Computer Networking

Computer Networks

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Outline

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Basic Concepts of Signals

A signal is a message that is transmitted from one place to another.

- Analog Signals are continuous and can take any value within a range.
- Digital Signals are discrete and can take only a limited number of values.
- Periodic Signals repeat themselves at regular intervals.
- Aperiodic Signals do not repeat themselves.
- Simple Signals are the building blocks of more complex signals.
- Complex Signals are made up of simple signals.
- Composite Signals are made up of simple and complex signals.
- Random Signals are unpredictable.

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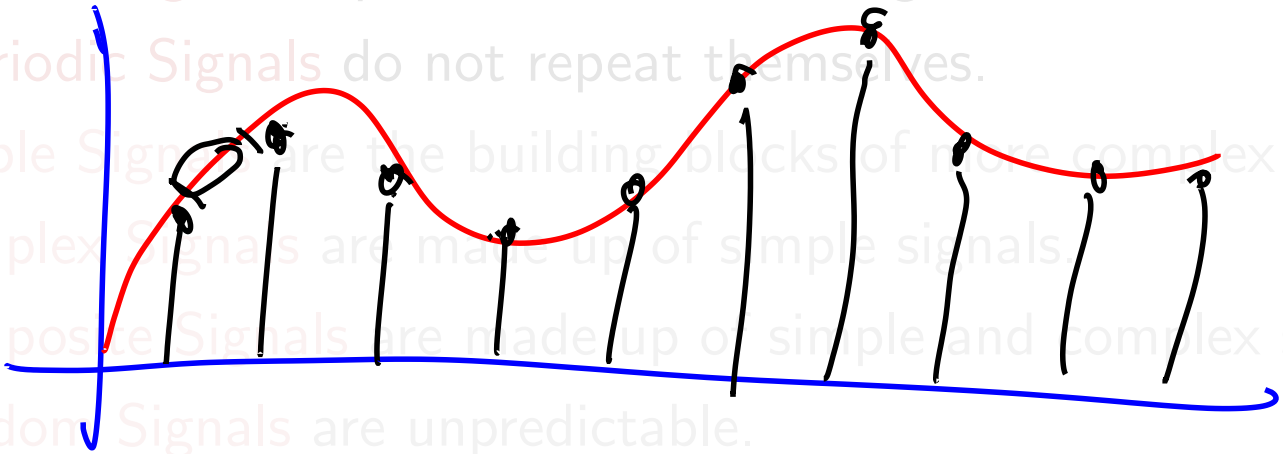

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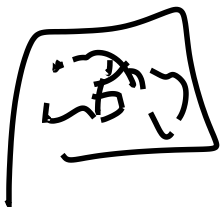

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Networks Signals

In computer networks, signals are used to transmit data from one place to another. Signals can be transmitted through a variety of media, including:

- Copper Wires: Used in telephone lines and Ethernet cables. Digital signals are transmitted as electrical impulses.
- Fiber Optic Cables: Used in high-speed networks. Digital signals are transmitted as light pulses.
- Wireless Signals: Used in Wi-Fi, Bluetooth, and cellular networks. Digital signals are transmitted as radio waves.
- Satellite Signals: Used in satellite communications. Digital signals are transmitted as radio waves.

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Math Representation of Signals

A function of time $f(t)$ can be used to represent a signal, where t is time and $f(t)$ is the value of the signal at time t.
For example, a sinusoidal signal can be represented by the function:

$$f(t) = A\sin(2\pi f t + \phi)$$

where:

- A is the amplitude of the signal,
- f is the frequency of the signal,
- ϕ is the phase of the signal.

This function describes a signal that oscillates between $-A$ and A over time, with a frequency of f cycles per second, and a phase shift of ϕ.

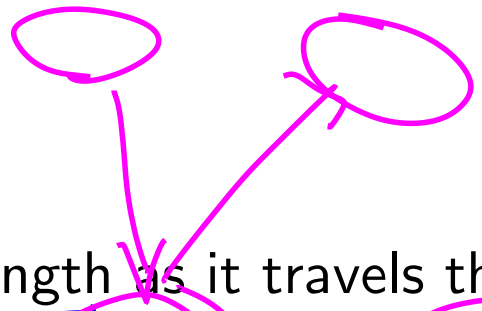
Noise in the Signals

Noise is any unwanted signal that interferes with the transmission of a message.
Noise can be introduced by a variety of sources, including:

- Electrical Interference: Caused by other electrical devices.
- Atmospheric Interference: Caused by weather conditions.
- Physical Interference: Caused by obstacles in the transmission medium.

Noise can be reduced by using error correction codes and error detection codes.

Transmission Troubles with Signals



Attenuation is the loss of signal strength as it travels through a medium. Attenuation can be reduced by using repeaters and amplifiers.

Delay is the time it takes for a signal to travel from one place to another. Delay can be reduced by using faster transmission media and shorter transmission paths.

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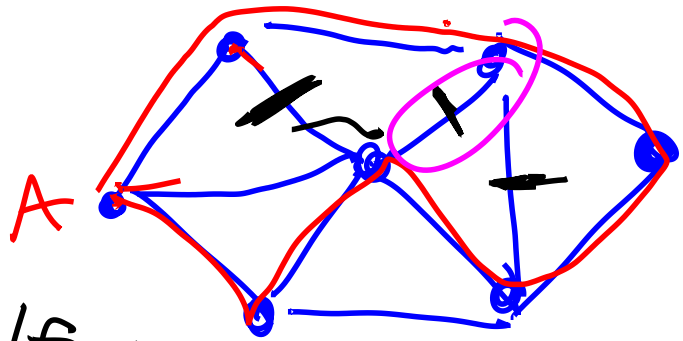
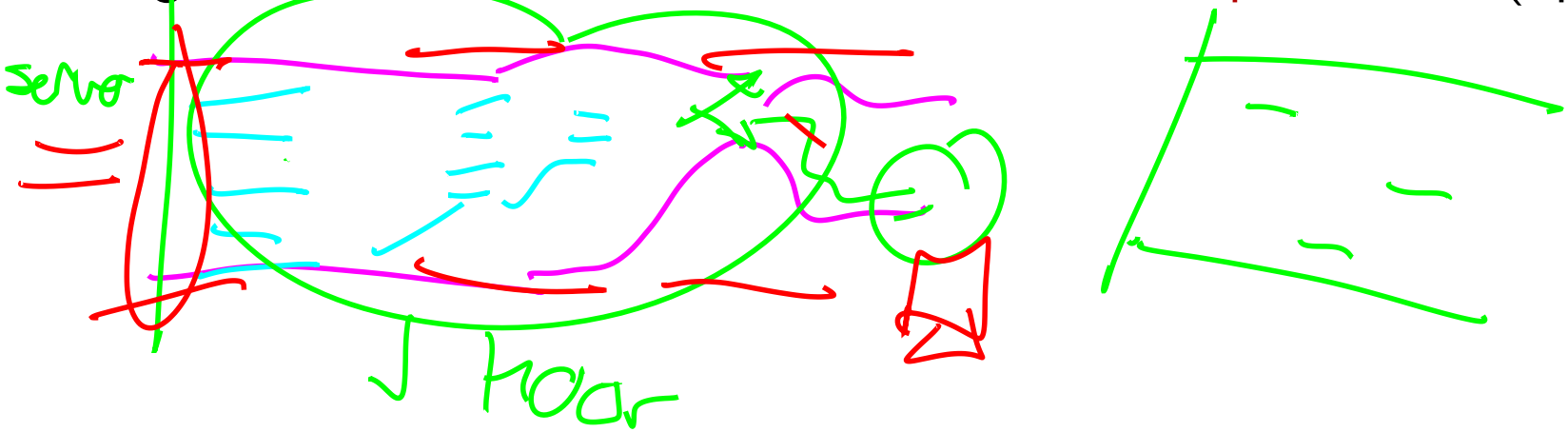


Transference Rate

The transference rate is the amount of data that can be transmitted in a given amount of time. It is measured in bits per second (bps).

- Bandwidth is the range of frequencies that can be transmitted over a medium. It is measured in hertz (Hz).
- Throughput is the actual amount of data that can be transmitted in a given amount of time. It is measured in bits per second (bps).



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Networks Protocols

Networks protocols are a set of rules and conventions that govern the way data is transmitted over a network.

- Physical Protocols govern the way data is transmitted over a physical medium.
- Data Link Protocols govern the way data is transmitted over a data link.
- Network Protocols govern the way data is transmitted over a network.
- Transport Protocols govern the way data is transmitted over a transport medium.
- Application Protocols govern the way data is transmitted over an application.

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Internet Protocols

The Internet Protocol Suite is a set of protocols that govern the way data is transmitted over the Internet. It is also known as the TCP/IP protocol suite.

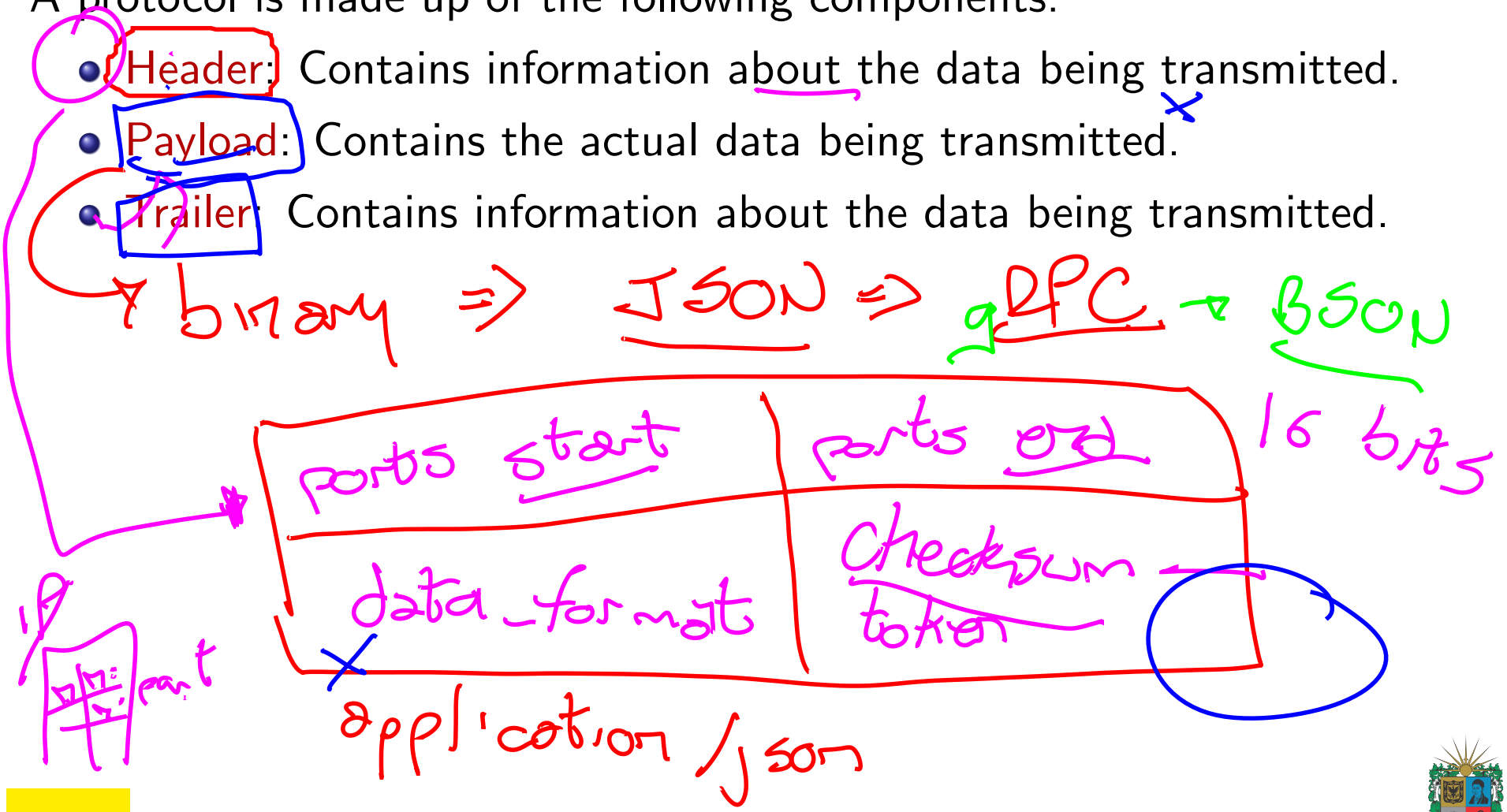
The Internet Protocol Suite is made up of the following protocols:

- Internet Protocol (IP): Governs the way data is transmitted over the Internet.
- Transmission Control Protocol (TCP): Governs the way data is transmitted over a transport medium.
- User Datagram Protocol (UDP): Governs the way data is transmitted over a transport medium.
- Internet Control Message Protocol (ICMP): Governs the way data is transmitted over the Internet.
- Internet Group Management Protocol (IGMP): Governs the way data is transmitted over the Internet.

Structure of a Protocol

A protocol is made up of the following components:

- Header: Contains information about the data being transmitted.
- Payload: Contains the actual data being transmitted.
- Trailer: Contains information about the data being transmitted.



Datagrams

CISCO Packet Tracer
↳ CCNA

A datagram is a self-contained unit of data that is transmitted over a network.

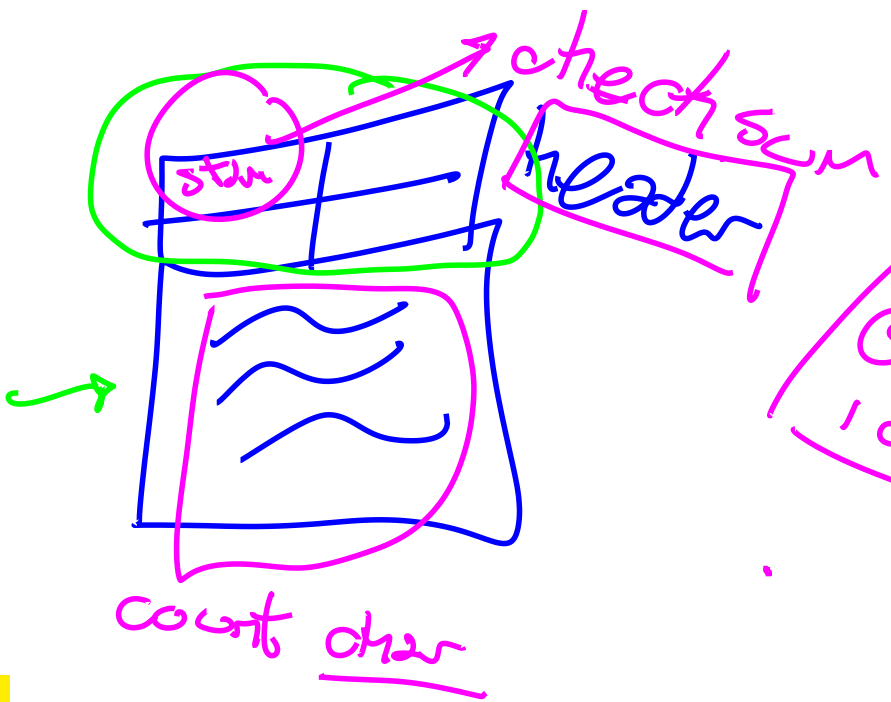
Datagram-based protocols are connectionless, meaning that each datagram is transmitted independently of the others.

Datagram-based protocols are used in packet-switched networks, where data is transmitted in discrete units called packets.

Data Encapsulation

Data encapsulation is the process of adding headers and trailers to a payload in order to transmit it over a network.

- Trailers are used to verify the integrity of the data being transmitted.
- Headers are used to route the data to its destination.



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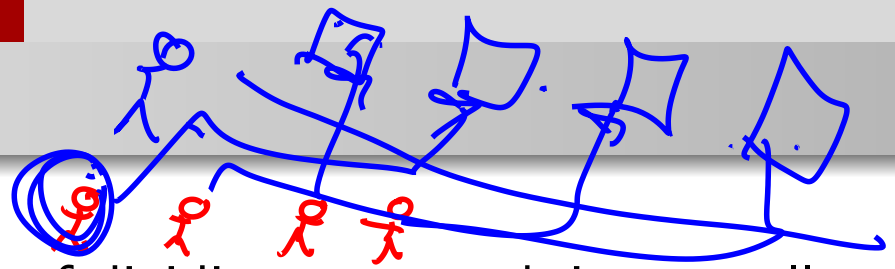
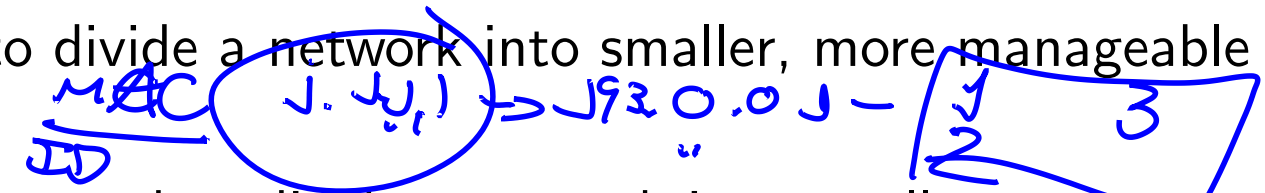
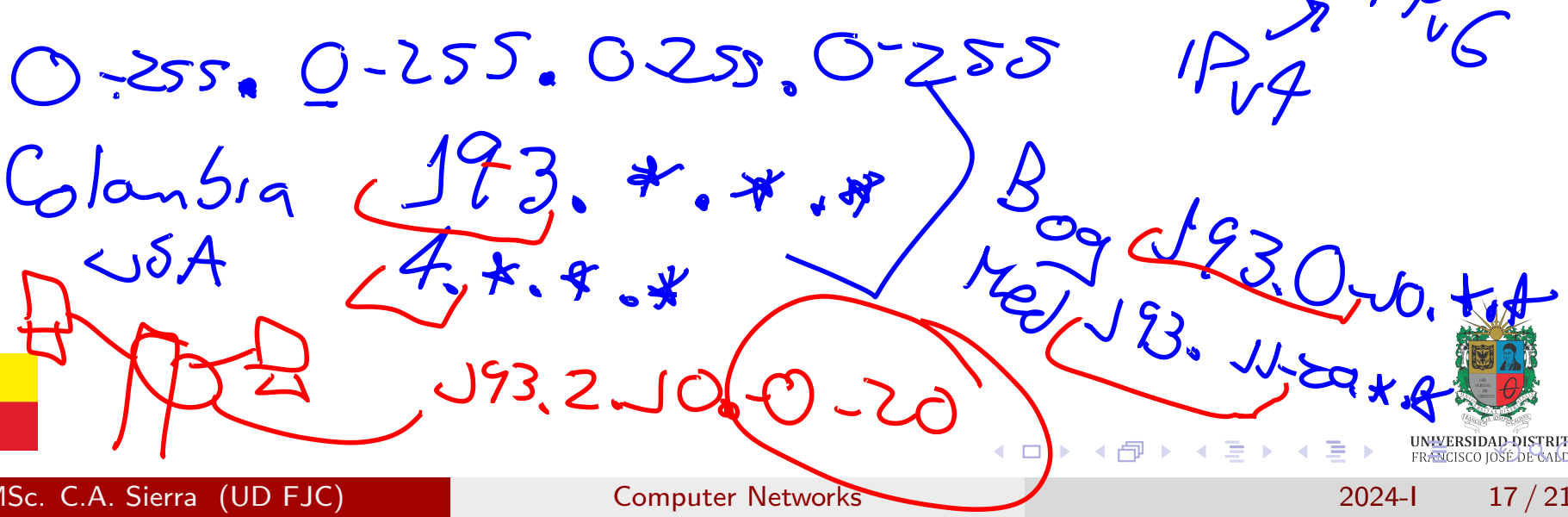
Networks Segmentation



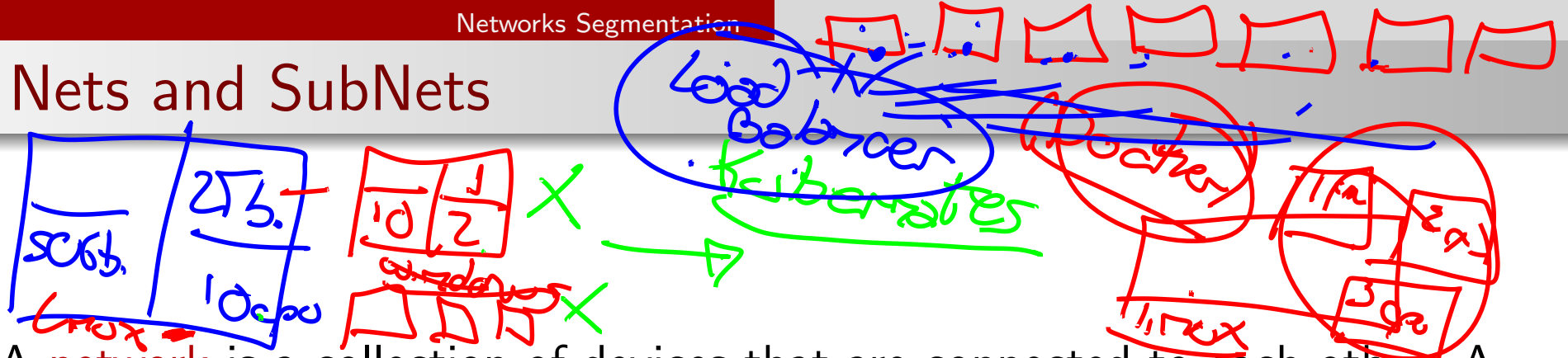
Network segmentation is the process of dividing a network into smaller, more manageable segments.

- Subnetting is the process of dividing a network into smaller, more manageable subnets.
- VLANs are used to divide a network into smaller, more manageable virtual LANs.
- Load Balancers are used to divide a network into smaller, more manageable load balancing domains.





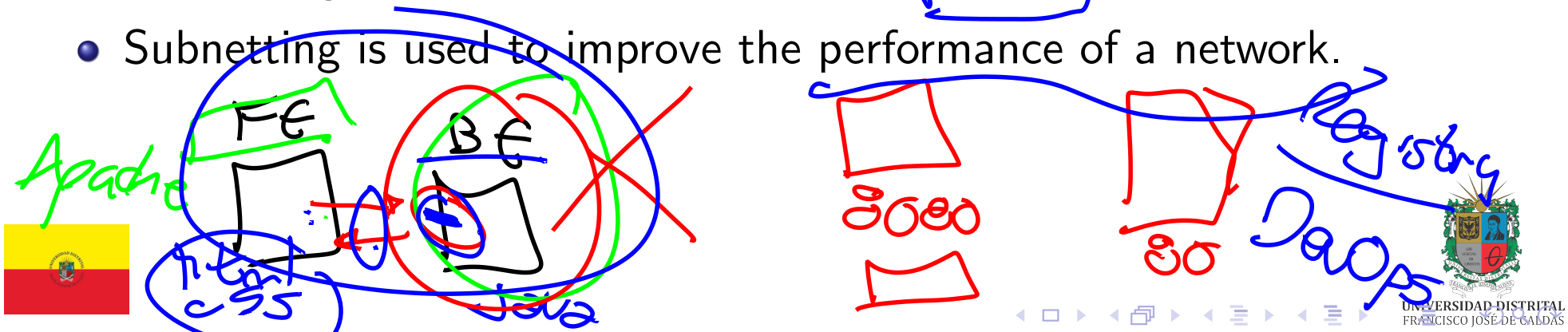
Nets and SubNets



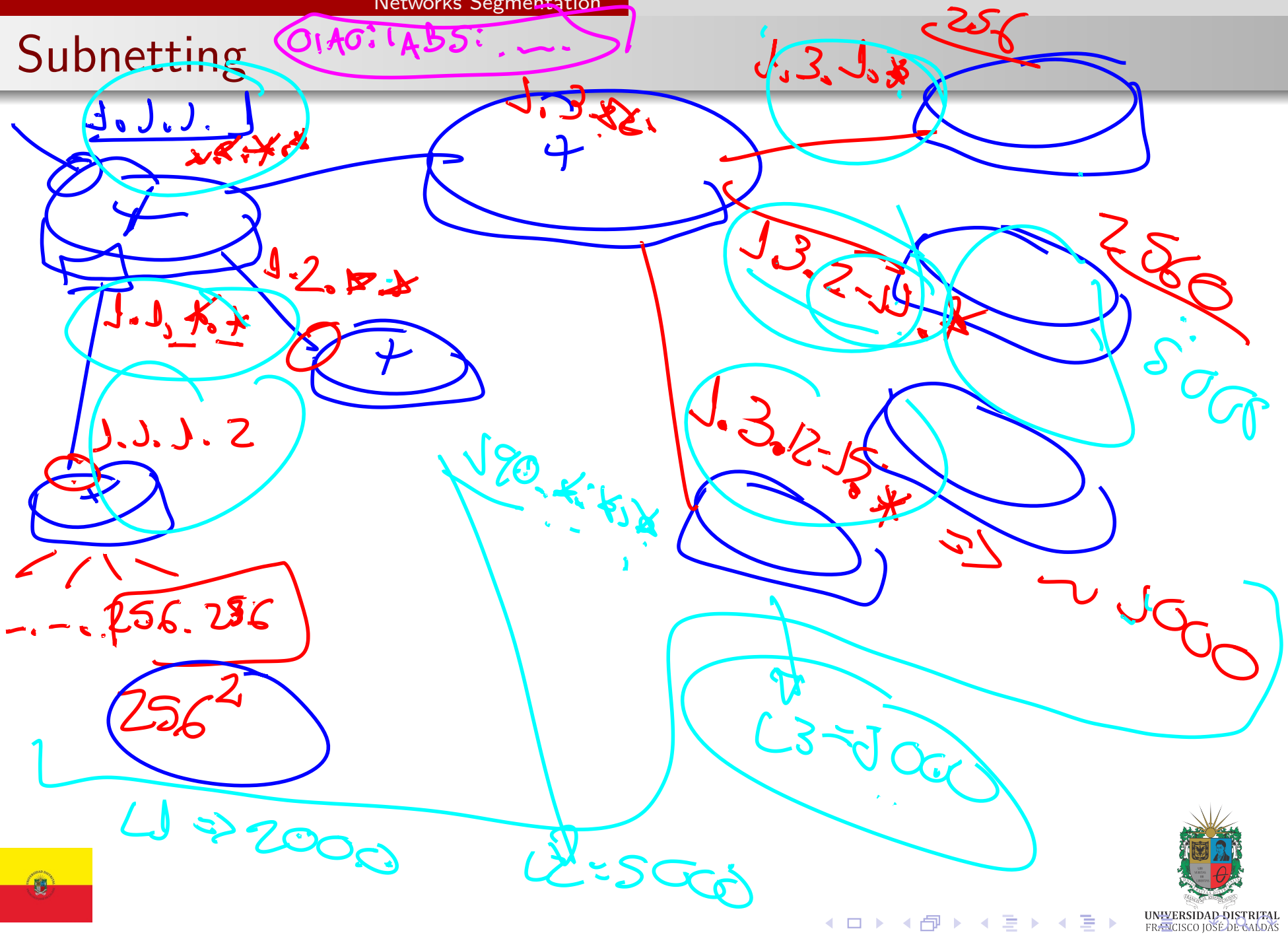
A network is a collection of devices that are connected to each other. A subnet is a collection of devices that are connected to each other and share the same network address.

Subnetting is used to divide a network into smaller, more manageable subnets.

- Subnetting is used to reduce the size of broadcast domains.
- Subnetting is used to reduce the size of collision domains.
- Subnetting is used to improve the performance of a network.



Subnetting



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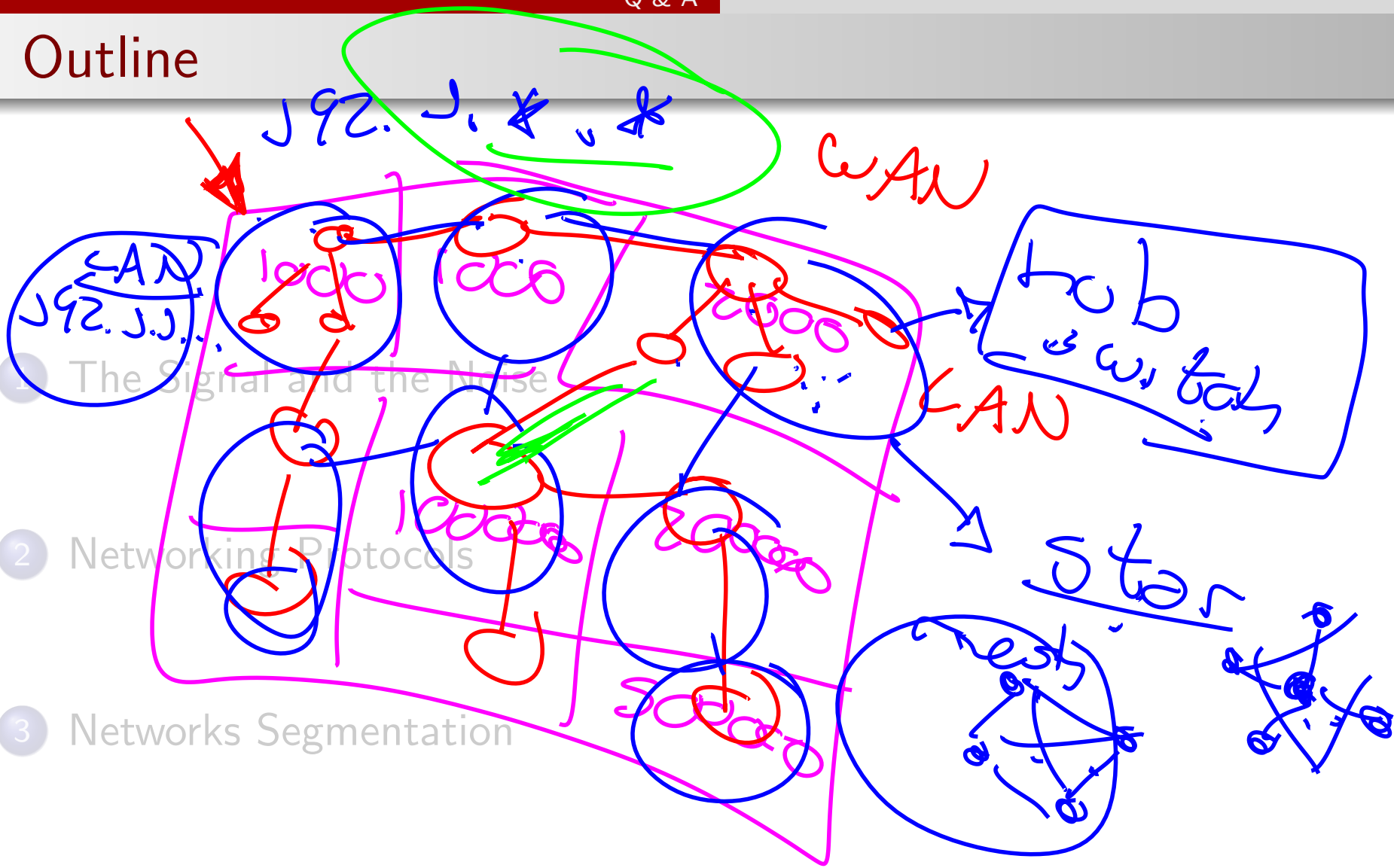

Thanks!

Questions?

Repo:

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