls, and proxy servers to boost the network's security. **Thus, a client/server setup is best for large networks over larger distances.**

- The disadvantage of this approach is that a client/server architecture is more expensive to set up, as you need a powerful server **to handle the network load. It also requires a dedicated administrator to manage the server, which adds to the payroll.**

- But the **biggest con of a client/server model is that the server is a weak link. If the server goes down, the entire network shuts down**. Thus, security is often the most robust at and near the server.

**Examples of Computer Network Architecture**

- **Each location, such as a factory, will have its own network. If the manufacturing site** uses Internet of Things (IoT) sensors on its equipment, it will most likely use edge computing. These sensors will be connected via **Wi-Fi to an edge gateway device or an on-site server**. This can also accept user devices **in the factory, such as employee workstations and mobile phones.**

- These **mini networks will then be connected to the company's wide area network (WAN),** often using a client/server architecture. Corporate headquarters will often house the central server**, although a server on the cloud is also a possibility these days**. Regardless, network administrators on HQ can monitor and manage the whole WAN infrastructure.

- **The enterprise WAN is also connected to the Internet via a broadband connection, courtesy of their service provider.**

**Sources Referred:**

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- Wikipedia

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