

OSI LAYERS

Computer Networks

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Outline

1 OSI Model

- The Physical Layer
- The Data Link Layer
- The Network Layer
- The Transport Layer
- The Application Layer



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OSI Layers & Protocols

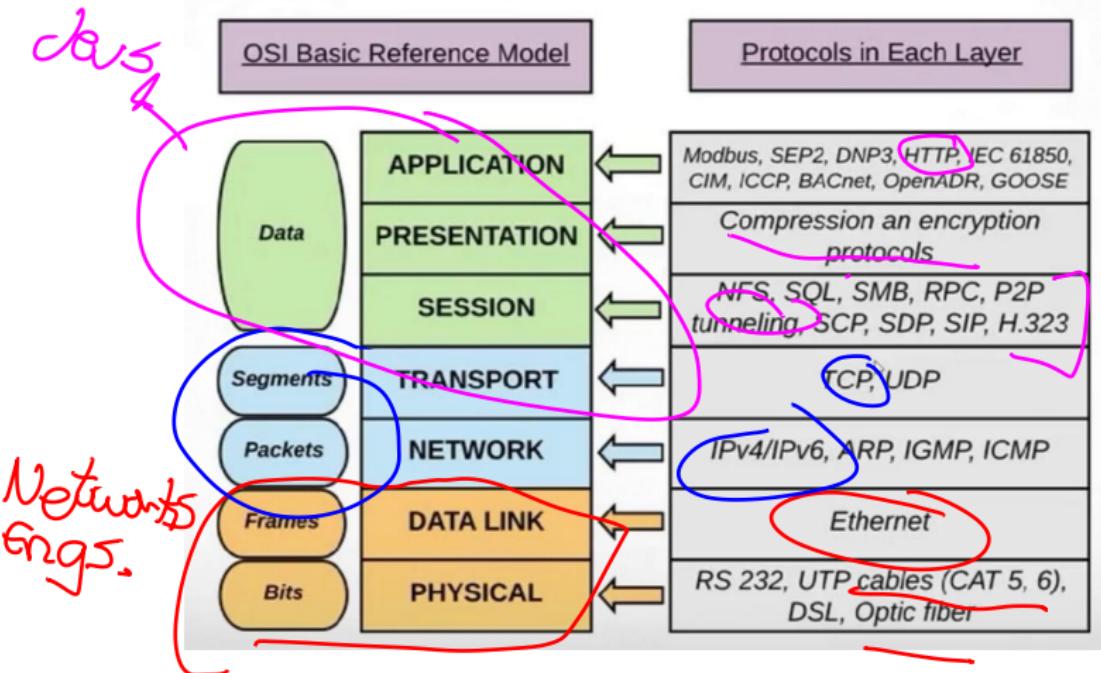


Figure: ISO Layers



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Moving Bits Across the Wire

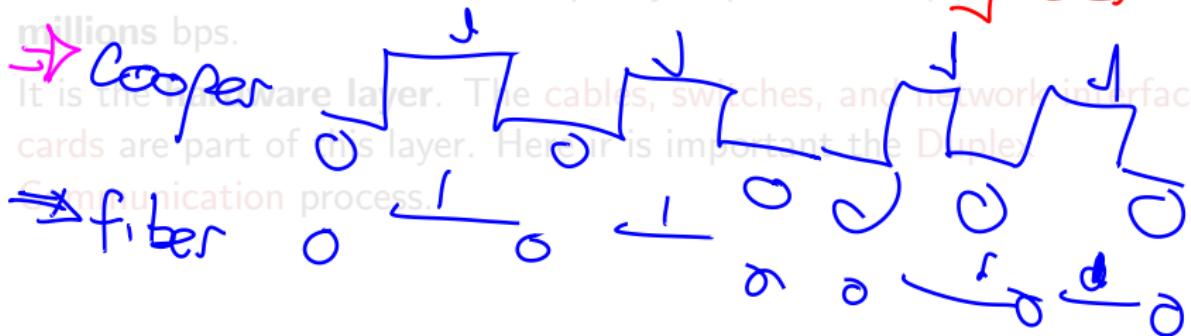
- **Physical Layer** is the **first layer** of the *OSI model*.
- It is responsible for moving **bits** across the wire.
- It defines the **electrical and physical specifications** of the data connection. Here **modulation** is pretty important, helps to move **10 millions bps**.
- It is the **hardware layer**. The **cables, switches, and network interface cards** are part of this layer. Here it is important the **Duplex Communication** process.



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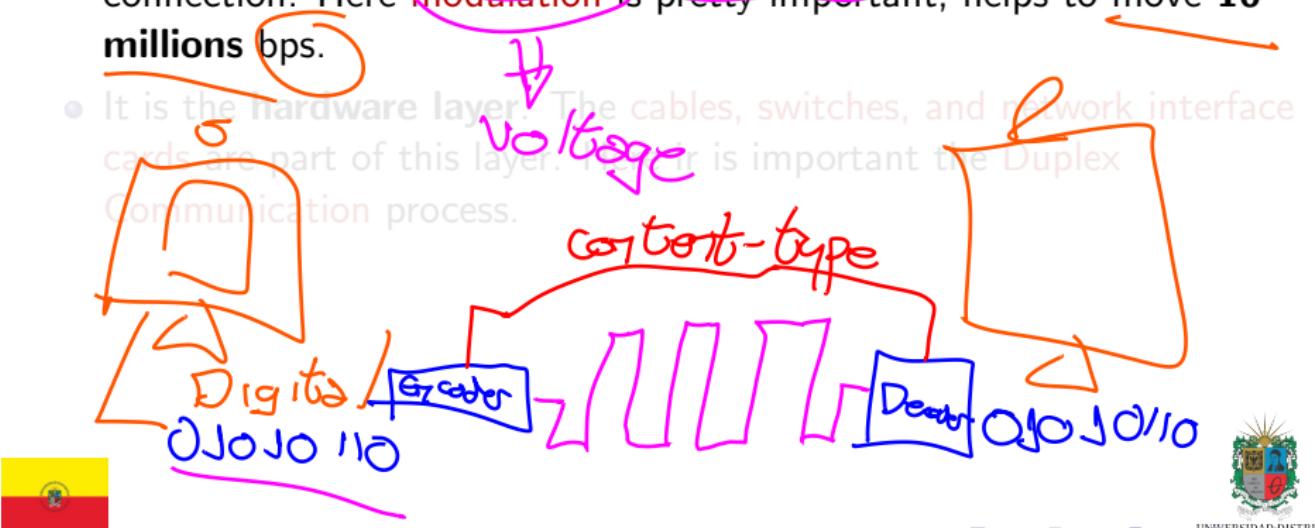
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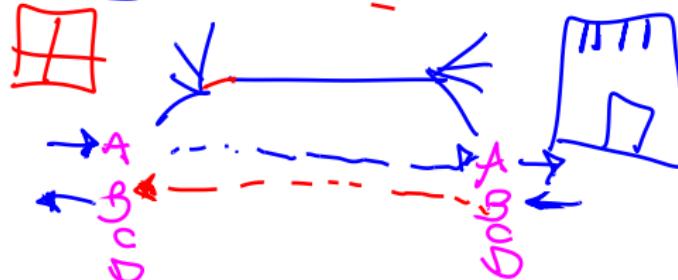


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Networks Ports and Patch Panels

Box 17
Cable - ISP Port

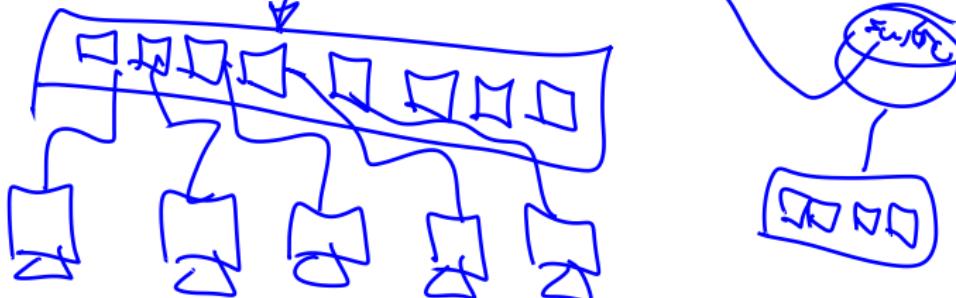
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Networks Ports and Patch Panels

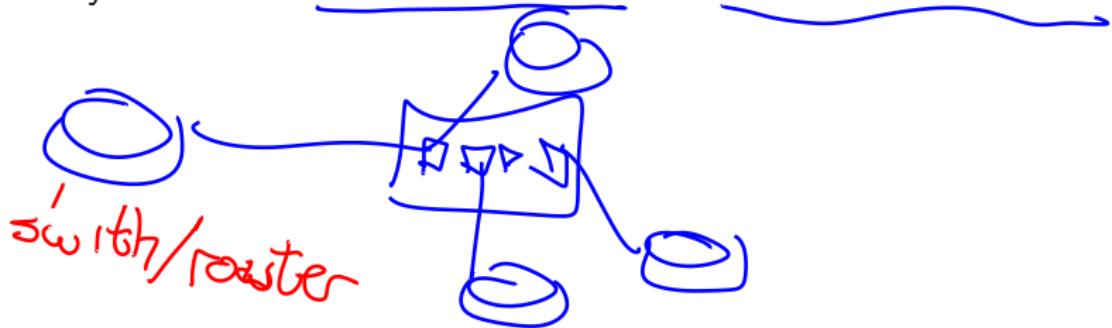


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Cabling Tools

- Crimping Tool is used to attach ~~connectors to the end of a cable.~~

- Cable Tester is used to verify that the cable is properly connected.

- Tone Generator is used to trace cables. It sends a signal through the cable.



- Punch Down Tool is used to terminate cables on patch panels.

- Loopback Plug is used to test network ports. It sends a signal back to the device.



- Network Analyzer is used to monitor network traffic. It captures and analyzes packets.

- Network Tap is used to capture network traffic. It copies the data to another device.



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- Note: Quality, speed*



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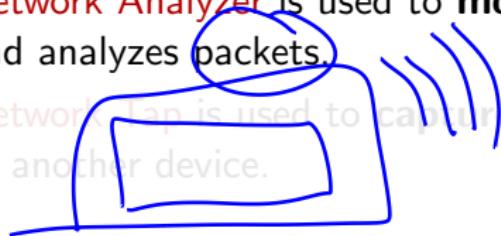
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Ethernet and MAC Addresses

• **Data Link Layer** is the **second layer** of the *OSI model*.

- It is responsible for framing and error detection.
- It defines the logical link control and media access control.
- It is a **software layer**. The Ethernet protocol (1908s) is part of this layer.
- **MAC Addresses** are **unique identifiers** assigned to network interfaces. It is a **48-bit** (six groups of two hexadecimal) number.
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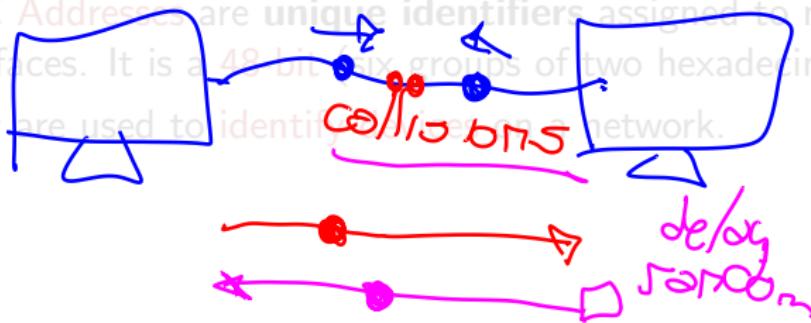
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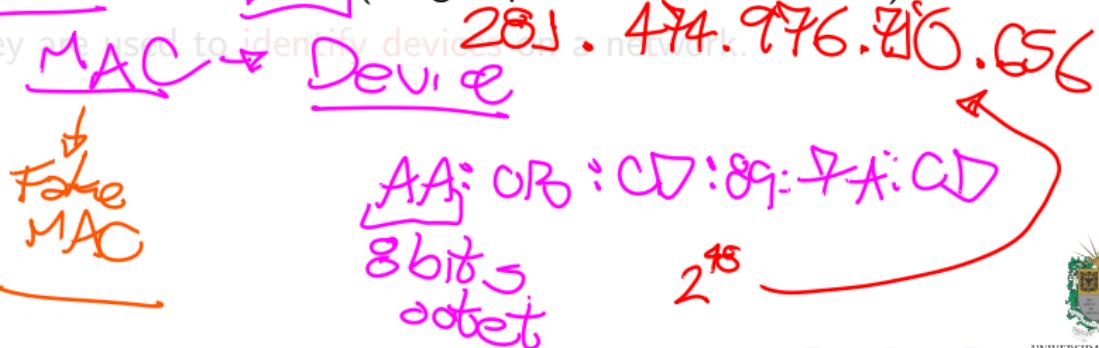
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MAC Address Structure



Figure: MAC Address Structure

OSIAADF ~ 000000
000001
000002



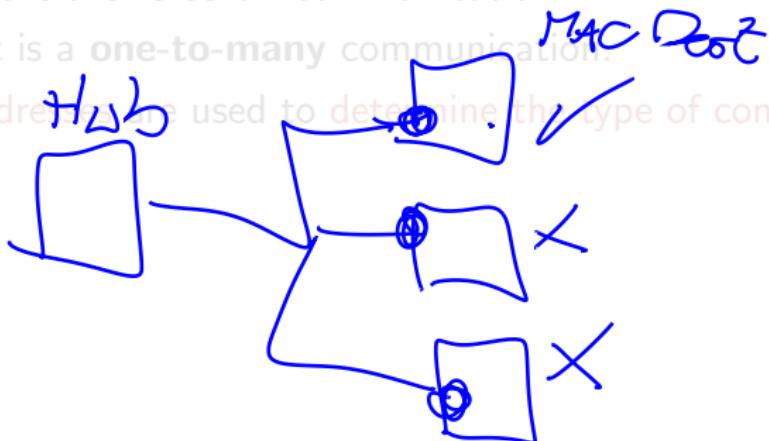
Unicast, Broadcast, and Multicast

- Unicast is a **one-to-one** communication.
- Broadcast is a **one-to-all** communication.
- Multicast is a **one-to-many** communication.
- MAC Addresses are used to determine the type of communication.



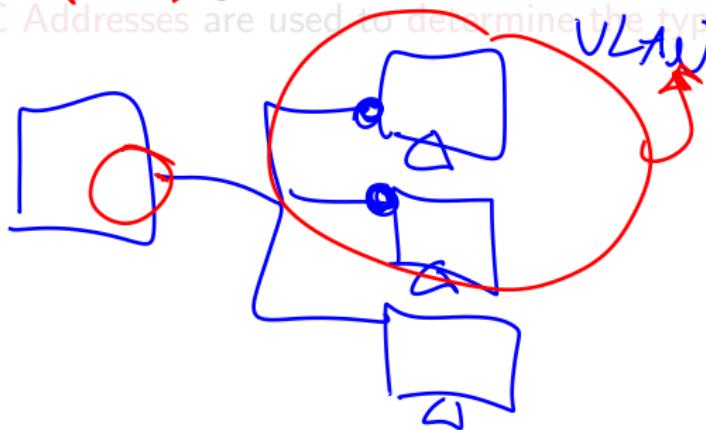
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Ethernet Frames

- **Ethernet Frames** are the **data packets** used in **Ethernet** networks.
 - They contain the **source and destination MAC addresses**.
 - They also contain the **type of data** and the **data payload**.
 - They are used to transfer data between devices on a network.

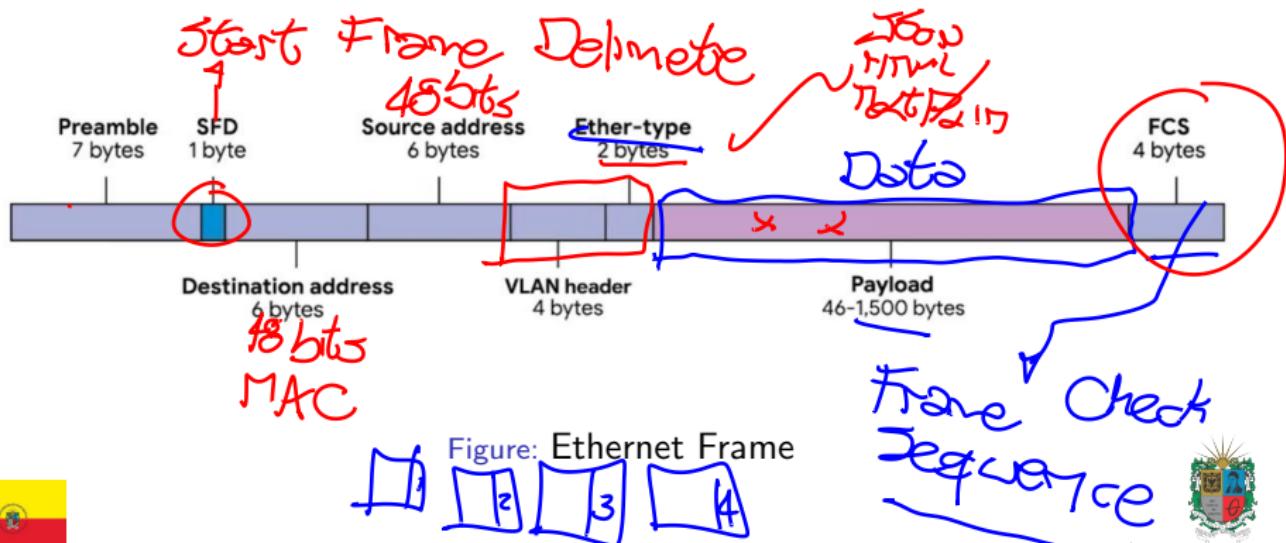


Figure: Ethernet Frame



Avoiding Data Corruption

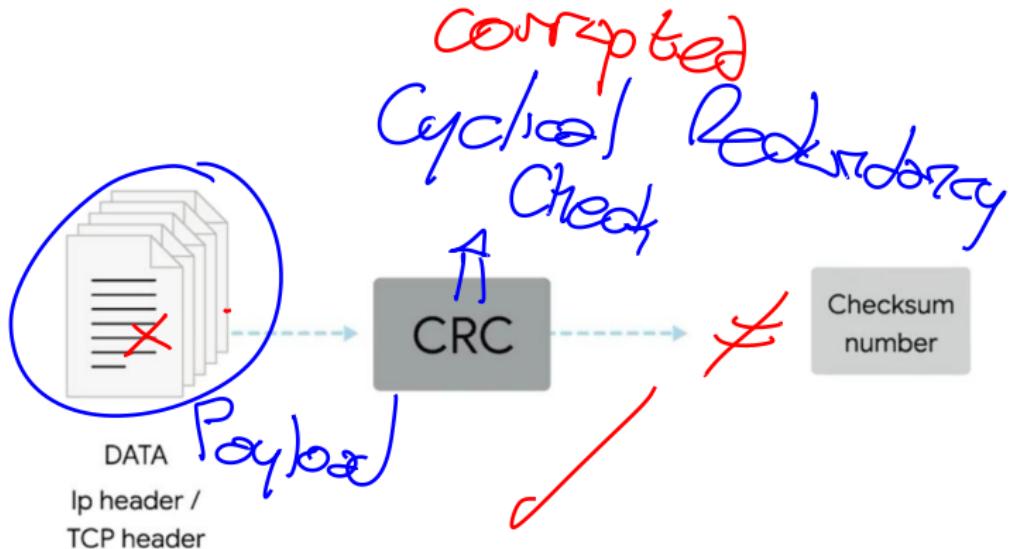


Figure: Checksum Validation



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IPv4 Addresses and Addresses Classes

- Network Layer is the **third layer** of the *OSI model*.
- It is responsible for **routing** and addressing.
- It defines the **logical addressing** and **path determination**.
- It is a **software layer**. The IP protocol is part of this layer.
- IPv4 Addresses are **32-bit numbers** used to identify devices on a network.
- They are divided into **classes** based on the **network size**.



IPv4 Addresses and Addresses Classes

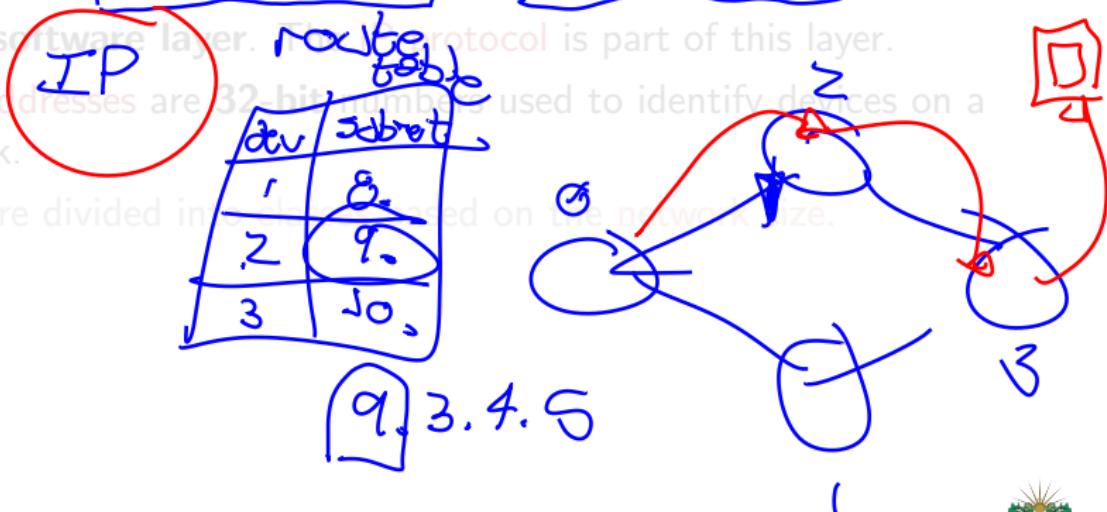
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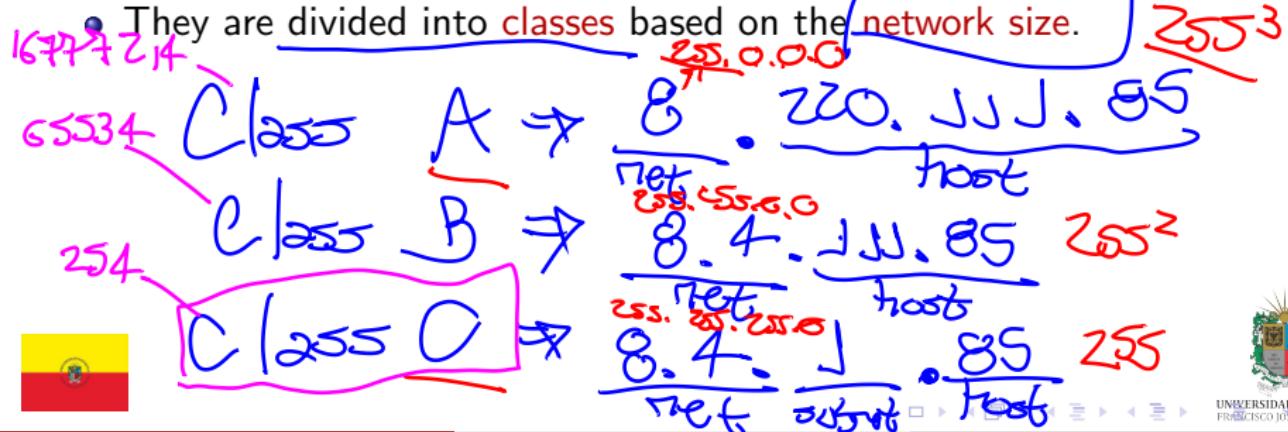
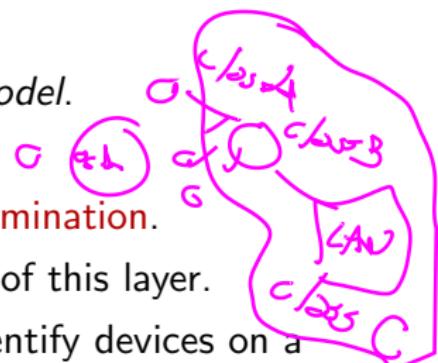
2³²
8 bits. E.g. 8.8.8.8

0-255.0-255.0-255.0-255



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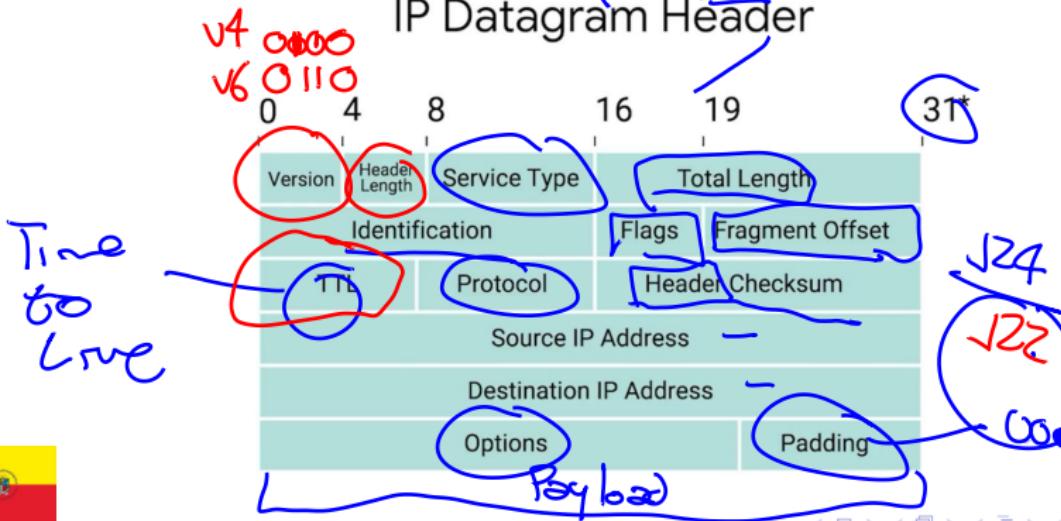


IPv4 Datagram

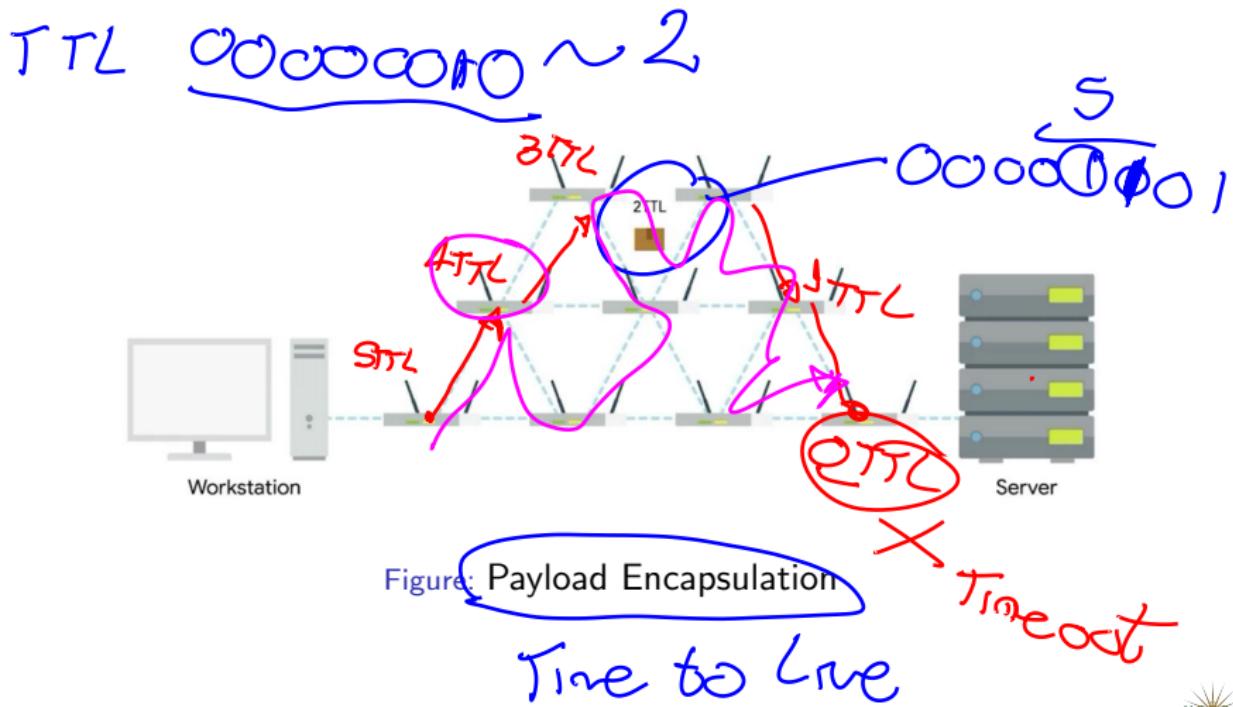
- **IPv4 Datagram** is the **data packet** used in **IP** networks.
 - It contains the source and destination IP addresses.
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 - It is used to **transfer data** between devices on a network.

IP
Ethernet

IP Datagram Header



Time To Live



Encapsulation

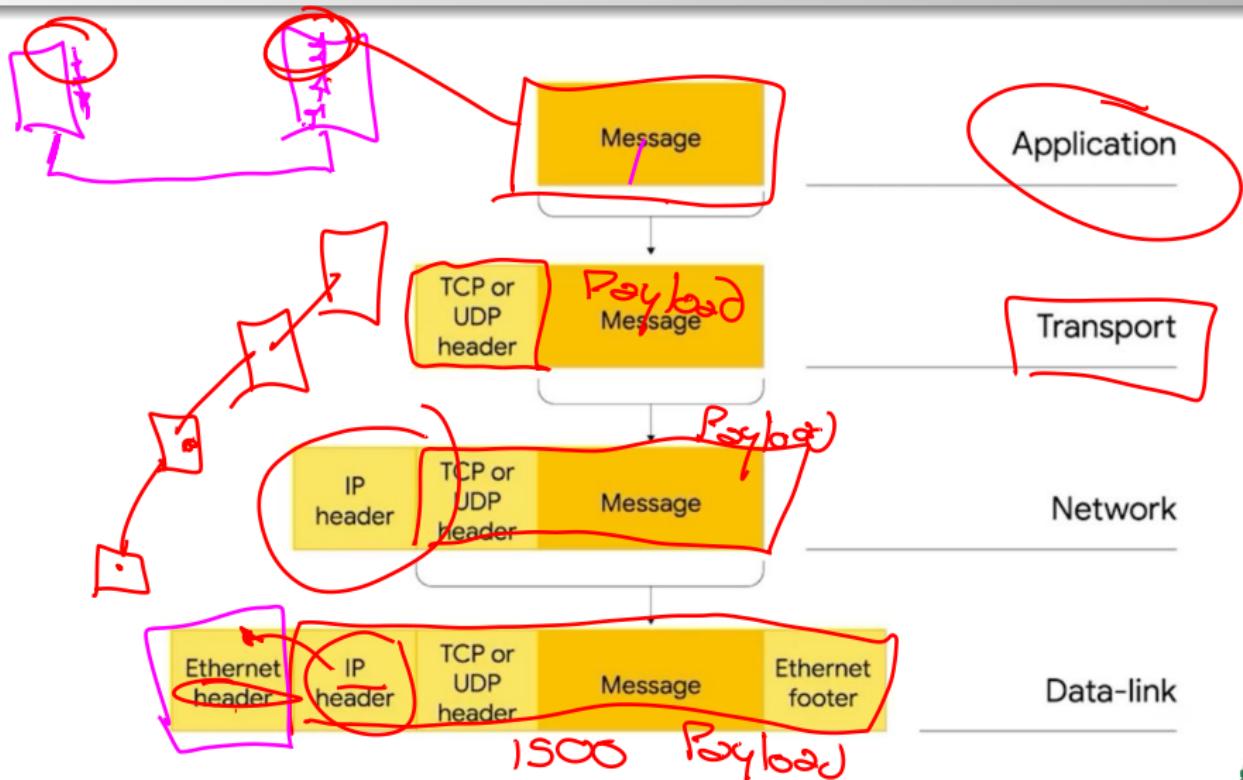
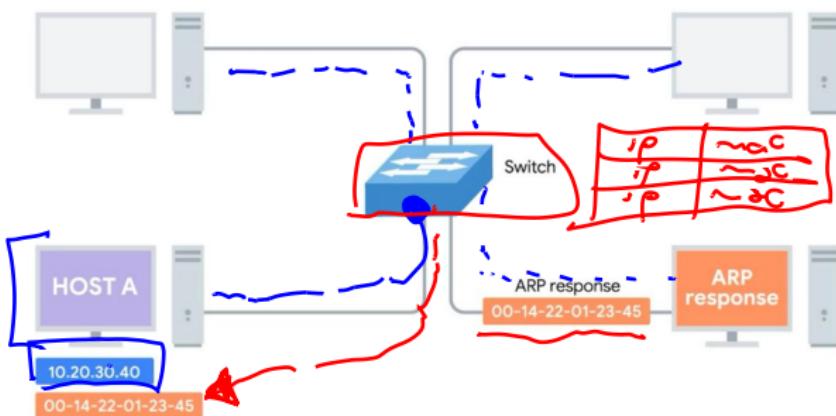


Figure: Time To Live Counter



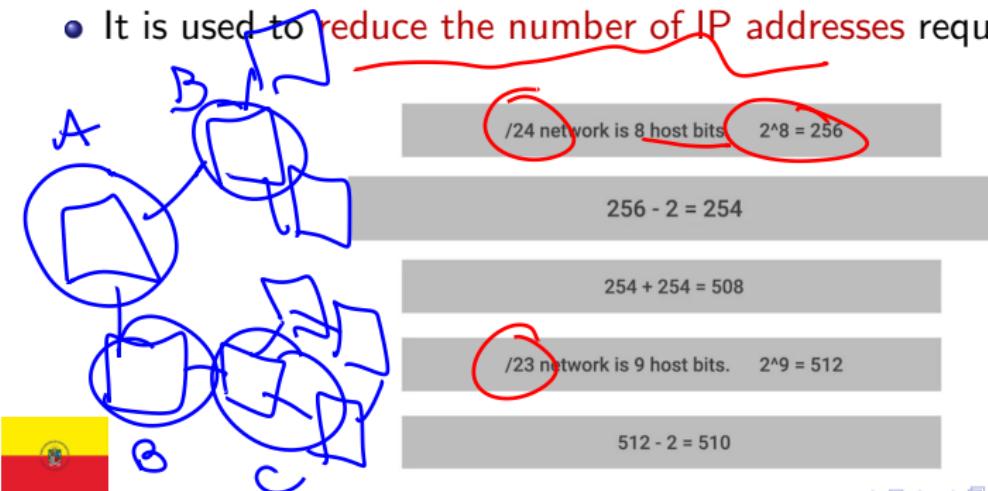
Address Resolution Protocol (ARP)

- Address Resolution Protocol (ARP) is used to map IP addresses to MAC addresses.
- It is used to resolve IP addresses to physical addresses, using ARP table or ARP cache.



Subnetting and CIDR

- Subnetting is the process of dividing a network into smaller subnets. $IP_A \Rightarrow IP_B \Rightarrow IP_C$
- It is used to reduce network congestion and improve network performance.
- CIDR (stands for ClassLess InterDomain Routing) is a subnetting technique that uses a prefix length to define the subnet.
- It is used to reduce the number of IP addresses required for a network.



Routing and Routers

- **Routing** is the process of **determining the best path** for data to travel on a network.
- It is used to forward data packets between devices on a network.
- Routers are devices that are used to route data between networks.
- They are used to connect different networks together.



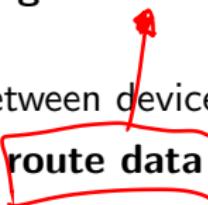
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TCP Segment

- **Transport Layer** is the **fourth layer** of the *OSI model*.
- It is responsible for end-to-end **communication** and **error recovery**.
- It defines the **connection-oriented** and **reliable** data transfer.
- It is a **software layer**. The TCP protocol is part of this layer.
- **TCP Segment** is the **data packet** used in TCP networks.
- It contains the **source and destination port numbers**.
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TCP Control Flags

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- They are used to **establish** and **terminate** connections.
- They are used to **acknowledge** data and **control the flow of data**.



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 - It is used to establish a **connection** between devices.
 - It is used to guarantee the **delivery** of data.
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 - It is used to send data without establishing a connection.
 - It is used when **speed** is more important than **reliability**.



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- They are used to **filter traffic** based on **rules** and **policies**.
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1 OSI Model

- The Physical Layer
- The Data Link Layer
- The Network Layer
- The Transport Layer
- The Application Layer



Application Layer Protocols

- **Application Layer** is the **fifth layer** of the *OSI model*.
- It is responsible for user interfaces and application services.
- It defines the **protocols** used by applications to communicate over the network.
- It is the **software layer**. The **HTTP protocol** is part of this layer.



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All the Layers Together

#	Layer Name	Protocol	Protocol Data Unit	Addressing
5	Application	HTTP, SMTP, etc...	Messages	n/a
4	Transport	TCP/UDP	Segment	Port #'s
3	Network	IP	Packet / Datagram	IP Address
2	Data Link	Ethernet, Wi-Fi	Frames	MAC Address
1	Physical	n/a	Bits	n/a

Figure: All the Layers working in Unison



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Thanks!

Questions?



Repo:

 github.com/engandres/ud-public/main/tree/computer-networks



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