# Network Architecture

by

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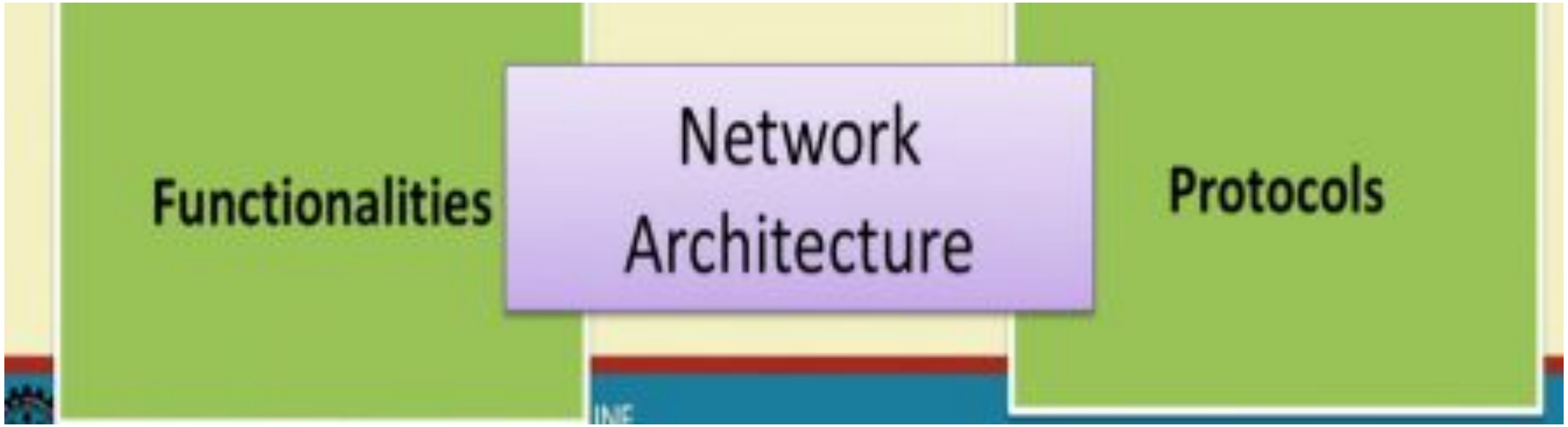
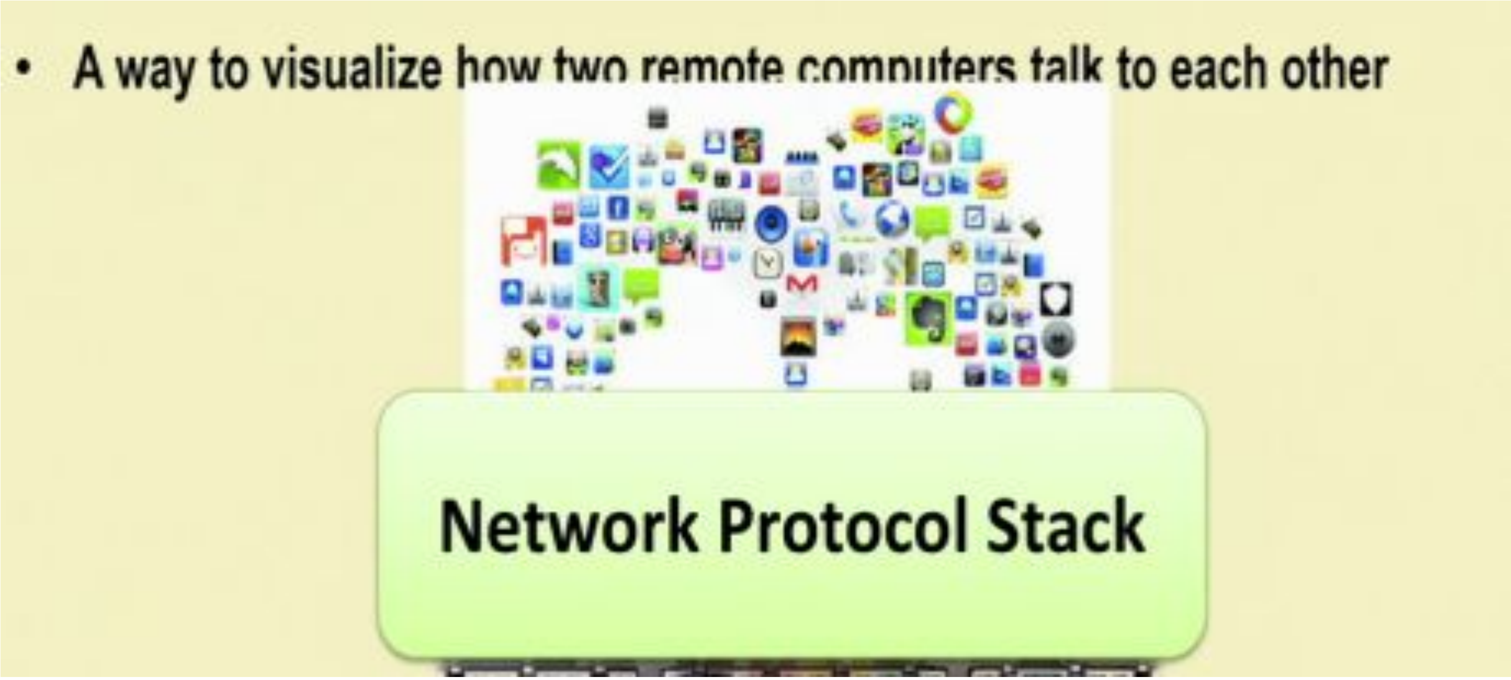
Tezpur University

# Network Architecture



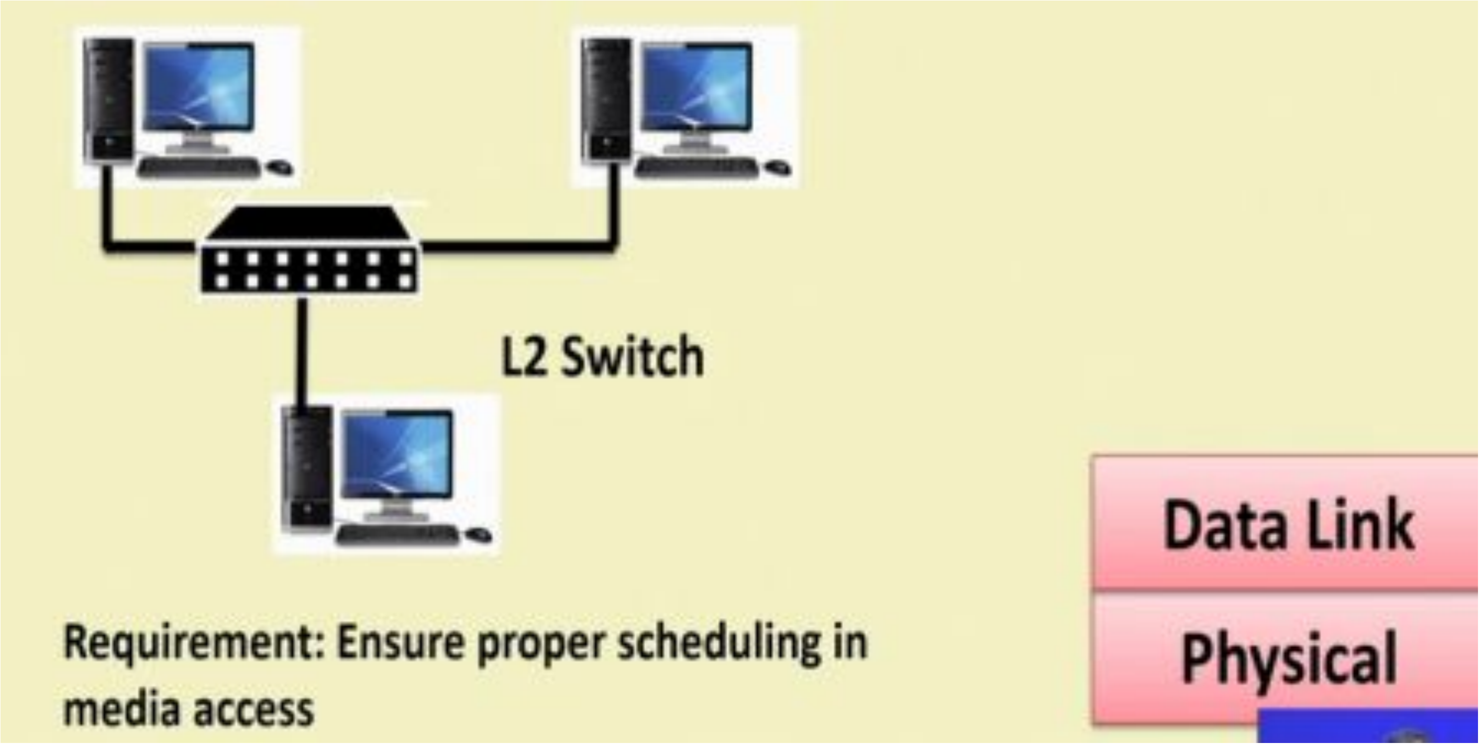
# What is Network Architecture



- A way to visualize how two remote computers talk to each other

# What is Network Architecture (contd..)

# Network Architecture (contd..)



Requirement: Ensure proper scheduling in media access

# Network Architecture (contd..)

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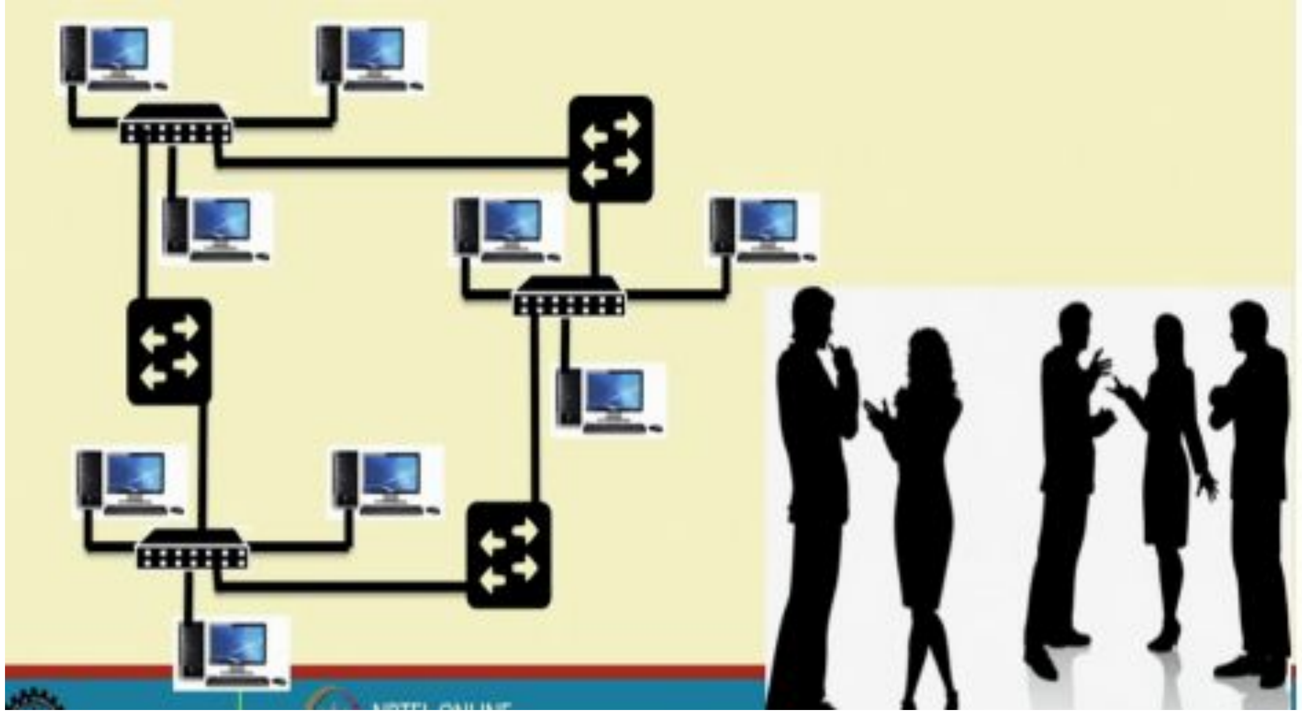

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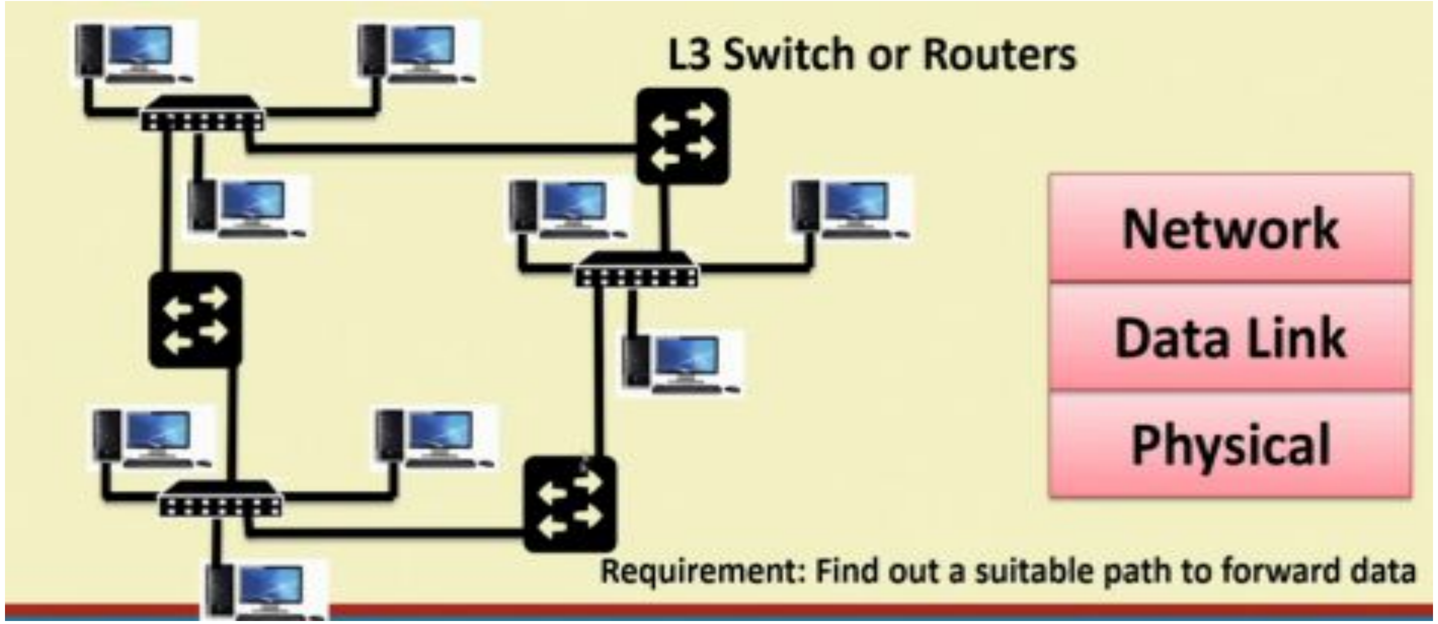

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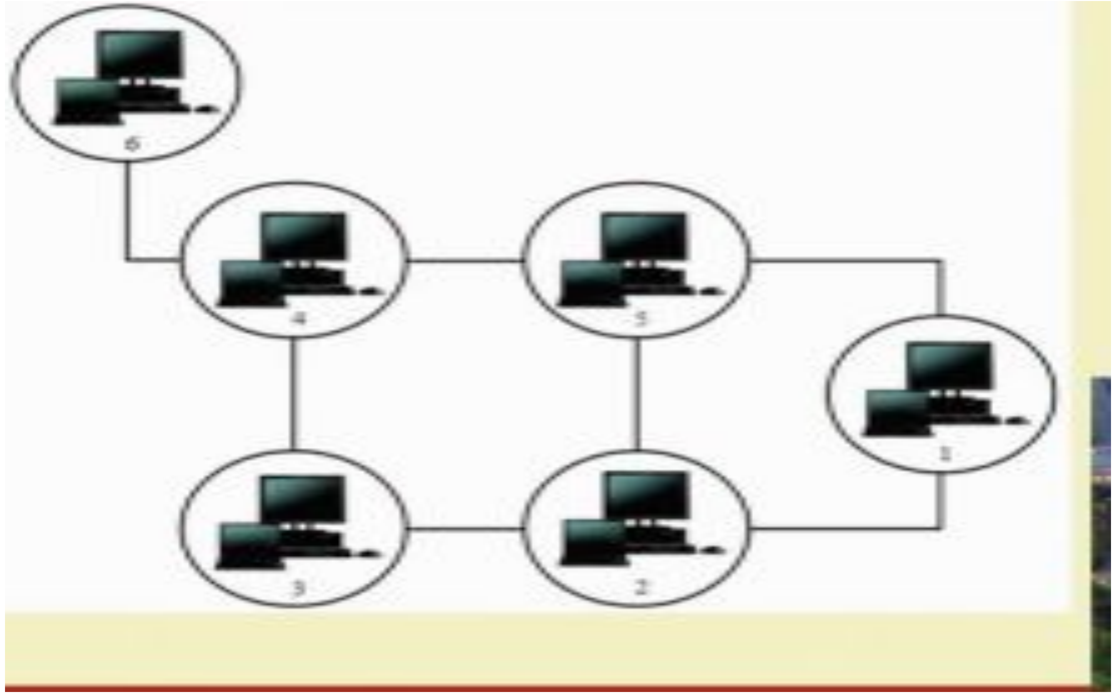
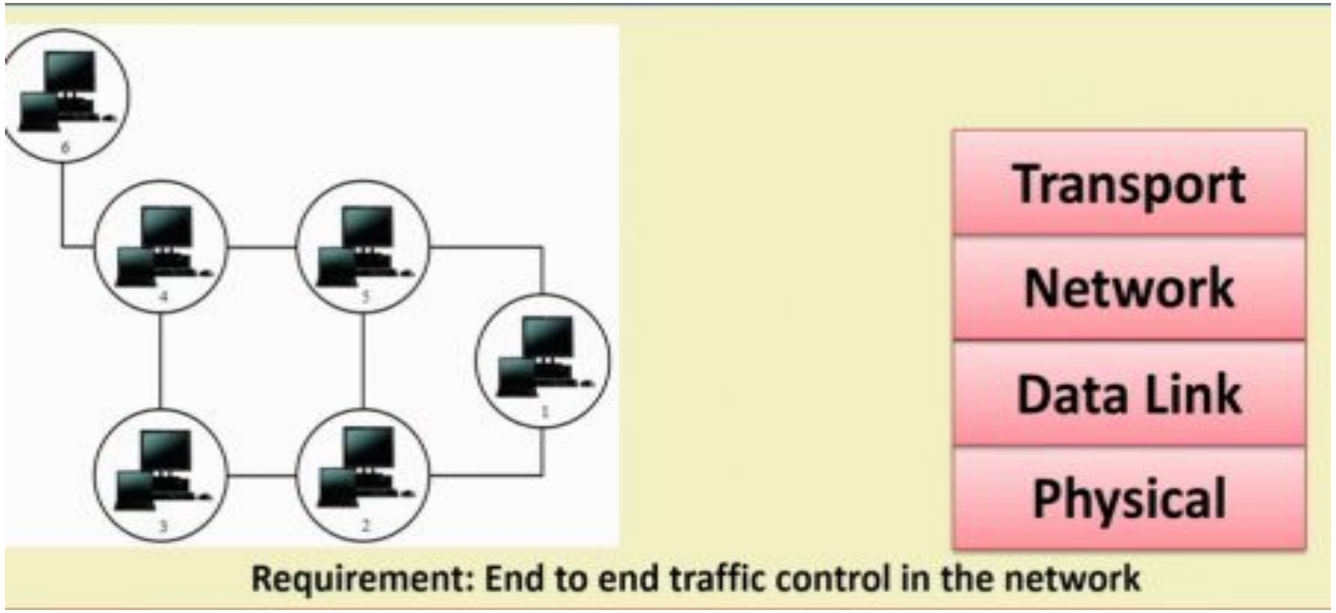
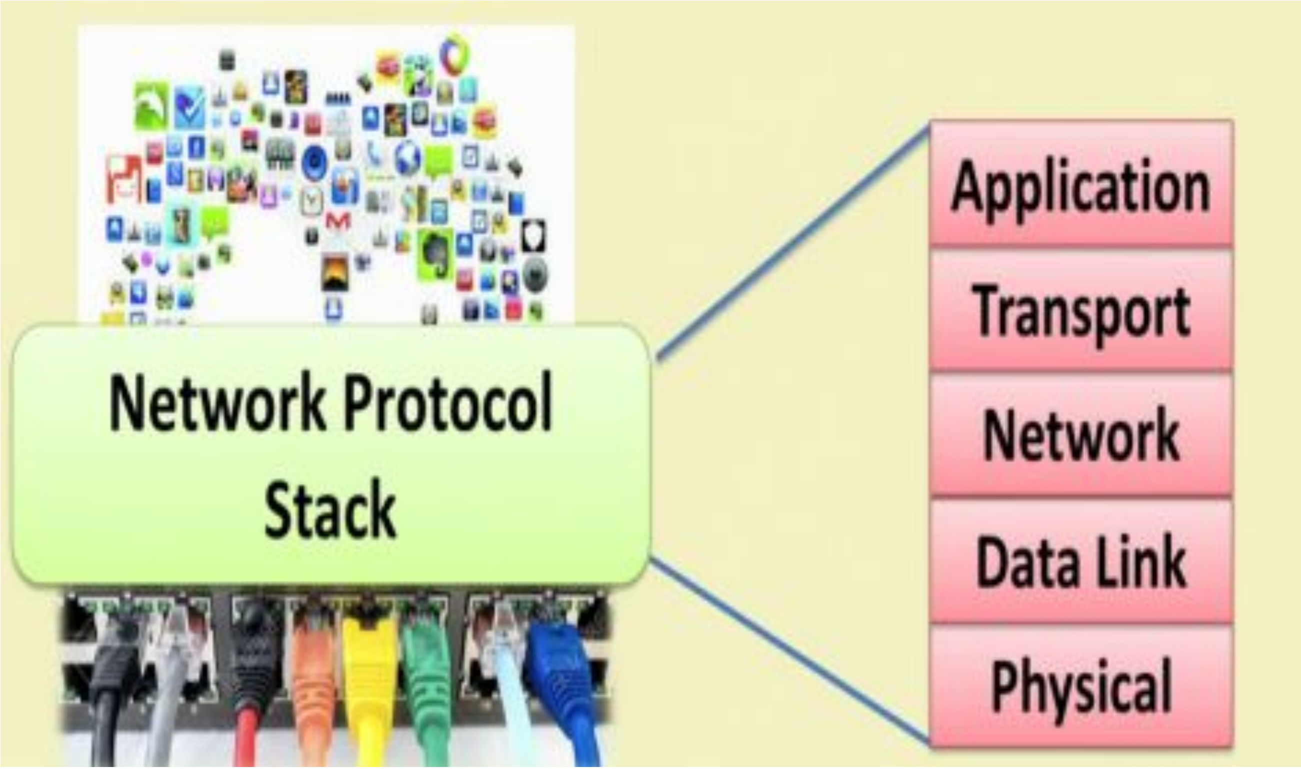


# Network Architecture (contd..)

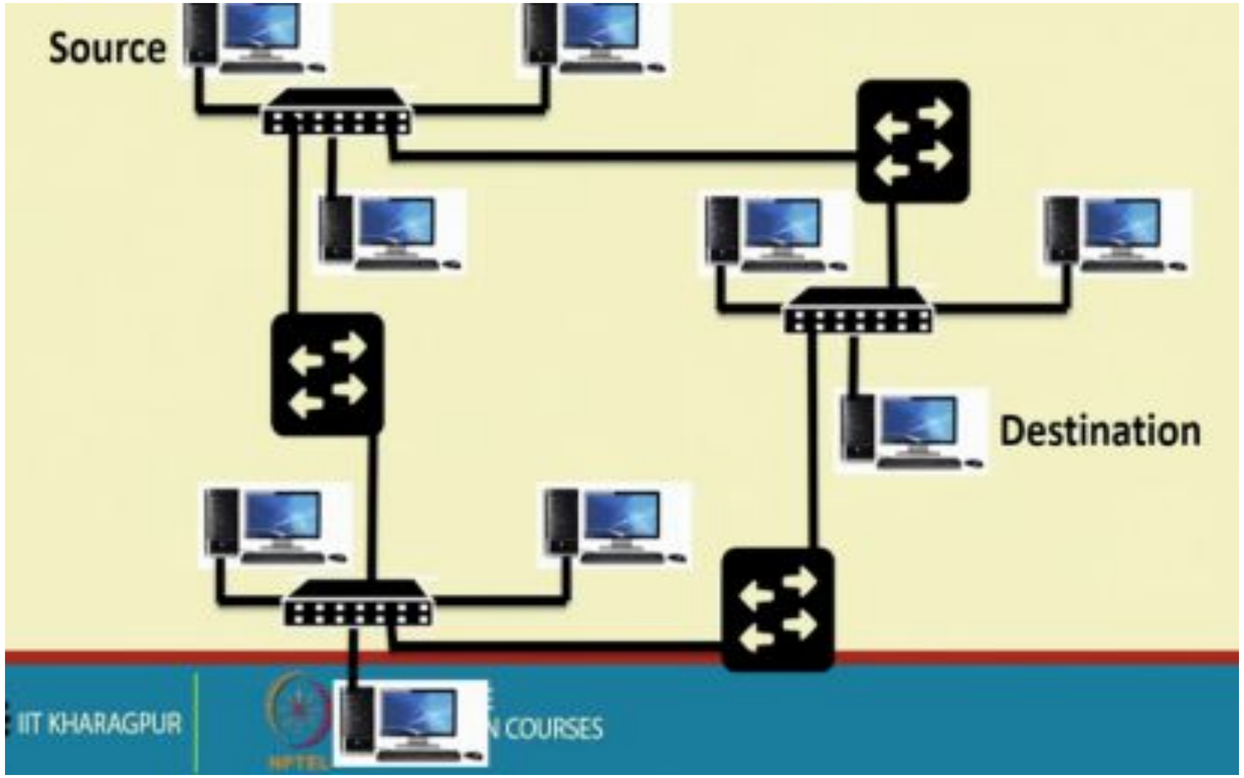


**Requirement: End to end traffic control in the network**

# Network Architecture (contd..)



# Data transfer between two remote machines



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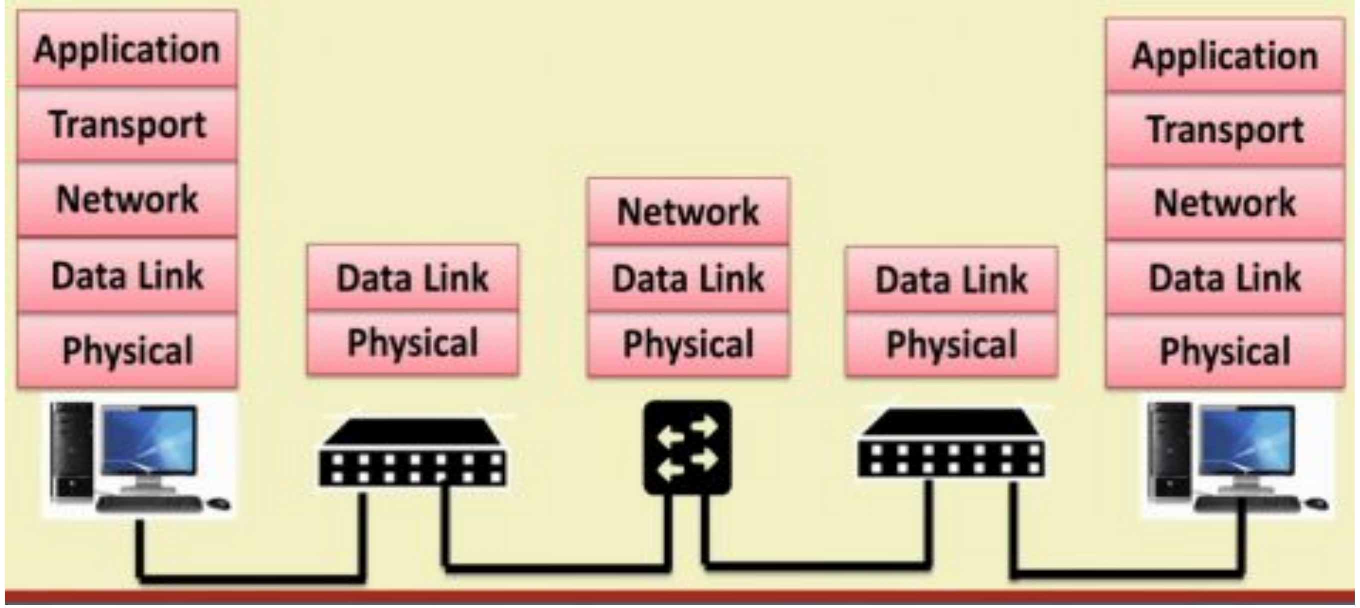
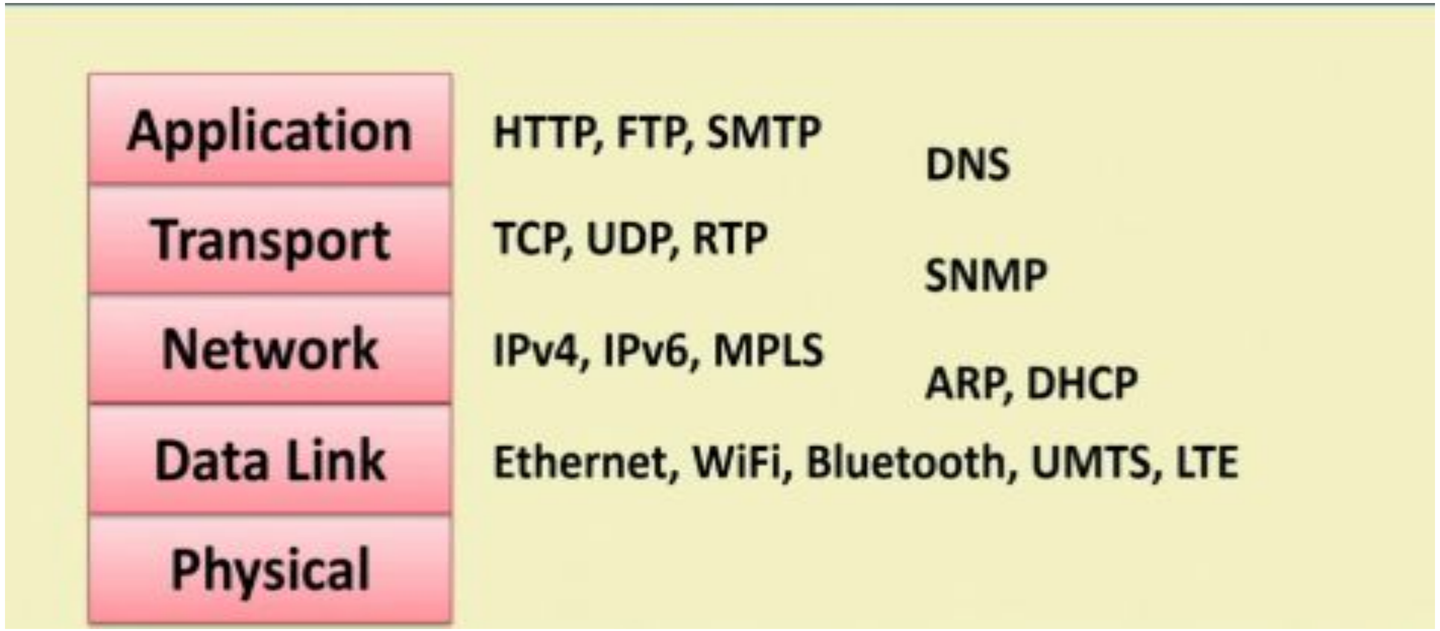


# Data transfer between two remote machines



Application HTTP, FTP, SMTP

DNS

Transport TCP, UDP, RTP

SNMP

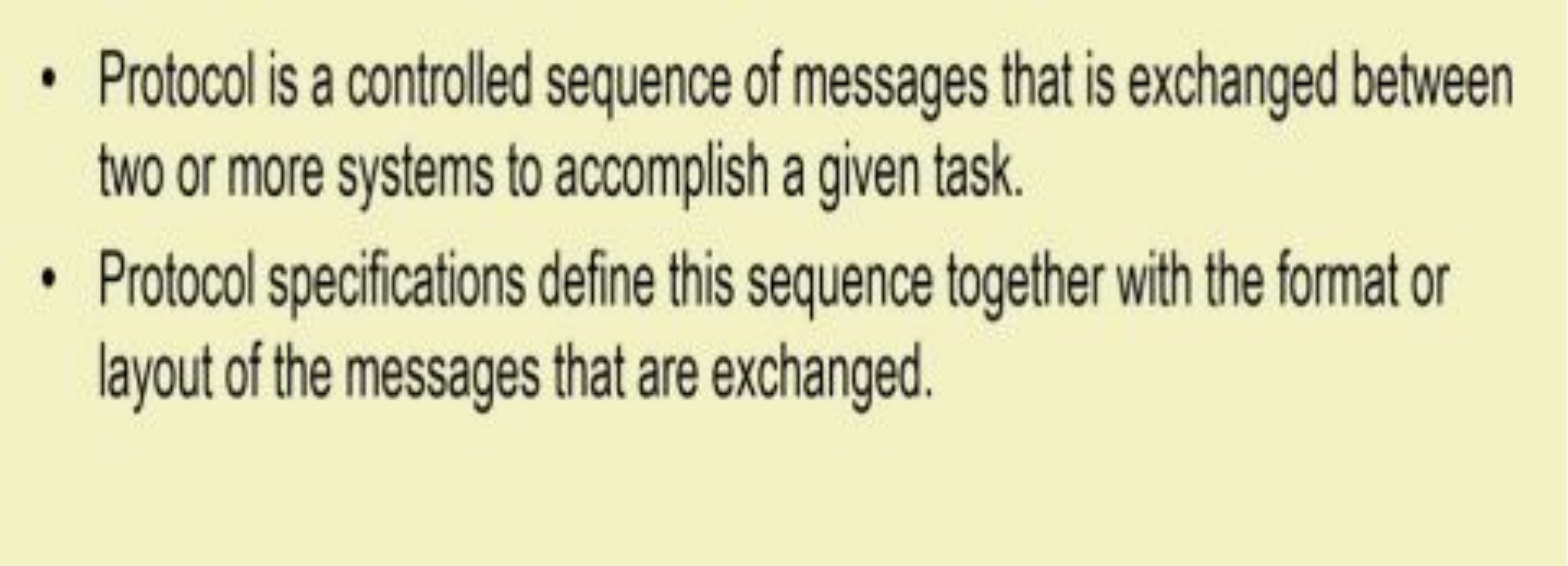
Network IPv4, IPv6, MPLS

ARP, DHCP

Data Link Ethernet, WiFi, Bluetooth, UMTS, LTE

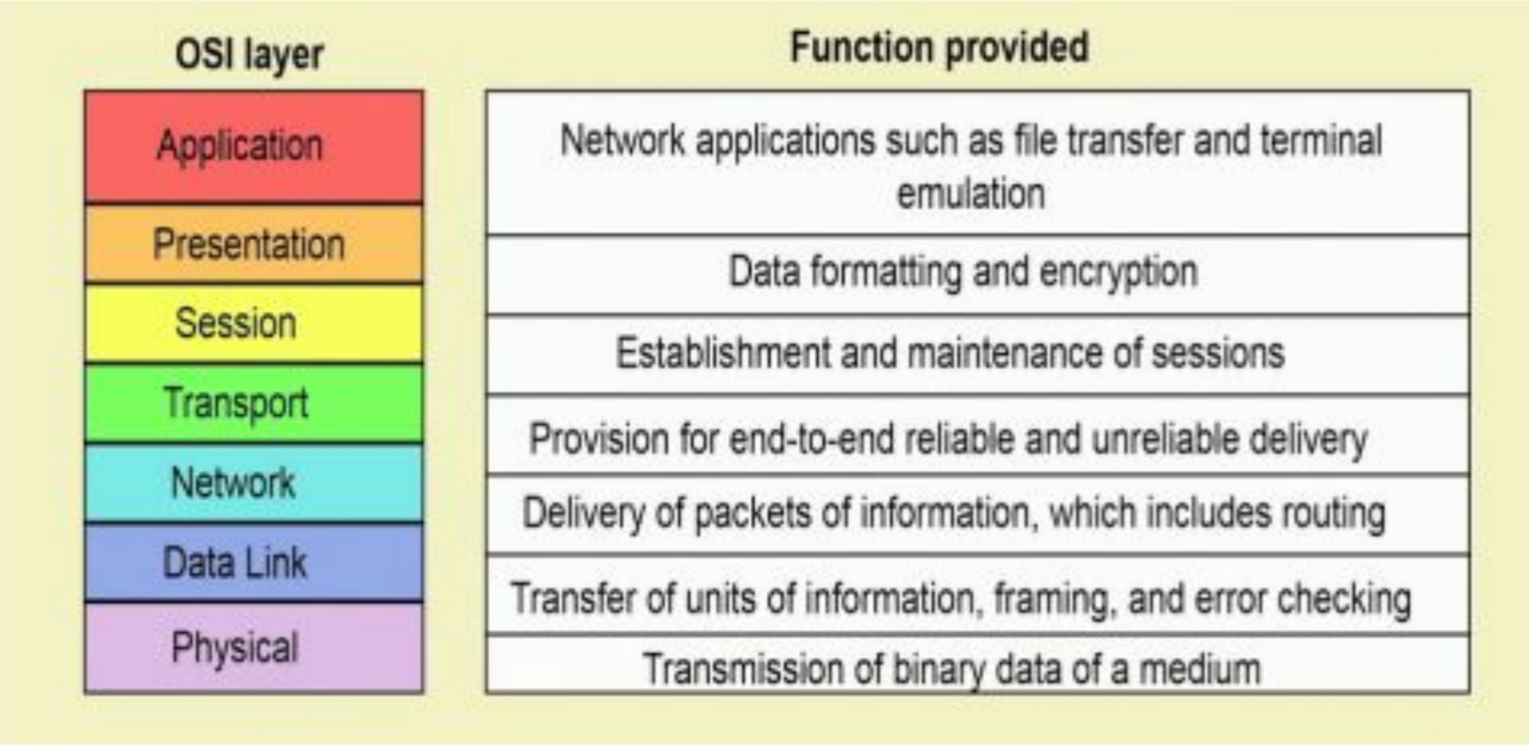
Physical

# Protocols



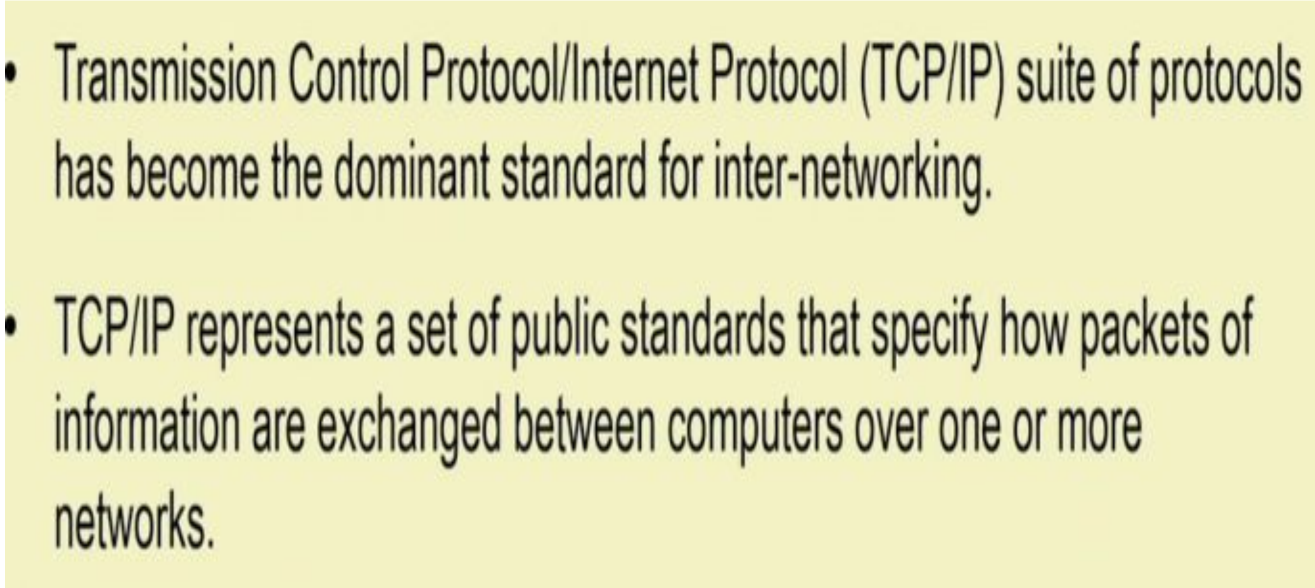
- Protocol is a controlled sequence of messages that is exchanged between two or more systems to accomplish a given task.
- Protocol specifications define this sequence together with the format or layout of the messages that are exchanged.

# OSI model layers



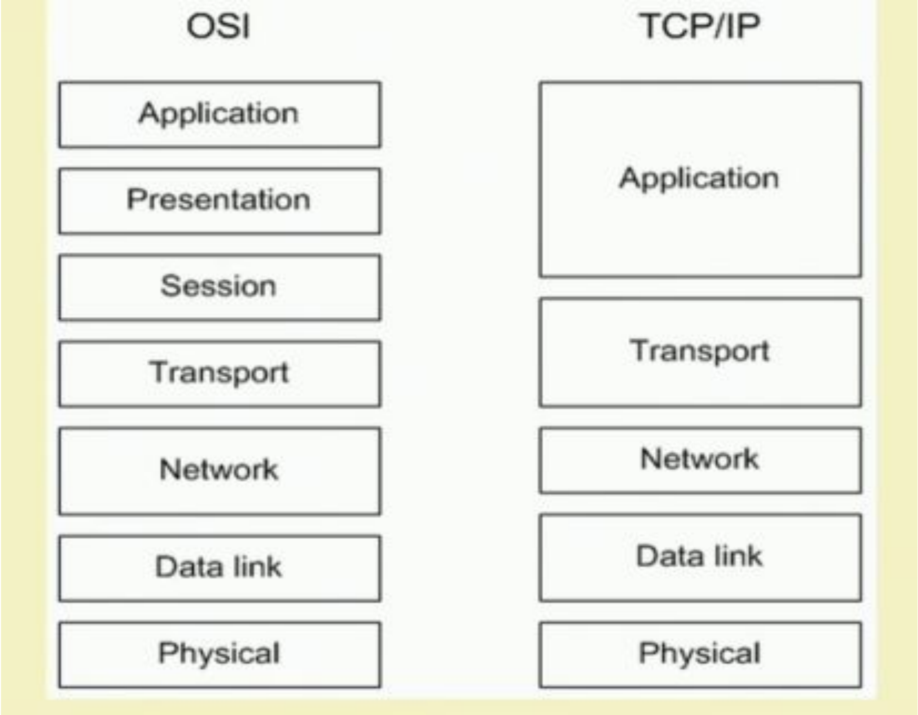
| OSI layer | Function provided |
|---|---|
| Application | Network applications such as file transfer and terminal emulation |
| Presentation | Data formatting and encryption |
| Session | Establishment and maintenance of sessions |
| Transport | Provision for end-to-end reliable and unreliable delivery |
| Network | Delivery of packets of information, which includes routing |
| Data Link | Transfer of units of information, framing, and error checking |
| Physical | Transmission of binary data of a medium |

# TCP/IP

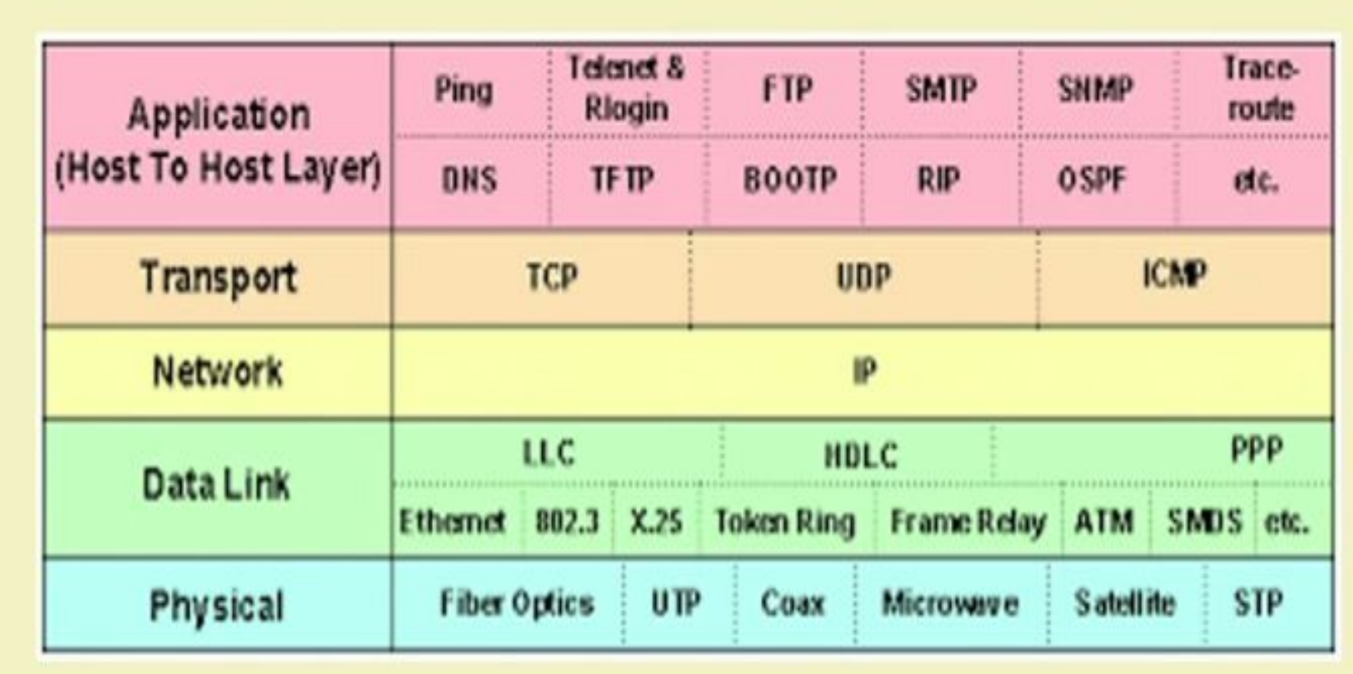


- Transmission Control Protocol/Internet Protocol (TCP/IP) suite of protocols has become the dominant standard for inter-networking.
- TCP/IP represents a set of public standards that specify how packets of information are exchanged between computers over one or more networks.

# OSI and TCP/IP

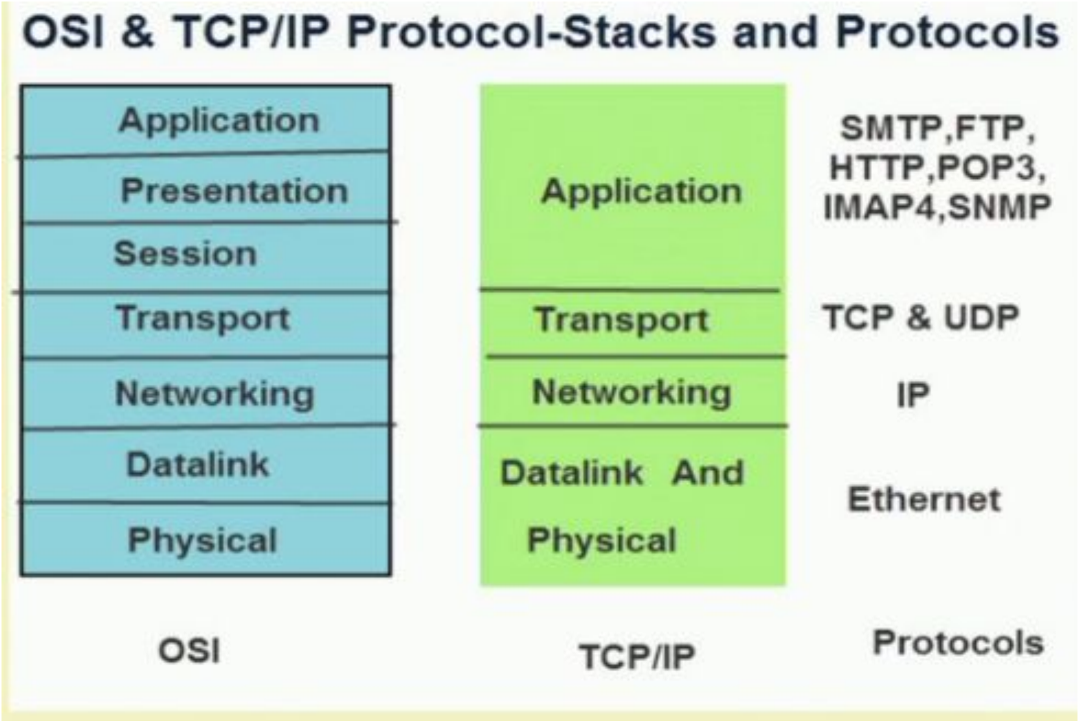


# TCP/IP



| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Application (Host To Host Layer) | Ping | Telenet & Rlogin | FTP | SMTP | SNMP | Trace-route | | |
| | DNS | TFTP | BOOTP | RIP | OSPF | etc. | | |
| Transport | TCP | UDP | ICMP | | | | | |
| Network | IP | | | | | | | |
| Data Link | LLC | HDLC | PPP | | | | | |
| | Ethernet | 802.3 | X.25 | Token Ring | Frame Relay | ATM | SMDS | etc. |
| Physical | Fiber Optics | UTP | Coax | Microwave | Satellite | STP | | |

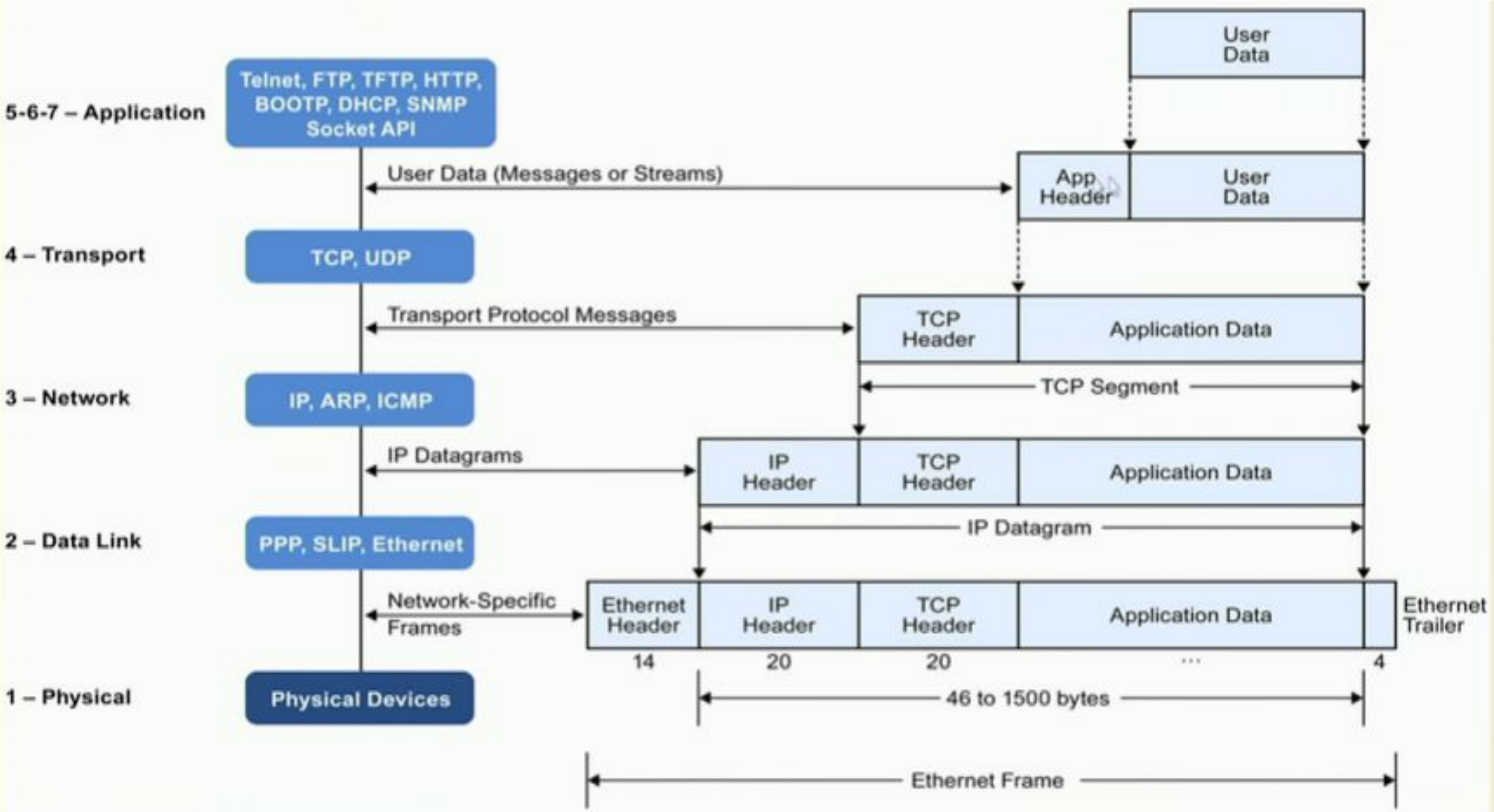
# OSI and TCP/IP



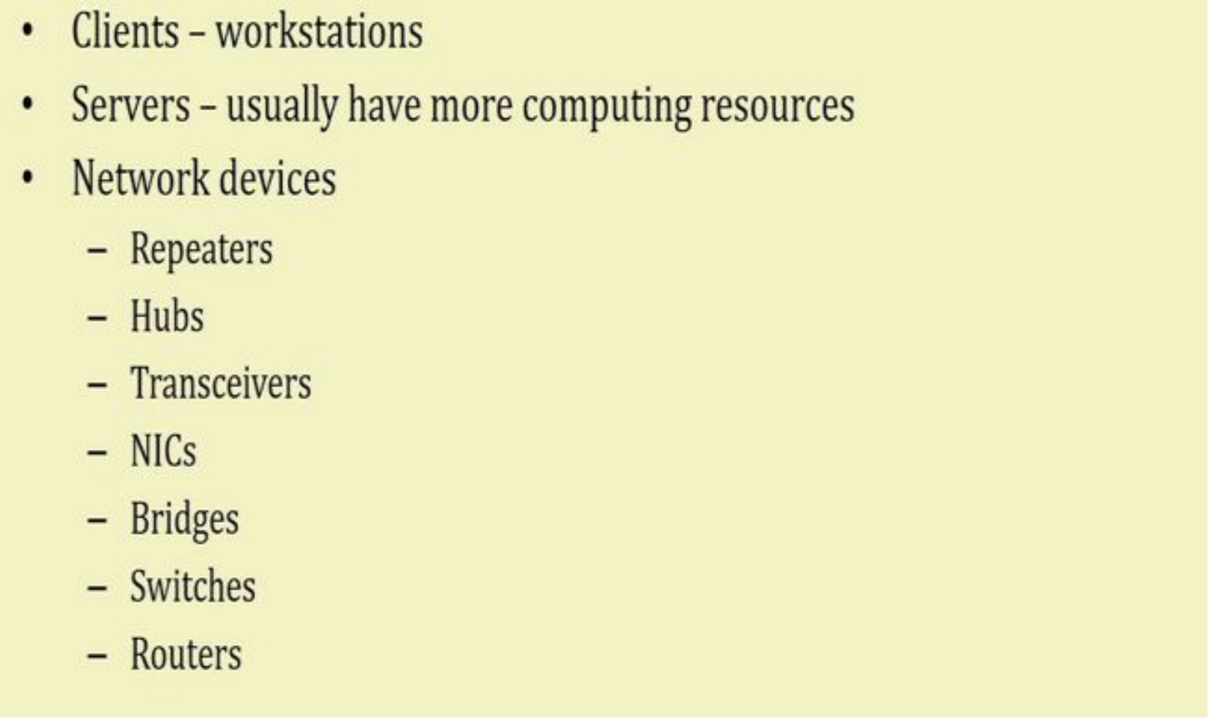
OSI & TCP/IP Protocol-Stacks and Protocols

| OSI | TCP/IP | Protocols |
|---|---|---|
| Application | Application | SMTP,FTP,<br>HTTP,POP3,<br>IMAP4,SNMP |
| Presentation | | |
| Session | | |
| Transport | Transport | TCP & UDP |
| Networking | Networking | IP |
| Datalink | Datalink And Physical | Ethernet |
| Physical | | |

# TCP/IP Packet encapsulation

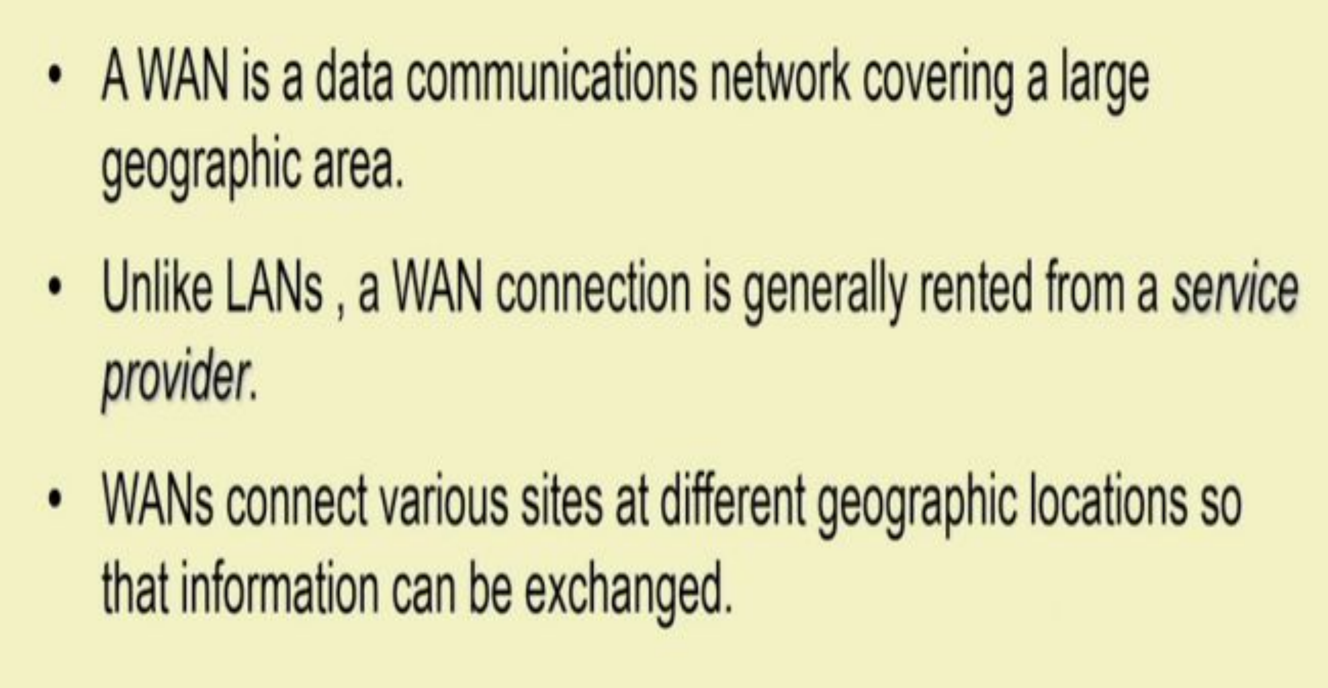


# LAN-Typical components



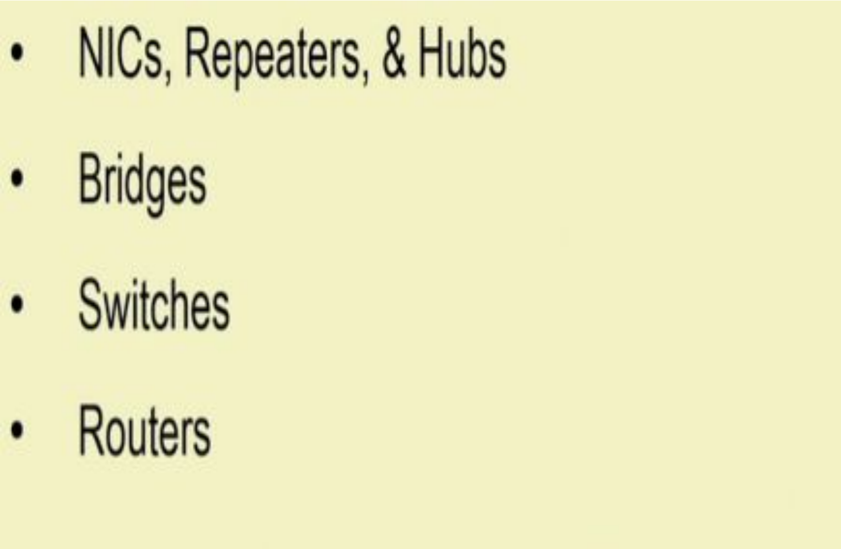
- Clients – workstations
- Servers – usually have more computing resources
- Network devices
  - Repeaters
  - Hubs
  - Transceivers
  - NICs
  - Bridges
  - Switches
  - Routers

# WAN (Wide Area Network)



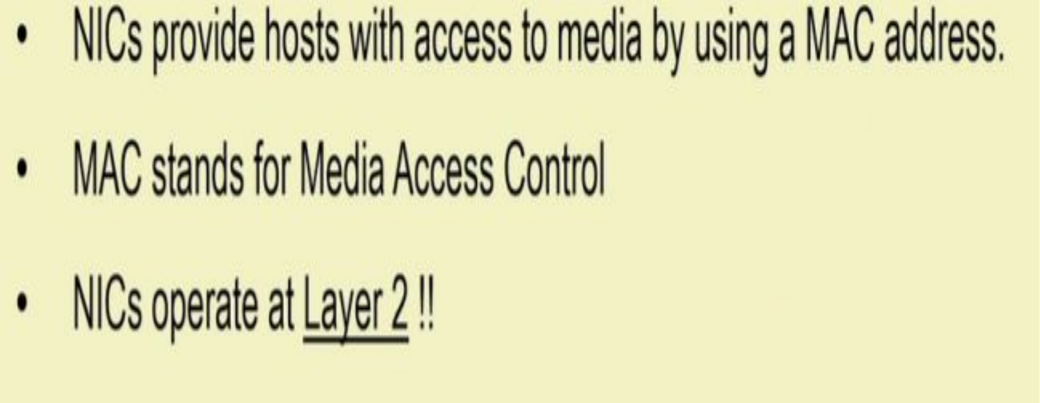
- A WAN is a data communications network covering a large geographic area.
- Unlike LANs , a WAN connection is generally rented from a *service provider*.
- WANs connect various sites at different geographic locations so that information can be exchanged.

# Evaluation of LAN devices



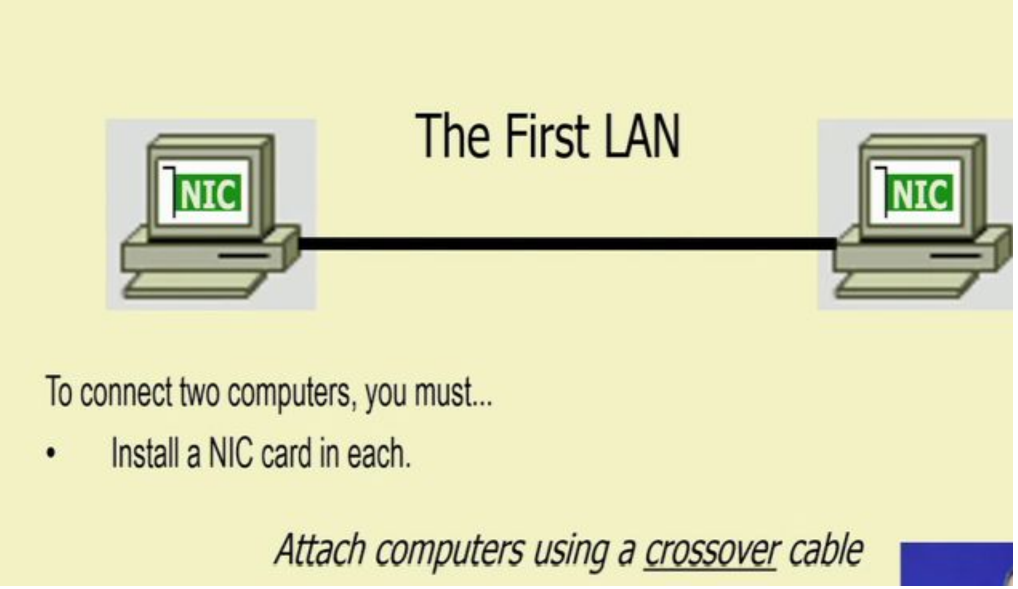
- NICs, Repeaters, & Hubs
- Bridges
- Switches
- Routers

# NIC Specific



- NICs provide hosts with access to media by using a MAC address.
- MAC stands for Media Access Control
- NICs operate at Layer 2 !!

# NICs, Repeater, Hub



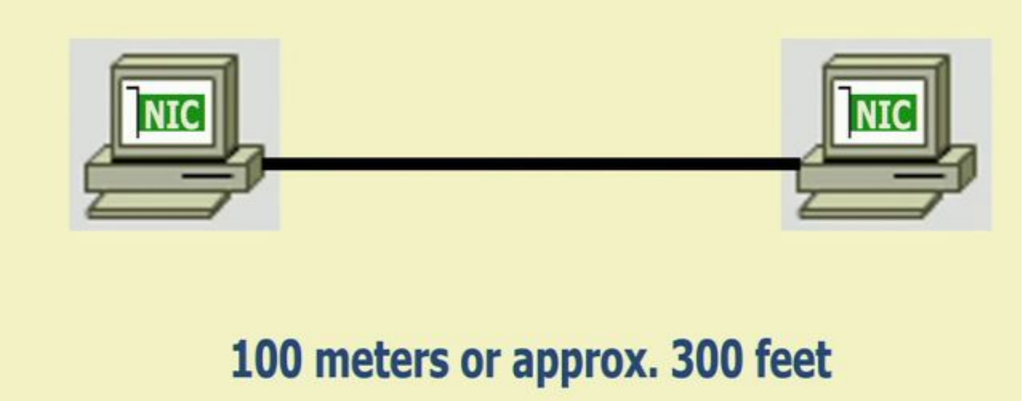
The First LAN

To connect two computers, you must...

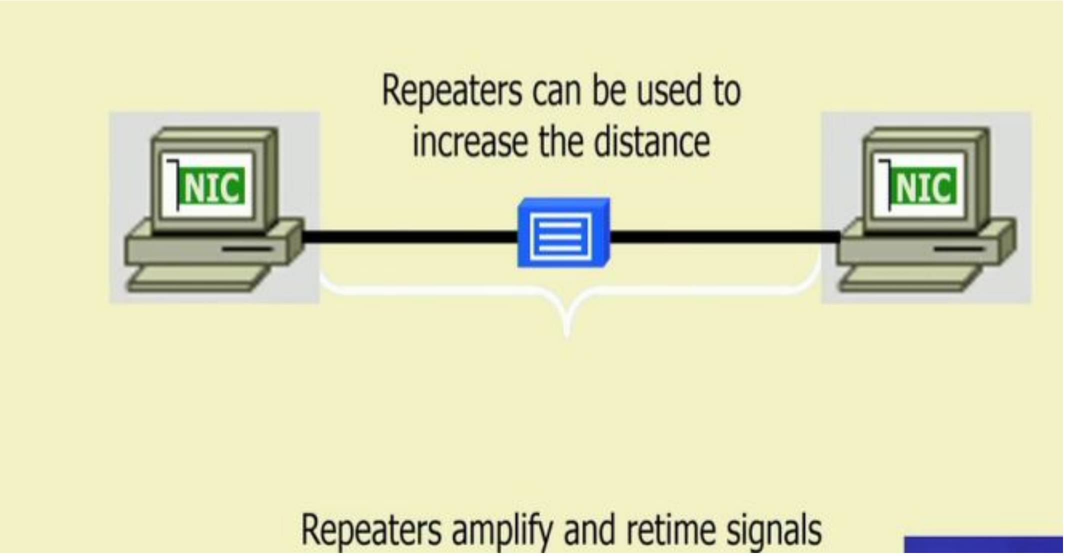
- Install a NIC card in each.

*Attach computers using a <u>crossover</u> cable*

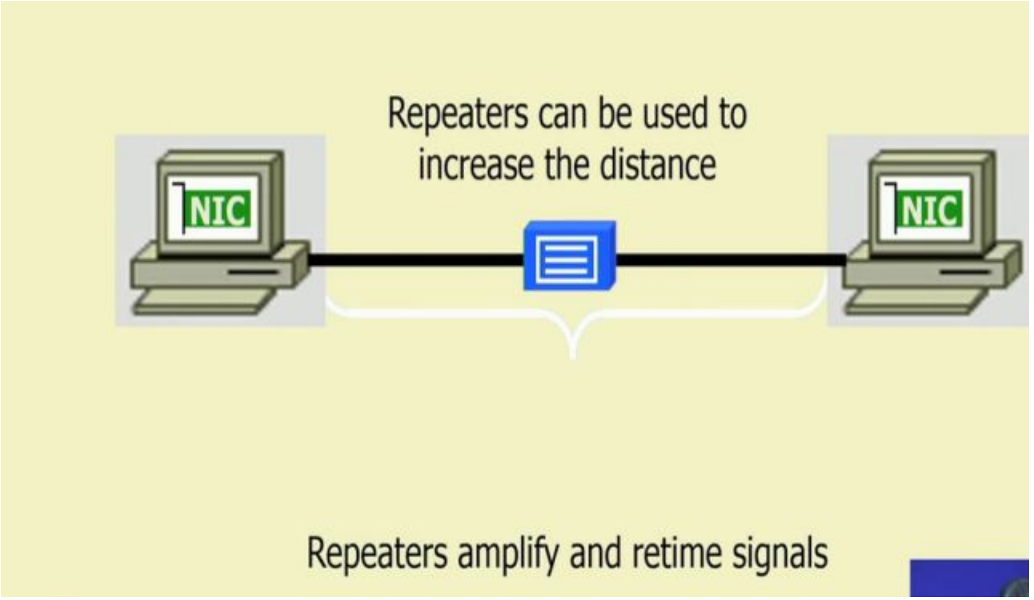
# NICs, Repeater, Hub



# NICs, Repeater, Hub


Repeaters can be used to increase the distance
NIC
NIC
Repeaters amplify and retime signals

# NICs, Repeater, Hub



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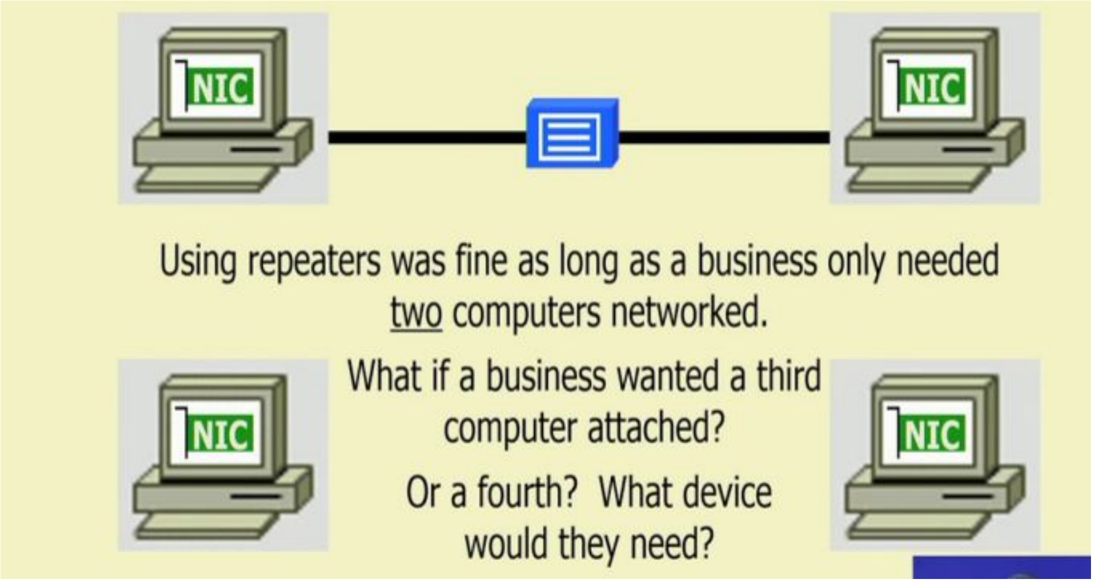
Repeaters amplify and retime signals

# NICs, Repeater, Hub

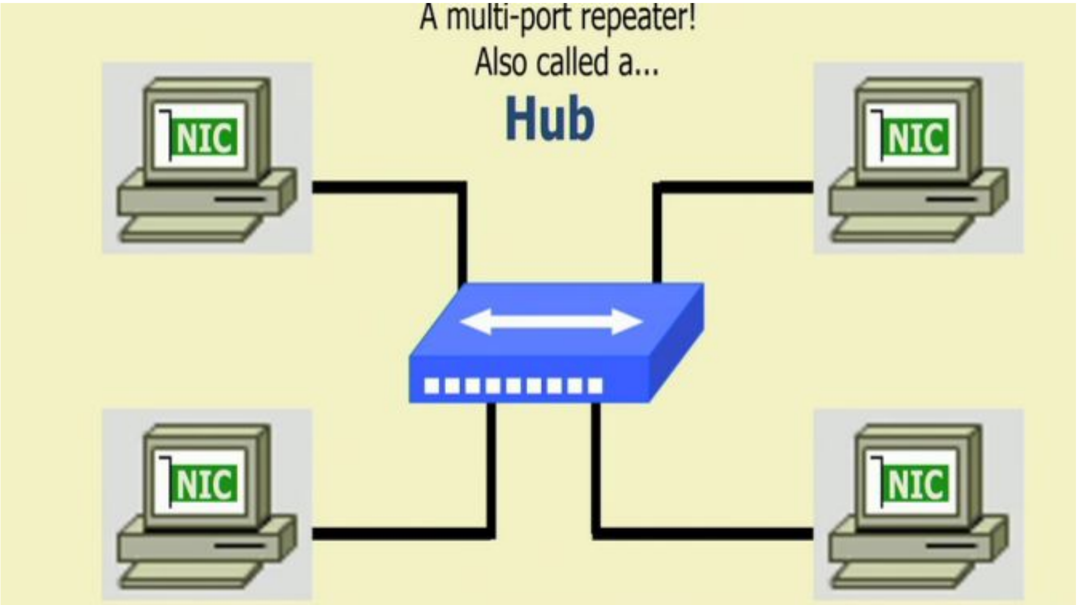


Using repeaters was fine as long as a business only needed two computers networked.

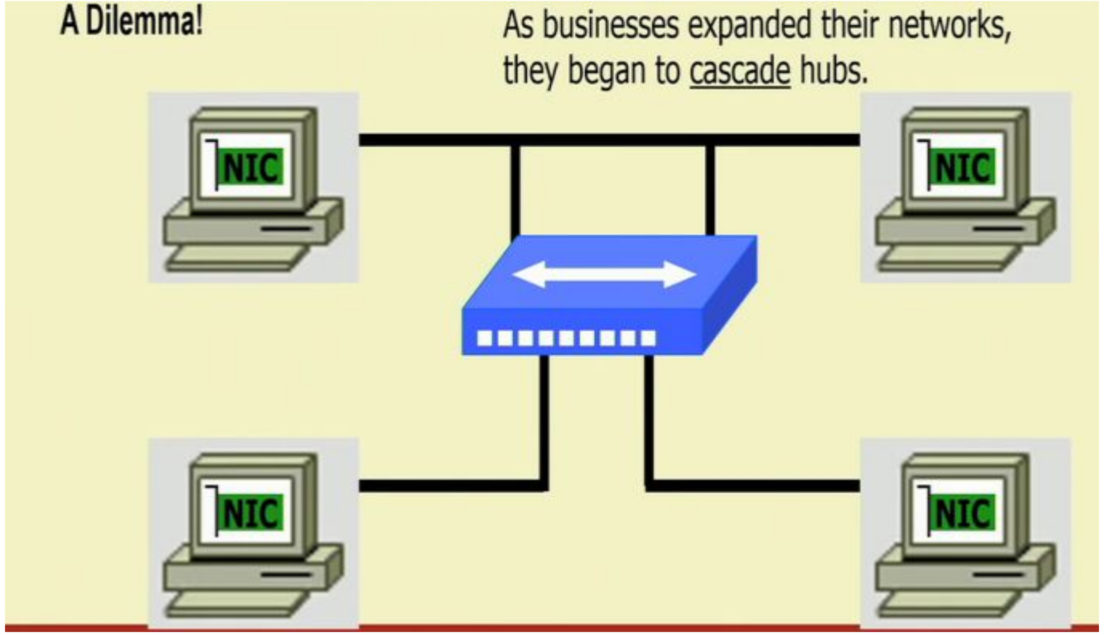
What if a business wanted a third computer attached?

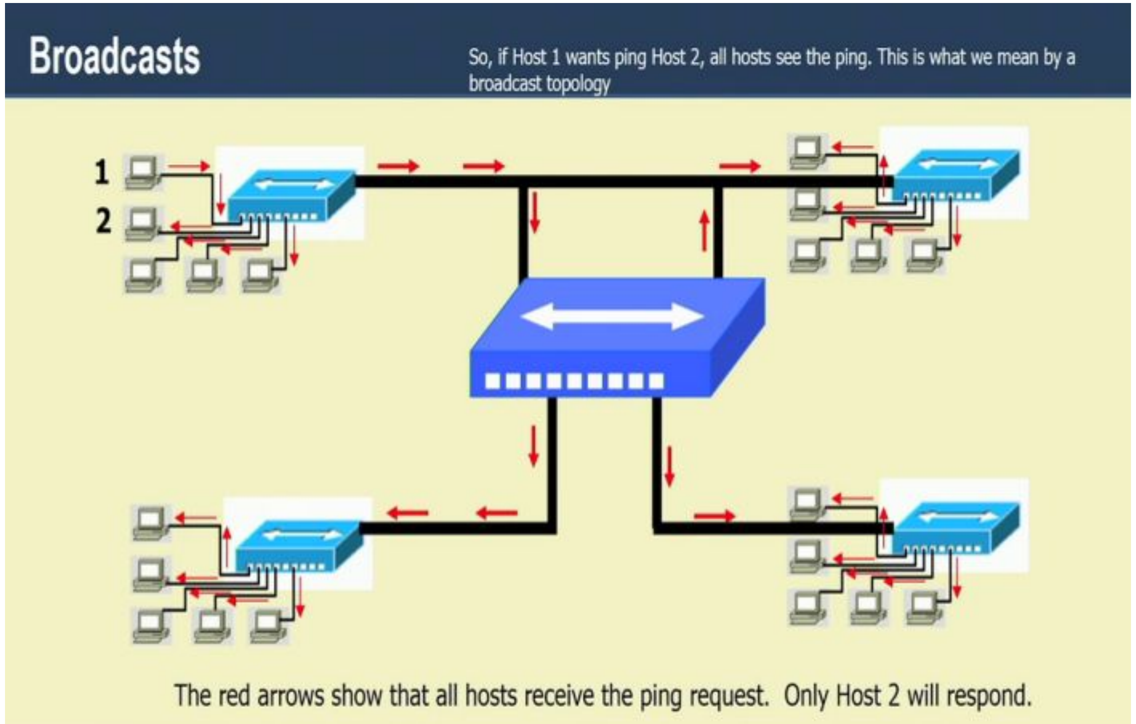
Or a fourth? What device would they need?

# NICs, Repeater, Hub



# NICs, Repeater, Hub


A Dilemma!
As businesses expanded their networks, they began to cascade hubs.
NIC
NIC
NIC
NIC

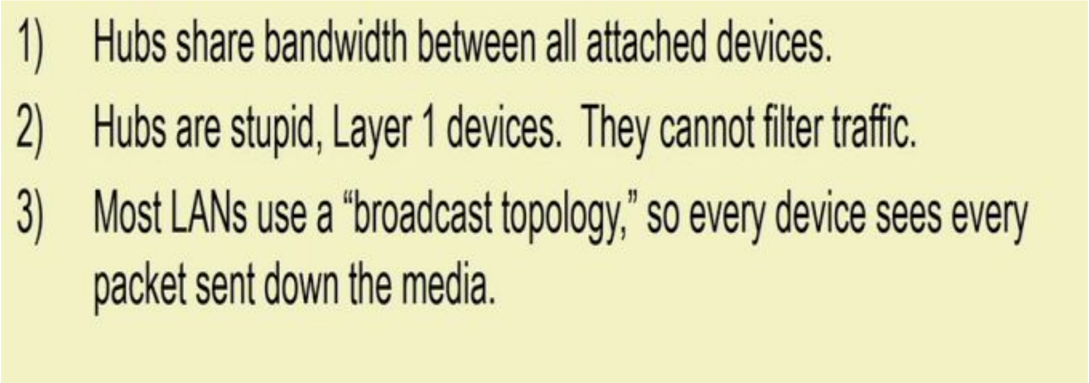


# Broadcasts

So, if Host 1 wants ping Host 2, all hosts see the ping. This is what we mean by a broadcast topology

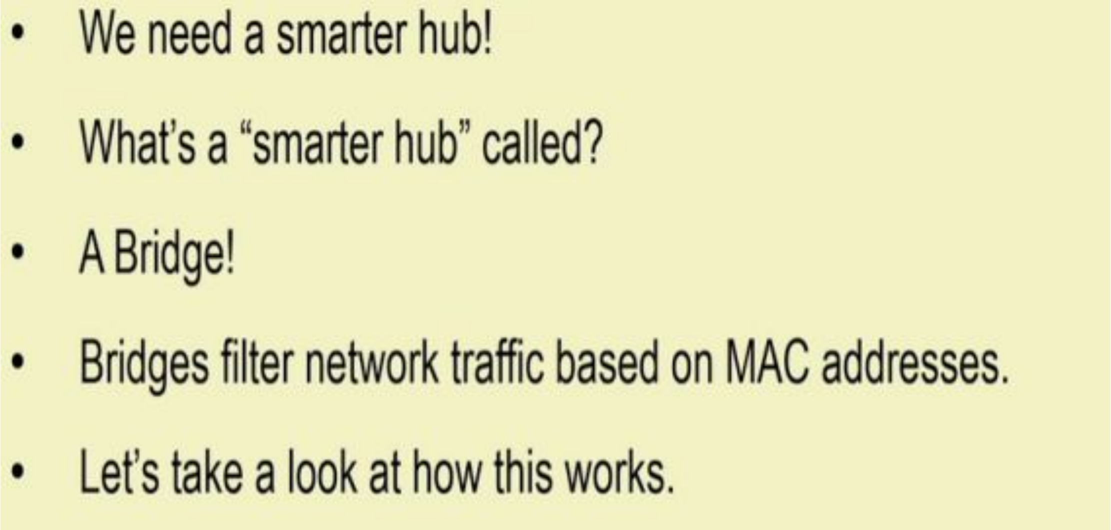
The red arrows show that all hosts receive the ping request.  Only Host 2 will respond.

# What is the problem



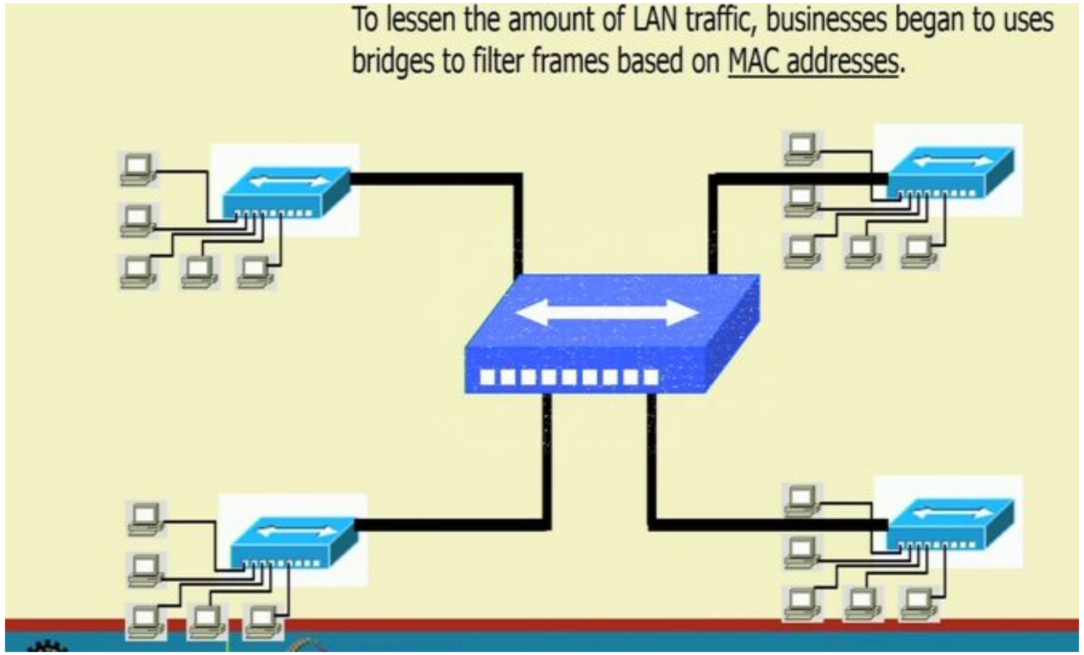
1) Hubs share bandwidth between all attached devices.
2) Hubs are stupid, Layer 1 devices.  They cannot filter traffic.
3) Most LANs use a “broadcast topology,” so every device sees every packet sent down the media.

# What is the solution?



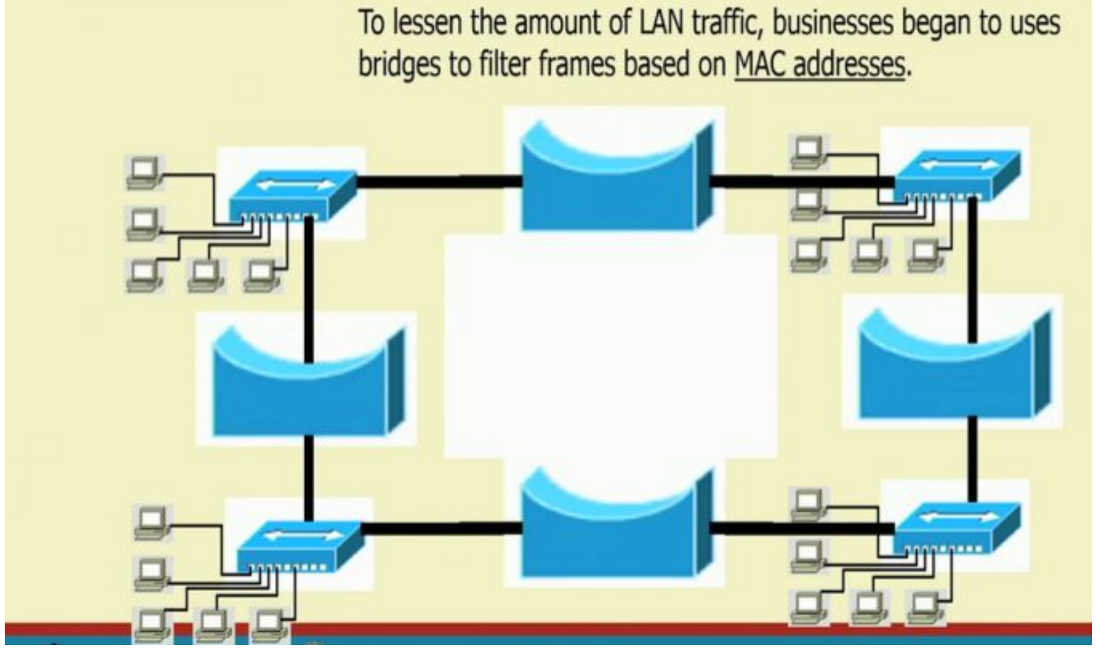
- We need a smarter hub!
- What’s a “smarter hub” called?
- A Bridge!
- Bridges filter network traffic based on MAC addresses.
- Let’s take a look at how this works.

# Bridge



To lessen the amount of LAN traffic, businesses began to uses bridges to filter frames based on MAC addresses.

# Bridge



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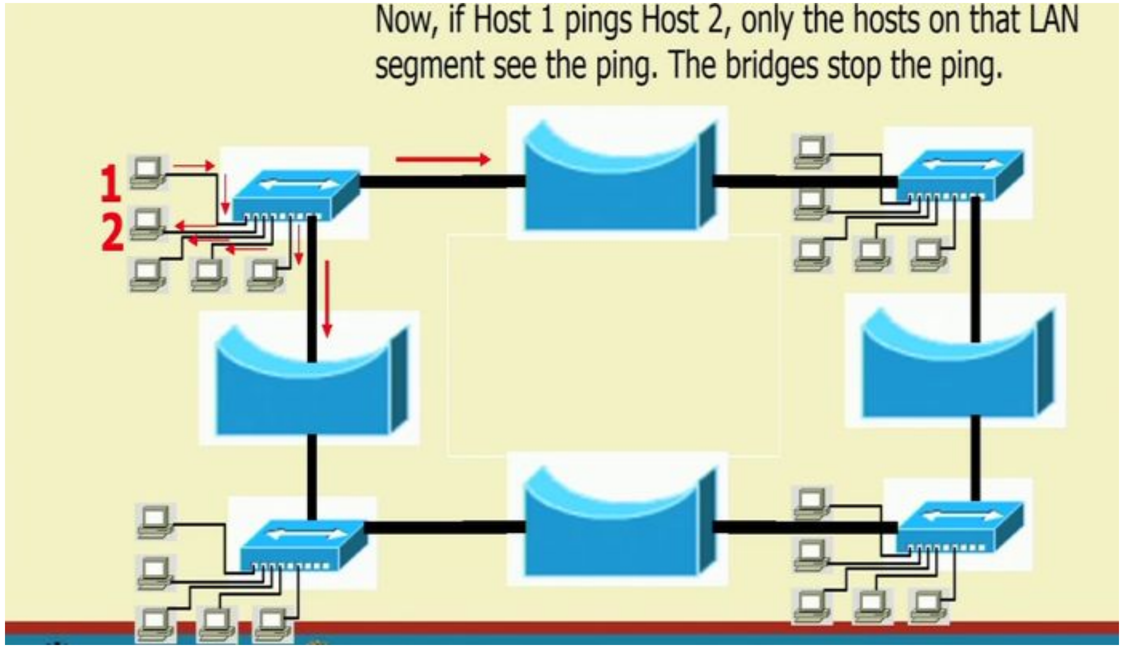
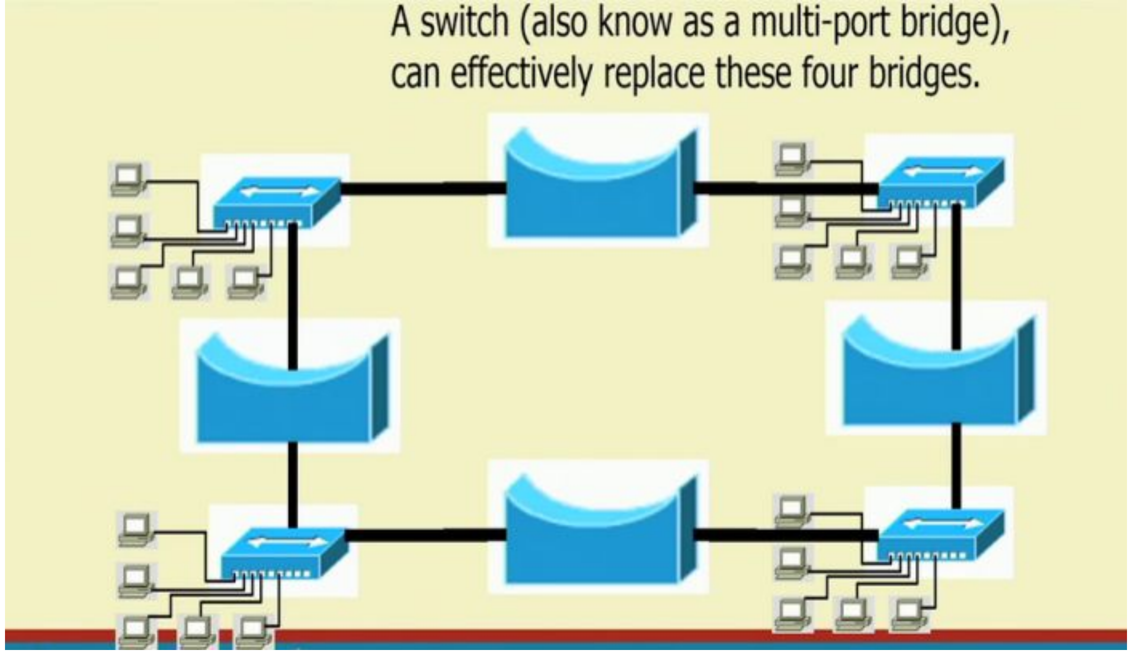
# Bridge



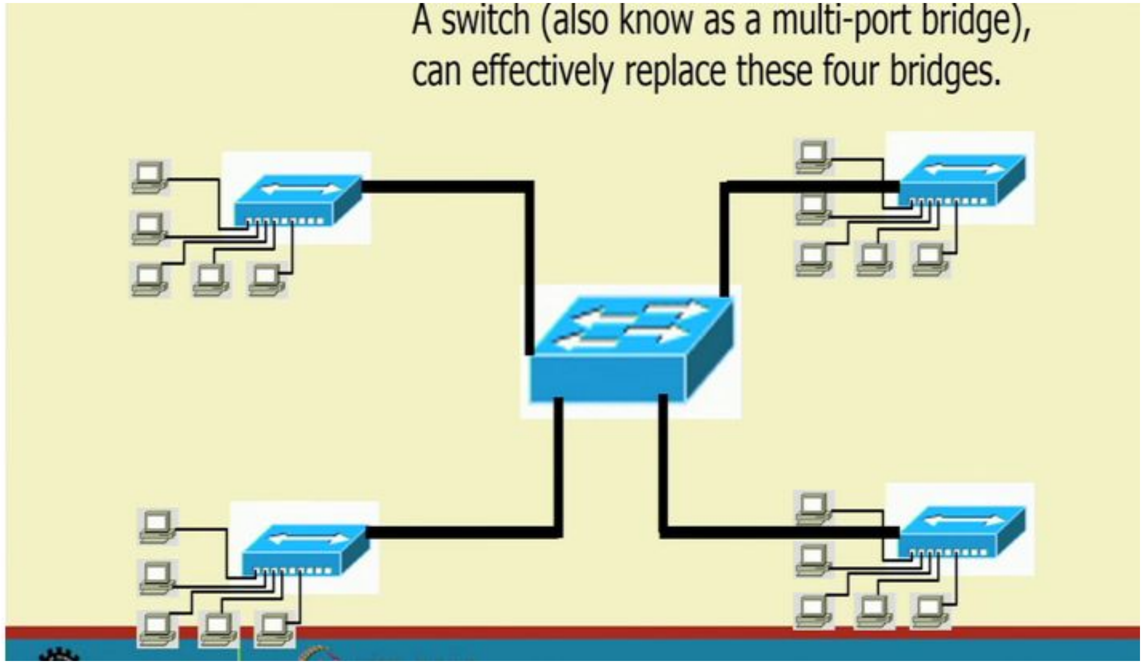
Now, if Host 1 pings Host 2, only the hosts on that LAN segment see the ping. The bridges stop the ping.

# Switch



A switch (also know as a multi-port bridge), can effectively replace these four bridges.

# Switch



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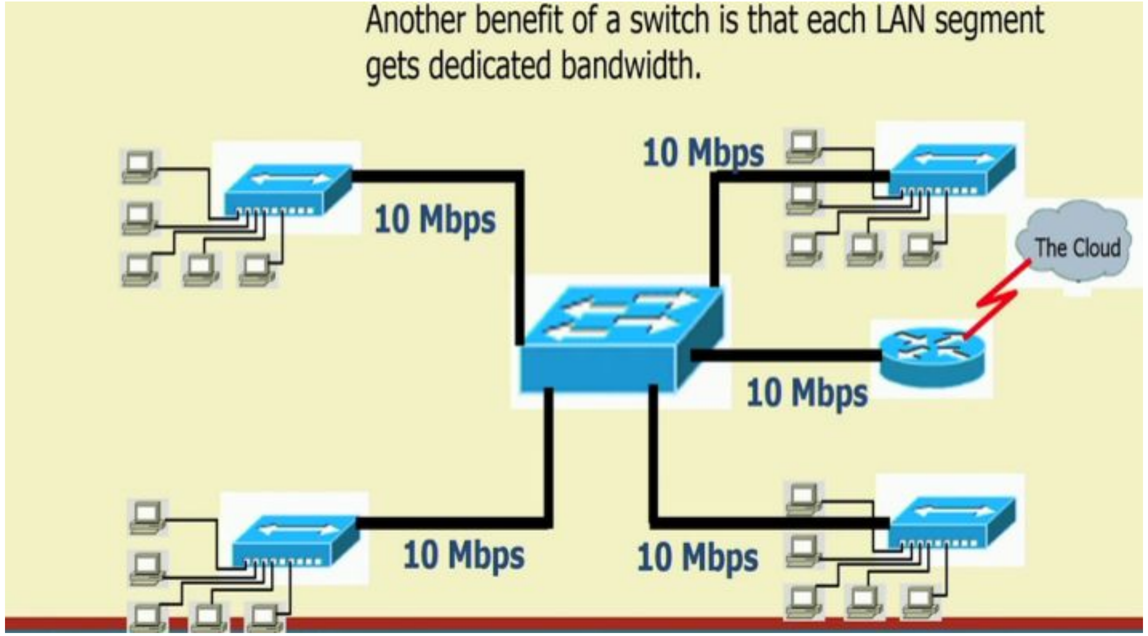
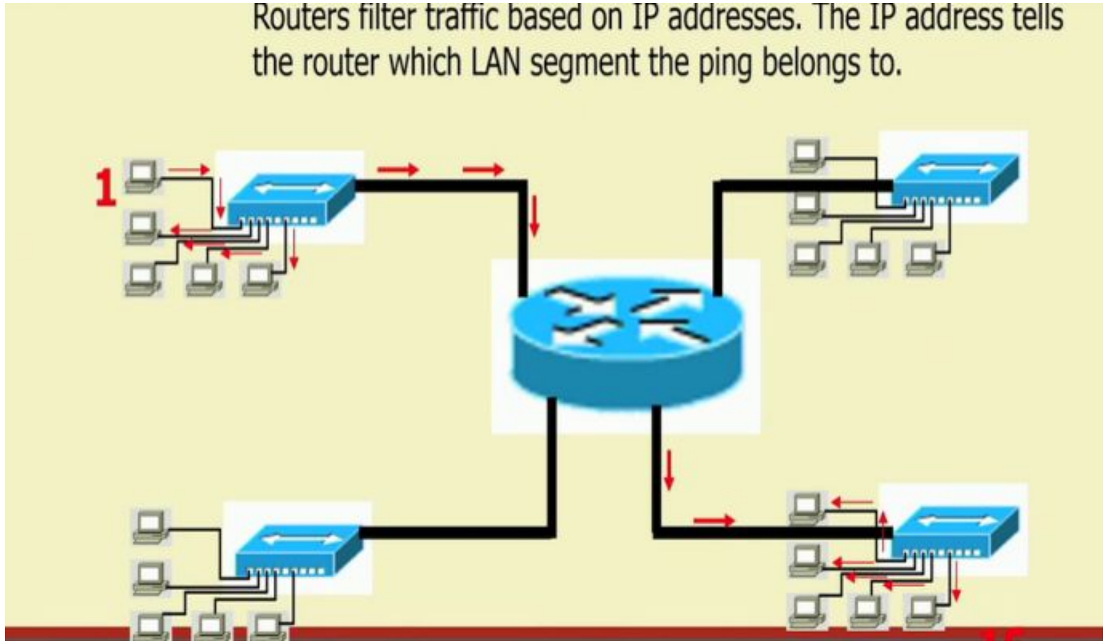


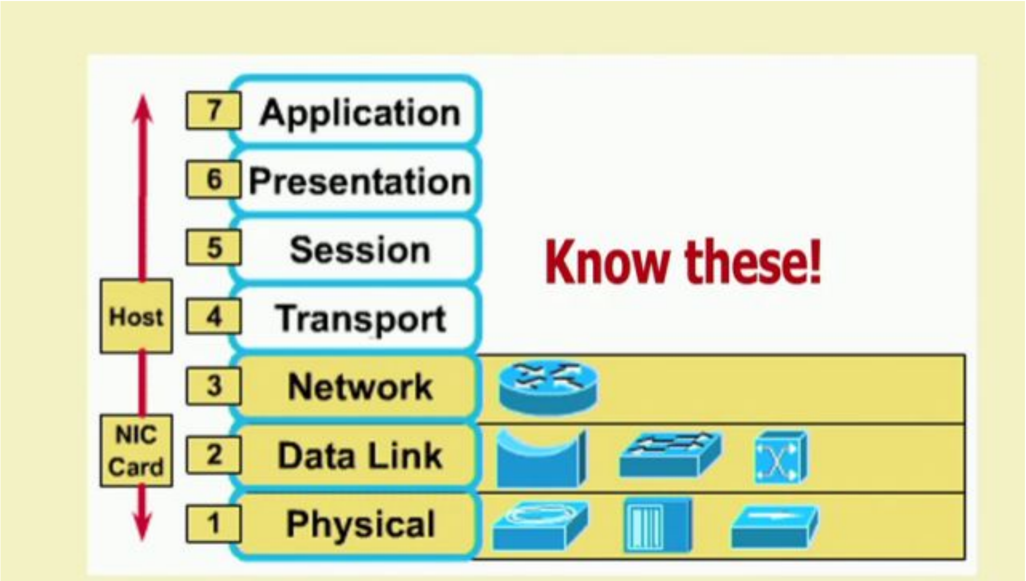
Another benefit of a switch is that each LAN segment gets dedicated bandwidth.

# Router



Routers filter traffic based on IP addresses. The IP address tells the router which LAN segment the ping belongs to.

# Devices function at layer



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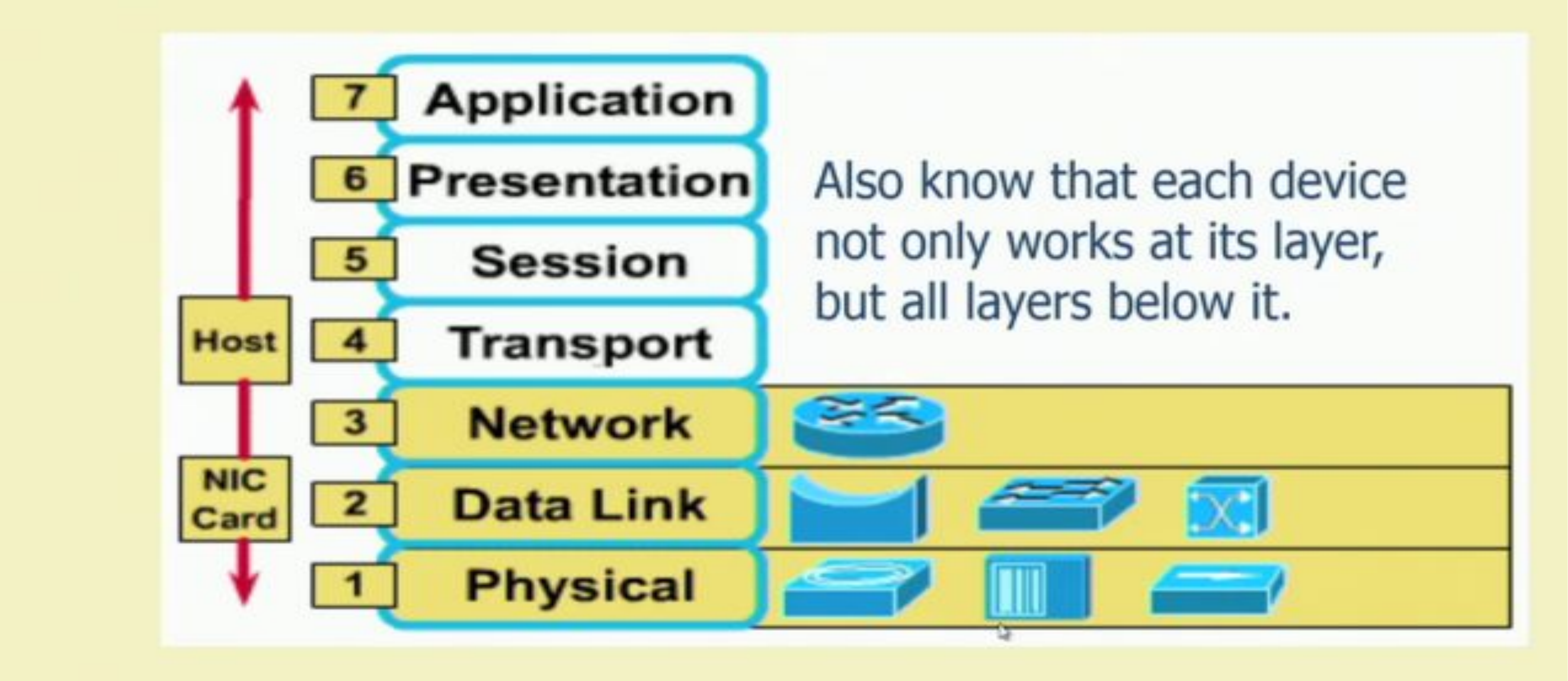
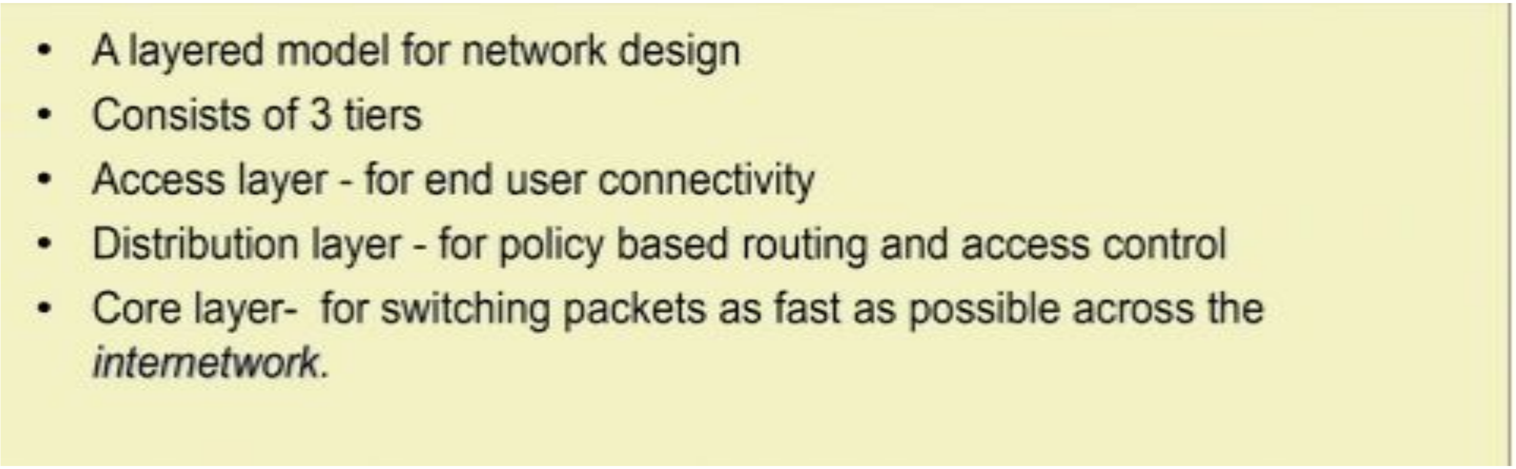


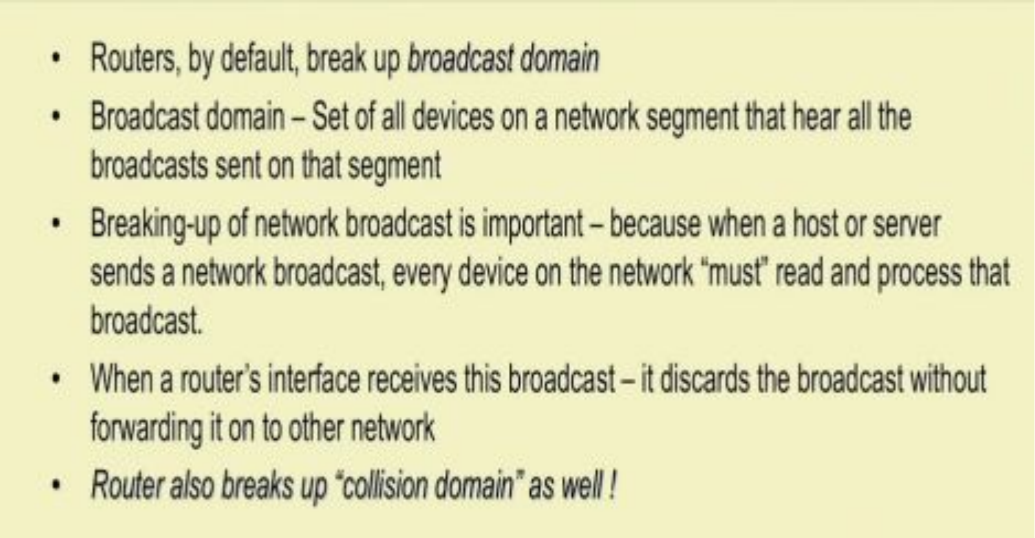
Also know that each device not only works at its layer, but all layers below it.

# Hierarchical Design Model



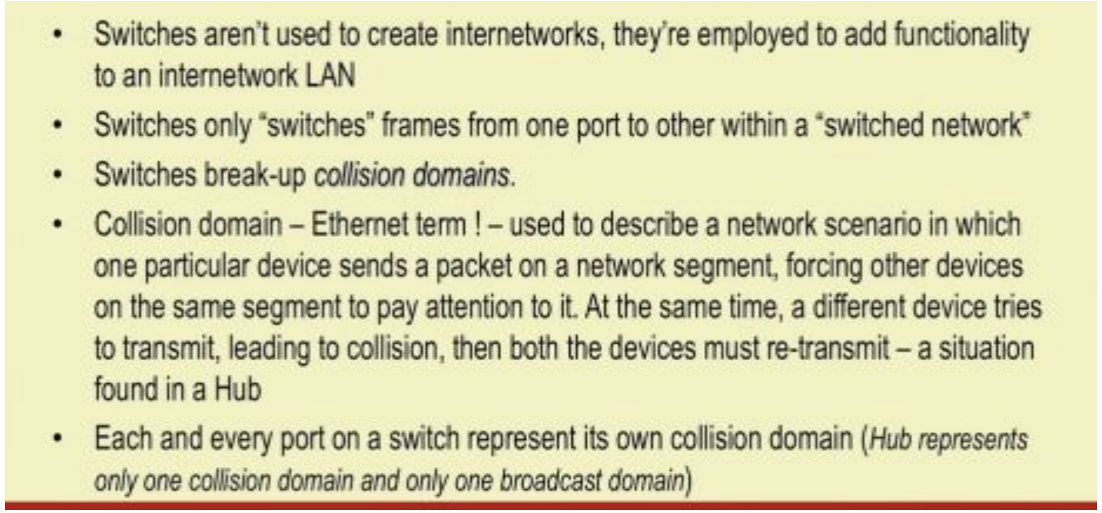
- A layered model for network design
- Consists of 3 tiers
- Access layer - for end user connectivity
- Distribution layer - for policy based routing and access control
- Core layer- for switching packets as fast as possible across the *internetwork*.

# Few points to note..



- Routers, by default, break up *broadcast domain*
- Broadcast domain – Set of all devices on a network segment that hear all the broadcasts sent on that segment
- Breaking-up of network broadcast is important – because when a host or server sends a network broadcast, every device on the network "must" read and process that broadcast.
- When a router's interface receives this broadcast – it discards the broadcast without forwarding it on to other network
- *Router also breaks up "collision domain" as well !*

# Few points to note..



- Switches aren't used to create internetworks, they're employed to add functionality to an internetwork LAN
- Switches only "switches" frames from one port to other within a "switched network"
- Switches break-up *collision domains*.
- Collision domain – Ethernet term ! – used to describe a network scenario in which one particular device sends a packet on a network segment, forcing other devices on the same segment to pay attention to it. At the same time, a different device tries to transmit, leading to collision, then both the devices must re-transmit – a situation found in a Hub
- Each and every port on a switch represent its own collision domain (*Hub represents only one collision domain and only one broadcast domain*)

# Performance of Network Architecture

- Bandwidth
- Latency
- Jitter
- Throughput

For more details you can follow

**DATA AND COMPUTER COMMUNICATIONS by William Stallings**

Any query?

# THANK YOU