

Computer Networks I



Abdul Hannan

Objectives



- Understand Computer Network
- TCP/IP
- IP Addressing Scheme
- Subnet Mask
- IP Classes



What is Network

- A Network in the world of computers is said to be a collection of interconnected hosts, via some shared media which can be wired or wireless.
- A computer network enables its hosts to share and exchange data and information over the media.
- Network can be a Local Area Network spanned across an office or Metro Area Network spanned across a city or Wide Area Network which can be spanned across cities and provinces.



Cont'd

- Computer network can be as simple as two PCs connected via a single copper cable or it can be grown up to the complexity where every computer in this world is connected to every other, the Internet.
- A network then includes more and more components to reach its goal of data exchange.
- Computer network components:
 - Hub Switch Firewall
 - Hosts Router
 - Media Gateway



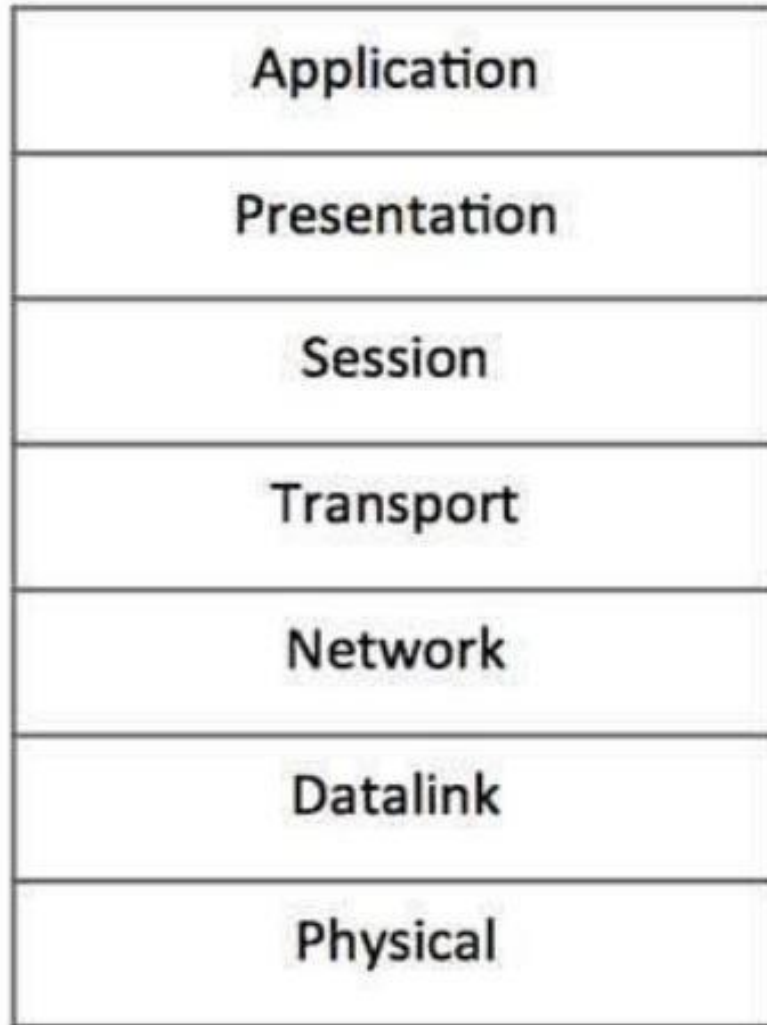
TCP/IP Overview

- **TCP/IP** refers to an entire suite of data communications protocols.
- The suite gets its name from two of the protocols that belong to it: the Transmission Control Protocol (TCP) and the Internet Protocol (IP).
- TCP/IP is that it provides interoperable communications between all types of hardware and all kinds of operating systems.

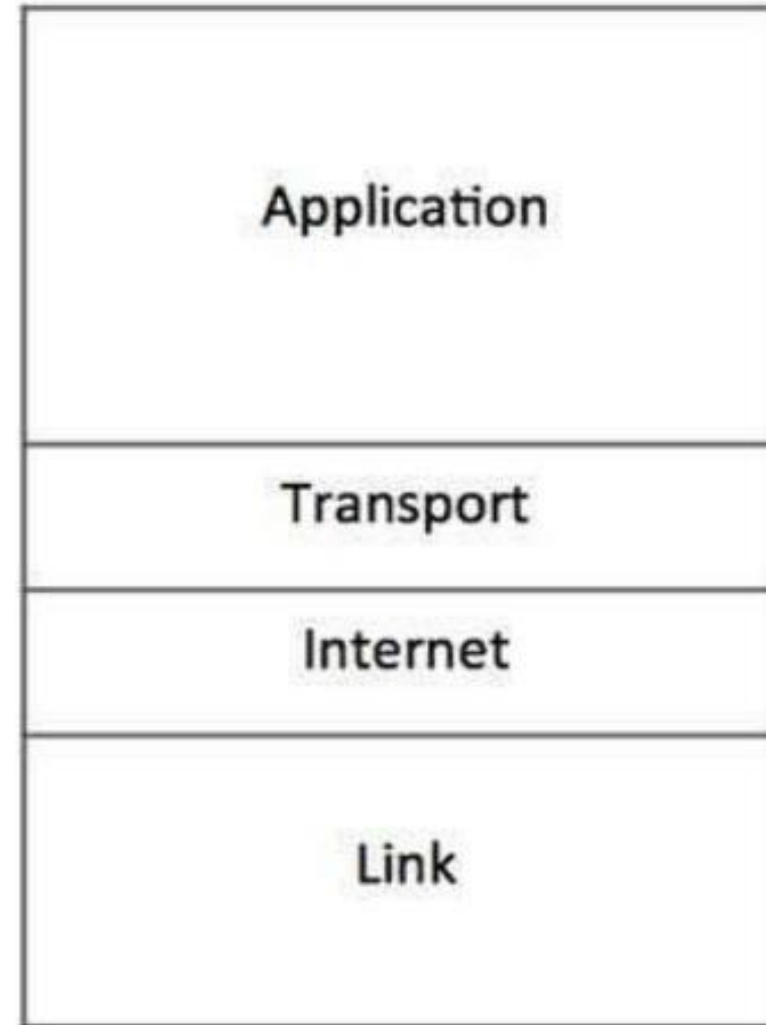


TCP/IP Features

- Open protocol standards, freely available and developed independently from any specific computer hardware or operating system.
- TCP/IP can be run over an Ethernet, a DSL connection, a dial-up line, an optical network, and virtually any other kind of physical transmission medium.
- Standardized high-level protocols for consistent, widely available user services.



OSI Reference Model



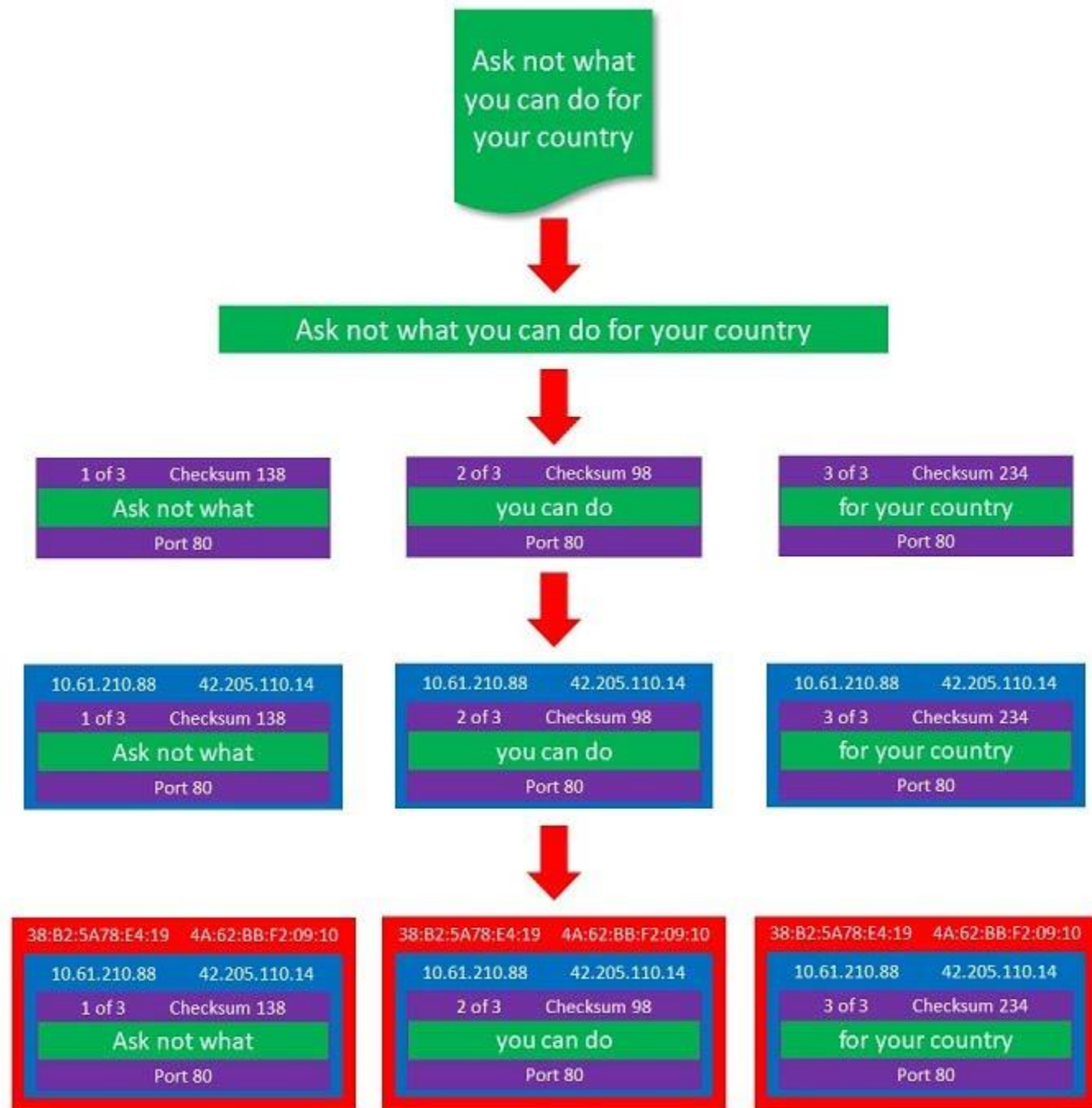
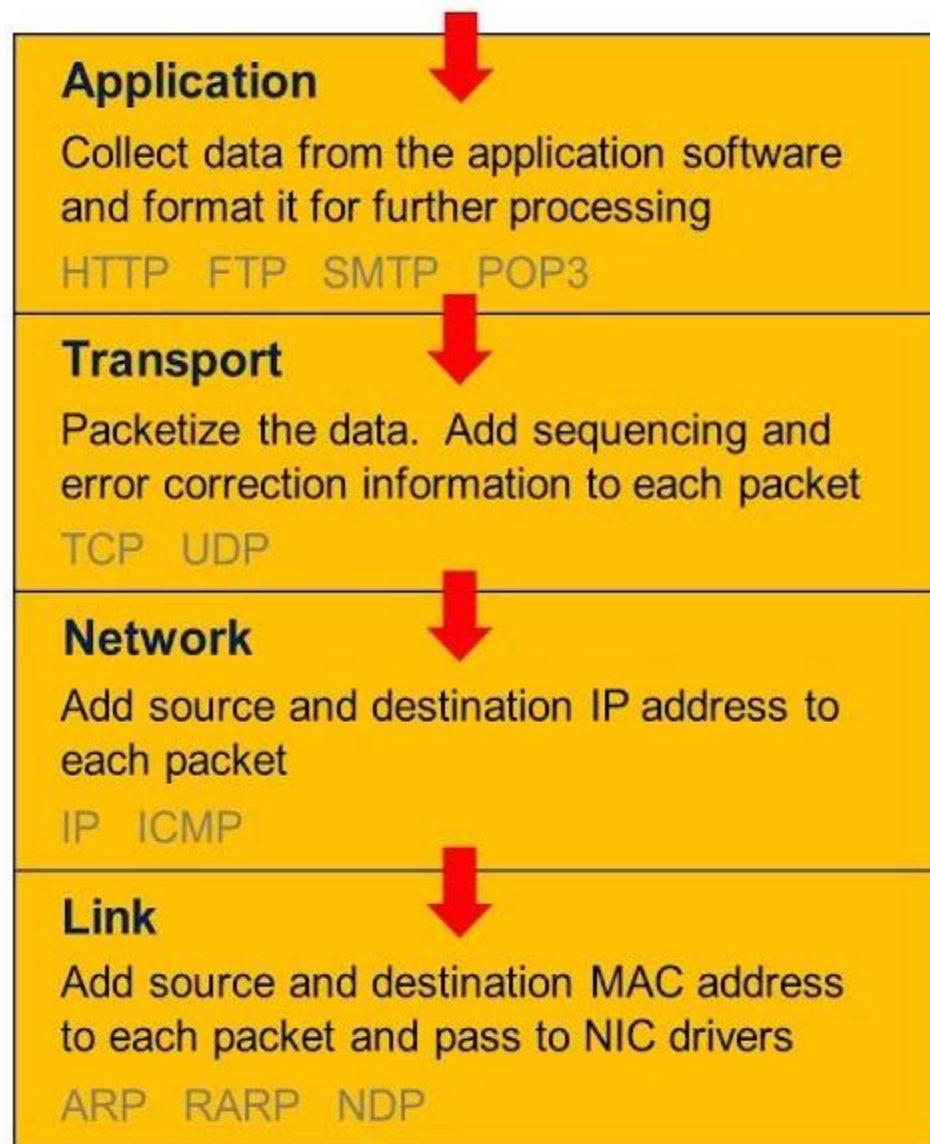
TCP/IP Reference Model



IPv4 - TCP/IP Model

- Majorly of the internet uses a protocol suite called the Internet Protocol Suite also known as TCP/IP protocol suite.
- Provides a mechanism to uniquely identify host by IP addressing scheme.
- This suite is a combination of protocols which encompasses several different protocols for different purpose and need.
- Because the two major protocols in this suites are TCP (Transmission Control Protocol) and IP (Internet Protocol), this is Commonly termed as TCP/IP Protocol suite.

TCP/IP Protocol Stack





Application Layer

- create user data and communicate this data to other applications on another or the same host.
- characterized by the application architecture:
 - Client-server model
 - Peer-to-peer model
- Protocols:
 - **Telnet** The Network Terminal Protocol, which provides remote login over the network.
 - **FTP** The File Transfer Protocol, which is used for interactive file transfer.
 - **SMTP** The Simple Mail Transfer Protocol, which delivers electronic mail.
 - **HTTP** The Hypertext Transfer Protocol, which delivers web pages over the network.



Transport Layer

- The transport layer establishes basic data channels between hosts.
- Provides end-to-end message transfer services.
- Provides error control, segmentation, flow control, congestion control and application addressing.
- UDP: connectionless
- TCP: guarantees transmission of packet.



Internet Protocol

- Responsible to route packet to destination host.
- Routing is supported host addressing or IP address.



Network Access Layer

- The Network Access Layer is the lowest layer of the TCP/IP protocol hierarchy.
- This layer provides the means for the system to deliver data to the other devices on a directly attached network.
- This layer defines how to use the network to transmit an IP datagram.
- Network Access Layer protocols must know the details of the underlying network (its packet structure, addressing, etc.) to correctly format the data being transmitted to comply with the network constraints.



IP Addressing Scheme

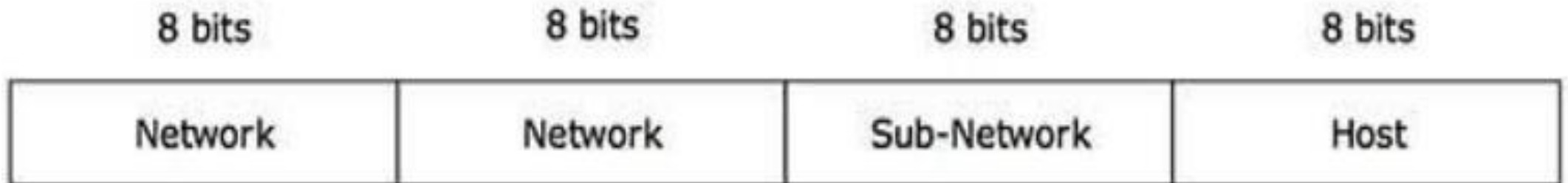
- The IP header has 32 bits assigned for addressing a desired device on the network.
- An IP address is a unique identifier used to locate a device on the IP network.
- IPv4 uses hierarchical addressing scheme.





Hierarchical Addressing Scheme

- IPv4 uses hierarchical addressing scheme. An IP address which is 32-bits in length, is divided into two or three parts as depicted:





Hierarchical Addressing Scheme

- A single IP address can contain information about the network and its sub-network and ultimately the host.
- This scheme enables IP Address to be hierarchical where a network can have many sub_networks which in turn can have many hosts.



Subnet Mask

- The 32-bit IP address contains information about the host and its network. It is very necessary to distinguish the both. For this, routers use Subnet Mask, which is if the size of the network address in the IP address.
- Subnet Mask is also 32 bits long. If the IP address in binary is ANDed with its Subnet Mask, the result yields the Network address. For example, say the IP Address 192.168.1.152 and the Subnet Mask is 255.255.255.0 then



Binary Representation

- The positional value method is the simplest form of converting binary from decimal value.
- IP address is 32 bit value which is divided into 4 octets. A binary octet contains 8 bits and the value of each bit can be determined by the position of bit value '1' in the octet.

MSB	8 th	7 th	6 th	5 th	4 th	3 rd	2 nd	1 st	LSB
	1	1	1	1	1	1	1	1	
Positional Value	128	64	32	16	8	4	2	1	



Subnet Mask

- This way Subnet Mast helps extract Network ID and Host from an IP Address. It can be identified now that 192.168.1.0 is the Network number and 192.168.1.152 is the host on that network.

IP	192.168.1.152	11000000	10101000	00000001	10011000	ANDed
Mask	255.255.255.0	11111111	11111111	11111111	00000000	
Network	192.168.1.0	11000000	10101000	00000001	00000000	Result



IPv4 – Address Classes

- IPv4 Addressing system is divided into 5 classes of IP Addresses.
- All the 5 classes are identified by the first octet of IP Address.

Class IP Address range

Class	Address range	Supports	
Class A	1.0.0.1 to 126.255.255.254	Supports 16 million hosts on each of 127 networks.	
Class B	128.1.0.1 to 191.255.255.254	Supports 65,000 hosts on each of 16,000 networks.	
Class C	192.0.1.1 to 223.255.254.254	Supports 254 hosts on each of 2 million networks.	
Class D	224.0.0.0 to 239.255.255.255	Reserved for <u>multicast</u> groups.	
Class E	240.0.0.0 to 254.255.255.254	Reserved for future use, or research and development purposes.	

Public IP Address Classes range

Class	1st Octet DEC range	1st Octet BIN	Start address	Finish address	1st Octet High order Bits	Network/ Host	Default Subnet Mask
A	1-126	00000001-01111110	0.0.0.0	126.255.255.255	0	N.H.H.H	255.0.0.0
B	128-191	10000000-10111111	128.0.0.0	191.255.255.255	10	N.N.H.H	255.255.0.0
C	192-223	11000000-11011111	192.0.0.0	223.255.255.255	110	N.N.N.H	255.255.255.0
D	224-239	11100000-11101111	224.0.0.0	239.255.255.255	1110		
E	240-255	11110000-11111111	240.0.0.0	254.255.255.255	11110		

Note: Class A address **127.0.0.0 - 127.255.255.255** cannot be used and is for **LOOPBACK** and diagnostic

Private IP Address Classes range

Class	1st Octet DEC range	1st Octet BIN	Start address	Finish address	1st Octet High order Bits	Network/ Host	Default Subnet Mask
A	10	00001010	10.0.0.0	10.255.255.255	0	N.H.H.H	255.0.0.0
B	172	10101100	172.16.0.0	172.31.255.255	10	N.N.H.H	255.255.0.0
C	192	11000000	192.168.0.0	192.168.255.255	110	N.N.N.H	255.255.255.0



References

Kurose James F and Keith W. Ross : Computer Networking: A Top-Down Approach Featuring the Internet, Pearson Education 2005.

William Stallings, Computer Networking with Internet Protocols and Technology, Pearson Education 2004.

Important publications in computer networks

Network Communication Architecture and Protocols: OSI Network Architecture 7 Layers Model

