Introduction. OSI and TCP/IP models.

Ing. Yelena Trofimova

Department of Computer Systems
Faculty of Information Technology
Czech Technical University in Prague

Computer networks, BIE-PSI
SS 2020/21, Lecture 1

`https://courses.fit.cvut.cz/BIE-PSI/`

Course structure

- lectures – 12x – once per week
- seminar – 6x – once per two weeks
- labs – 6x – once per two weeks

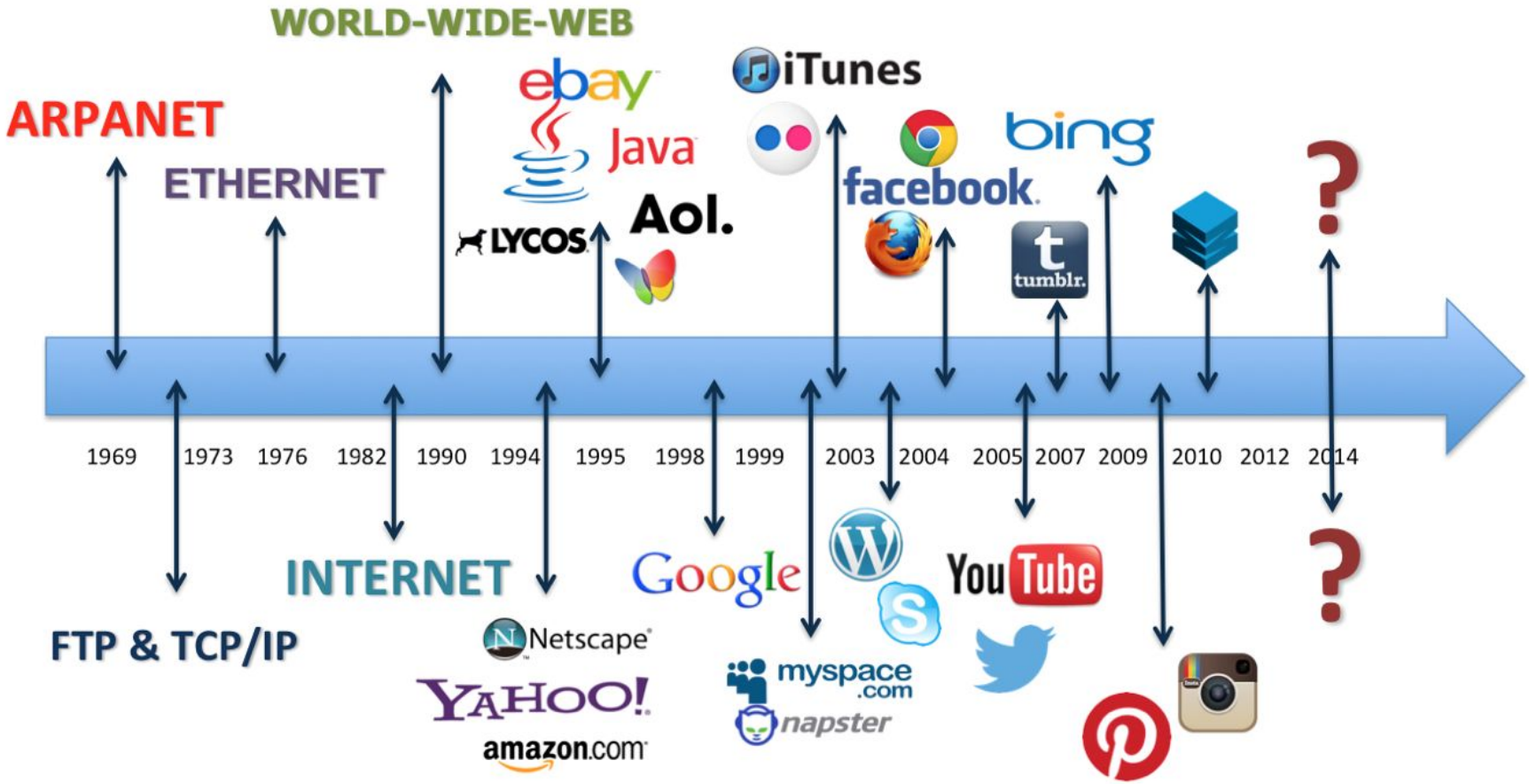
Course evaluation

- During the semester:
  - 4 labs: no points, but practical knowledge for an exam
  - programming homework: 15 points, penalization is applied for late submission
  - test: 5 points
  - activity points: 5 points
- Exam:
  - 80 points
  - two parts: test in Moodle and oral part
  - mandatory tasks, that is not passed, mean failure at the exam

Assessment requirements:

- homework 1 is mandatory
- 10 points from the semester
- homework is done individually, plagiarism check

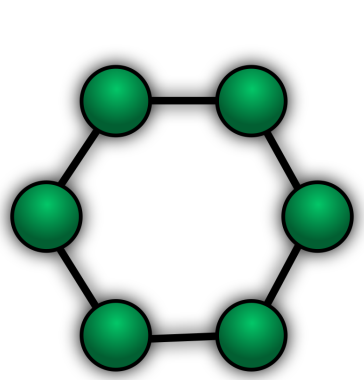
History of networks



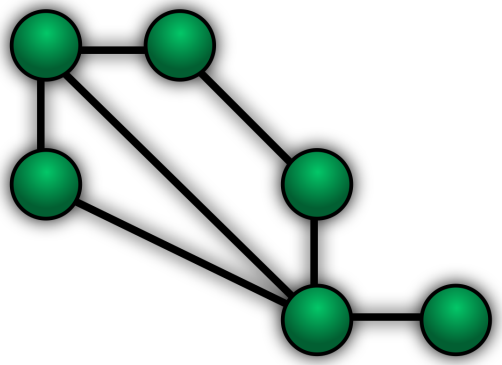
Categories of networks

- Connection: Connection-Oriented (circuit switching), Connectionless (packet switching)
- Architecture: peer-to-peer, client – server
- Use: public, private, hybrid
- Size: PAN (cca 1 m), LAN (cca 100 m), MAN (cca 10 km), WAN (cca 1000 km)
- Topology: line, bus, star, ring, mesh, tree, fully connected (direct link between any two nodes)

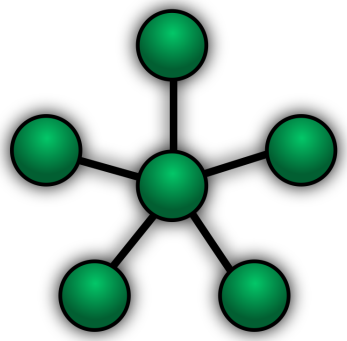
Network topologies



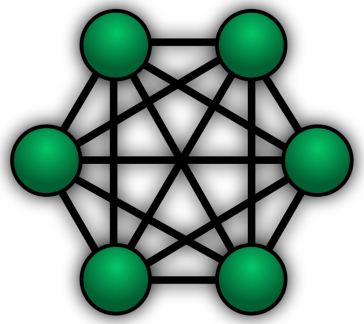
Ring



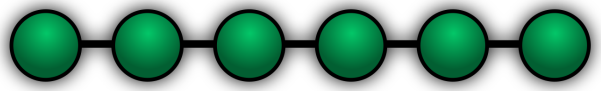
Mesh



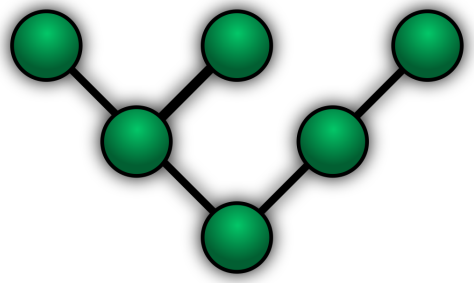
Star



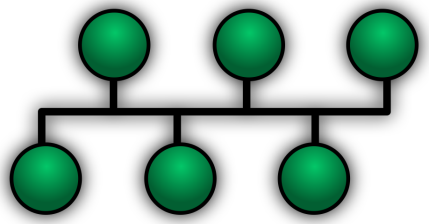
Fully Connected



Line



Tree



Bus

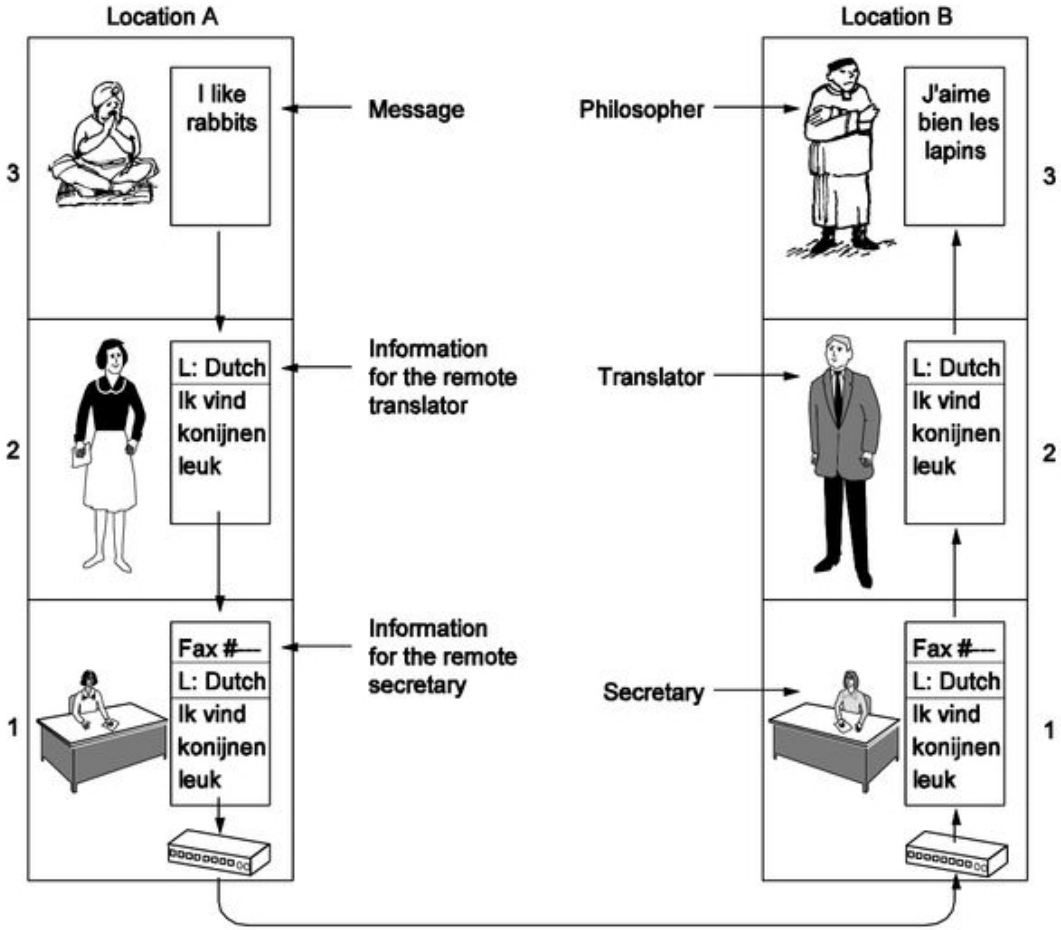
Layers and protocols

- Layers
  - system decomposition
  - design simplification
  - implementation independence, possibility of exchange
- Protocols
  - refer to a particular layer
  - define means of communication between two parties

Functions of layers

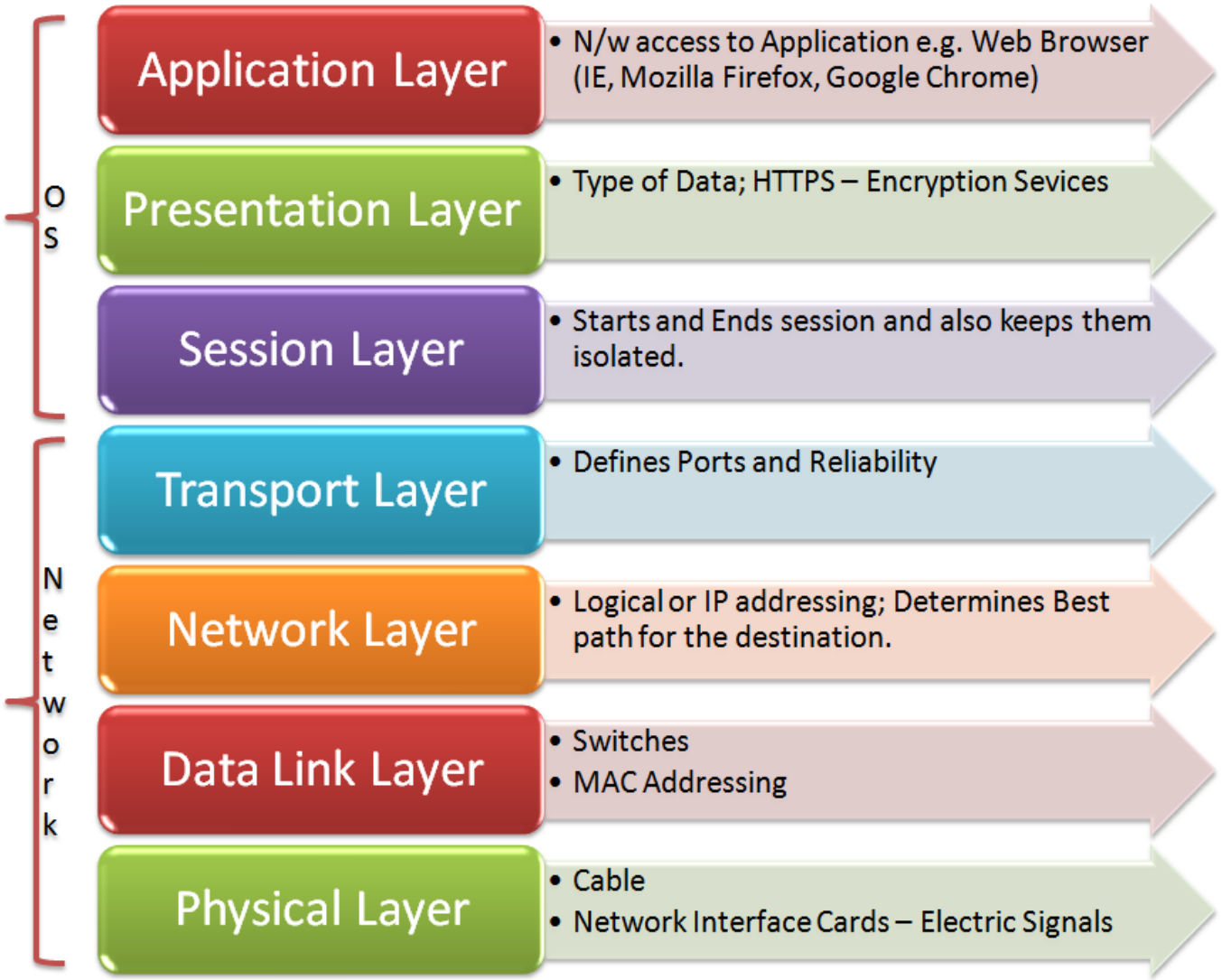
- directly interact with neighboring layers
  - provide services to upper layers
  - use services of lower layers
- communicate with the same layer on another device
- lower layers add information to the data blocks from upper layers

Layers and protocols



The philosopher-translator-secretary architecture. Source: Tanenbaum, 2011.

OSI model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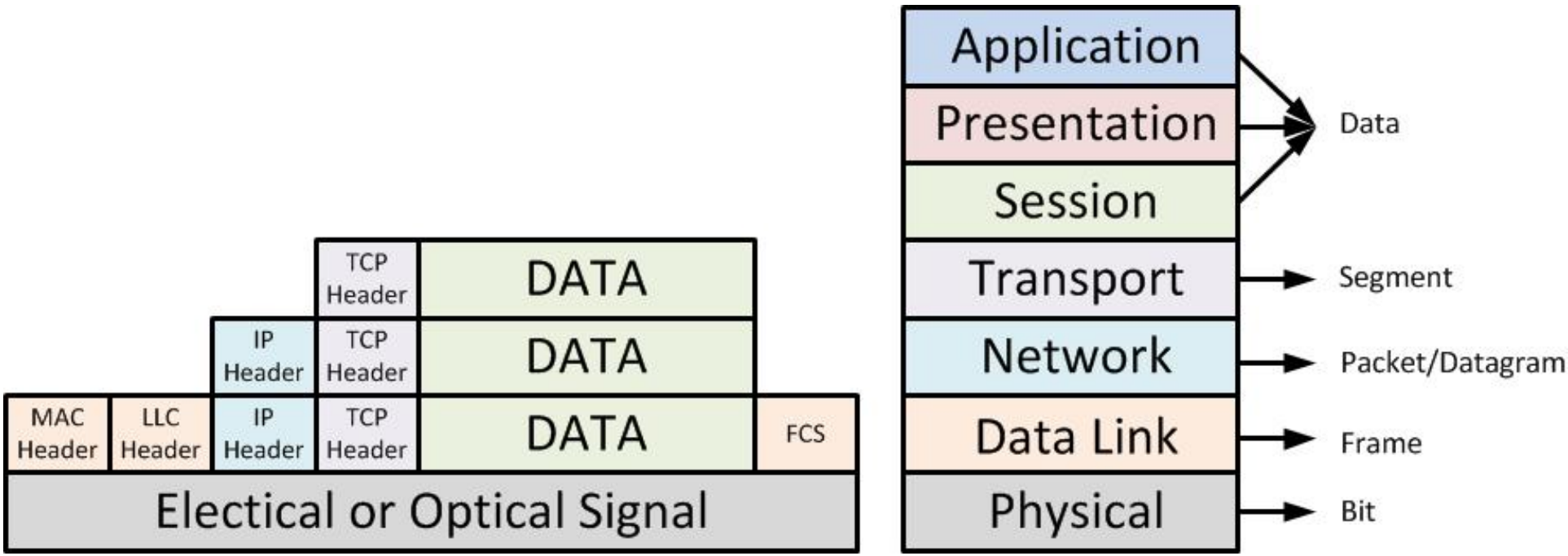
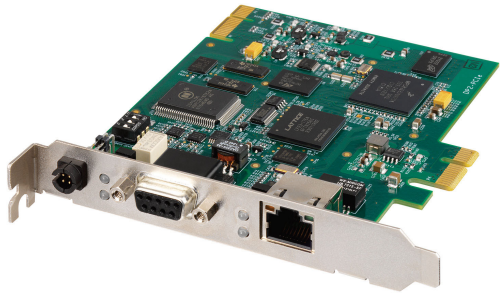
Application Layer
• N/w access to Application e.g. Web Browser (IE, Mozilla Firefox, Google Chrome)
Presentation Layer
• Type of Data; HTTPS – Encryption Sevices
Session Layer
• Starts and Ends session and also keeps them isolated.
Transport Layer
• Defines Ports and Reliability
Network Layer
• Logical or IP addressing; Determines Best path for the destination.
Data Link Layer
• Switches
• MAC Addressing
Physical Layer
• Cable
• Network Interface Cards – Electric Signals

Data encapsulation

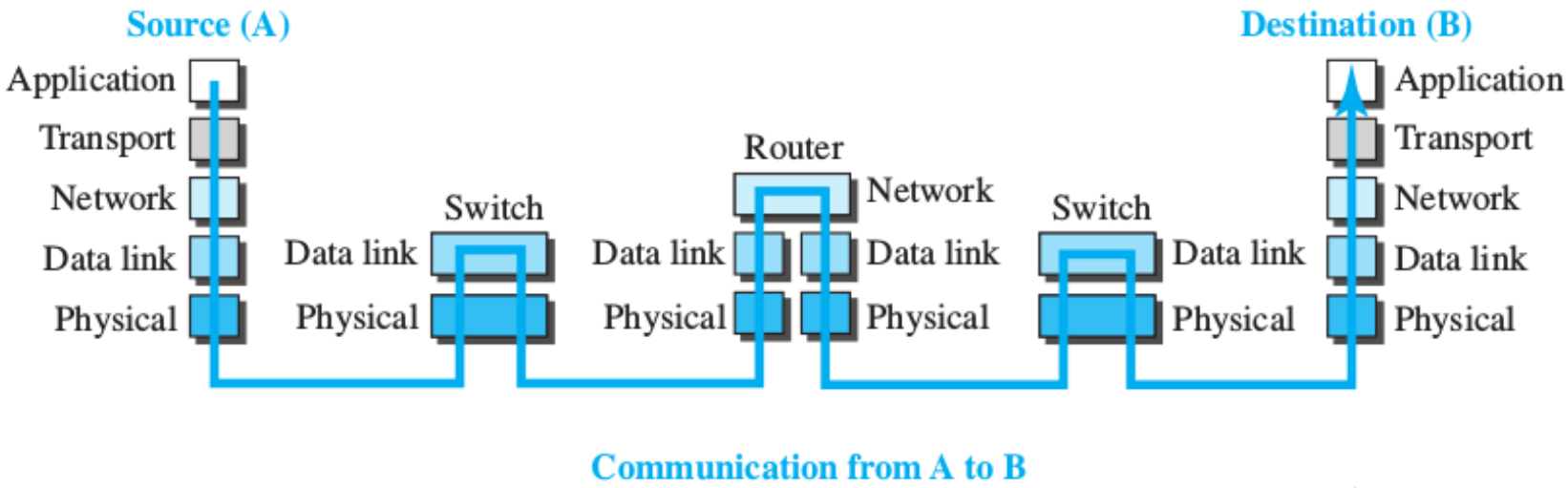


Network components

- switch
- router
- access point
- end station: NIC



Communication between devices



Physical layer

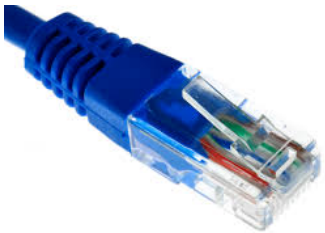
- transmits bits from one device to another through the channel
- regulates the transmission of a stream of bits over a physical medium
- defines how the cable is attached to the network adapter and what transmission technique is used to send data over the cable

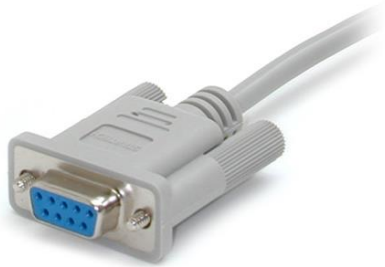
Examples:

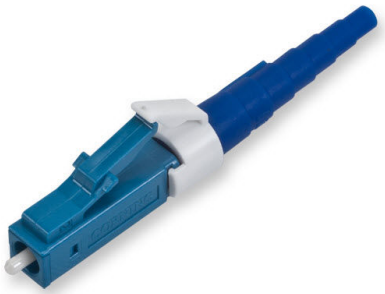
- Ethernet 10BaseT
- RS232
- ADSL

Cables and connectors

- ethernet (straight/crossover)
- serial (male/female)
- optical fiber (multi-mode/single-mode; simplex/duplex)







Data Link layer

- connects bits from the Physical Layer into frames (logical, structured parts for data)
- it is responsible for transferring frames from one computer to another, without errors (detection, sometimes correction of errors)
- controls the access to shared medium
- unique address in the scope of network segment
  - ex. MAC in Ethernet

Examples:

- Ethernet
- IEEE 802.11
- PPP

Network layer

- handles addressing and routing of data between networks
- unique address in the scope of the whole network (internet)
  - ex. IP address
- determines the route from a source to a destination

Examples:

- IP
- X.25
- IPX

Transport layer

- (TCP) handles error recognition and recovery, manages end-to-end control (whether all packets have arrived)
- transfers data between processes, separates data of processes at the same device
- manages traffic problems (flow control), such as congestion of data packets
- packet segmentation

Examples:

- TCP
- UDP

Session layer

- creates logical interface for application
- holds the connection even in case of temporary communication blackout
- performs synchronizing (ex. DB transaction)
- ensures authentication, control of access rights

Examples:

- RPC
- storage sharing

Presentation layer

- Cares about syntax and semantics (encoding, formatting and presentation of data)
- performs encryption and compression
- usually is a part of an operating system

Examples:

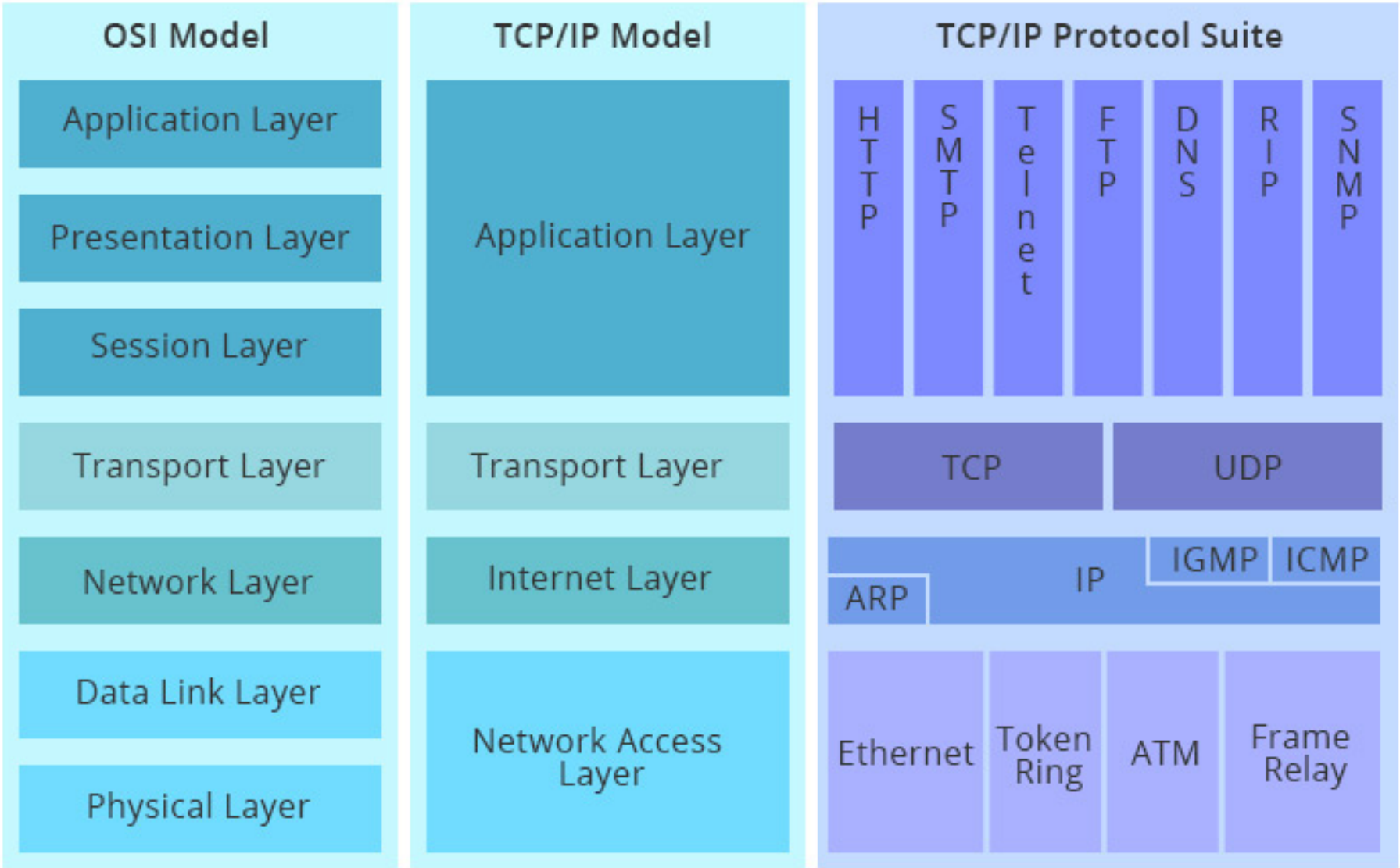
- ASCII/EBDIC
- XDR, ASN.1

Application layer

Represents the services that directly support applications such as software for file transfers, database access, email, network games, and others.
Examples:

- SMTP
- HTTP

OSI and TCP/IP models



Comparison of OSI and TCP/IP models

- Structure:
  - TCP/IP application layer includes the OSI application, presentation and most of the session layers.
  - TCP/IP transport layer includes functions of the OSI session layer as well as the OSI transport layer.
  - TCP/IP network access layer includes the OSI data link and physical layers.
- The OSI model is proven to be a good reference for network description and protocol design.
- The TCP/IP protocols appeared first, the model appeared as an addition, thus is not general and is not suitable for description of all networks.