Internet Protocol (IP)

- Presentation

Presented by….

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What is IP……?

- IP stands for Internet Protocol
- IP specifies the format of packets, also called datagrams, and the addressing scheme. Most networks combine IP with a higher-level protocol called Transmission Control Protocol (TCP), which establishes a virtual connection between a destination and a source.

What is IP……? (cont.)

- IP by itself is something like the postal system.
- It allows you to address a package and drop it in the system, but there's no direct link between you and the recipient.
- TCP/IP, on the other hand, establishes a connection between two hosts so that they can send messages back and forth for a period of time.

Purpose…..

- Need a standard means of communication between devices
- Can’t communicate if speaking two different languages

Therefore we have a concept called “Protocol”

What is Protocol…

- Rules and conventions explaining how something must be done
- Used to describe how devices can communicate
- Protocol also defines the format of Data i.e. : being exchanged.

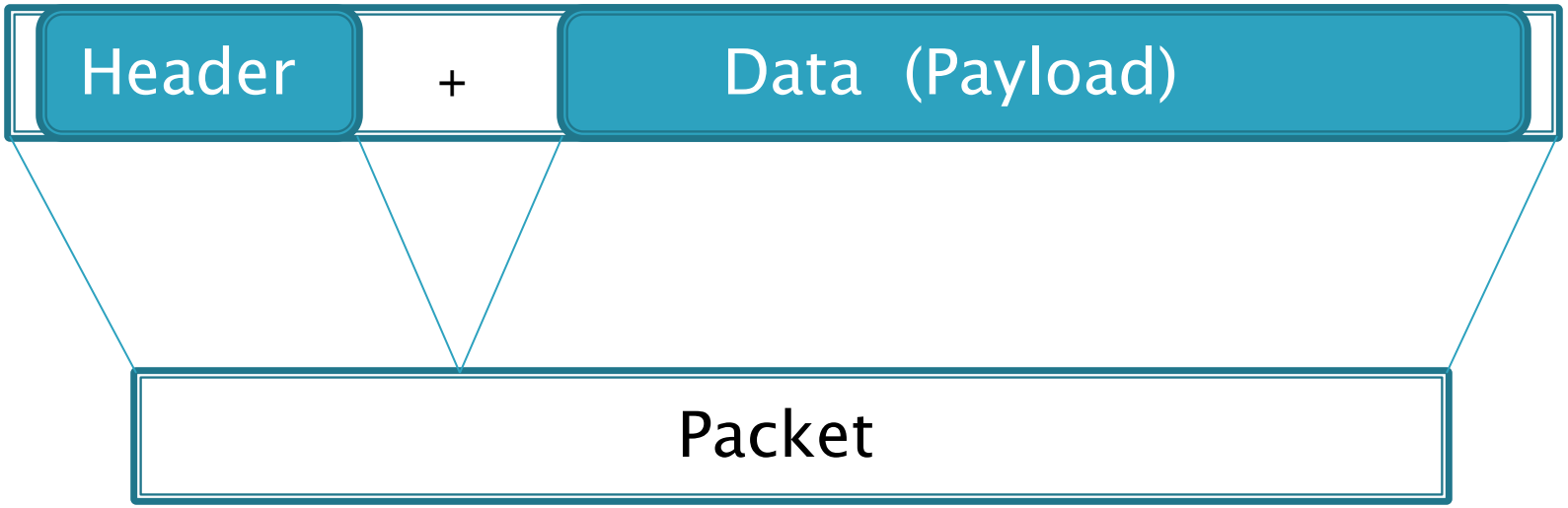
If we both utilize the same protocol then you know how to format data so I will understand it and I know how to format data so you will understand it

Purpose of the IP….

- The Internet Protocol defines the basic unit of data transfer (IP Datagram)
- IP software performs the routing function
- IP includes a set of rules that process the idea of unreliable packet delivery.
  - How hosts and routers should process packets
  - How & when error messages should be generated
  - The Conditions under which packets can be discarded.

Construction of Datagrams….

- Each #datagram has two components
  - Header
  - Payload



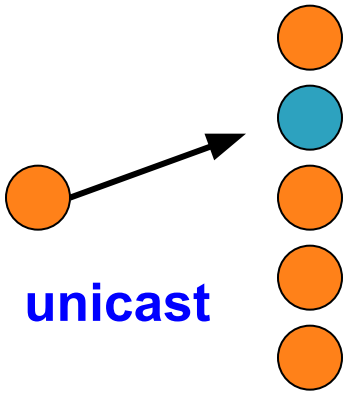
IP Service

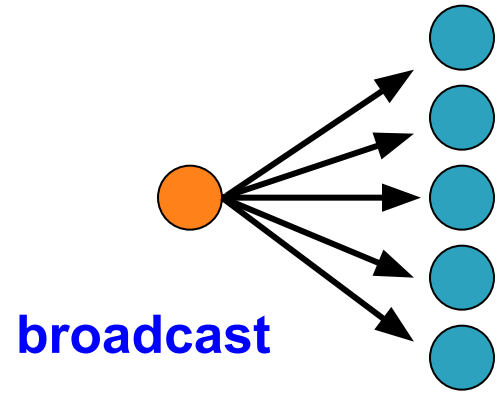
- Delivery service of IP is minimal.

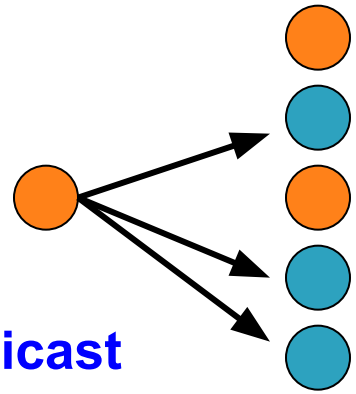
- IP provides an unreliable connectionless best effort service
  - Unreliable : IP doesn't make an attempt to recover lost packets
  - Connectionless : Each packet is handled independently
  - Best Effort : IP doesn't make guarantees on the service (No through output , No delay guarantee…)

IP Service (Cont.…)

- IP supports the following services
  - One-to-one (unicast)
  - One-to-all (broadcast)
  - One-to-several (multicast)

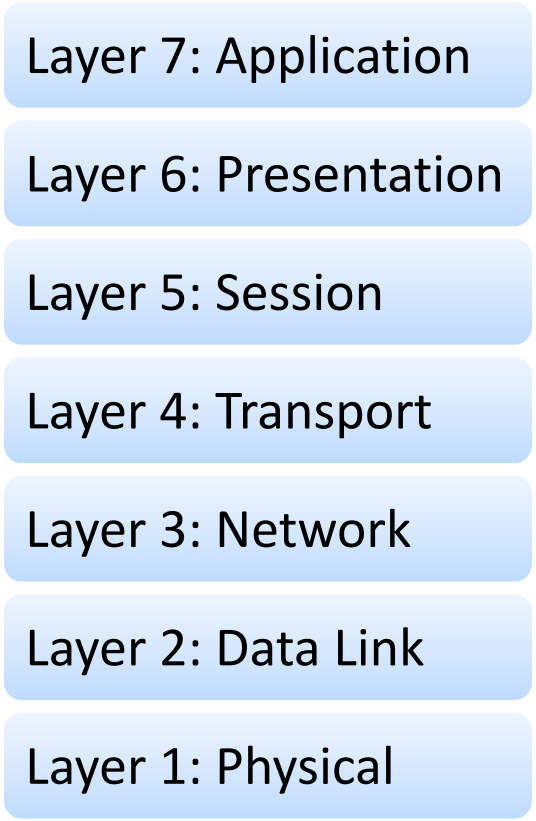






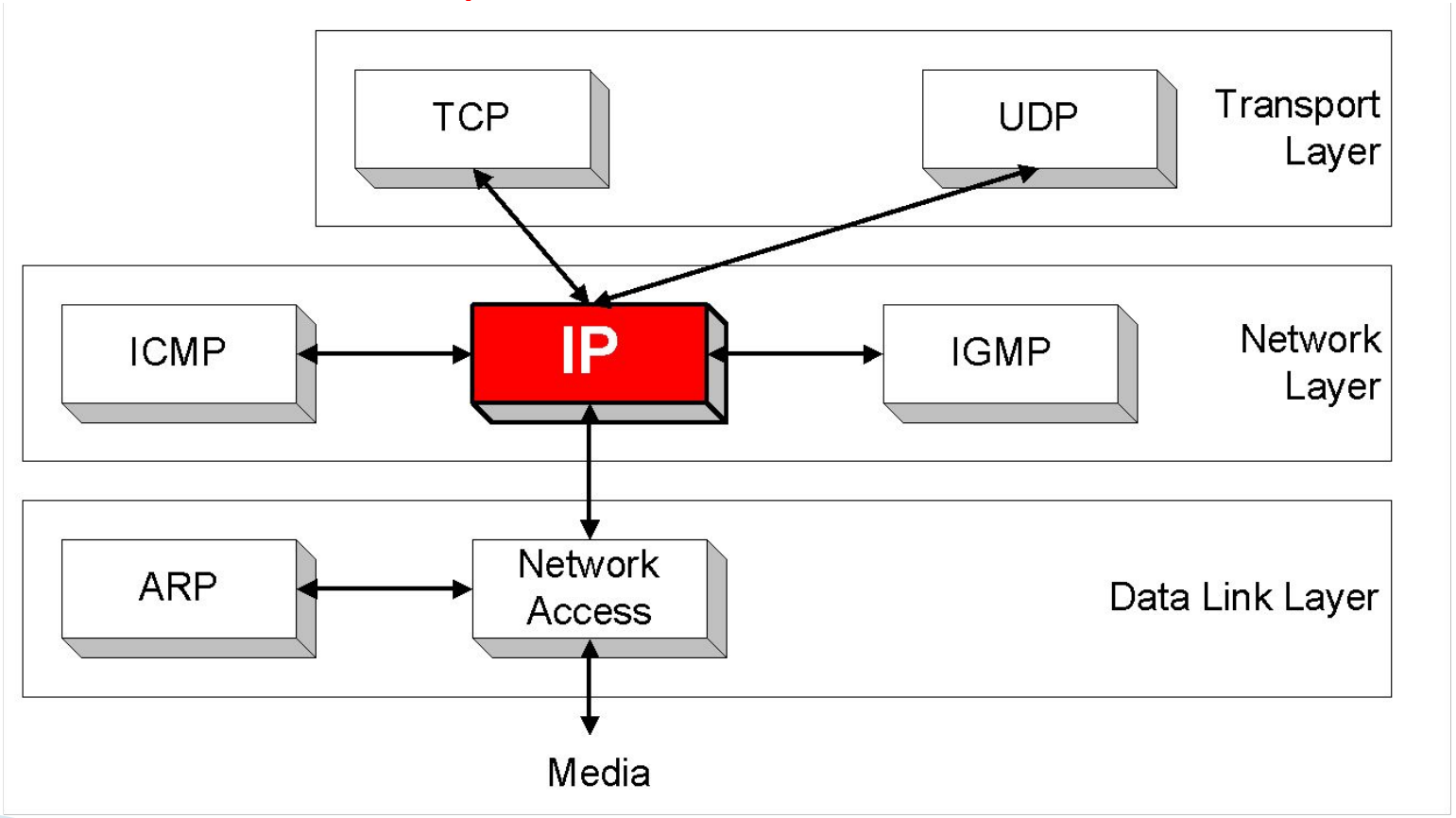
OSI Reference Model

- Open Systems Interconnection Reference Model
- Splits communication system into seven layers
- Each layer performs their task and passes the data to the next layer



Orientation of Internet Protocol

- IP is a Network Layer Protocol



1.Physical Layer

- This layer deals with the Hardware of network.
- Physical Layer Hardware
  - Cables , Connectors, Hubs, Repeaters.. Etc.
- Function :
  - Manages signaling to and from physical network connections
- Physical Layer Protocols & Standards
  - Ethernet (802.3), Token Ring(802.5) , Wi-Fi(802.11)

2.Data Link Layer

- This layer deals with MAC addresses of devices
- Responsible for Physical Addressing , Error correction & preparing the information for the media frames.
- Devices
  - Switches , Bridges , Wireless Access Points , NICs, etc.
- Data Link Layer Protocols & Standards
  - L2TP, PPP,SLIP etc….

3.Network Layer

- This layer deals with Packets (Data Bundles)
- Responsible for logical addressing and routing
- Devices
  - Routers, Layer 3 Switches, Firewalls.. Etc.
- Network Layer Protocols
  - ARP, IP, RIP, IGRP.. Etc.

4.Transport Layer

- This layer deals with Segments
- Breaks information into segments and is responsible for connection & connectionless communication
- Hardware
  - Proxy Server , Gateways , Firewall…etc.
- Transport Layer Protocols
  - TCP
  - UDP

5.Session Layer

- Responsible for establishing, managing & terminating user connections.
- Acknowledgements of data received during a session.
- Retransmission of data if it is not received by a device.
- Session Layer Protocols
  - RTP , SIP , Net BIOS.. etc.

6.Presentation Layer

- Allows hosts & applications to use a common language.
- Performs..
  - Data formatting
  - Encryption & Decryption for security
  - Compression & Expansion
- Examples
  - JPEG, MP3, MPEG…. Etc.

7.Application Layer

- This layer is what the user sees….

  (Loading an application such as web browser or email..)

- Provides Interface for users to communicate with applications.

- Examples
  - Email , Instant Messengers, Http , SMTP, Telnet, Ping… etc.

What is TCP/IP..?

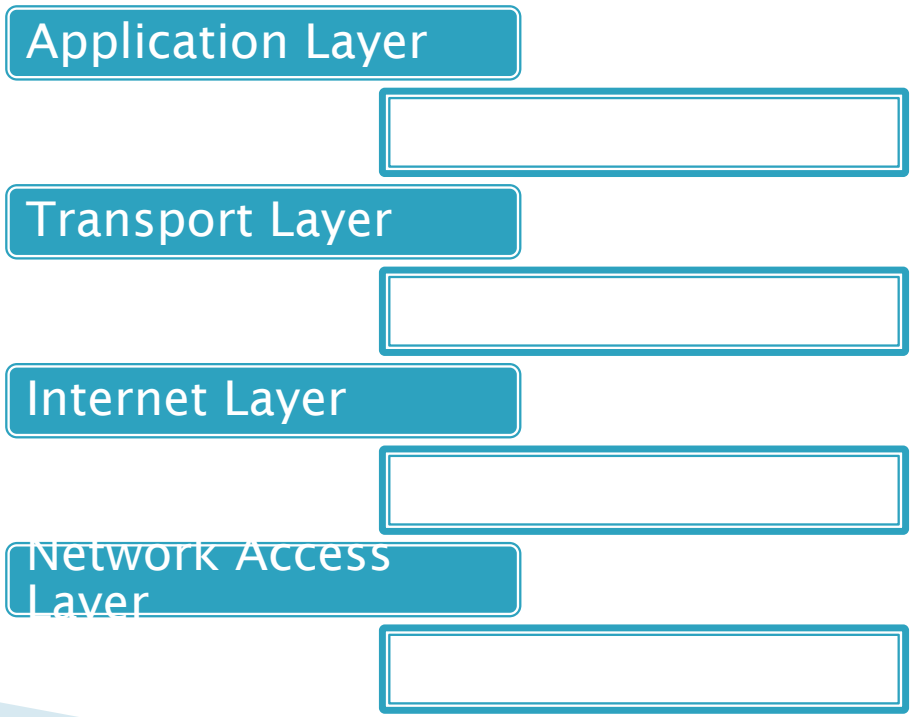
- TCP/IP is a set of protocols developed to allow cooperating computers to share resources across a network.
- TCP stands for Transmission Control Protocol
- They are Transport Layer & Network Layer protocols in OSI model.
- The most well known network that adopted TCP/IP is --> Internet. (The Biggest WAN)

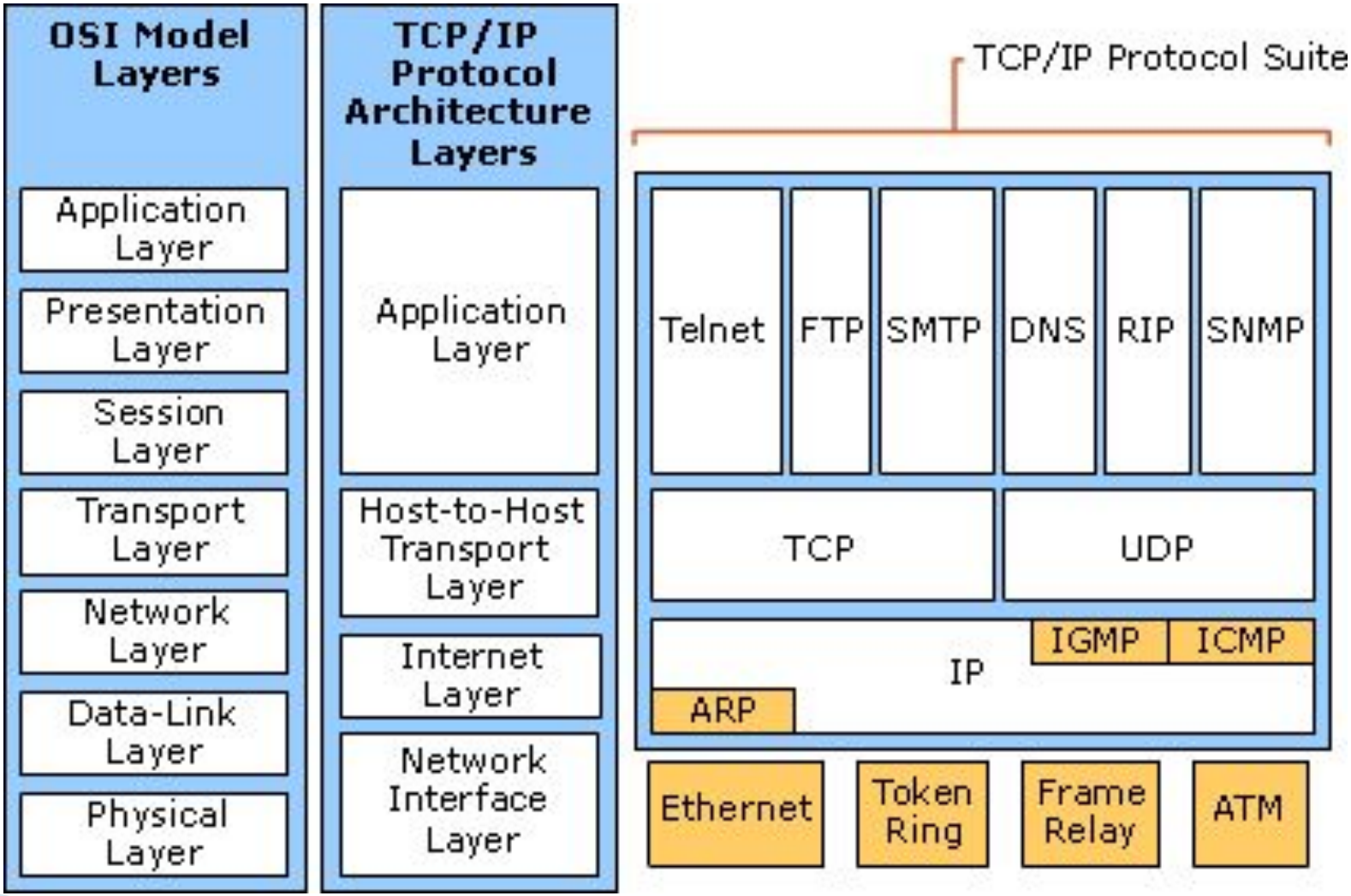
Why TCP/IP is so popular..?

- TCP/IP was developed very Early!
- Technologies were widely discussed in documents called “Request For Comments” (RFC) – free of charge
- Supported by UNIX Operating System

TCP/IP Model

- Because TCP/IP was developed earlier than the OSI 7 layer model, it doesn't have 7 layers but only 4 layers.




OSI Model Layers
Application Layer
Presentation Layer
Session Layer
Transport Layer
Network Layer
Data-Link Layer
Physical Layer
TCP/IP Protocol Architecture Layers
Application Layer
Host-to-Host Transport Layer
Internet Layer
Network Interface Layer
TCP/IP Protocol Suite
Telnet
FTP
SMTP
DNS
RIP
SNMP
TCP
UDP
IGMP
ICMP
IP
ARP
Ethernet
Token Ring
Frame Relay
ATM

Application Layer…….

- Application layer protocols defined the rules when implementing specific network applications.

- Examples :
  - FTP – (File Transfer Protocol)
  - Telnet – (Remote Terminal Protocol)
  - SMTP – (Simple Mail Transfer Protocol)
  - HTTP – (Hyper Text Transfer Protocol)

Transport Layer…

- End to End data transfer……
- Examples :
  - TCP (Transmission Control Protocol)
    - Connection oriented (connection established before data exchanged)
    - Reliable delivery of data
  - UDP (User Datagram Protocol)
    - Connectionless service
    - Delivery is not guaranteed (unreliable)

Internet Layer……

- Internet layer protocols define the rules of how to find the routers for a packet to the destination.
- It only gives best effort delivery. (packets can be delayed, corrupted, lost or out of order)
- Examples :
  - IP – Internet Protocol (Provide packet delivery)
  - ARP – Address Resolution Protocol (Defined the procedure of network address / mac address translation)
  - ICMP – Internet Control Message Protocol (Defined the procedure of error message transfer)

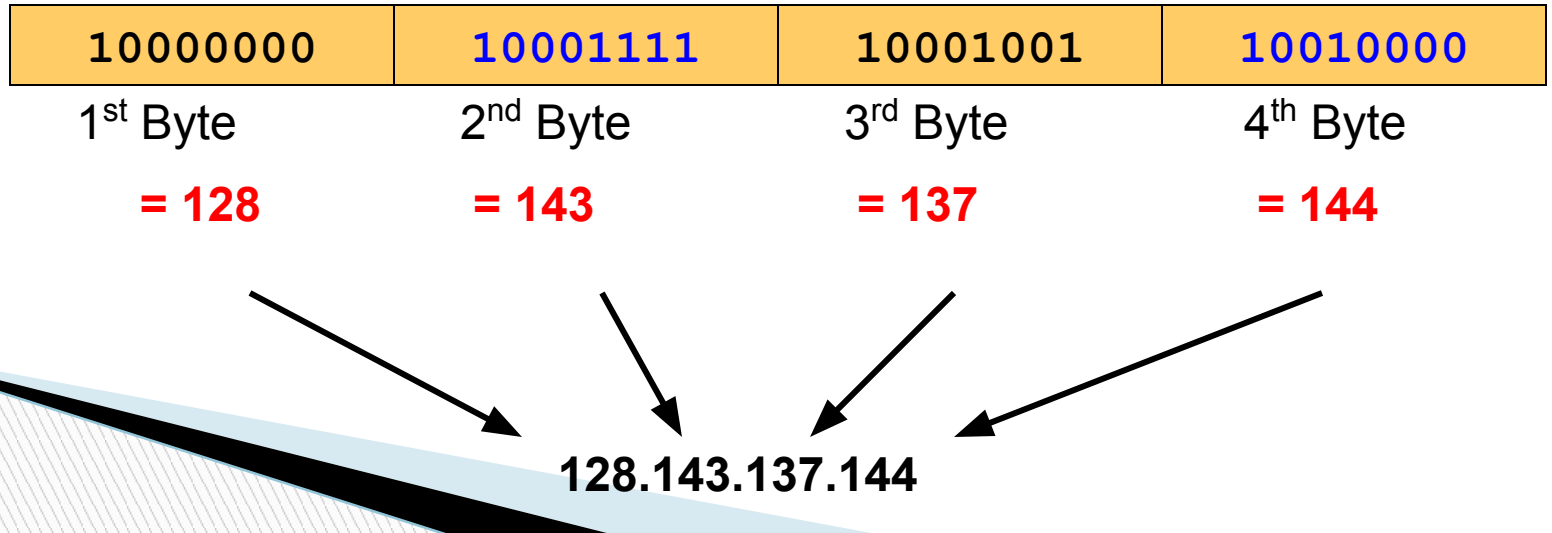
Network Access Layer….

- Also known as Network Interface Layer…
- The Network Access Layer is the layer in the TCP/IP model at which data is transmitted and received across the physical network.
  - Mostly in hardware
  - A well known example is Ethernet
- Examples :
  - Ethernet
  - Token Ring
  - Frame Relay
  - ATM (Asynchronous Transfer Mode)

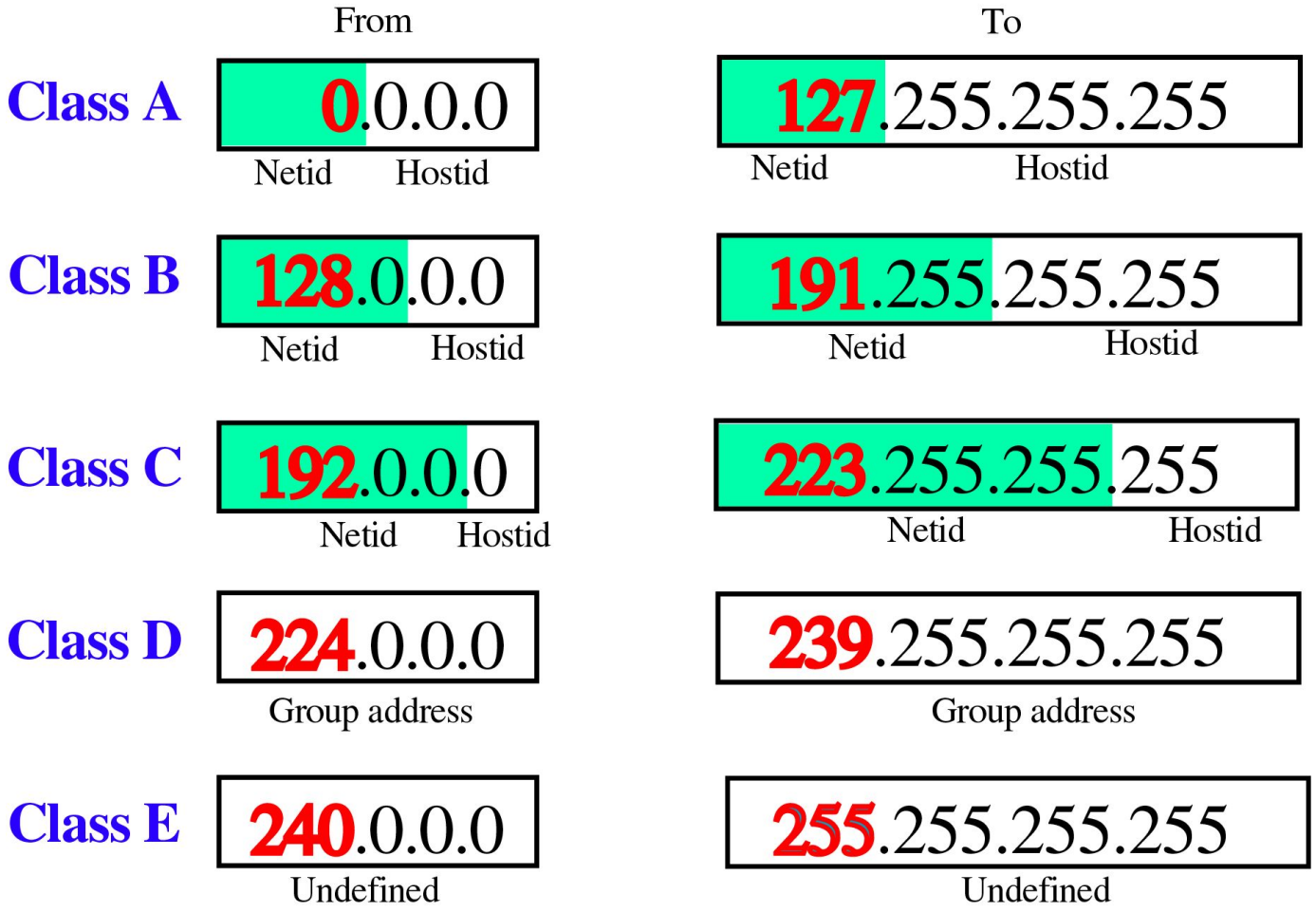
IP Address

- What is an IP address…?
  - An IP address is a unique global address for a network interface

- is a **32 bit long** identifier
- encodes a network number (**network prefix**) and a **host number**

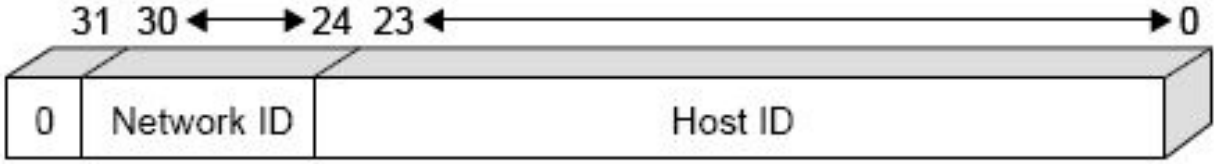


Class Ranges of Internet Addresses



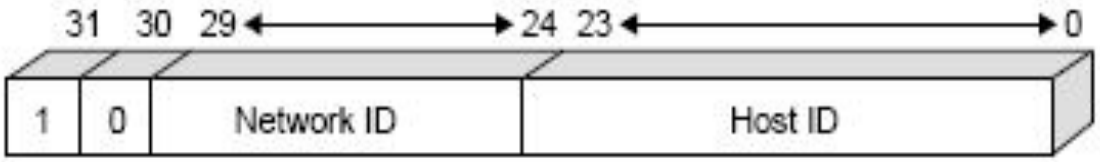
Class A

- Class A addresses are assigned to networks with a very large number of hosts
- The high-order bit in a class A address is always set to zero.
- The next seven bits (completing the first octet) complete the network ID.
- The remaining 24 bits represent the host ID.



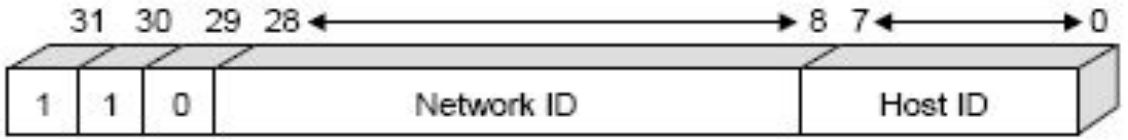
Class B

- Class B addresses are assigned to medium-sized to large-sized networks.
- The two high-order bits in a class B address are always set to binary 1 0.
- The next 14 bits complete the network ID.
- The remaining 16 bits represent the host ID.



Class C

- Class C addresses are used for small networks.
- The three high-order bits in a class C address are always set to binary 1 1 0.
- The next 21 bits complete the network ID.
- The remaining 8 bits represent the host ID.



Class D & E

- Class D addresses are reserved for IP multicast addresses.
  - The four high-order bits in a class D address are always set to binary 1 1 1 0.
  - The remaining bits are for the address that interested hosts recognize.
- Class E is an experimental address that is reserved for future use
  - The high-order bits in a class E address are set to 1111.

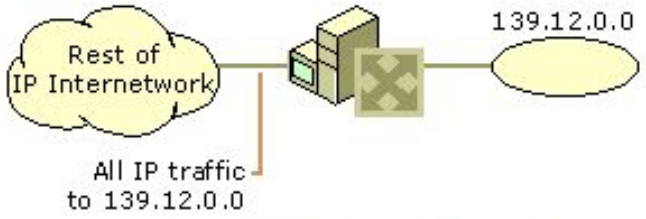
Class Ranges of Network IDs…

Address Class	First Network ID	Last Network ID
Class A	1.0.0.0	126.0.0.0
Class B	128.0.0.0	191.255.0.0
Class C	192.0.0.0	223.255.255.0

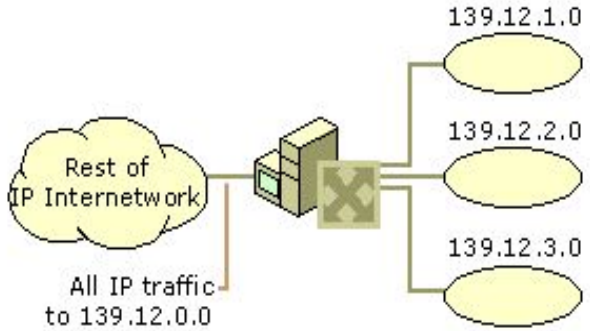
- The network ID cannot begin with the number 127. The number 127 in a class A address is reserved for internal loopback functions.
- All bits within the network ID cannot be set to 1. All 1's in the network ID are reserved for use as an IP broadcast address.

Subnetting….

- Subnetting enables the network administrator to further divide the host part of the address into two or more subnets.
- In this case, a part of the host address is reserved to identify the particular subnet.
- This is easier to see if we show the IP address in binary format.



Network 139.12.0.0 Before Subnetting



Network 139.12.0.0 After Subnetting

Subnet Mask….

- Subnet masks are frequently expressed in dotted decimal notation.
- Subnet mask is not an IP address.
- Each host on a TCP/IP network requires a subnet mask even on a single segment network.

Address Class	Bits for Subnet Mask	Subnet Mask
Class A	11111111 00000000 00000000 00000000	255.0.0.0
Class B	11111111 11111111 00000000 00000000	255.255.0.0
Class C	11111111 11111111 11111111 00000000	255.255.255.0

Journey to IP Versions…

- IPV(1-3) : were not formally assigned.
- IPV4 : TCP/IP , 32bit IP address currently used.
- IPV5 : Internet Stream Protocol (SP)
  - Experimental Protocol
  - Never Introduced for public use.
- IPV6 : Designed to replace IPV4 , 128bit IP address

Features of IPV4…

- Connectionless protocol and best effort based.

- Simplicity
  - It is simpler and easy to remember
  - Require less memory

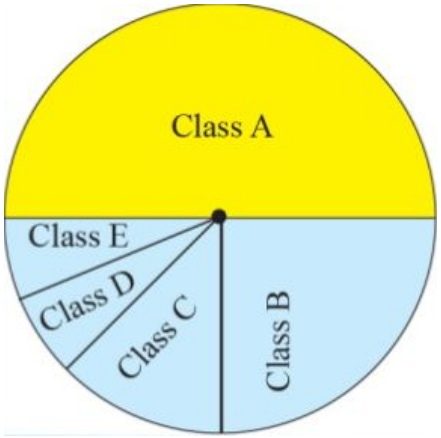
- Familiarity
  - Millions of devices are already knowing it
  - Existing infrastructure already support it

Benefits of IPV4….

- Widely support
- Shorter & Sweeter (header)
- Support of all Operating Systems
- All commonly used protocols are supported

Shortcoming of IPV4….

- IPV4 specification didn't identify any security mechanism.
- Millions of class A addresses are wasted.
- Many class B addresses also wasted.
- Not so many organizations are so small to have a class C block.
- Class E addresses were reserved for future purposes.

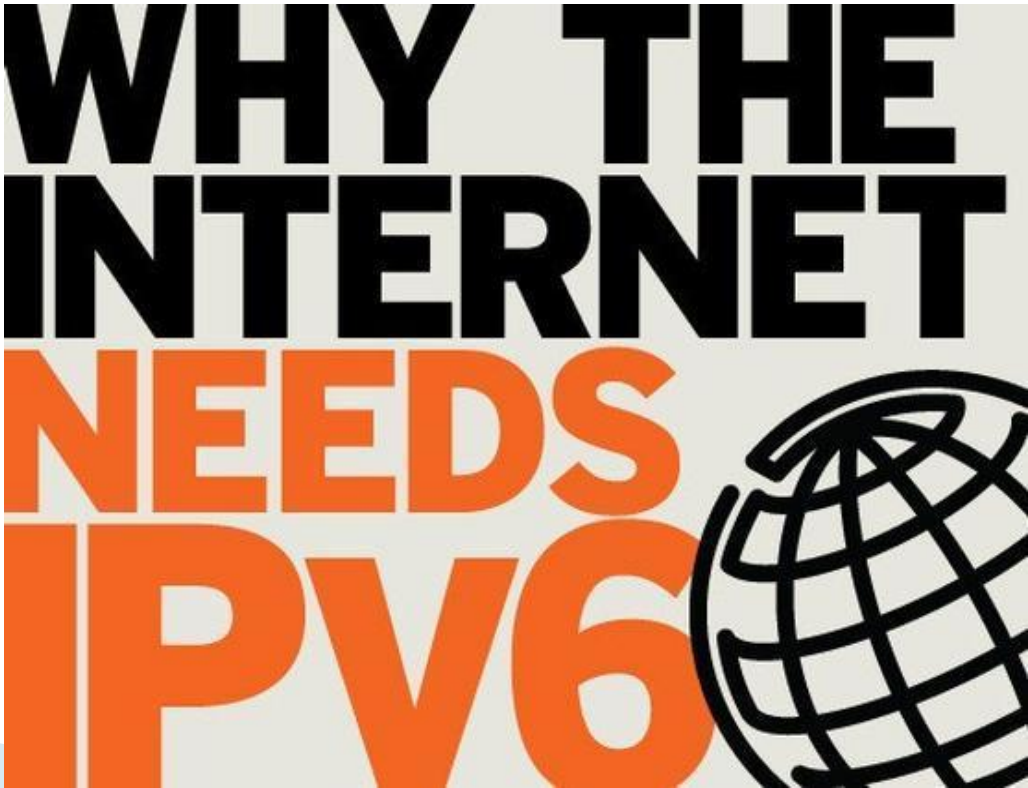


IPV4 Supporting Devices..

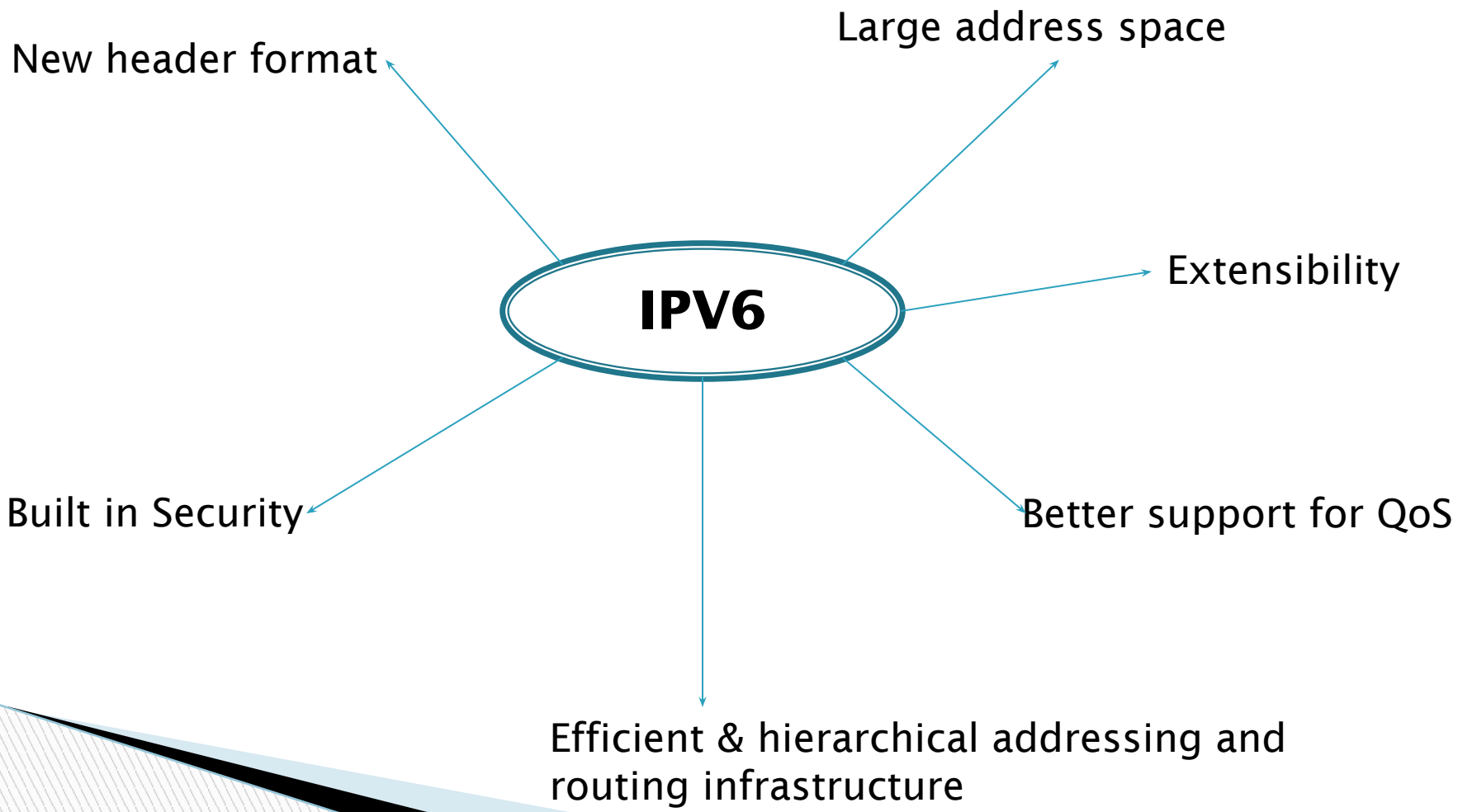
- PCs
- Servers
- Modems
- Routers
- Printers
- Cameras
- Smart Phones
- Tablets & Gaming Systems
- Just about anything else connecting to the Internet

Why IPV6…..?

IPV6 provides a platform on new internet functionality that will be needed in the immediate future and provide flexibility for future growth and expansion.



Benefits of IPV6…..



IP Based Technologies..

- Internet
- VoIP
- IP – TV
- IP-VPN
- Wireless Mobile Technology
- Internet Broadcasting
- Multihoming


thank you!