CCN: Design and Issues

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Goals:

❖ **Computer Network Design**

❖ **Network Issues**

  ✓ **Communication Problem**

  ✓ **Identification Problem**

  ✓ **Connection Problem**
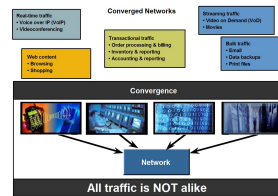
Computer Network Design

Computer Network Design

❖ Need to define the Network Architecture, Protocols, Applications, Interfaces, Policies, Usages.

❖ **Who deploys the network**
  • Enterprise, government, end-user

❖ **Where is the network deployed**
  • Home, building, campus, state, country, continent, globe

Network Issues

Computer Network Issues

❖ Some of the Network issues to be known while interconnecting with collection of autonomous computers

  • **Communication Problem**

  • **Identification Problem**
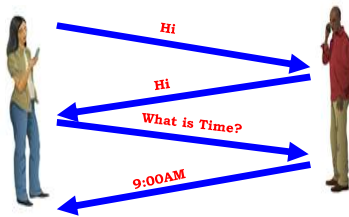
  • **Connection Problem**

Communication Problem

Communication Problem (A Human Protocol)

❖ How **communication** can take place between **Human Beings**

Hi

Hi

What is Time?

9:00AM

Communication Problem can be overcome in Computer Networks

?

Solution....

❖ **Communication** between **two computers** done through the **PROTOCOLS**

❖ **Protocols** takes **two (or more) communicating entities** running the **same protocol** in order to **accomplish a task**

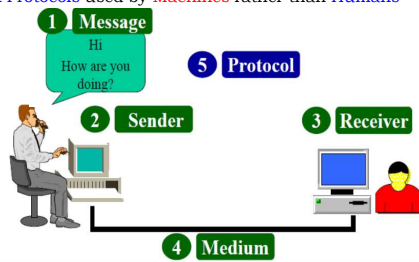❖ **Protocols** that **control** the **sending and receiving of information** within the network
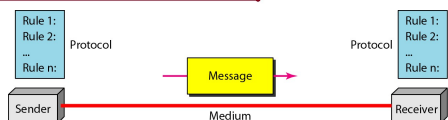
Communication Problem

❖ Network Protocols used by Machines rather than Humans

Communication Problem: Abstract View

❖ Protocols define

✓ Format,

✓ Order of messages sent and received among network entities,

✓ Actions taken on message transmission/receipt

Communication Problem(A Network Protocol)
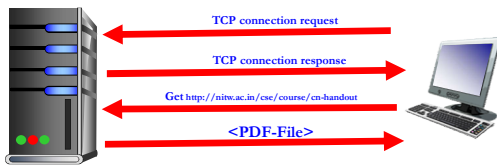
❖ How **communication** can take place between **Network Entities**

TCP connection request

TCP connection response

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<PDF-File>

Various Protocols Used in Networking

❖ **Protocols** are **set of rules**. These **protocol standards** are proposed by **RFC (Request for Comments).**

- ✓ **FTP → File Transfer Protocol**
- ✓ **HTTP → Hyper Text Transfer Protocol**
- ✓ **SSH → Secure Shell**
- ✓ **POP3→ Post Office Protocol,**
- ✓ **SMTP →Simple Mail Transfer Protocol**
- ✓ **TFTP →Trivial File Transport Protocol**
- ✓ **Telnet →Remote Login), etc..,**

Identification Problem

Identification Problem

❖ General **identification problems** that occur in networks

  ✓ **Identification of the network**

  ✓ **Identification of the system** with in the **network**

  ✓ **Identification of the process** with in the **system**

Identification of the Network
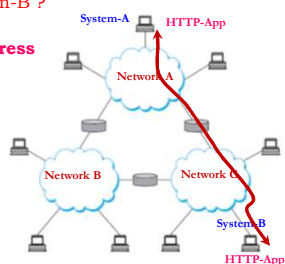

Identification of the Network

❖ How to identify the network of System-B ?

  • Need to know the **Network Address (ID)**

Addressing System
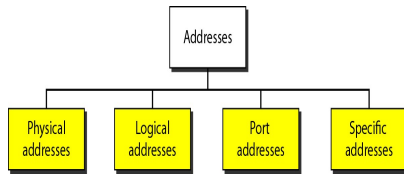
Addresses

| Physical addresses | Logical addresses | Port addresses | Specific addresses |

Addressing System

Application layer	Processes	→	Specific addresses
Transport layer	SCTP	TCP	UDP	→	Port addresses
Network layer	IP and other protocols	→	Logical addresses
Data link layer / Physical layer	Underlying physical networks	→	Physical addresses
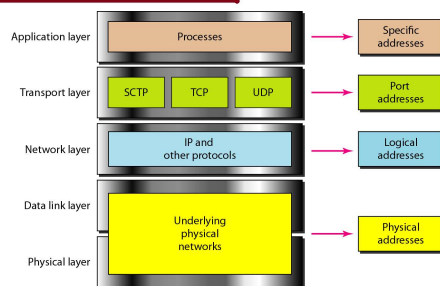
Application Layer Addressing

❖ **Application Layer Addressing** :

  ✓ Website Address (URL) – **Uniform Resource Locator**

  ✓ Like www.google.com

Application Layer Addressing

❖ **Uniform Resource Locator (URL)**

    ✓ HTTP protocol : http://www.nitw.ac.in

    ✓ FTP protocol : http://ftp.nitw.ac.in

    ✓ SMTP protocol : http://webmail.nitw.ac.in

❖ Generally **URL resolves IP Address** using **DNS servers (Domain Name Servers)**
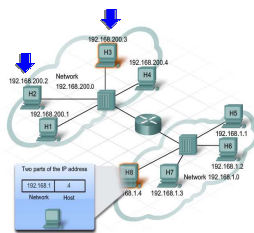
❖ How to **get the IP address for the particular URL ?**

Logical Addressing:

❖ Logical Addressing:

    ✓ Logical Addressing is mainly used for Identification of Network

    ✓ Logical Addressing used in Network Layer Addressing

    ✓ Example of Network Layer Addressing is Internet Protocol Addressing (IP Addressing)

Logical Addressing:
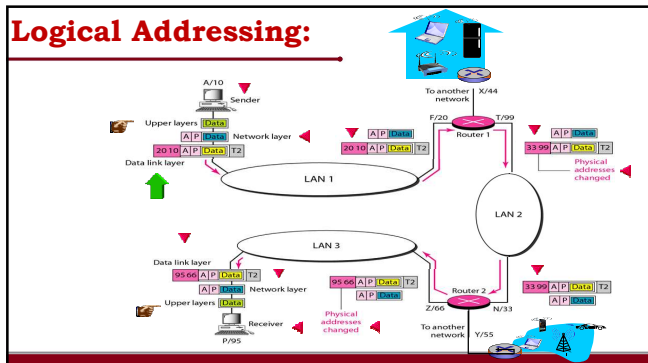
Identification of the **System** with in the Network
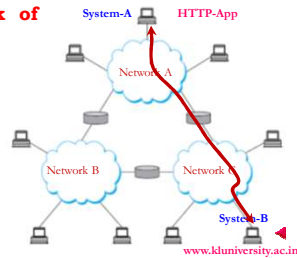

Identification of the System with in the Network

❖ How to **identify the network of**

System-B ?

  ✓ Need to **know the host ID**

System-A   HTTP-App

Network A

Network B   Network

System-B

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Identification of the System with in the Network

❖ **Physical Layer Addressing** is used to **identify the System**

within network

  ✓ **ARP addressing schema**

  ✓ **MAC address (Medium access control)**

Physical Addressing

❖ **Physical Addressing System** are **Permanent Addressing system** because **physical address** remains the **same** regardless of where the **host is placed on the network.**

✓ On a Host, the **MAC address** does not **change**, it is physically assigned to the **host NIC** and is known as the **physical address.**

✓ A **Physical address is a 48-bit flat address** burned into the **NIC card**

Physical Addressing

Physical Addressing

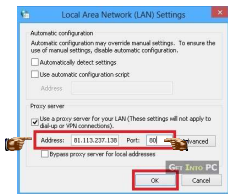# Identification of the **Process** with in the system

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Identification of the process with in the system

❖ **Service(Port) Point Addressing System** is mainly used to **identify the process with in the system**

- ✓ Use of **Port Number**
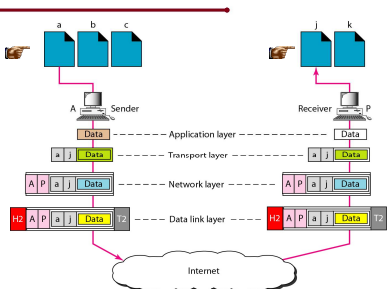
- ✓ For Ex: **Port 80 for HTTP**
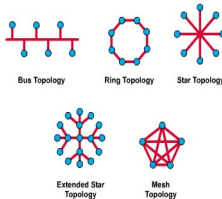

Port Addressing

Connection Problem

Connection Problem

❖ General Connection problems can be solved using Network Topologies

    ✓ BUS, RING, MESH, STAR etc......

❖ Topology refers to the way a network is laid out, either physically or logically

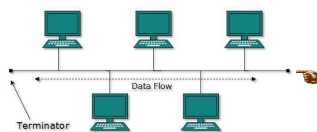   ✓ Two or more devices connect to a link, two or more links form a **topology**

Bus Topology

❖ This topology is commonly referred to as a **Linear Bus**,

    ✓ All the devices on a bus topology are connected by **one single cable.**

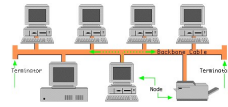   ✓ In other words, A long cable acts as a backbone to link all the devices

Bus Topology

❖ **Advantages:**

  ✓ Ease of installation, Less cabling

❖ **Disadvantages:**

  ✓ Fault isolation difficult,

  ✓ A fault or break in the cable stops all transmissions
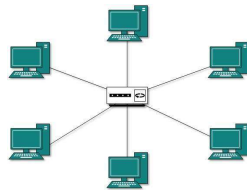

Star Topology

❖ The star topology is the most commonly used architecture in **Ethernet LANs.**

  ✓ The star topology resembles spokes in a bicycle wheel.

  ✓ When used with network devices that filter frames or packets

❖ This topology significantly reduces the traffic on the wires by sending packets only to the wires of the destination host.
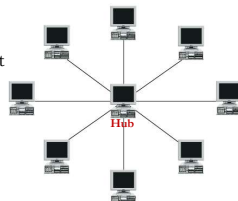

Star Topology

❖ Each device has a dedicated point-to-point link only to a central controller, usually **called a hub**. **No direct traffic between devices**

❖ **Advantages:**

  ✓ Less expensive, Less cabling and Robust
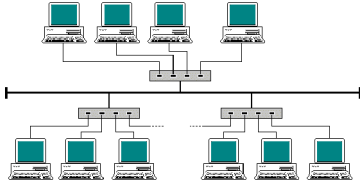
❖ **Disadvantages:**

  ✓ More cabling than Bus

Tree Topology

❖ Larger networks use the **Extended Star Topology** also called **Tree Topology.**

Tree Topology

❖ **Advantages:**

   ✓ It scales well

   ✓ Expansion of Network is possible and easy.

   ✓ Managing and maintaining is easy

   ✓ Error detection and correction is easy.

❖ **Disadvantages**

   ✓ It relies heavily on the main bus cable, if it breaks whole network is fails

   ✓ As more and more nodes and segments are added, the maintenance becomes difficult.

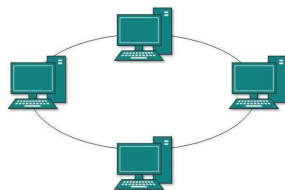   ✓ Scalability of the network depends on the type of cable used.

Ring Topology

❖ A Frame travels around the ring, stopping at each node.

   ✓ If a node wants to transmit data, it adds the data as well as the destination address to the frame.

❖ The frame then continues around the ring until

   ✓ it finds the destination node, which takes the data out of the frame.

Ring Topology

❖ **Single ring** – All the devices on the network share a single cable

❖ **Dual ring** – The dual ring topology allows data to be sent in both directions.

❖ **Advantages:**

  ✓ Installation and reconfiguration relatively easy,

   fault isolation simple

❖ **Disadvantages:**

  ✓ A break in the ring can disable the entire network
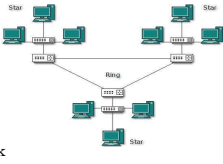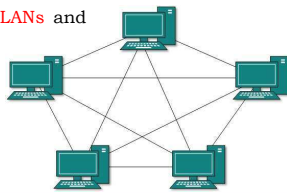
Mesh Topology

❖ The mesh topology connects all devices (nodes) to each other for

  redundancy and fault tolerance.

❖ It is used in WANs to interconnect LANs and

  for mission critical networks

  ✓ Banks and financial institutions.
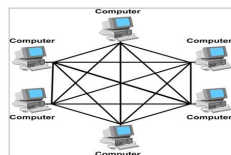
Mesh Topology

❖ **Advantages:**

  ✓ Dedicated connection,

  ✓ Robust privacy/security

  ✓ Fault identification/isolation easy

❖ **Disadvantages:**

  ✓ Amount of cabling and I/O ports

  ✓ installation and reconfiguration is difficult

  ✓ Implementing the mesh topology is expensive and difficult.

Devices

1. **Hub**: A distributor that has a lot of ports which connected to computers.
2. **Switches:** like a hub but it transmit packets to it destination
3. **Bridge:** it is used to connect two similar LANs.
4. **Routers:** choose the best path to transmit the packet.
5. **Gateway:** it is use to connect two different LANs.
6. **Repeaters:** repeats signals that travels via long distance

Considerations When Choosing a Topology

❖ **Cost:** A linear bus network may be the least expensive way to install a network;

❖ **Infrastructure:** Length of cable needed. The linear bus network uses shorter lengths of cable.

❖ **Future growth:** With a star topology, expanding a network is easily done

❖ **Cable type:** The most common cable is unshielded twisted pair, which is most often used with star topologies.

Goals:

❖ **Computer Network Design**

❖ **Network Issues**

✓ **Communication Problem**

✓ **Identification Problem**

✓ **Connection Problem**

Thank You