7. Networking

Computer Networking Basics

Here is what you will find in this::

1. Components
2. OSI Model
3. Classification
4. Devices
5. Home Network
6. IP Addresses
7. Protocols
8. DNS & DHCP
9. Network Commands

ISO

What is a computer network?
Communication between two or more network interfaces.

Components of computer network

1. Two or more computers/devices
2. Cables as links between computers
3. a network interfacing card (NIC) on each
4. computer
5. seitches
6. routers
7. software called OS
8. etc

OSI Model

- People around the world uses computer network to communicate with each other.
- for worldwide data communicaiton, systems must be developed which are compatible to communicate with each other.
- There shoud be standard communication methods and devices.

- ISO (Internation organisation of standardization) has developed this standard.
- The communicaiton model is called OSI(Open system interconnection).
- ISO-OSI model is a 7 layer architecture developed in 1984.

OSI Model
7. Application
6. Presentation
5. Session
4. Transport
3. Network
2. Data Link

1. Phyical Layer

The basic elements of a layered model are:

- services
- protocols
- and interfaces

1. A service is a set of action that a layer offers to another (higher) layer.
2. A protocol is a set of rules that a layer uses to exchange information.
3. An interface is communication between the layers.

Physical Layer
Lowest layer in the OSI model. Responsible for actual physical connection between devices. **Information here are in bits**. So when it receives the signal it will convert it into bits and will send it to datalink Layer

Data link Layer
Second layer. Main function is to make sure transfer is error free from one node to another. **The data is in frame**. It consists of Physical addressing. (MAC and LLC). The data is then presented to the network layer

Network Layer
Works for the transmission of data from one node to another which are located in different networks. It works on the IP address. T**he data here are in packets** and the senders and receivers IP address are placed in the header of the packets by the network layer.

Transport Layer
Takes the service from network layer and provides it to the application layer. End to end connection and reliablility is checked. Responsible for end to end delivery of the complete message. It also provides the acknowlegdment. If there is any failure it will retransmit the data.

Session Layer, Presentation Layer and Application Layer

In TCP/IP model they are presented as one layer. responsible in security, maintanence, encryption and decryption and presenting the data for applicaitons.

In brief:

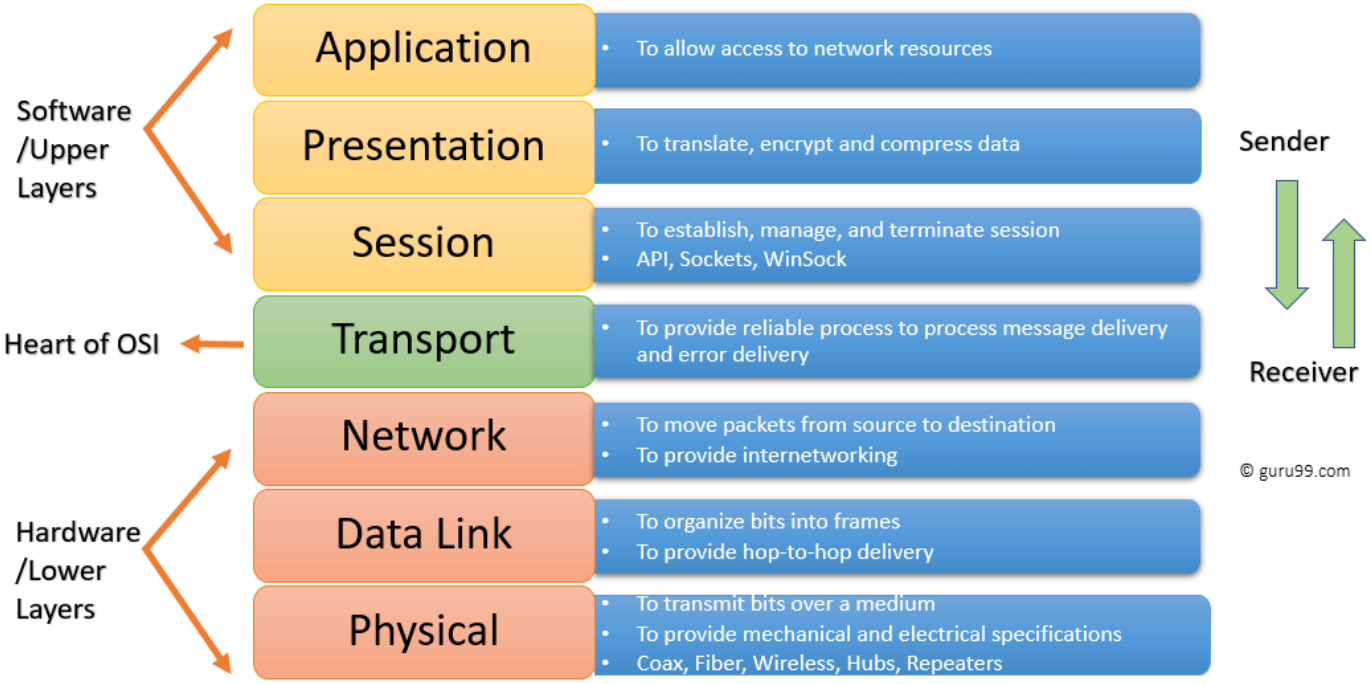
Session Layer - Interhost Communication

Presentation Layer - Data and Represenation and Encryption/decryption

Application layer - Network Process to application

<table>
<tr><th>OSI Model</th><th>DoD Model</th><th colspan="2">protocols</th><th>devices/apps</th></tr>
<tr><td>layer 5, 6, 7</td><td>application</td><td colspan="2">dns, dhcp, ntp, snmp, https, ftp, ssh, telnet, http, pop3... others</td><td>web server, mail server, browser, mail client...</td></tr>
<tr><td>layer 4</td><td>host-to-host</td><td>tcp</td><td>udp</td><td>gateway</td></tr>
<tr><td>layer 3</td><td>internet</td><td colspan="2">ip, icmp, igmp</td><td>router, firewall layer 3 switch</td></tr>
<tr><td>layer 2</td><td rowspan="2">network access</td><td colspan="2">arp (mac), rarp</td><td>bridge layer 2 switch</td></tr>
<tr><td>layer 1</td><td colspan="2">ethernet, token ring</td><td>hub</td></tr>
</table>

Summary of Layers



Classification of network by Geography

- LAN : Local area network (Very close to eachother like in a room)
- MAN : Metropolitan area network (Muncipality, Metrotrains)
- WAN : Wide Area network (Internet)
- CAN : Campus Area network (Office, colleges, campus)
- PAN : Personal Area Network (Bluetooth, hotspot)

Devices

Switches Layer 2 device which facilitate the sharing of resources by connecting together all the devices."

Router Layer 3 device which is used to connect multiple networks together. it receives and sends data on computer network.

IP address

IPV4

192.168.100.1

192 - 1st octet - 11000000(Bits)
168 - 2nd octet - 10101000(Bits)
100 - 3rd octet - 01100100(Bits)
1 - 4th octet - 00000001(Bits)

total made out 32 bits (8+8+8+8)
each octet consists of 8 bit

IPV4 Range
0.0.0.0 - 255.255.255.255
32 (8+8+8+8) zeroes and 32 (8+8+8+8)one in each bit

Public IP -> Internet (Eg - 54.86.23.90)
Private IP -> For local network (Eg - 192.168.1.10)

Private IP Ranges (3 we use)
Class A 10.0.0.0 - 10.255.255.255
Class B 172.16.0.0 - 172.31.255.255
Class C 192.168.0.0 - 192.168.255.255

Class D and E - used for research and multicast purposes only.

Protocols

In general, called set of rules.
In networking and communication area, a protocol is the formal specification that defines the procedures that must be followed when transmitting ir receiving data. Protocols define the format, timing, sequence, and error checking used on the network.

In protocol of Layer 4 (Transport Layer)

TCP and UDP protocol

TCP

- Reliable protocol
- Connection oriented
- Performs 3 way handshake
- Provision for error detection and retransmission
- Most application use TCP for guranteed and reliable transmission
- FTP, HTTP, HTTPS

UDP

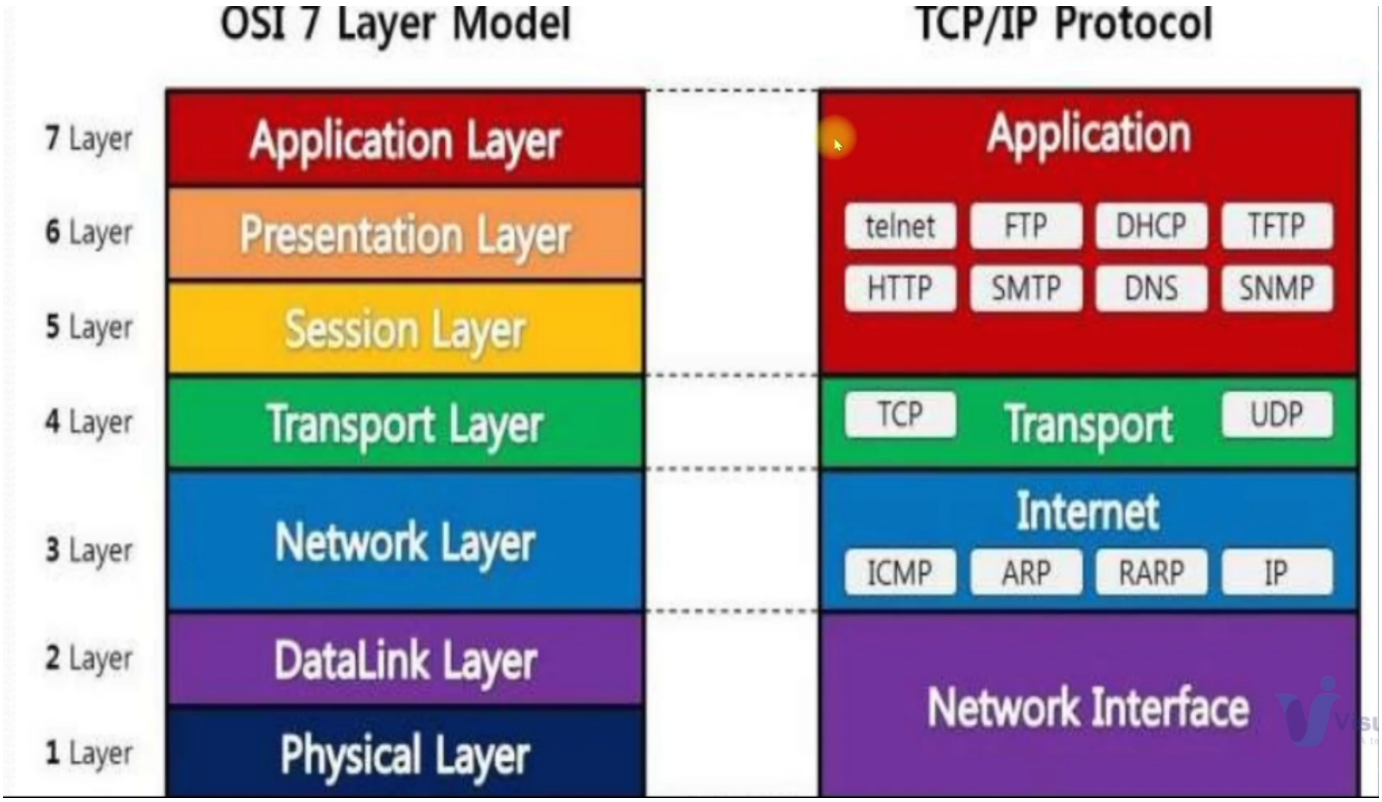
- Unreliable Protocol
- Connectionless
- Much faster than TCP
- No acknowledgement waits

- No proper sequencing of data units
- Suitable for application where speed matter more than reliabilty
- DNS, DHCP, TFTP, ARP, RARP

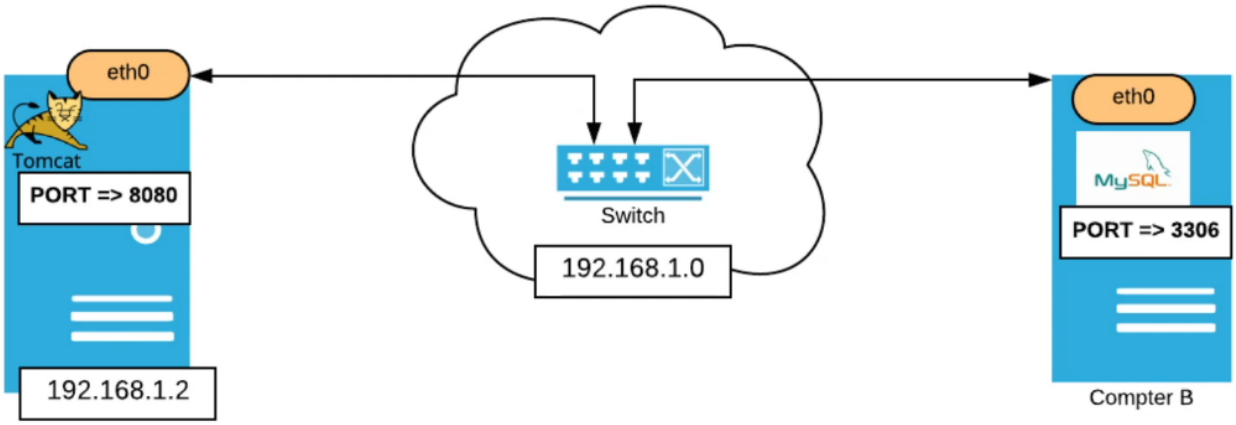
Port numbers

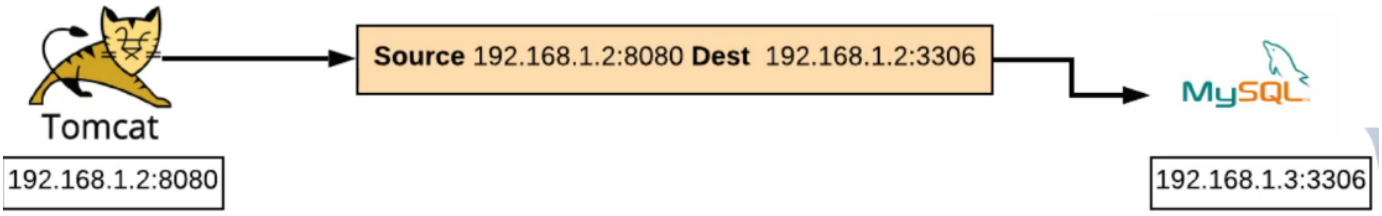
Label on Column	Service Name	UDP and TCP Port Numbers Included
DNS	Domain Name Service – UDP	UDP 53
DNS TCP	Domain Name Service – TCP	TCP 53
HTTP	Web	TCP 80
HTTPS	Secure Web (SSL)	TCP 443
SMTP	Simple Mail Transport	TCP 25
POP	Post Office Protocol	TCP 109, 110
SNMP	Simple Network Management	TCP 161,162 UDP 161,162
TELNET	Telnet Terminal	TCP 23
FTP	File Transfer Protocol	TCP 20,21
SSH	Secure Shell (terminal)	TCP 22
AFP IP	Apple File Protocol/IP	TCP 447, 548

OSI 7 Layer Model and **TCP/IP Model**

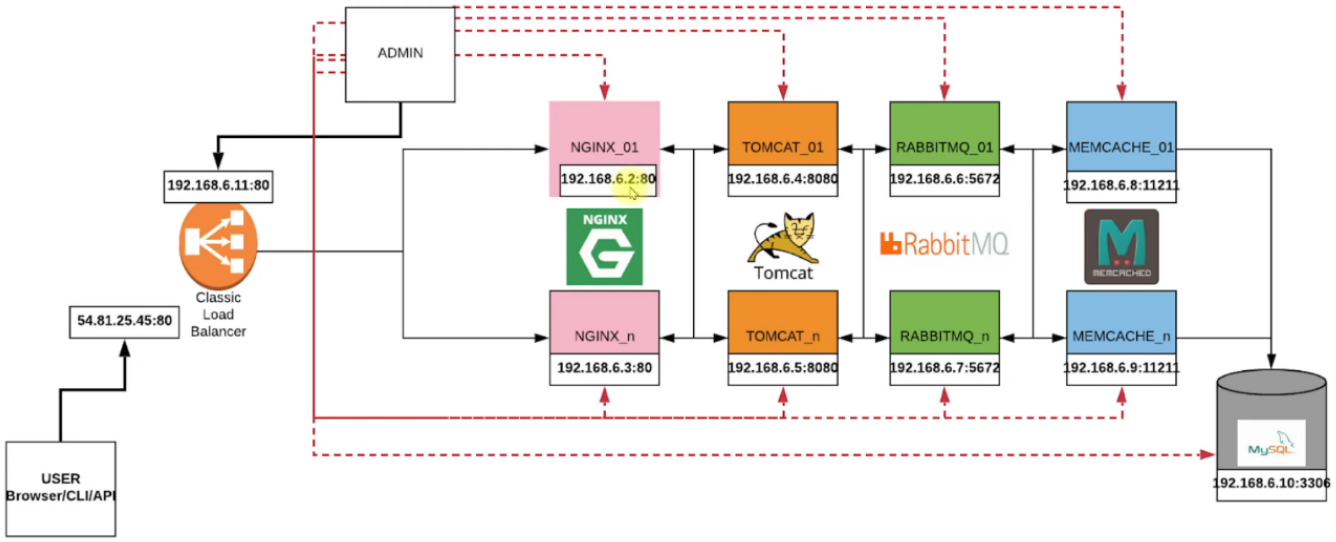


Why IP address?





We will see a java based project which will have the following architecture.



Linux networking commands:

ifconfig
ip addr show
ping
tracert or traceroute
netstat -antp (will show all the open ports)
nmap
dig (Will show DNS lookup or DNS queries)
nslookup(something like an older version of dig)

route -n (shows gateways of network interface)
arp (for view or add the content to kernel arp table)
mtr `<ip address>` (its like tracert but a live version(Realtime version of tracert))
telnet `<ip address> <portnumber>`

connect to the machine with name instead of ip address
do
vim /etc/hosts

put
`<ip address> <name>`
it will point to this