

# Fundamentals of Computer Science

## Exercise Session 10

# What do we do today

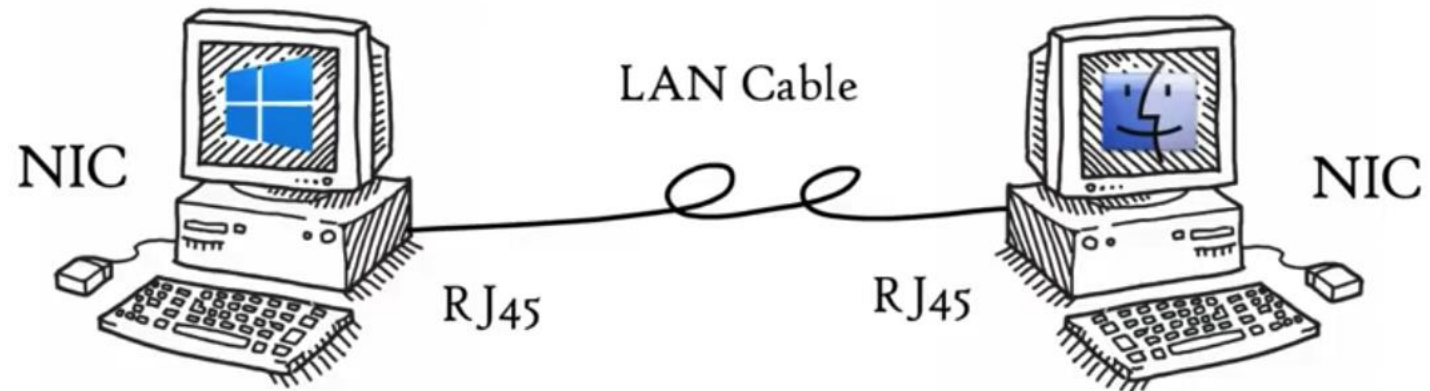
- Review solution assignment 8
- Review quiz 6
- Networking stack

# Networking Stack

How are they going to communicate using different operation systems?

→ Make communication possibilities independent from Hardware

→ How? Define a standard → Networking stack!



# Networking Stack OSI



If we talk to a human being in a language that both of us know, we can understand each other and process the information in our brains.

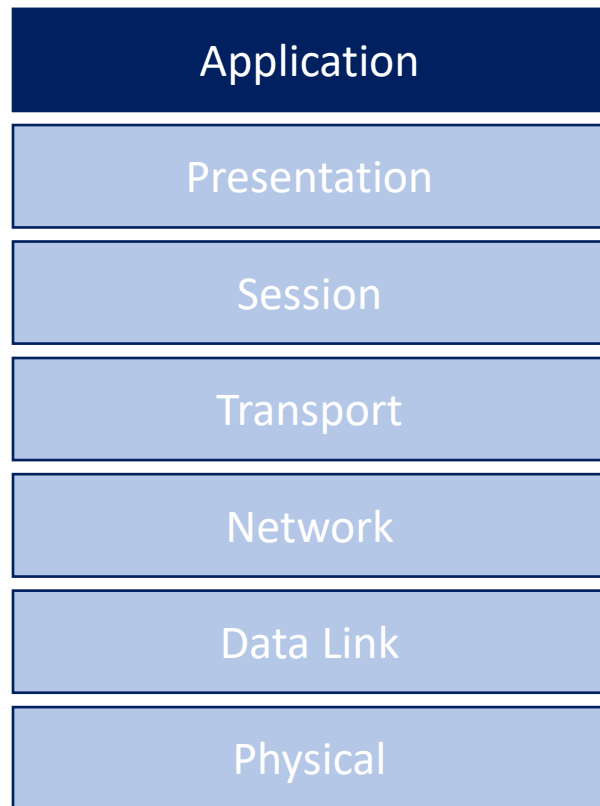
If a windows computer talks to a windows computer over LAN they can understand each other as they are directly connected (like circuit-switching).

If a human says hi to a friend in facebook and clicks on send: what happens in the background? Is it a problem if my friend is on Apple and I am on Windows?

→ We need a standardized approach so that human-beings can talk in facebook as they would physically. Computers as middlemen!

→ Networking stack: Separation of concerns!

# Networking Stack



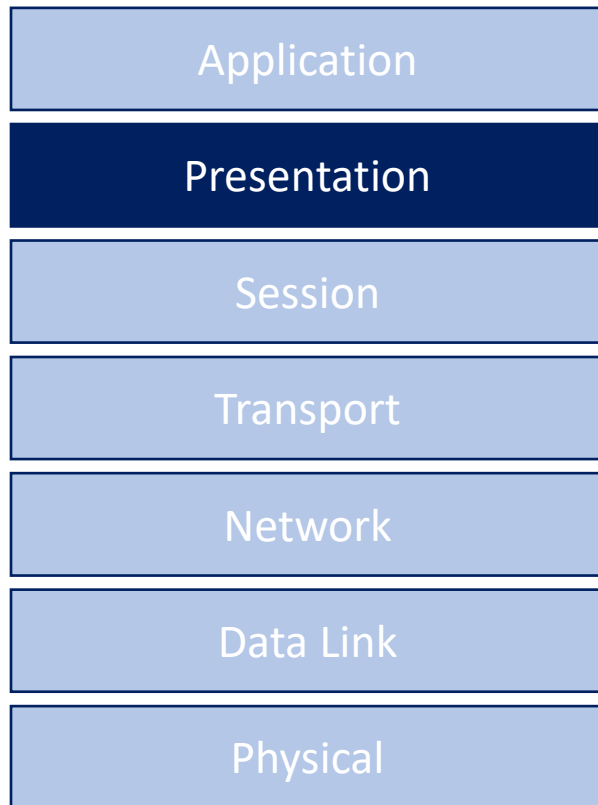
All these application use protocols of the application layer! HTTP, HTTPS, FTP, POP3, SMTP etc.

- Web surfing
- File transfer
- Emails

Application layer provides services for Network Applications with the help of protocols to perform user activities.

We as users interact always interact with the Application layer! It is the gateway.

# Networking Stack



Presentation layer receives characters and numbers from Application layer

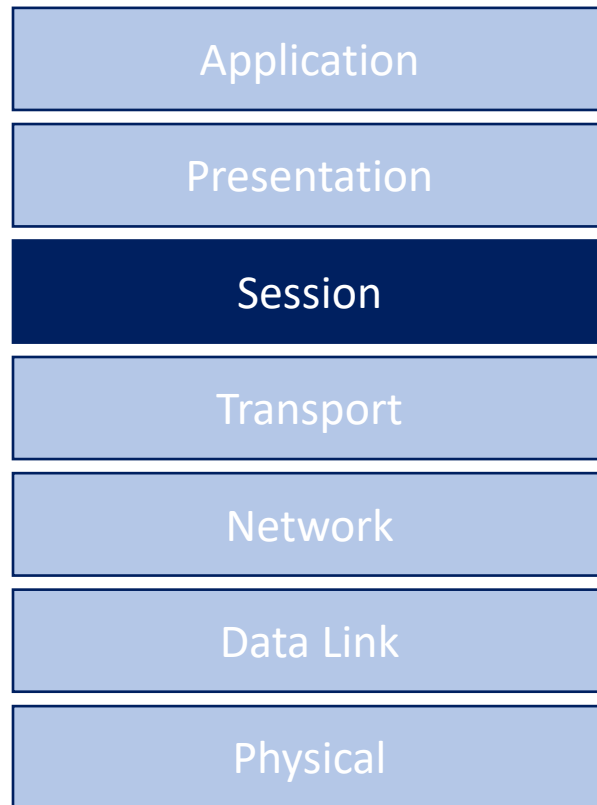
How should a machine understand my message "Hey darling"?

Remember: Computers only know 0 and 1 (binary)

Presentation layer as a middle-men between language of users and language of computers.

1. Translation: Conversion of characters into binary code
2. Data Compression: Reduction of binary data → netflix-streaming
3. Encryption/Decryption

# Networking Stack



Now we have the data in binary-format. How do we send it to the server?

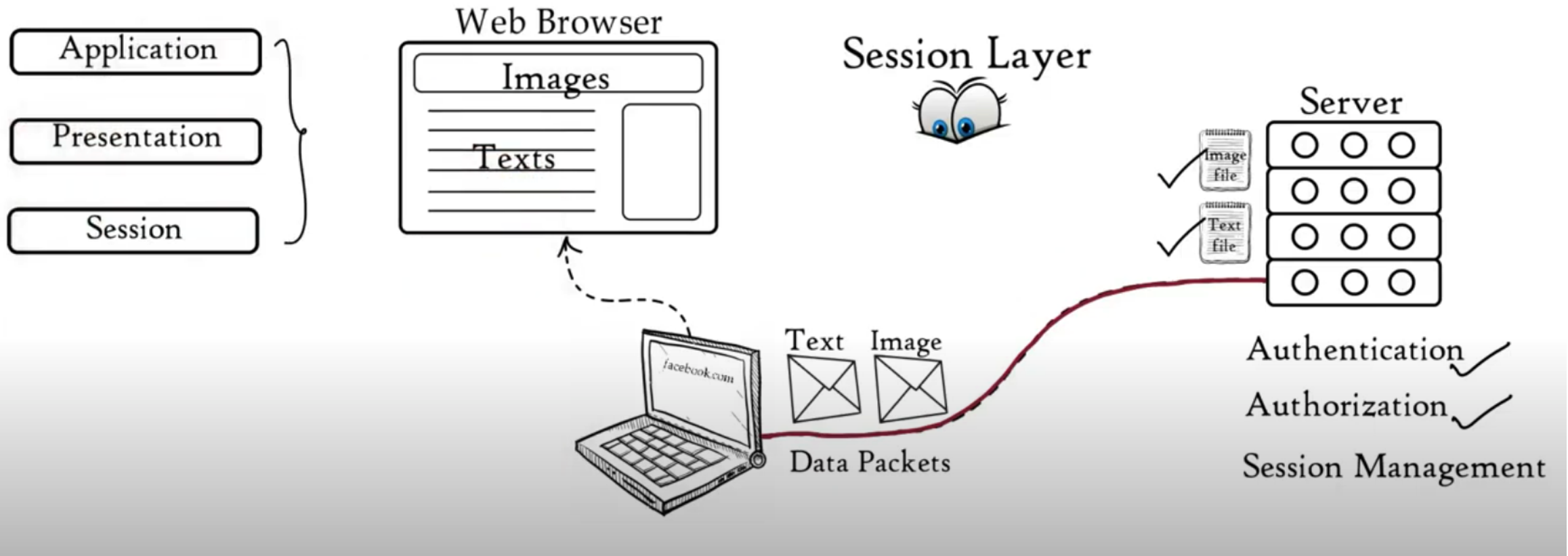
Session layers helps in setting up and maintaining connections

- Enabling sending and receiving of data
- Followed by termination of connection or sessions
- Keeps track which data belongs to which application and where the data should go

How is it done?

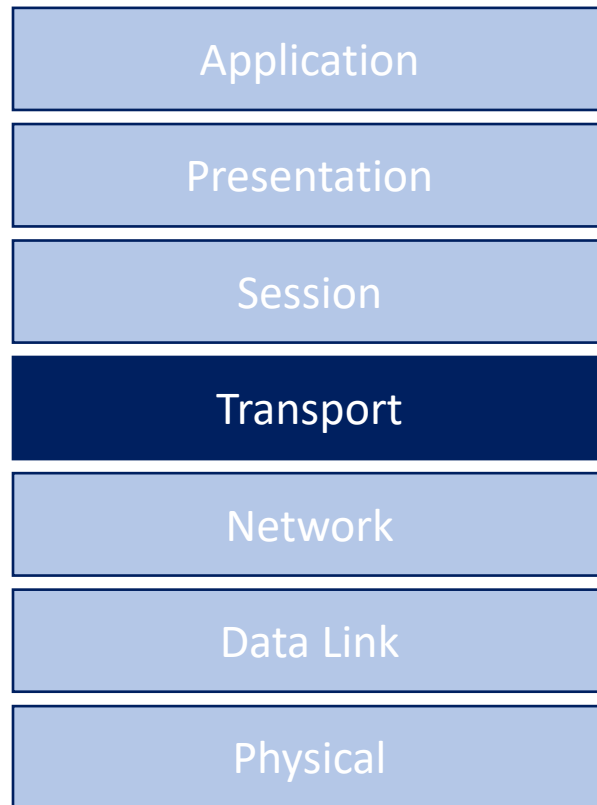
- Authentication
- Authorization
- Session management

→ Request in your web-browser opens separate session to download each file individually in form of packages





# Networking Stack



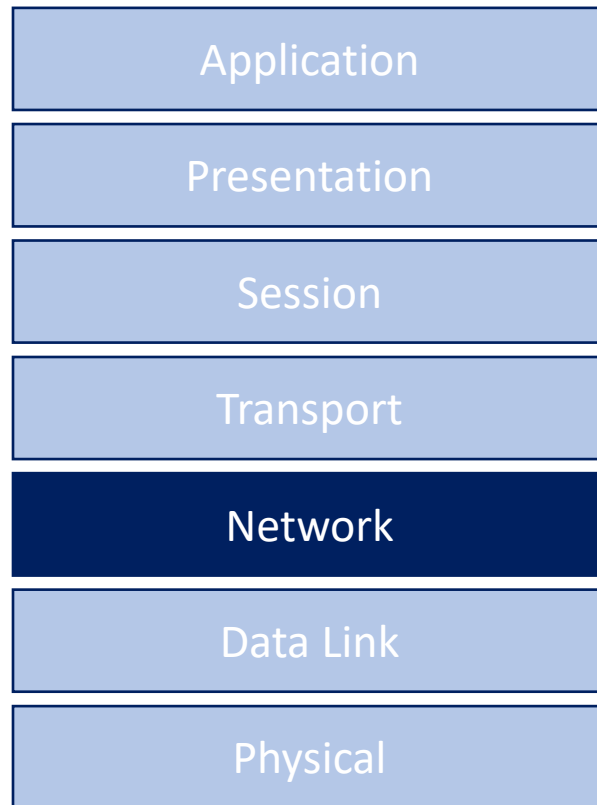
Controls the reliability of communication

- *Segmentation*
  - Data from session layer is divided into segments
  - Each segment contains
    - Port numbers (direct each segment to correct application)
    - Sequence numbers (re-assemble segments into correct order)
- *Flow control*
  - Amount of data being transmitted (10 Mbps vs. 10 Mbps)
- *Error control*
  - Automatic repeat request (sequence number very important)

TCP → Connection oriented transmission (3 way handshake, e.g. Email)

UDP → connectionless transmission (faster & provides no feedback , e.g. DNS)

# Networking Stack

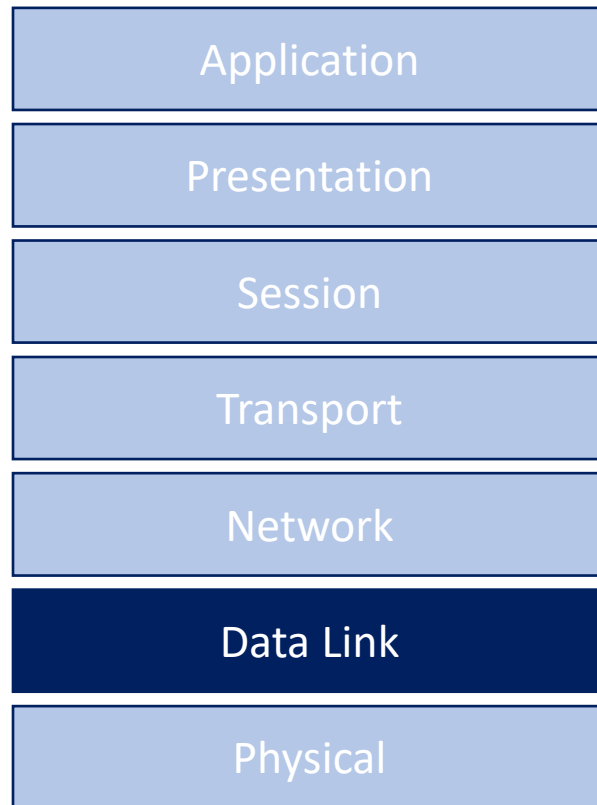


Receives data segments from Transport layer

Transmission of the received data segments in form of IP packets from client to server which are placed in different networks

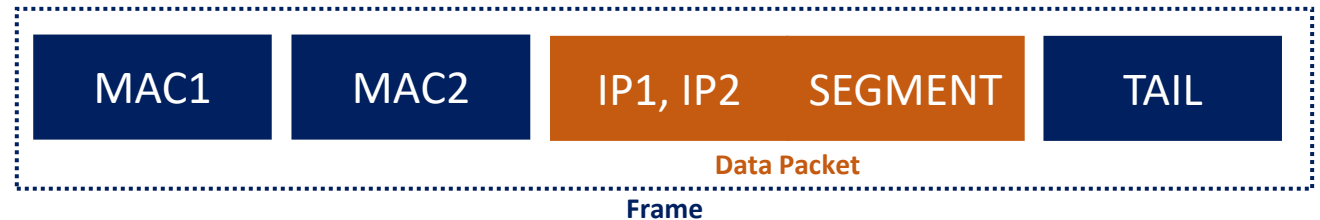
- Logical addressing
  - assigns sender and receiver and IP address to form an IP packet
- Routing (made in network)
  - Moving data package from source to destination, redirect packet to correct client within a network based on IP address (IPv4 & IPv6)
- Path determination
  - Choosing best possible path for data delivery (max-hops?)

# Networking Stack



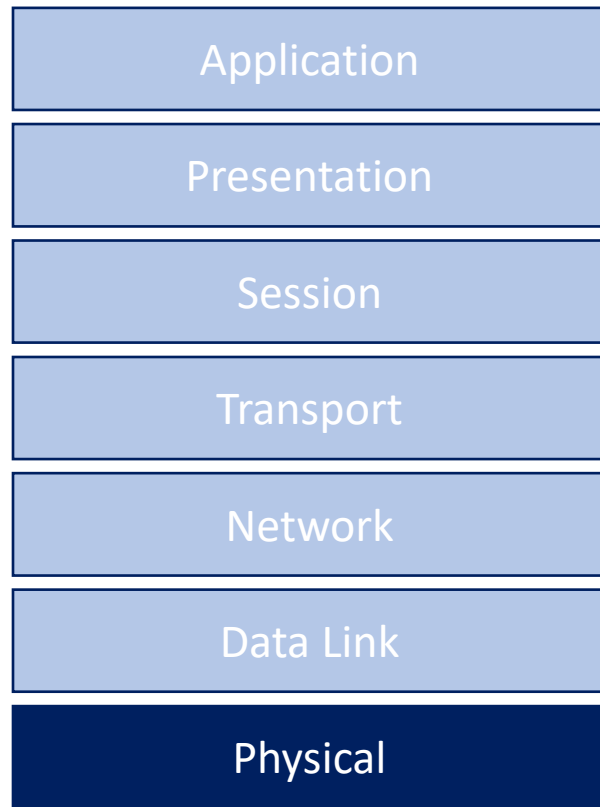
Receives data IP packets from Network layer, forms a frame and transfers this frame over local media

- Physical addressing
  - Mac addresses of sender and receiver (12-digit number) embedded in computer

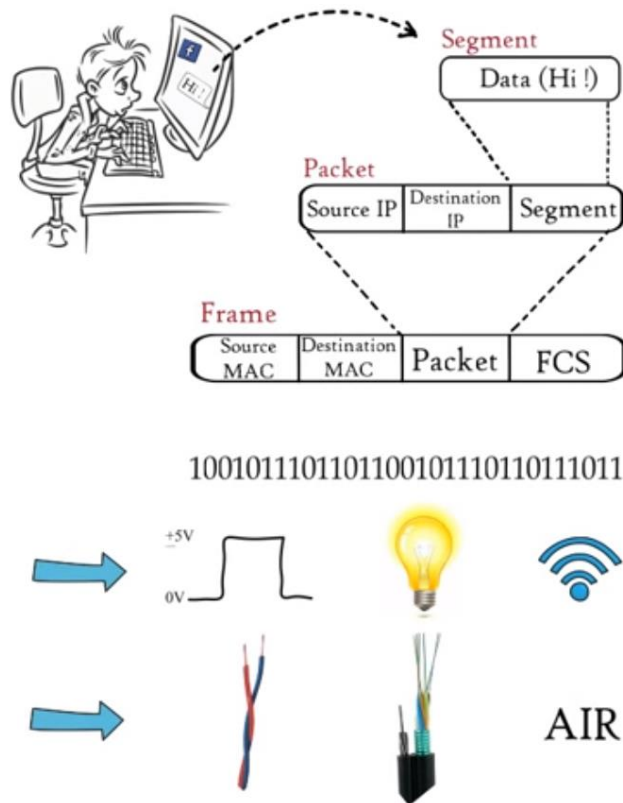


- Transport data over local media
  - Fiber
  - Cable etc.
- Encapsulation & Decapsulation
- Provides access to media (e.g. Fiber) for higher layers

# Networking Stack



Put the received frame on the carrier thorough electrical signals  
(depending on the media)



TRANSPORT LAYER

NETWORK LAYER

DATA LINK LAYER

BITs

SIGNALS

MEDIA



SIGNALS

APPLICATION LAYER



Application Layer

Presentation Layer

Session Layer

Transport Layer

Network Layer

Data Link Layer

Physical Layer



# Networking Stack

## OSI

Application
Presentation
Session
Transport
Network
Data Link
Physical

## TCP/IP (taught in lecture)

Application
Transport
Network
Data Link
Physical

## Data Units

Data
Segments
Packets
Bit/Frame
Bit

## Device

PC (more or less)
Router
Bridge / Switch
Hub

Source: [https://www.youtube.com/watch?v=vv4y\\_uOneC0](https://www.youtube.com/watch?v=vv4y_uOneC0)