مرکز آموزش نیـــرا سیستم

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Computer Network

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Introduction

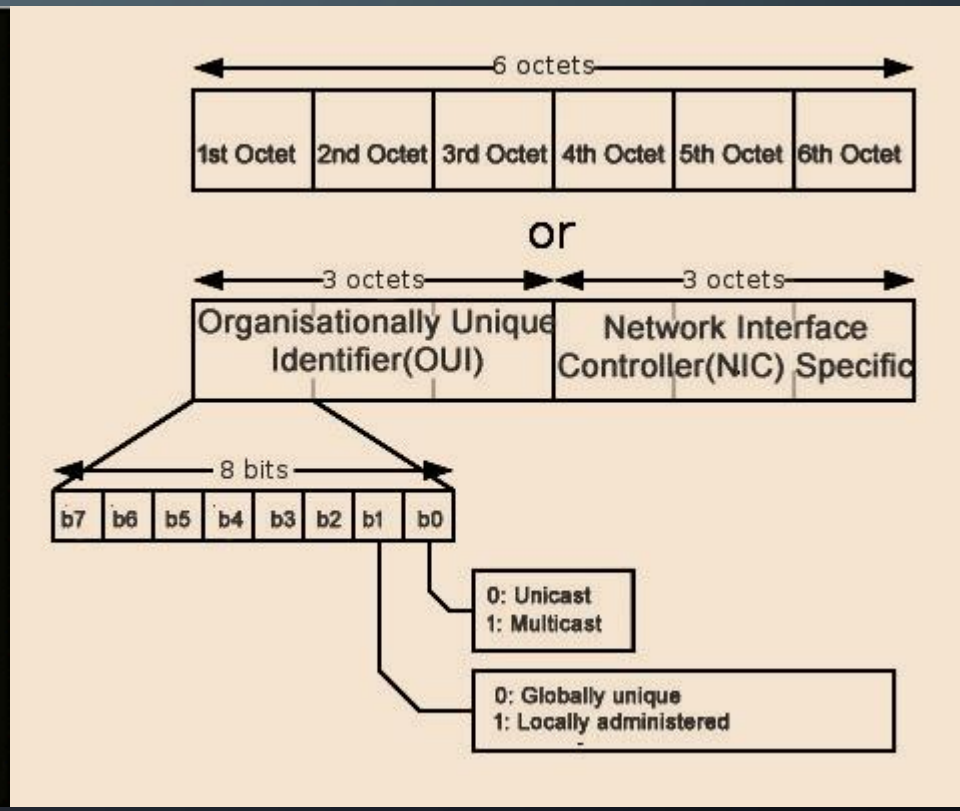
- A computer network is a collection of interconnected devices that communicate and share resources.
- These networks can range from simple home networks to complex enterprise networks, facilitating the exchange of data, enabling communication, and providing access to shared resources like files, printers, and internet connections.
- Computer networks are fundamental to modern computing, supporting a wide range of applications from web browsing to cloud computing.

MAC Address

- A Media Access Control (MAC) address is a unique identifier assigned to network interfaces for communications at the data link layer of a network segment.
- It is a 48-bit address usually represented in hexadecimal format (e.g., 00:1A:2B:3C:4D:5E).
- MAC addresses are used for directing data to the correct physical device on a local network.

MAC Address

```
[root@aimsit ~]# ifconfig
eth0      Link encap:Ethernet  HWaddr 00:1C:C4:21:25:63
          inet addr:192.168.1.10  Bcast:192.168.1.255  Mask:255.255.255.0
          inet6 addr: fe80::21c:c4ff:fe21:2563/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:8772654 errors:0 dropped:0 overruns:0 frame:0
          TX packets:2577871 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:2153470542 (2.0 GiB)  TX bytes:680636817 (649.1 MiB)
          Interrupt:16 Base address:0x6000

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          inet6 addr: ::1/128 Scope:Host
          UP LOOPBACK RUNNING  MTU:16436  Metric:1
          RX packets:2048 errors:0 dropped:0 overruns:0 frame:0
          TX packets:2048 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:1660245 (1.5 MiB)  TX bytes:1660245 (1.5 MiB)

virbr0    Link encap:Ethernet  HWaddr 00:00:00:00:00:00
          inet addr:192.168.122.1  Bcast:192.168.122.255  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
```

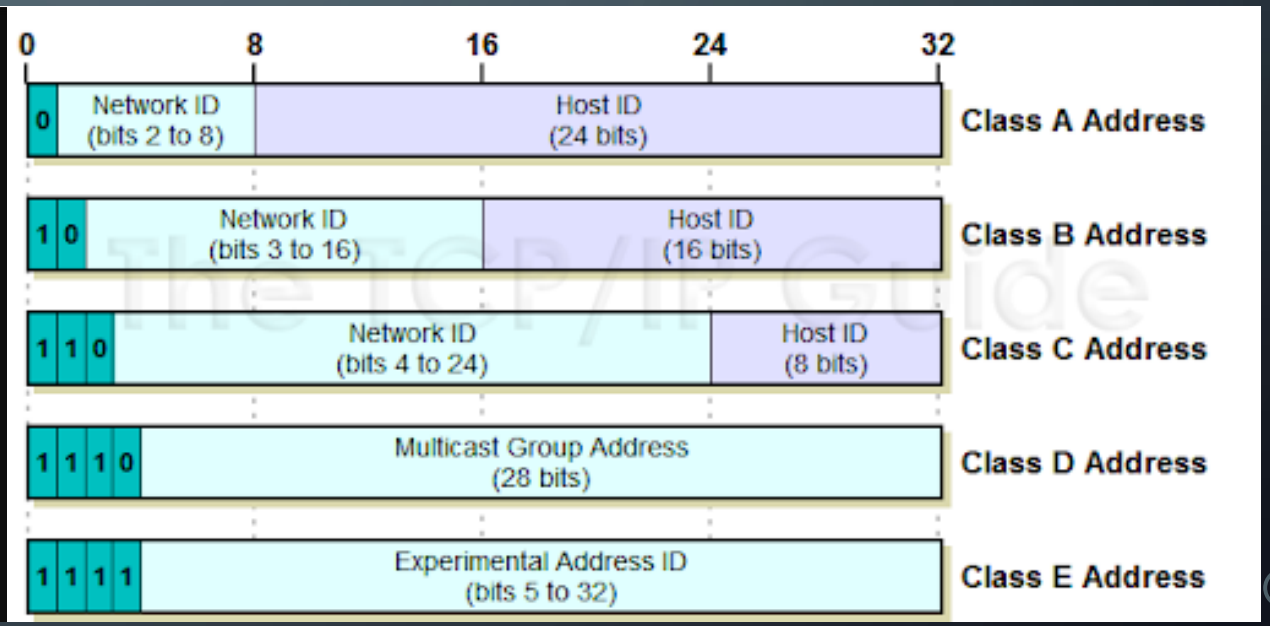


IP Address

- An Internet Protocol (IP) address is a numerical label assigned to each device connected to a computer network that uses the IP for communication.
- IP addresses serve two main purposes:
  - identifying the host or network interface
  - providing the location of the host in the network.
- IP addresses are of two types:
  - **IPv4**: 32-bit address written as four octets (e.g., 192.168.1.1).
  - **IPv6**: 128-bit address written as eight groups of four hexadecimal digits (e.g., 2001:0db8:85a3:0000:0000:8a2e:0370:7334).

IP Address

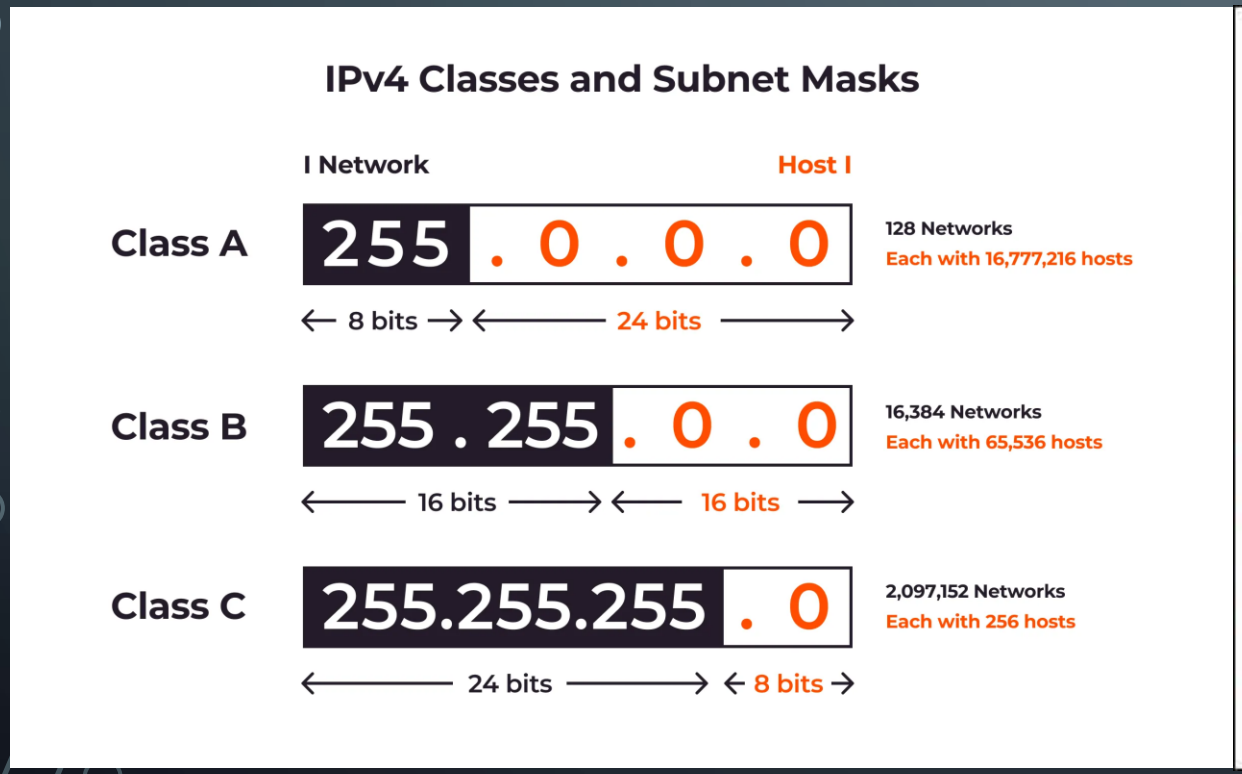
```
C:\Users\Ksound>ipconfig

Windows IP Configuration


Ethernet adapter Ethernet:

   Media State . . . . . . . . . . . : Media disconnected
   Connection-specific DNS Suffix  . :

Wireless LAN adapter Wi-Fi:

   Connection-specific DNS Suffix  . :
   Link-local IPv6 Address . . . . . : fe80::b1f2:1a0d:4394:56aa%5
   IPv4 Address. . . . . . . . . . . : 192.168.0.100
   Subnet Mask . . . . . . . . . . . : 255.255.255.0
   Default Gateway . . . . . . . . . : 192.168.0.1
```



Subnet Mask

- A subnet mask is a 32-bit number used in IPv4 addresses to divide the IP address into network and host portions.
- It helps in defining the range of IP addresses within a subnet.
- A subnet mask works in conjunction with an IP address to determine which part of the address denotes the network and which part denotes the host.
- For example, a subnet mask of 255.255.255.0 applied to an IP address of 192.168.1.10 indicates that the first three octets (192.168.1) are the network part, and the last octet (10) is the host part.

Subnet Mask



Subnet Mask

Suffix	Hosts	32-Borrowed=CIDR	2^Borrowed = Hosts	Binary=> dec = Suffix
.255	1	/32	0	11111111
.254	2	/31	1	11111110
.252	4	/30	2	11111100
.248	8	/29	3	11111000
.240	16	/28	4	11110000
.224	32	/27	5	11100000
.192	64	/26	6	11000000
.128	128	/25	7	10000000

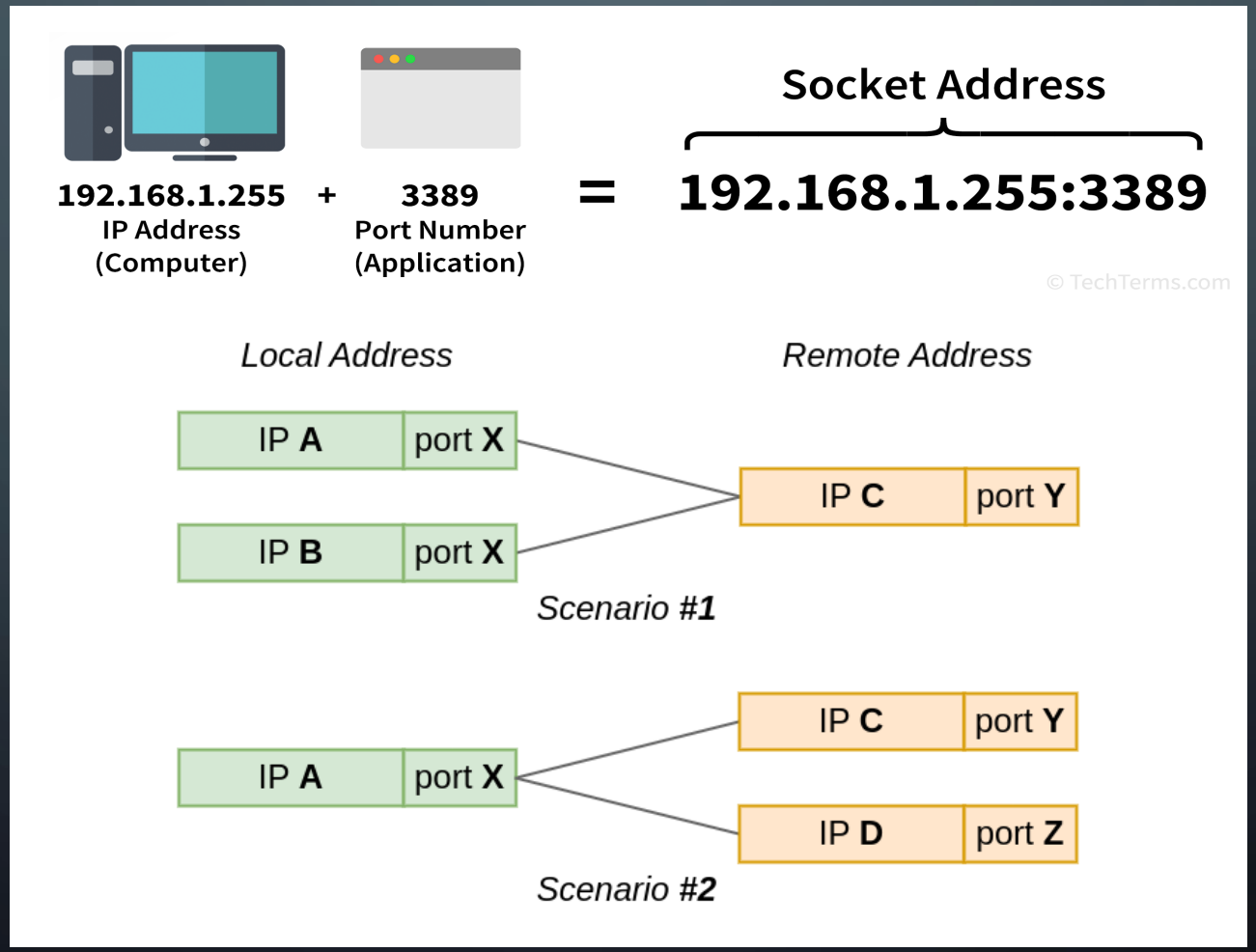
Gateway

- A gateway is a network node that serves as an access point to another network, often used to connect different network architectures and protocols.
- In a typical home or small business network, the gateway is usually a router that connects the local network to the internet.
- The default gateway is the device that routes traffic from a local network to destinations outside the subnet.

Socket Port

- A socket port is an endpoint in network communication, associated with an IP address and a protocol.
- Ports are used to identify specific processes or services on a device, with the combination of an IP address and port number forming a socket.
- Ports are categorized into three ranges:
  - **Well-Known Ports**: 0 to 1023, reserved for common services like HTTP (port 80) and FTP (port 21).
  - **Registered Ports**: 1024 to 49151, assigned by IANA for specific services.
  - **Dynamic/Private Ports**: 49152 to 65535, used for temporary or private purpose

Socket Port


Socket Address
192.168.1.255
IP Address
(Computer)
+
3389
Port Number
(Application)
=
192.168.1.255:3389
© TechTerms.com
Local Address
Remote Address
IP A
port X
IP B
port X
IP C
port Y
Scenario #1
IP A
port X
IP C
port Y
IP D
port Z
Scenario #2

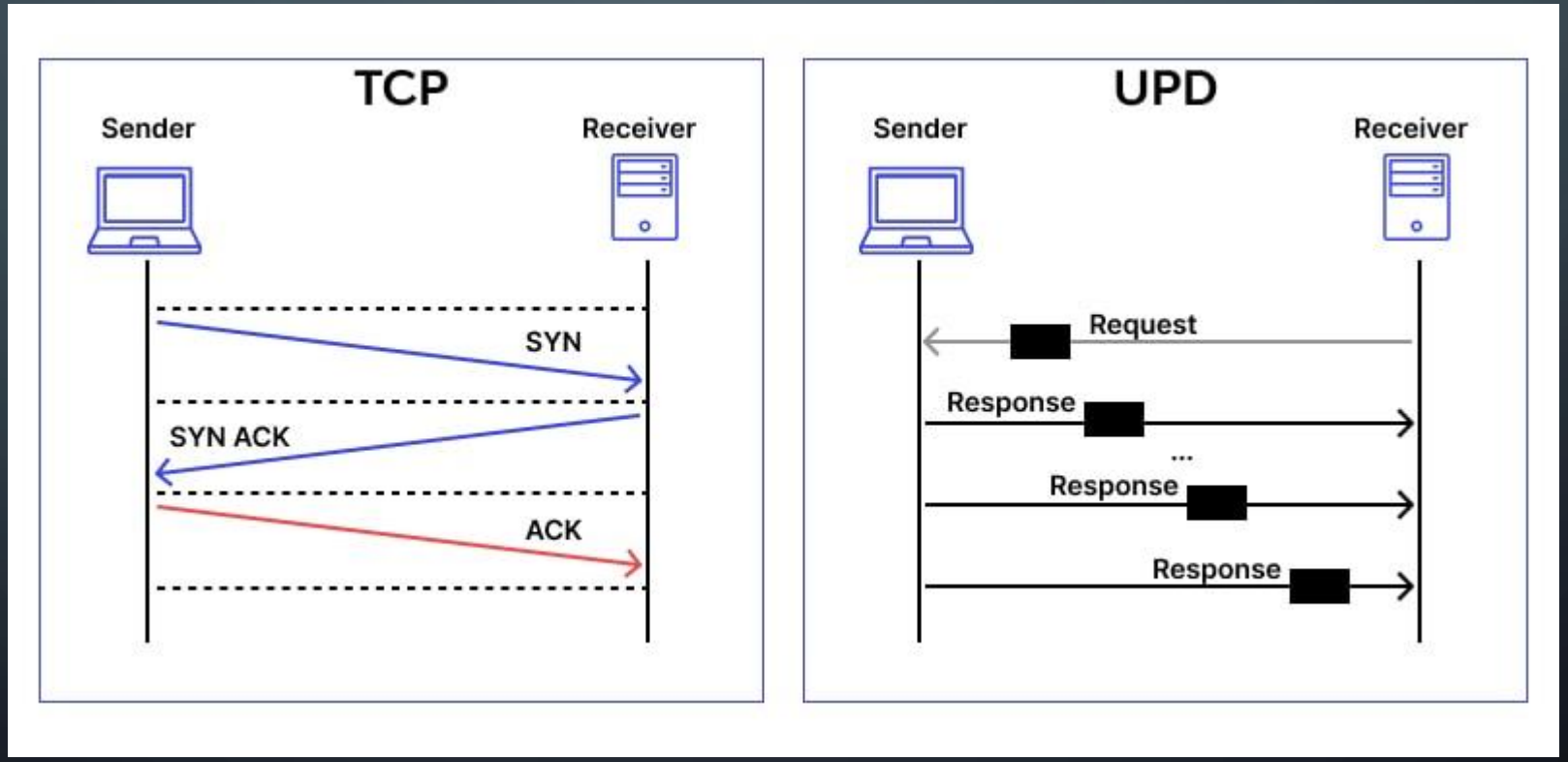
TCP

- The Transmission Control Protocol (TCP) is a core protocol of the internet protocol suite, providing reliable, ordered, and error-checked delivery of data between applications running on hosts communicating via an IP network.
- TCP establishes a connection before data transfer and ensures that data is delivered accurately and in sequence, making it suitable for applications like web browsing, email, and file transfers.

UDP

- The User Datagram Protocol (UDP) is another core protocol of the internet protocol suite, which provides a connectionless and lightweight method of data transmission without guaranteeing delivery or order.
- Unlike TCP, UDP does not establish a connection and does not perform error checking, making it faster but less reliable.
- It is suitable for applications where speed is critical and some data loss is acceptable, such as streaming audio and video, online gaming, and real-time communication.

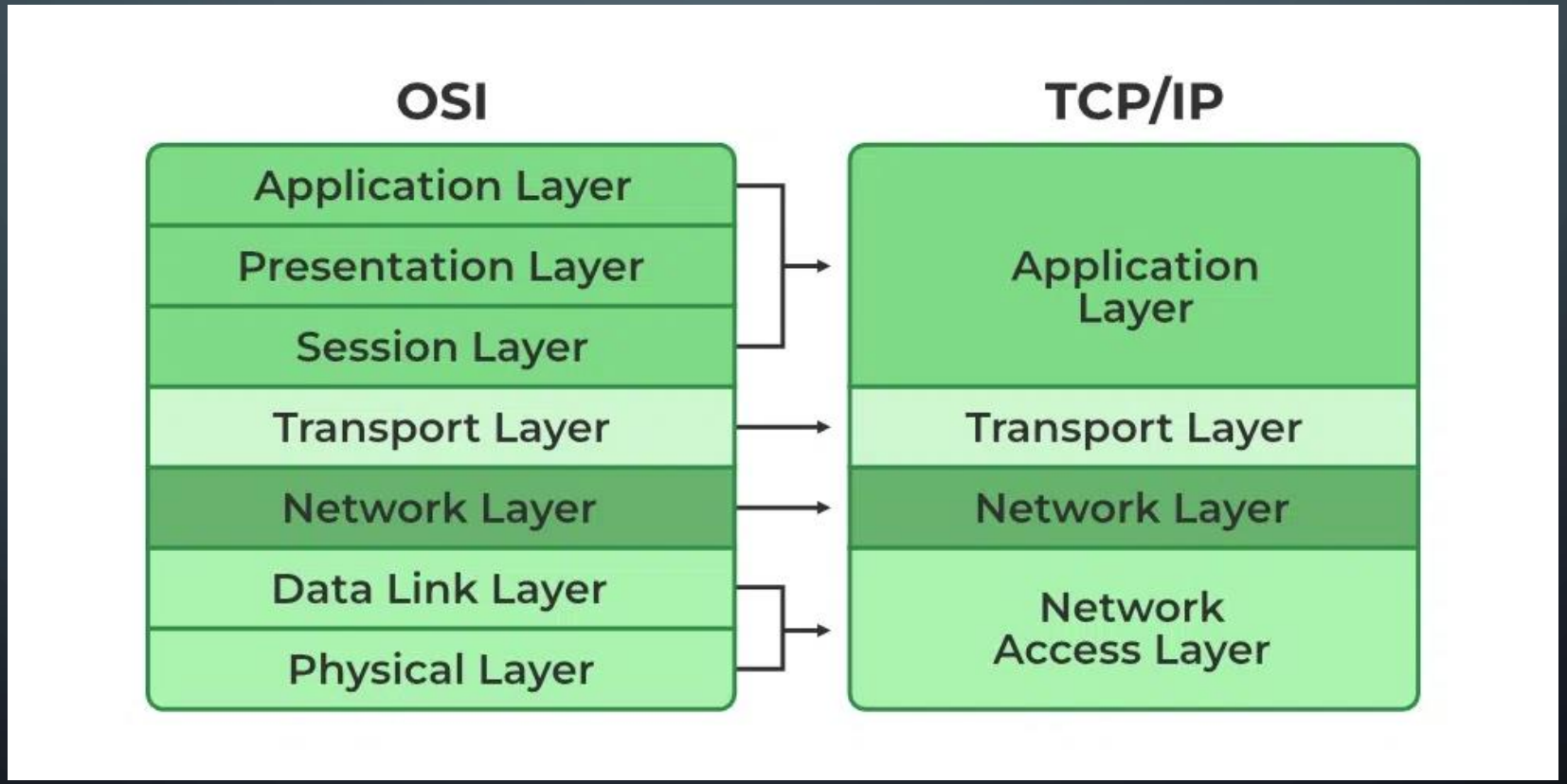
TCP vs. UDP


TCP
Sender
Receiver
SYN
SYN ACK
ACK
UPD
Sender
Receiver
Request
Response
...
Response
Response

HTTP

- The Hypertext Transfer Protocol (HTTP) is an application-layer protocol used for transmitting hypertext documents on the World Wide Web.
- HTTP defines how messages are formatted and transmitted and how web servers and browsers should respond to various commands.
- It uses TCP as its transport protocol, typically over port 80.
- HTTP/1.1 is the most widely used version, though HTTP/2 and HTTP/3 offer improvements in performance and efficiency.
- HTTP is the foundation of data communication on the web, enabling web pages, images, and other resources to be accessed and displayed in browsers.

TCP/IP vs. OSI


OSI
TCP/IP
Application Layer
Presentation Layer
Session Layer
Transport Layer
Network Layer
Data Link Layer
Physical Layer
Application Layer
Transport Layer
Network Layer
Network Access Layer