12-13-2020
https://youtu.be/A7uNJFZhTro

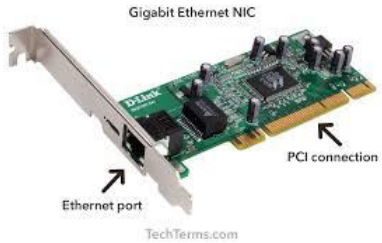
Network

A **Network** is a collection of computers, servers, network devices, peripherals or any other device connected to one another to allow the sharing of data. Example is Internet

Basic requirement

- NIC, Media, Topology, Protocol, IP Address

NIC



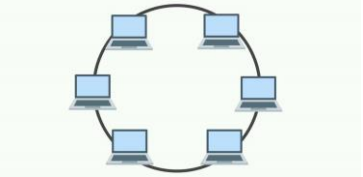
- Hardware/ MAC address: 08:00:27:bd:99:25 # < ---burnt into the hard ware and you cannot change it
- IP Address IPv4: 192.168.137.236
- IP Address IPv6: fe80::a00:27ff:febd:9925

Media

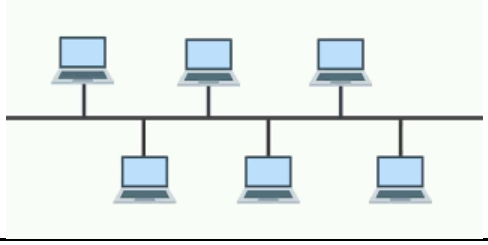
- Cables
- RJ45 –
- CAT5 or CAT6 etheret calbes
- WiFI
- HotSpots

Topology

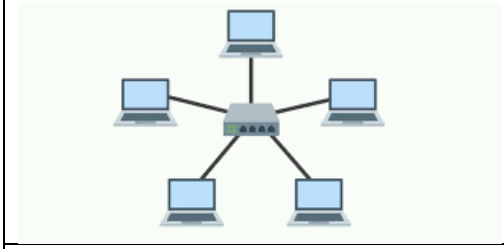
Ring



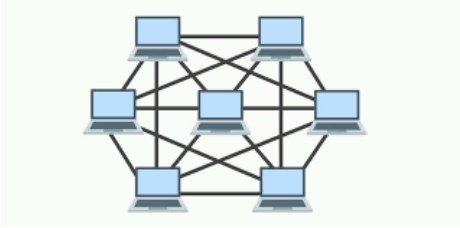
Bus



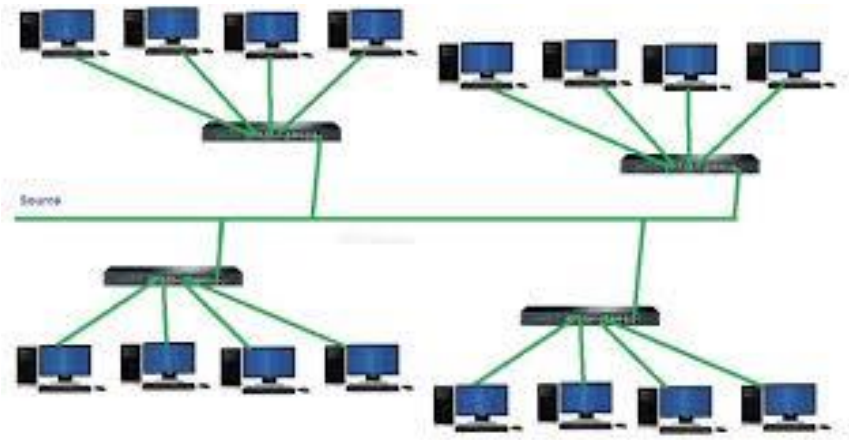
Star



Mesh



Tree



- You have a network
- Each router you add becomes subnet
- Max of 256 devices
- 2^8 = 2x2x2x2x2x2x2x2

Protocol

In computer world, Protocol is set of rules or procedures for transmitting data between electronic devices such as computers.

OSI Layers

OSI – Open Standard interconnection – 7 layer model

- Physcial layer – Hardware
- Data layer – Data Being generated
- Network layer – working network – switches, router etc
- Transport layer – communication is being done using serveral methods
- Session layer – session established between two hosts
- Presentation layer – data is presented to application
- Application layer – exam ms office

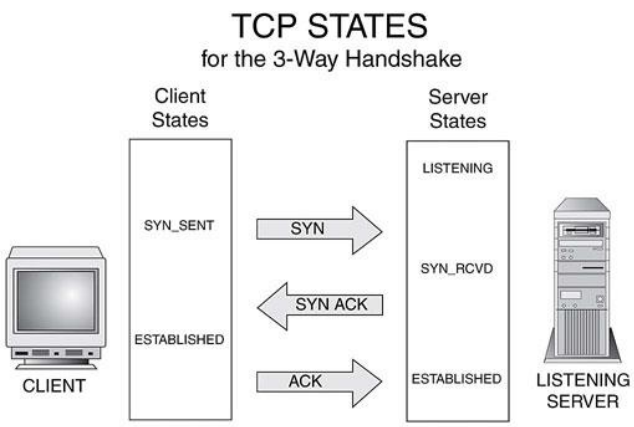
TCP – Transport Control Protocol

TCP – Transport Control Protocol

- Connection protocol
- DATA, Network, Transport, Application – DNTA

- Connection oriented protocol
- TCP protocol makes 3way hanshake connection
-

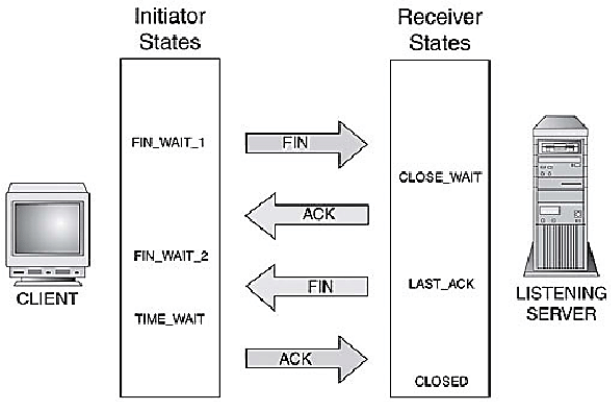
TCP makes a 3way Handshake connection established



Establishing Connection

- A to B – Syncronization signal is sent
- B to A – Syncronization signal and Acknowledgement signal
- A to B – Acknowledgement
- Connection is established and DATA is transferred
- Sync – Sync Ack – Ack

TCP connection Termininaiton



Closing the connection

- A to B – Fisinshed – complete connection
- B to A – Acknowledge to Finish connection
- B to A – Send the Finsh signal
- A to B - Acknowledge the final signal
- Fin - Fin Ack – Ack

2^16 = 65536 ports

Exmaple

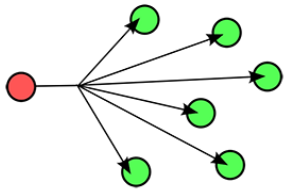
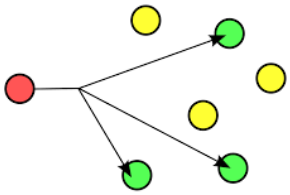
SSH connection is using TCP protocol and is connection oriented

```
[root@localhost ~]# netstat -anp | grep -w 22
tcp        0      0 192.168.137.20:22
```

UDP

UDP – User Datagram Protocol

- Connection less protocol
- Just sends the Data to the host without confirmation
- Connection is faster
-

Two types of UDP	
Boradcast	Multicast
	
Signal is sent on network without confirmation	Singal is sent only the host which are part of group without confirmation

Differences between TCP and UDP

TCP	UDP
Connection oriented	Connection less
Reliable	Unreliable
Slow	Fast
SSH, HTTP, FTP, SMTP	DNS, DHCP, Broadcast

12-19-2020
https://youtu.be/NfzvBHVBD0M

IP Address

An Internet Protocol address is a numerical label assigned to each device connected to a computer network that uses the Internet Protocol for communication. An IP address serves two main functions: host or network interface identification and location addressing.

192.168.56.108

Computers work on Binary system – it can only recognize two digits – base 2

Zero = 0 = off
One = 1 = on

IP address is based on **32** binary bits structure – 2^8 octects
Information is written in Binary

192	168	56	108
8 bits	8 bits	8 bits	8 bit

Total = 32

2^7 = 1

1 bit 2^0							
4 bit = nibble = 2^2							
8 bit = octet = 1 byte = 2^3							

2^0 = 1
2^1 = 2
2^2 = 4
2^3 = 8 = 1 Byte

8	7	6	5	4	3	2	1
7	6	5	4	3	2	1	0
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1

192.168.56.108

192 – 11000000 #< --- right to left

8	7	6	5	4	3	2	1
7	6	5	4	3	2	1	0
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1
192 -128	64 - 64	0 - 32	0 - 16	0 - 8	0 - 8	0 - 2	0 - 1
1	1	0	0	0	0	0	0

168 - 10101000

8	7	6	5	4	3	2	1
7	6	5	4	3	2	1	0
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1
168 -128	40 - 64	40 - 32	8-16	8-8	0-4	0-2	0-1
1	0	1	0	1	0	0	0

56 – 00111000

8	7	6	5	4	3	2	1
7	6	5	4	3	2	1	0
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1
56 -128	56-64	56-32	24-16	8-8	0-4	0-2	0-1
0	0	1	1	1	0	0	0

108 – 01101100

8	7	6	5	4	3	2	1
7	6	5	4	3	2	1	0
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1
108-128	108-64	44-32	12-16	12-8	4-4	0-2	0-1
0	1	1	0	1	1	0	0

192.168.56.108 = 11000000101010000011100001101100

Numbers are from right to left

9-0

Arabic numbers

Gateway

router	switch
	

- Router gives out IP address to each connected devices
- Total maximu of 256 IP addresses are available
- 2^8 = 256
- Each router added becomes a subnet (network in its self)
- 1 IP is reserverd for router itself
- This reserved IP is entry point for the network to communicate with other networks
- Reserved ip is referred to as default gateway
-
- [root@zmpt01 ~]# netstat -rn
- Kernel IP routing table
- Destination Gateway Genmask Flags MSS Window irtt Iface
- 0.0.0.0 10.0.2.1 0.0.0.0 UG 0 0 0 enp0s9

Ports – connection on with a application is connected to another device

65,536 – ports on OS

Linux or Windows

Commonly used ports

Port Number	Usage
20	File Transfer Protocol (FTP) Data Transfer
21	File Transfer Protocol (FTP) Command Control
22	Secure Shell (SSH)
23	Telnet - Remote login service, unencrypted text messages
25	Simple Mail Transfer Protocol (SMTP) E-mail Routing
53	Domain Name System (DNS) service
80	Hypertext Transfer Protocol (HTTP) used in World Wide Web
110	Post Office Protocol (POP3) used by e-mail clients to retrieve e-mail from a server
119	Network News Transfer Protocol (NNTP)
123	Network Time Protocol (NTP)
143	Internet Message Access Protocol (IMAP) Management of Digital Mail
161	Simple Network Management Protocol (SNMP)
194	Internet Relay Chat (IRC)
443	HTTP Secure (HTTPS) HTTP over TLS/SSL

IP Address Classess

192.168.56.108

- There are 4 subnets information in each ip address
- 192.168.56.108

192	168	56	108

-
- 2^8 = 256 = each subnet
-

256	256	256	256
0	0	0	0

256x256x256x256	4,294,967,296	Maximum for IPv4
0x0x0x0	0	2^32

-
- 0.0.0.1 =
- My Public IPv6 is: 2607:fb90:a345:19f9:c171:a28e:9a34:571f
-

- IPv6 capacity = 340,282,366,920,938,463,463,374,607,431,768,211,456

CIDR	Subnet mask (decimal)	Subnet mask (binary)	Available addresses	
/0	0.0.0.0	00000000.00000000.00000000.00000000	4.294.967.296	2^{32}
/1	128.0.0.0	10000000.00000000.00000000.00000000	2.147.483.648	2^{31}
/2	192.0.0.0	11000000.00000000.00000000.00000000	1.073.741.824	2^{30}
/3	224.0.0.0	11100000.00000000.00000000.00000000	536.870.912	2^{29}
/4	240.0.0.0	11110000.00000000.00000000.00000000	268.435.456	2^{28}
/5	248.0.0.0	11111000.00000000.00000000.00000000	134.217.728	2^{27}
/6	252.0.0.0	11111100.00000000.00000000.00000000	67.108.864	2^{26}
/7	254.0.0.0	11111110.00000000.00000000.00000000	33.554.432	2^{25}
/8	255.0.0.0	11111111.00000000.00000000.00000000	16.777.216	2^{24}
/9	255.128.0.0	11111111.10000000.00000000.00000000	8.388.608	2^{23}
/10	255.192.0.0	11111111.11000000.00000000.00000000	4.194.304	2^{22}
/11	255.224.0.0	11111111.11100000.00000000.00000000	2.097.152	2^{21}
/12	255.240.0.0	11111111.11110000.00000000.00000000	1.048.576	2^{20}
/13	255.248.0.0	11111111.11111000.00000000.00000000	524.288	2^{19}
/14	255.252.0.0	11111111.11111100.00000000.00000000	262.144	2^{18}
/15	255.254.0.0	11111111.11111110.00000000.00000000	131.072	2^{17}
/16	255.255.0.0	11111111.11111111.00000000.00000000	65.536	2^{16}
/17	255.255.128.0	11111111.11111111.10000000.00000000	32.768	2^{15}
/18	255.255.192.0	11111111.11111111.11000000.00000000	16.384	2^{14}
/19	255.255.224.0	11111111.11111111.11100000.00000000	8.192	2^{13}
/20	255.255.240.0	11111111.11111111.11110000.00000000	4.096	2^{12}
/21	255.255.248.0	11111111.11111111.11111000.00000000	2.048	2^{11}
/22	255.255.252.0	11111111.11111111.11111100.00000000	1.024	2^{10}
/23	255.255.254.0	11111111.11111111.11111110.00000000	512	2^{9}
/24	255.255.255.0	11111111.11111111.11111111.00000000	256	2^{8}
/25	255.255.255.128	11111111.11111111.11111111.10000000	128	2^{7}
/26	255.255.255.192	11111111.11111111.11111111.11000000	64	2^{6}
/27	255.255.255.224	11111111.11111111.11111111.11100000	32	2^{5}
/28	255.255.255.240	11111111.11111111.11111111.11110000	16	2^{4}
/29	255.255.255.248	11111111.11111111.11111111.11111000	8	2^{3}
/30	255.255.255.252	11111111.11111111.11111111.11111100	4	2^{2}
/31	255.255.255.254	11111111.11111111.11111111.11111110	2	2^{1}
/32	255.255.255.255	11111111.11111111.11111111.11111111	1	2^{0}