

Topic 03

Introduction to Computer Network

RECAP SUMMARY

Network Components (Hardware)

Network interface card

- an add-on card plugged into a motherboard expansion slot that provides a connection between the computer and the network

Network medium

- A cable that plugs into the NIC and makes the connection between a computer and the rest of the network
- Network media can also be the air waves, as in wireless networks

Interconnecting device

- allow two or more computers to communicate on the network without having to be connected directly to one another

Network Components (Software)

Network clients and servers

- **Network client software** requests information stored on another network computer or device (e.g. [Chrome web browser](#))
- **Network server software** allows a computer to share its resources (e.g. [Apache web server](#))

Protocols

- Define the **rules** and formats a computer must use when sending information across the network (e.g. [TCP/IP protocol stack](#))

NIC driver

- Receives data from protocols and forwards this data to the physical NIC

Layers of the Network Communication Process

Step	Description	Layer
1	An application tries to access a network resource.	User application
2	Client software detects the attempt to access the network and passes the message on to the network protocol.	Network software
3	The protocol packages the message in a format suitable for the network and sends it to the NIC driver.	Network protocol
4	The NIC driver sends the data in the request to the NIC card, which converts it into the necessary signals to be transmitted across the network medium.	Network interface

Layers of the Network Communication Process (Cont'd)

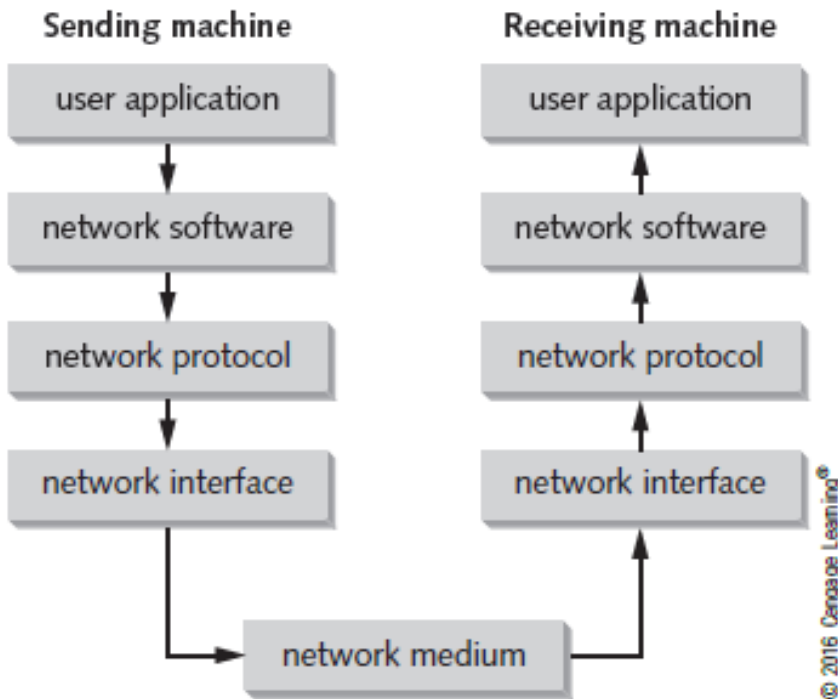


Figure 1-6 Layers of the network communication process

- Each step required for a client to access network resources is referred to as a “layer”
- Each layer has a task, and all layers work together

How Two Computers Communicate on a LAN

TCP/IP is the most common protocol (language) used on networks

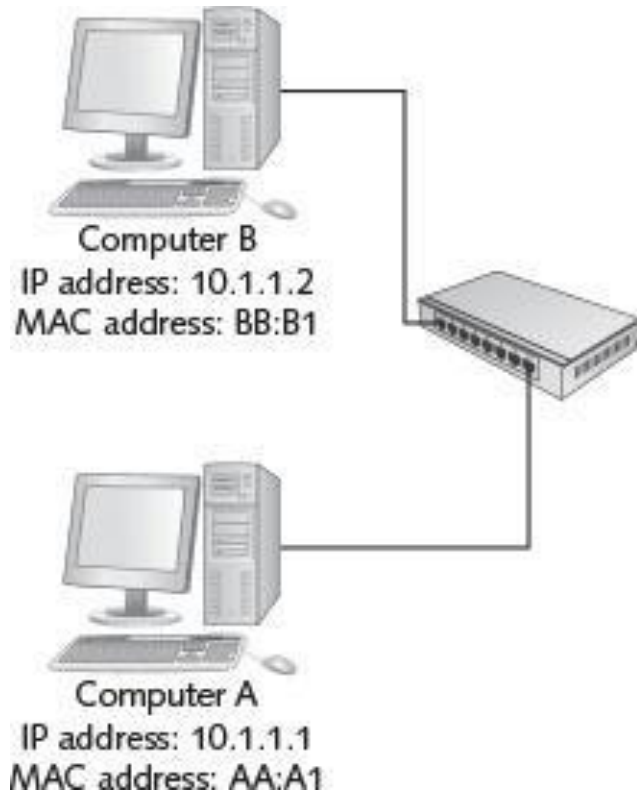
TCP/IP uses 2 addresses to identify devices

- Logical address (IP address) – e.g. 192.168.1.41
- Physical address (MAC address) – e.g. 24-77-03-FA-24-D0

Just as a mail person needs an address to deliver mail, TCP/IP needs an address in order to deliver data to the correct device on a network

- Think of the Logical address as **your name** and the **Physical address** as your postal address

How Two Computers Communicate on a LAN



1. A user at Comp A types ping 10.1.1.2 at a command prompt
2. Network software creates a ping message
3. The network protocol packages the message by adding IP address of sending and destination computers and acquires the destination computer's MAC address
4. The network interface software adds MAC addresses of sending and destination computers
5. Comp B receives message, verifies that the addresses are correct and then sends a reply to Comp A using Steps 2 – 4

CIDR IP Address

CIDR Range	192.168.1.0/24
Netmask	255.255.255.0
Wildcard Bits	0.0.0.255
First IP	192.168.1.0
Last IP	192.168.1.255
Total Host	256

RESERVED IP ADDRESS

192.168.1.0	subnet
192.168.1.255	broadcast
$256 - 2 = 254$	Total usable hosts

174.16.0.0 /24

10101110. 00010000. 00000000. 00000000

11111111. 11111111. 11111111. 00000000
255.255.255.0

172.16.0.0 /24

What are the first and last assignable IPs?

	10101100. 00010000. 00000000. 00000000	
First	10101100. 00010000. 00000000. 00000001	172.16.0.1
Last	10101100. 00010000. 00000000. 11111110	172.16.0.254

152.2.136.0 /26

	10011000. 00000010. 10001000. 00000000	
First	10011000. 00000010. 10001000. 00000001	152.2.136.1
Last	10011000. 00000010. 10001000. 00111110	152.2.136.62

CIDR IP Address

CIDR Video Guide

Subnetting from CIDR Notation

192.168.10.55 /20 (255.255.240.0)

Network ID:	192	168	48	0
Broadcast ID:	192	168		255

Usable IPs:

128	64	32	16	8	4	2	1
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xxxxxx xxxxxx .00111100 xxxxxxxx
11111111 11111111 11111111 00000000
                        00110000
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Broadcast IP address:

Example: 192.168.1.255/24

Broadcast addressing was designed to facilitate message broadcasting for all network devices. The following is a broadcast addressing analogy:

- A teacher is preparing to announce the winner of a student competition and can use either of the following approaches:
 - (1) The teacher could stop by each student's desk and discreetly reveal the winner's name, or
 - (2) The teacher could announce the winner's name to the class and then ask the winner to stand for recognition. The second option, which is more efficient, is broadcast addressing in the real world.

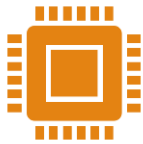
LANs, Internetworks, WANs, and MANs

Network	Description
Local area network (LAN)	Small network, limited to a single collection of machines and connected by one or more interconnecting devices in a small geographic area
Internetwork	<p>A networked collection of LANs tied together by devices such as routers</p> <p>Reason for creation:</p> <ul style="list-style-type: none">• Two or more groups of users and their computers need to be logically separated but still need to communicate• Number of computers in a single LAN has grown and is no longer efficient• The distance between two groups of computers exceeds the capabilities of most LAN devices

LANs, Internetworks, WANs, and MANs

Network	Description
Wide area networks (WANs)	Uses the services of third-party communication providers to carry network traffic from one location to another (covers world-wide)
Metropolitan area networks (MANs)	Uses WAN technologies to interconnect LANs in a specific geographic region, such as a county or city (or a campus)

broadcast IP address



Internet

A worldwide public internetwork. Uses protocols such as TCP/IP and HTTP to transfer and view information



Intranet

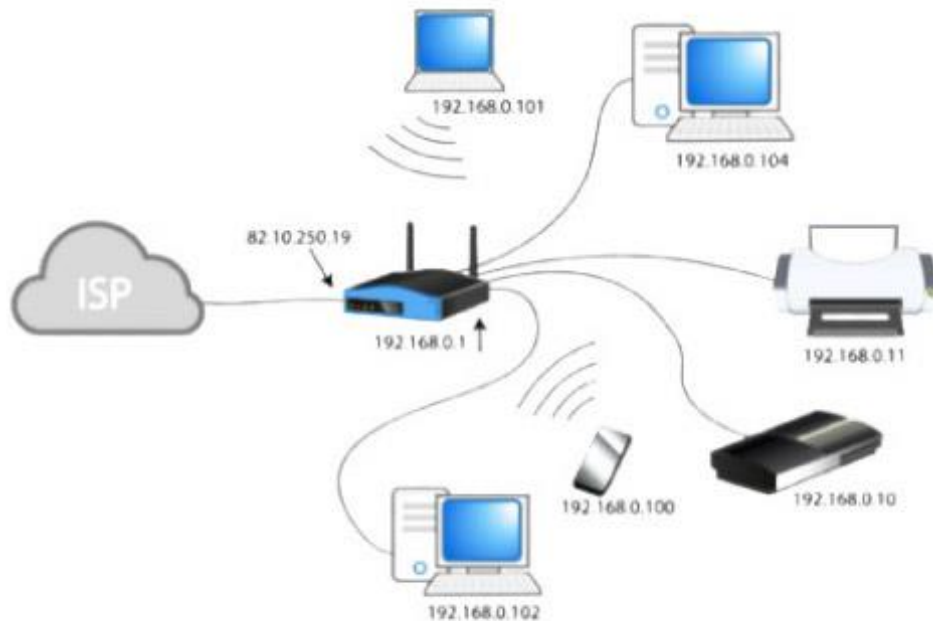
A private internetwork in which devices and servers are only available to those users connected to the internal network (like an internal Internet)



Extranet

Allows limited and controlled access to internal resources by outside users

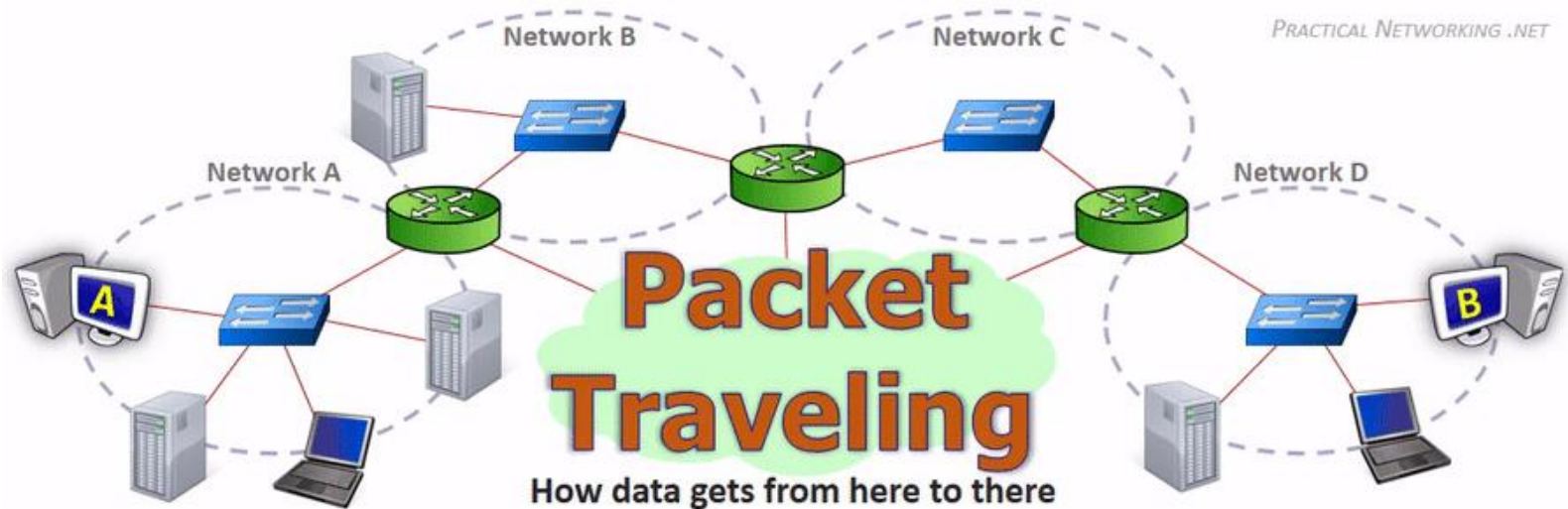
LAN: Privated IP address



Reserved for private networks. The organizations that distribute IP addresses to the world reserves a range of IP addresses for private networks.

- 192.168.0.0 - 192.168.255.255 (65,536 IP addresses)
- 172.16.0.0 - 172.31.255.255 (1,048,576 IP addresses)
- 10.0.0.0 - 10.255.255.255 (16,777,216 IP addresses)

Packet Traveling

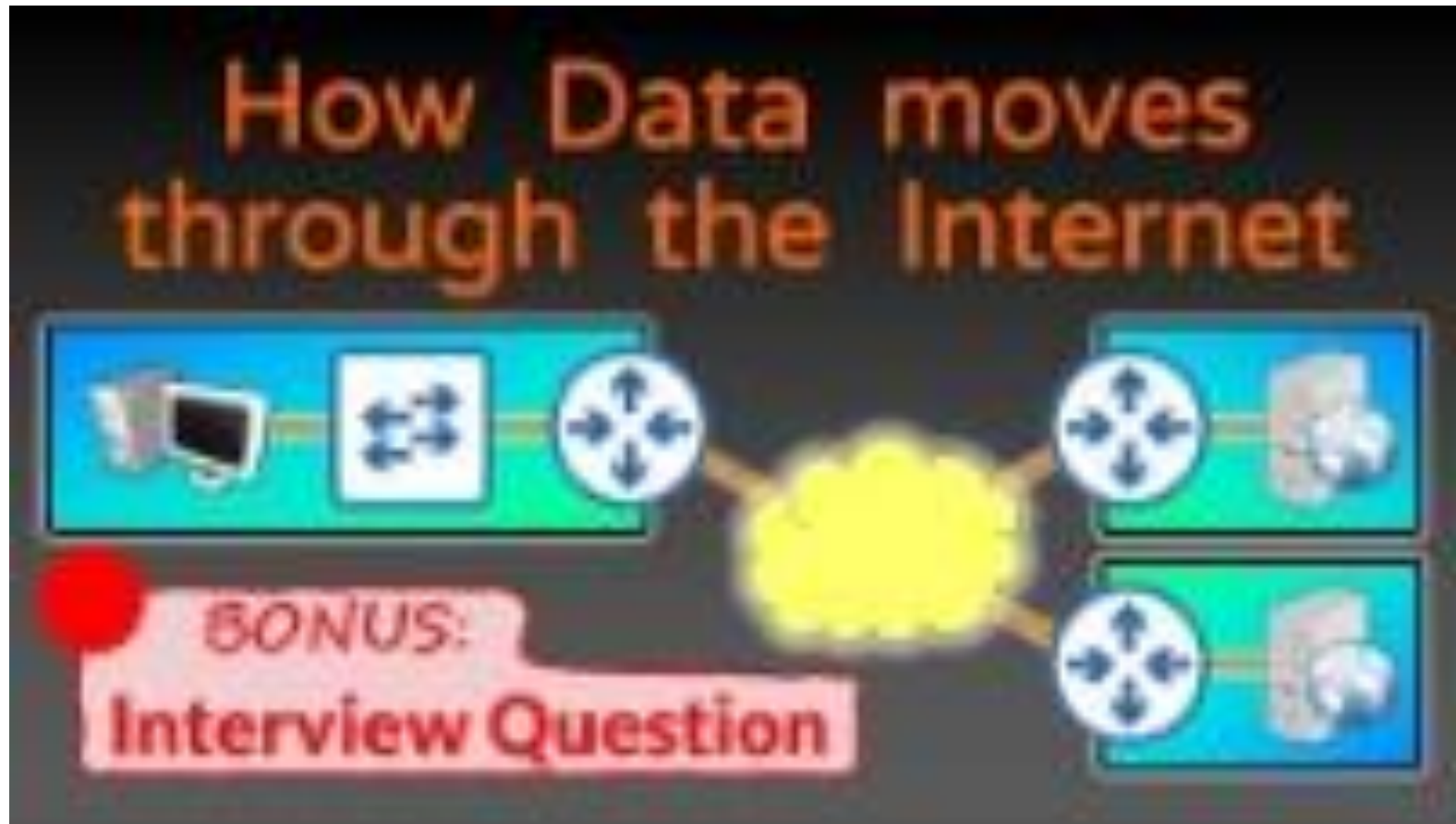


When data leaves your computer, it is grouped into small chunks called Packets. These packets are essentially **little envelopes that carry data across the Internet** (Network of networks connected through Routes)

Computers transfer information across networks in short bursts of about **1500 bytes** of data (**bursty – unlike video streaming**)

<https://www.practicalnetworking.net/series/packet-traveling/packet-traveling/>

Packet Traveling (Video)



Packets and Frames (Reasons data is transferred this way)

Pause between bursts allows other computers to transfer data during pauses

Allows the receiving computer to process received data

Allows the receiving computer receive data from other computers at the same time

Gives the sending computer an opportunity to receive data from other computers and perform other processing tasks

If an error occurs during transmission of a large file, only the chunks of data involved in the error have to be sent again

Packets

Packet: a chunk of data with a source and destination IP address added to it (routers route packets between networks)

Using the U.S. mail analogy, you can look at a packet as an envelope that has had the zip code added to the address but not the street address

Dst IP: 164.78.252.4	Src IP: 192.1.2.4	Protocol: TCP	Dst Port: 80	Src Port: 1234	HTTP Request
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Frames

Frame: a packet with the source and destination MAC addresses added to it

- The packet is “framed” by the MAC addresses on one end and an error-checking code on the other (**NIC sends and receives frames**)

The process of adding IP addresses and MAC addresses to chunks of data is called **encapsulation**

- Information added to the front of the data is called a header and information added to the end is called a trailer

Dst MAC: MAC C	Src MAC: MAC A	Dst IP: 164.78.252.4	Src IP: 192.1.2.4	Protocol: TCP	Dst Port: 80	Src Port: 1234	HTTP Request	Frame Trailer
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Clients

A **client** can be a workstation running a client OS or it can refer to the network software on a **computer that requests network resources** from a server

The word “client” is usually used in these three contexts:

- Client operating system – the OS installed on a computer
- Client computer – primary role is to run user applications and access network resources
- Client software – software that requests network resources from server software on another computer

Servers

A computer becomes a server when software is installed on it that **provides a network service** to client computers

The term “server” is also used in three contexts:

- Server operating system – OS installed on a computer designed to share network resources and provide other network services
- Server computer – a computer’s primary role in the network is to give client computers access to network resources and services
- Server software – responds to requests for network resources from client software