NETWORK A

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DEFINITION

We consider a network as a graph of connected entities created to allow exchange informations through nodes

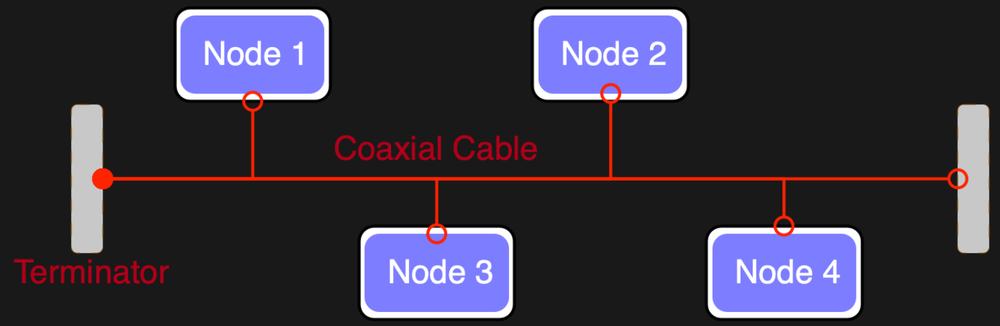
UNICAST, BROADCAST MULTICAST

Cast is the packet data stream. 1. `Unicast` will send data to an unique address, recipient 2. `Broadcast` send data to all recipients of a network 3. `Multicast` send data to a group of recipients

NETWORK TOPOLOGY

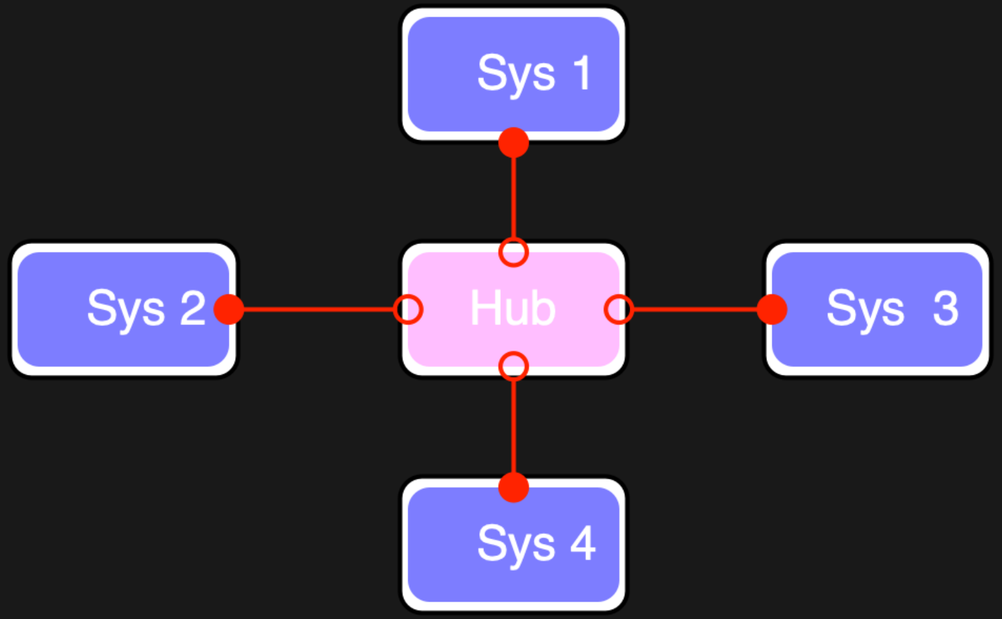
Network Topology refers to the physical and logical arrangement of devices on a network. There are several different types of Network Topologies, including Bus, Star, Ring, Mesh, and Tree.

BUS TOPOLOGY



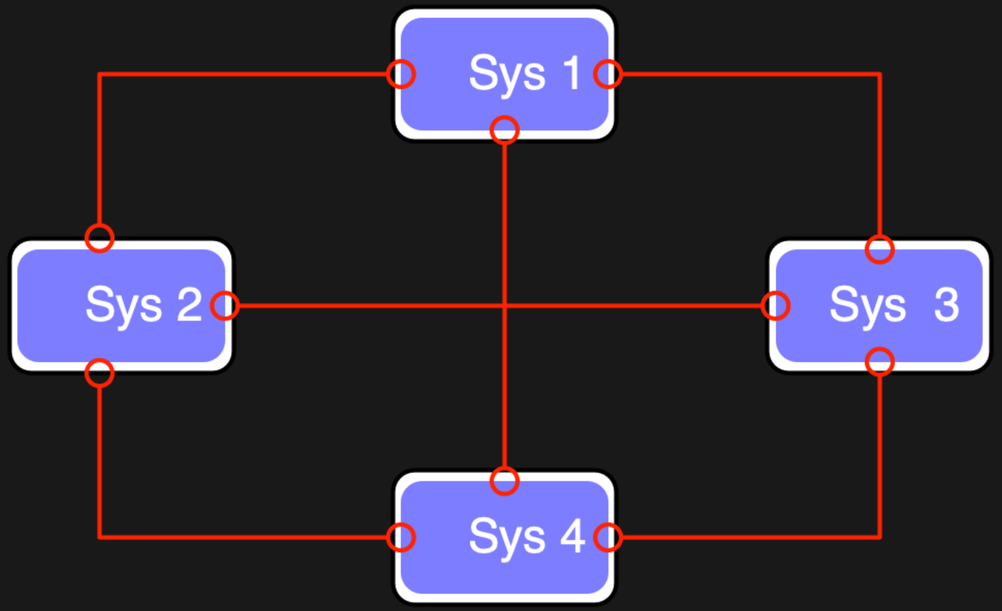
This type of topology is easy to set up and manage, but it can be vulnerable to failure if the backbone cable or bus is damaged

STAR TOPOLOGY



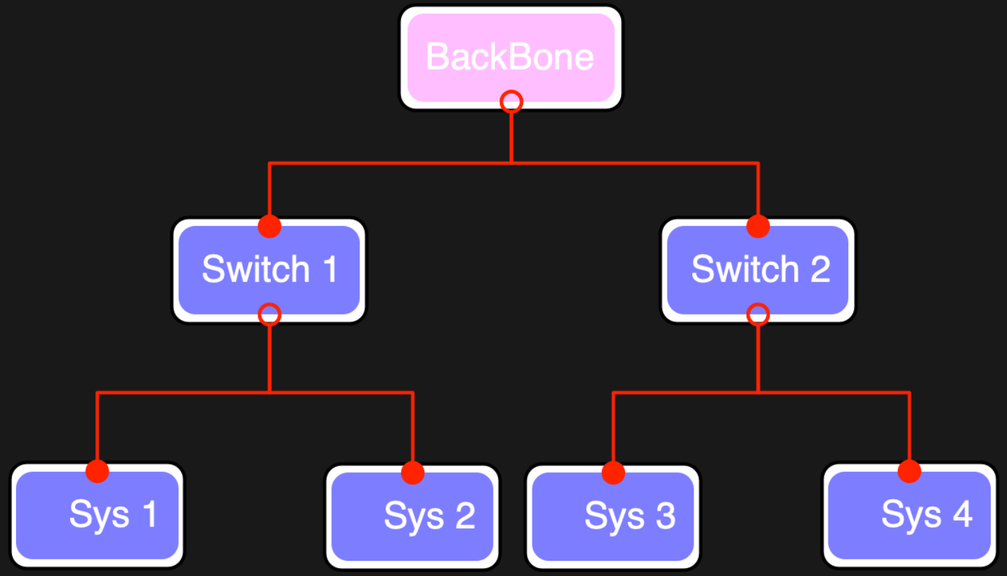
This type of topology is more robust than the Bus topology, but it can be more expensive to set up and manage.

STAR TOPOLOGY



This type of topology is highly reliable and robust, but it can be expensive to set up and manage.

TREE TOPOLOGY



This type of topology is easy to set up and manage, but it can be affected by a single device failure.

TYPES OF NETWORKS

Main Types are

1. LAN (local Area Network)
2. MAN (Metropolitan Area Network)
3. WAN (Wide Area Network) Other networks: PAN (Personal Area Network), SAN (Storage Area Network),EPN (Enterprise Private Network), VPN (Virtual Private Network)

PAN

a personal area network having an interconnection of personal technology devices to communicate over a short distance. It covers only less than 10 meters. Usually is a `bluethoot` network

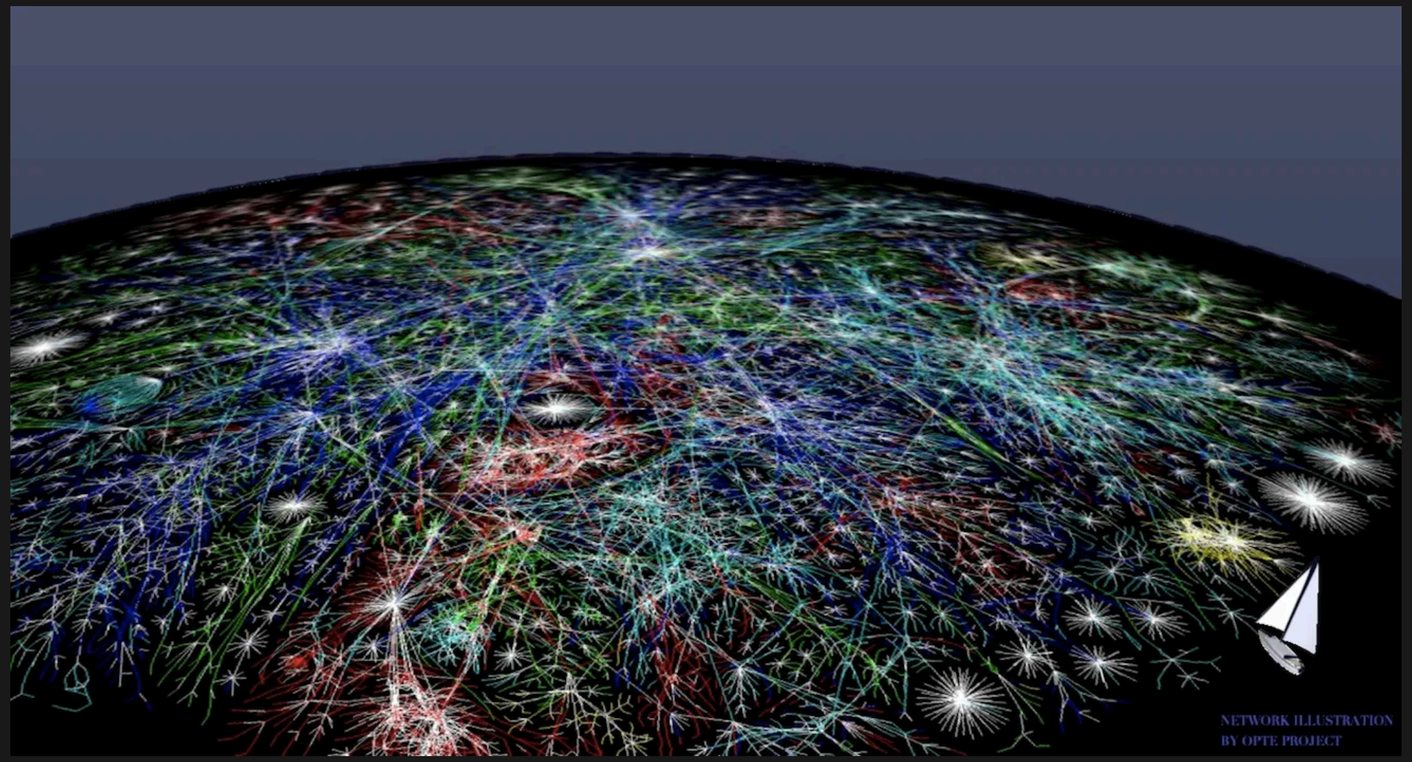
LAN

Connects network devices in such a way that personal computers and workstations can share data, tools, and programs. The group of computers and devices are connected together by a switch, or stack of switches, using a private addressing scheme as defined by the TCP/IP protocol.

MAN

Covers a larger area than that covered by a LAN and a smaller area as compared to WAN. MAN has a range of 5-50km. It connects two or more computers that are apart but reside in the same or different cities. It covers a large geographical area and may serve as an ISP (Internet Service Provider).(FastWeb)

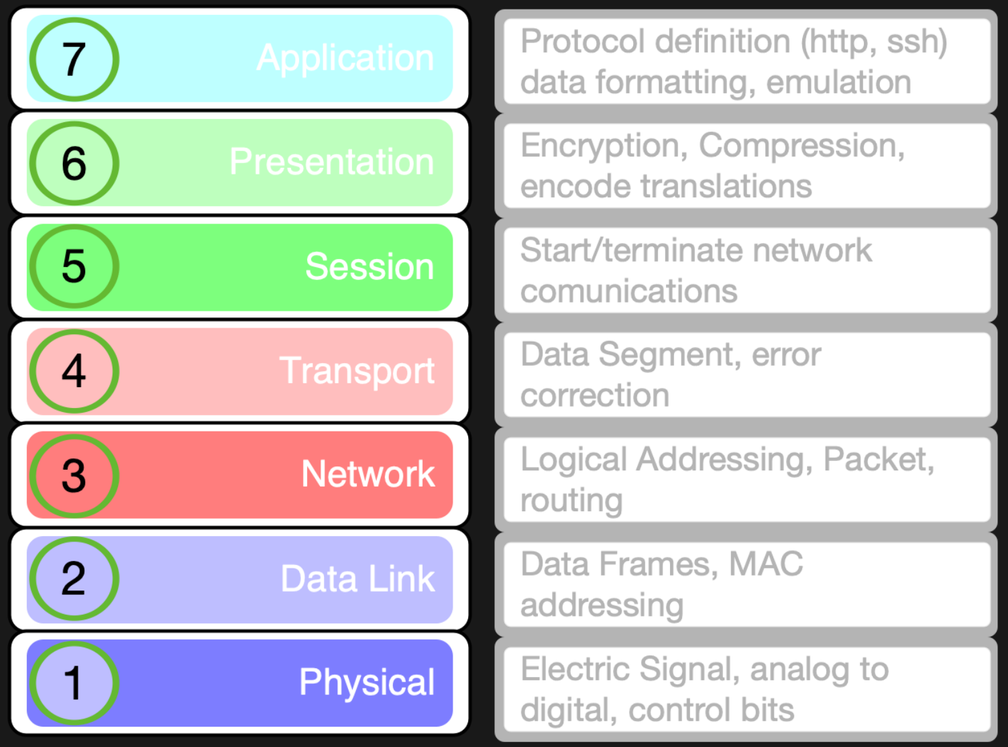
WAN



The world internet connection via fiber line, satellites links

THE OSI MODEL

OSI LAYERS



Open System Interconnection model

LAYER 1

Physical Layer

- Telephone network modems.
- IrDA physical layer.
- USB physical layer.
- EIA RS-232, EIA-422....
- Ethernet cables and plugs 10BASE-T, 10BASE ...
- Varieties of 802.11 Wi-Fi physical layers.
- DSL.
- ISDN.

LAYER 1 DEVICES

Modems
Hubs

LAYER 2

Data Link Protocols

- ARP Address Resolution Protocol
- Ethernet
- FDDI Fiber Distributed Data Interface
- IEEE 802.2 MAC layers
- IEEE 802.11 wireless LAN
- I²C
- PPP Point-to-Point Protocol
- Spanning Tree Protocol
- Token ring

LAYER 2 DEVICES

Switches
WAP (wireless access point)

LAYER 3

Network Layer Protocols

- ICMP Internet Control Message Protocol
- IPsec Internet Protocol Security
- IPv4/IPv6 Internet Protocol
- IPX Internetwork Packet Exchange
- RSMLT Routing Information Protocol

LAYER 4

Transport Layer

- ATP AppleTalk Transaction Protocol
- IL Fibre Channel Protocol
- TCP Transmission Control Protocol
- UDP User Datagram Protocol

LAYER 5

Session Layer Protocol

- ADSP AppleTalk Data Stream Protocol
- H.245 Call Control Protocol for Multimedia Communication
- NetBIOS Network Basic Input Output System
- PAP Password Authentication Protocol
- PPTP Point-to-Point Tunneling Protocol
- RPC Remote Procedure Call Protocol
- SMPP Short Message Peer-to-Peer
- SOCKS the SOCKS internet protocol

LAYER 6

Presentation Layer

Is the lower layer for an application layer can usually manage

- Data conversion
- Character code translation
- Compression
- Encryption and Decryption

LAYER 7

Application Layer

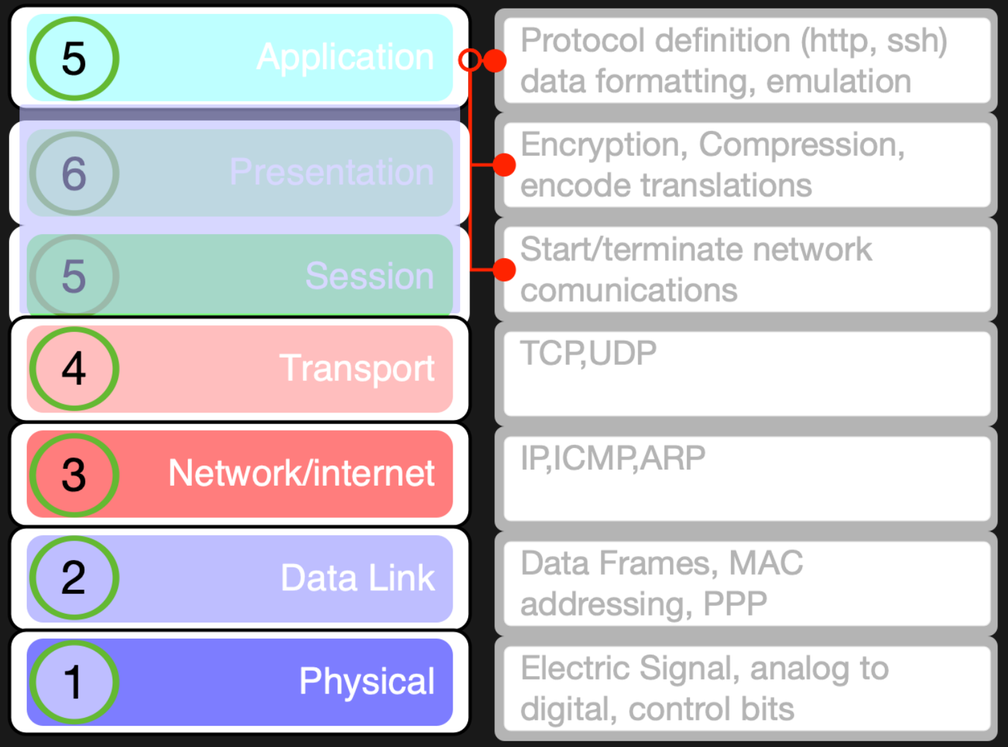
- Atom(rss) Publishing Protocol
- HTTP HyperText Transfer Protocol
- LDAP Lightweight Directory Access Protocol
- NFS Network File System
- RPC Remote Procedure Call
- SMB Server Message Block
- SMTP Simple Mail Transfer Protocol
- SSH Secure Shell
- Tor anonymity network

TCP/IP MODEL

DOD MODEL

designed and developed by the Department of Defense (DoD) in the 1960s and is based on standard protocols. It stands for Transmission Control Protocol/Internet Protocol.

TCP/IP LAYERS



LAYER 3

Internet Layer

- IP Will deliver packets from the source to the destination using the IP addresses in the packet headers. IP has 2 versions: IPv4 and IPv6.
- ICMP Internet Control Message Protocol. It is encapsulated within IP datagrams.Provide information about network.
- ARP Address Resolution Protocol. Its job is to find the hardware address of a host from a known IP address.

LAYER 4

Transport Layer

- TCP Character-by-character transmission rather than separate packets. A starting point that establishes the connection, the whole transmission in byte order, and an ending point that closes the connection.
- UDP Connections between receiving and sending hosts are not verified by UDP. Applications that transport little amounts of data use UDP

LAYER 5

Application Layer

- HTTP and HTTPS
- SSH
- FTP and `sftp`
- `ldap` and `ldaps`
- etc

DIFFERENCES I

TCP/IP	OSI
TCP refers to Transmission Control Protocol.	OSI refers to Open Systems Interconnection.
TCP/IP has 5 layers.	OSI has 7 layers.

DIFFERENCES II

TCP/IP	OSI
TCP/IP is more reliable	OSI is less reliable
TCP/IP does not have very strict boundaries.	OSI has strict boundaries

DIFFERENCES III

TCP/IP	OSI
TCP/IP follows connection-less a horizontal approach.	OSI follows a vertical approach.
TCP/IP uses both session and presentation layer in the application layer itself.	OSI uses different session and presentation layers.

DIFFERENCES IV

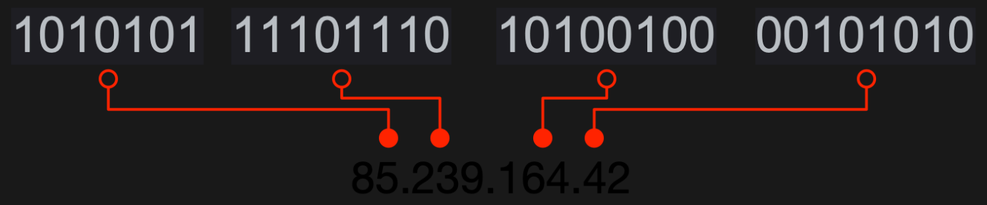
TCP/IP	OSI
TCP/IP developed protocols then model.	OSI developed model then protocol.
Transport layer in TCP/IP does not provide assurance delivery of packets.	In OSI model, transport layer provides assurance delivery of packets.

DIFFERENCES V

TCP/IP	OSI
TCP/IP model network layer only provides connection less services.	Connection less and connection-oriented both services are provided by the network layer in the OSI model.
Protocols cannot be replaced easily in TCP/IP model.	Protocols are better covered and is easy to replace with the change in technology.

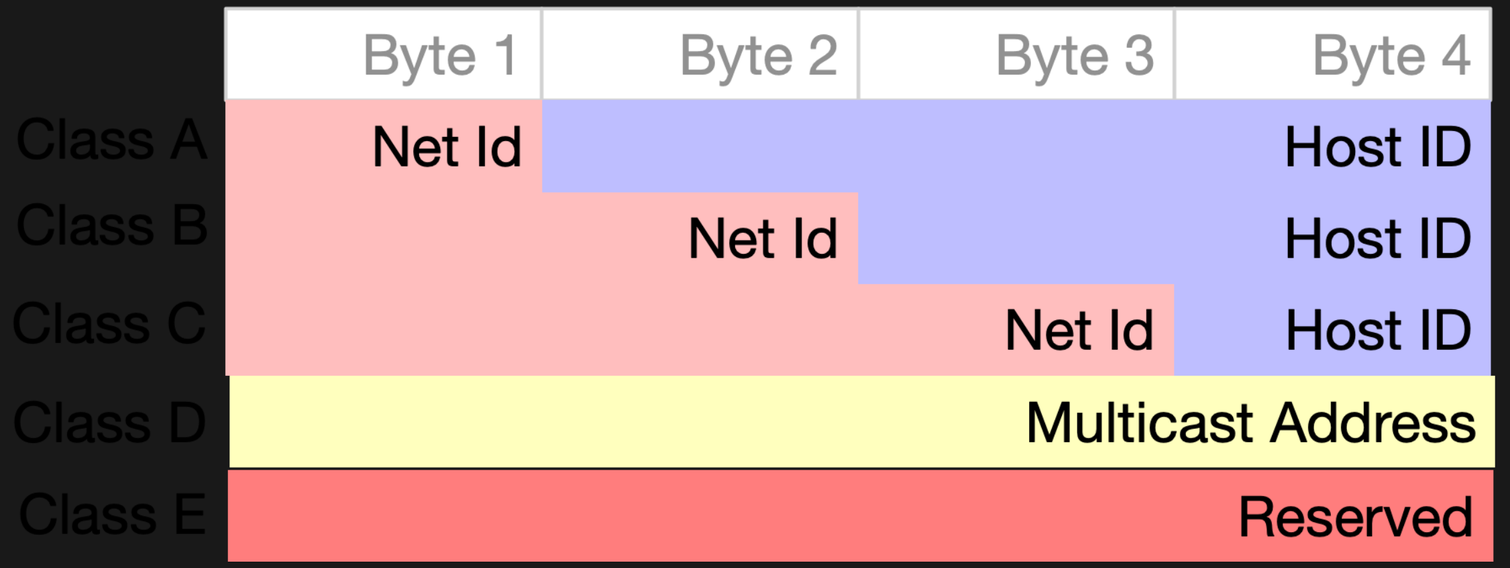
IP ADDRESSING

IP ADDRESSING



IP address is an address having information about how to reach a specific host, especially outside the LAN. An IP address is a 32 bit unique address having an address space of 2^32.

CLASSFULL IP



CLASSFULL IP II

Class	Leading bits	Size of *network number* bit field	Size of *rest* bit field	Number of networks	Addresses per network	Total addresses in class	Start address	End address	Default subnet mask in dot-decimal notation	CIDR notation
Class A	0	8	24	128 (2^7)	16,777,216 (2^{24})	2,147,483,648 (2^{31})	*0.0.0.0*	*127.255.255.255*[a]	*255.0.0.0*	*/8*
Class B	10	16	16	16,384 (2^{14})	65,536 (2^{16})	1,073,741,824 (2^{30})	*128.0.0.0*	*191.255.255.255*	*255.255.0.0*	*/16*
Class C	110	24	8	2,097,152 (2^{21})	256 (2^8)	536,870,912 (2^{29})	*192.0.0.0*	*223.255.255.255*	*255.255.255.0*	*/24*
Class D (multicast)	1110	not defined	not defined	not defined	not defined	268,435,456 (2^{28})	*224.0.0.0*	*239.255.255.255*	not defined	/4[7]
Class E (reserved)	1111	not defined	not defined	not defined	not defined	268,435,456 (2^{28})	*240.0.0.0*	*255.255.255.255*[b]	not defined	not defined

CLASSLESS ROUTING

Classless Inter-Domain Routing (CIDR) is a method for allocating IP addresses and for IP routing. The Internet Engineering Task Force introduced CIDR in 1993 to replace the previous classful network addressing architecture on the Internet

CIDR NOTATION

CIDR notation is a compact representation of an IP address and its associated network mask. The notation was invented by Phil Karn in the 1980 CIDR notation specifies an `IP address`, a slash (`'/'`) character, and a decimal number.

The decimal number is the count of consecutive leading 1-bits (from left to right) in the network mask. The number can also be thought of as the width (in bits) of the network prefix.

EXAMPLE

For example:

198.51.100.14/24 represents the IPv4 address 198.51.100.14 and its associated network prefix 198.51.100.0, or equivalently, its `subnet mask 255.255.255.0`, which has `24 leading 1-bits`.

SUBNET MASK

A subnet mask is a `bitmask` that encodes the prefix length associated with an IPv4 address or network in quad-dotted notation: 32 bits, starting with a number of 1-bits equal to the prefix length, ending with 0-bits, and encoded in four-part dotted-decimal format: `255.255.255.0`.

IANA

The Internet Assigned Numbers Authority (IANA) issues to regional Internet registries (RIRs) large, short-prefix CIDR blocks. However, a /8 (with over sixteen million addresses) is the largest block IANA will allocate

CIDR BLOCKS

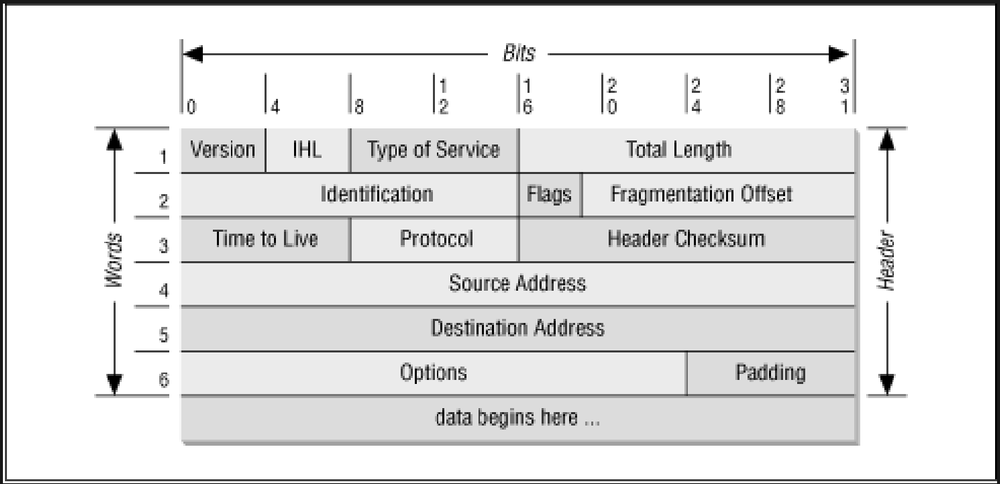
Address format	Difference to last address	Mask	Addresses		Relative to class A, B, C	Restrictions on *a*, *b*, *c* and *d* (0..255 unless noted)	Typical use
			Decimal	2^n			
a.b.c.d/32	*+0.0.0.0*	*255.255.255.255*	1	2^0	$^1/_{256}$ C		Host route
a.b.c.d/31	*+0.0.0.1*	*255.255.255.254*	2	2^1	$^1/_{128}$ C	$d = 0 \dots (2n) \dots 254$	Point-to-point links (RFC 3021)
a.b.c.d/30	*+0.0.0.3*	*255.255.255.252*	4	2^2	$^1/_{64}$ C	$d = 0 \dots (4n) \dots 252$	Point-to-point links (glue network)
a.b.c.d/29	*+0.0.0.7*	*255.255.255.248*	8	2^3	$^1/_{32}$ C	$d = 0 \dots (8n) \dots 248$	Smallest multi-host network
a.b.c.d/28	*+0.0.0.15*	*255.255.255.240*	16	2^4	$^1/_{16}$ C	$d = 0 \dots (16n) \dots 240$	Small LAN
a.b.c.d/27	*+0.0.0.31*	*255.255.255.224*	32	2^5	$^1/_8$ C	$d = 0 \dots (32n) \dots 224$	
a.b.c.d/26	*+0.0.0.63*	*255.255.255.192*	64	2^6	$^1/_4$ C	$d = 0, 64, 128, 192$	
a.b.c.d/25	*+0.0.0.127*	*255.255.255.128*	128	2^7	$^1/_2$ C	$d = 0, 128$	Large LAN
a.b.c.0/24	*+0.0.0.255*	*255.255.255.0*	256	2^8	1 C		
a.b.c.0/23	*+0.0.1.255*	*255.255.254.0*	512	2^9	2 C	$c = 0 \dots (2n) \dots 254$	
a.b.c.0/22	*+0.0.3.255*	*255.255.252.0*	1,024	2^{10}	4 C	$c = 0 \dots (4n) \dots 252$	Small business
a.b.c.0/21	*+0.0.7.255*	*255.255.248.0*	2,048	2^{11}	8 C	$c = 0 \dots (8n) \dots 248$	Small ISP/ large business
a.b.c.0/20	*+0.0.15.255*	*255.255.240.0*	4,096	2^{12}	16 C	$c = 0 \dots (16n) \dots 240$	
a.b.c.0/19	*+0.0.31.255*	*255.255.224.0*	8,192	2^{13}	32 C	$c = 0 \dots (32n) \dots 224$	ISP/ large business
a.b.c.0/18	*+0.0.63.255*	*255.255.192.0*	16,384	2^{14}	64 C	$c = 0, 64, 128, 192$	
a.b.c.0/17	*+0.0.127.255*	*255.255.128.0*	32,768	2^{15}	128 C	$c = 0, 128$	

PRIVATE NETWORK BLOCKS

RFC 1918 name	IP address range	Number of addresses	Largest CIDR block (subnet mask)	Host ID size	Mask bits	*Classful* description[Note 1]
24-bit block	10.0.0.0 – 10.255.255.255	16 777 216	10.0.0.0/8 (255.0.0.0)	24 bits	8 bits	single class A network
20-bit block	172.16.0.0 – 172.31.255.255	1 048 576	172.16.0.0/12 (255.240.0.0)	20 bits	12 bits	16 contiguous class B networks
16-bit block	192.168.0.0 – 192.168.255.255	65 536	192.168.0.0/16 (255.255.0.0)	16 bits	16 bits	256 contiguous class C networks

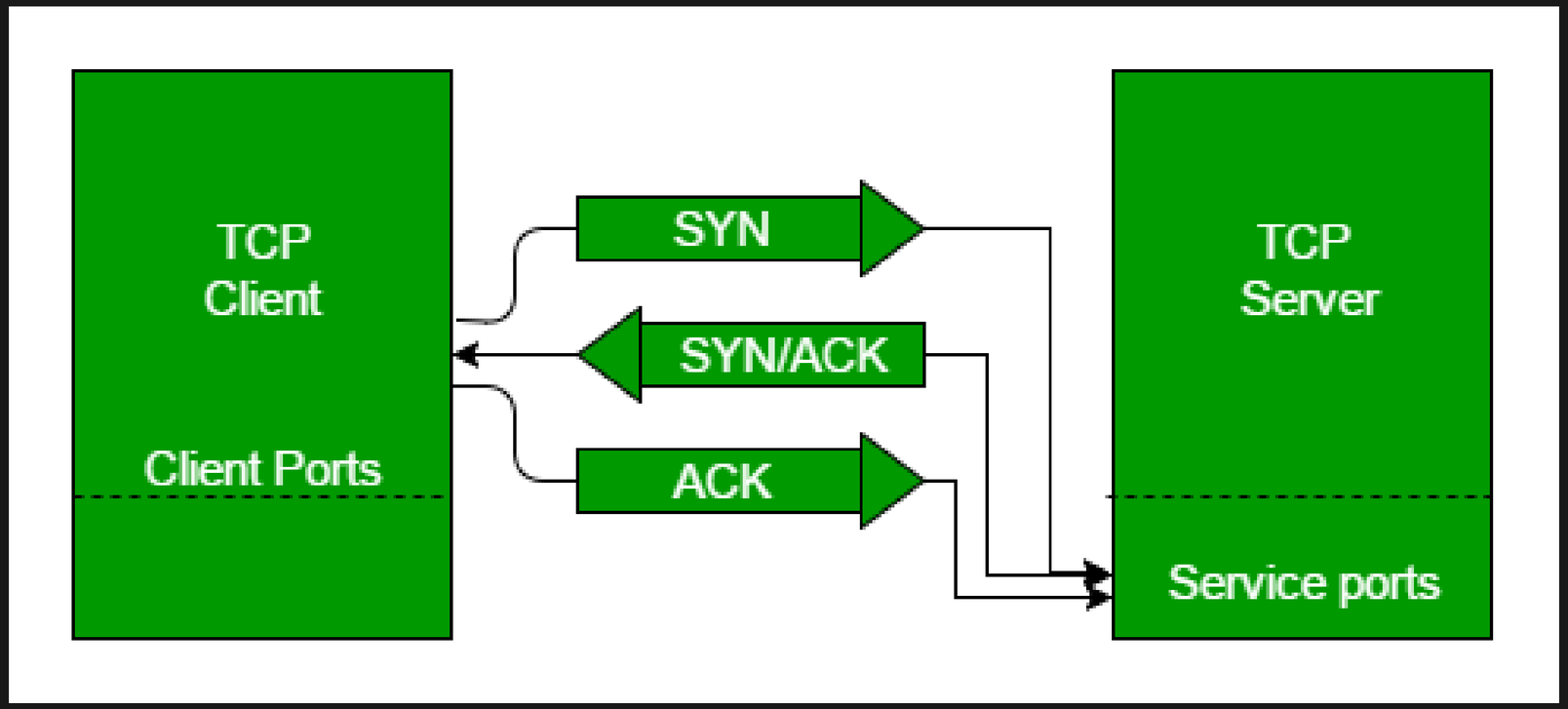
TCP/IP

IP HEADER



The ip header has an header checksum that will ensure that the packet header is correctly formed. This will avoid for example “spoofing” pratices(different IP adress of the sender)

PROTOCOL HANDSHAKE



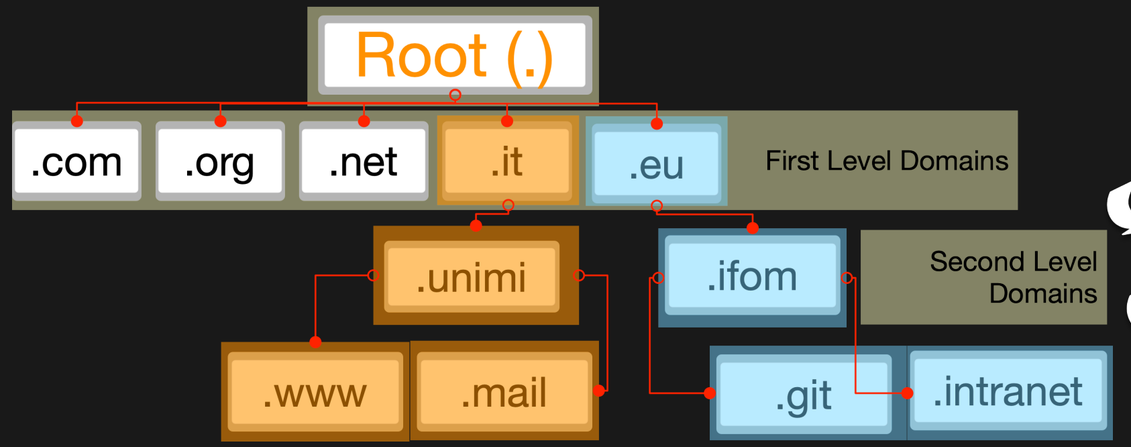
The ending of the handshake will result in a properly crafted connection on a server designed port.

DNS

DNS

The Domain Name System (DNS) is the phonebook of the Internet. Humans access information online through domain names, like ifom.eu or unimi.it. Web browsers interact through Internet Protocol (IP) addresses. DNS translates domain names to IP addresses so browsers can load Internet resources.

DOMAIN TREE



How dns server hierarchy work

Tell me the ip of **git.ifom.eu**

Ask dns server root **(.)** for **.EU**

Ask dns server **.eu** for **.ifom**

Ask dns server **.ifom** for **.git**

host git.ifom.eu has address 85.239.163.68