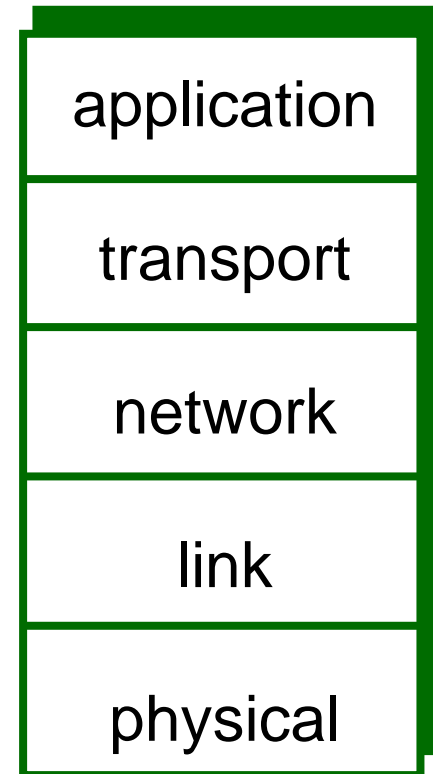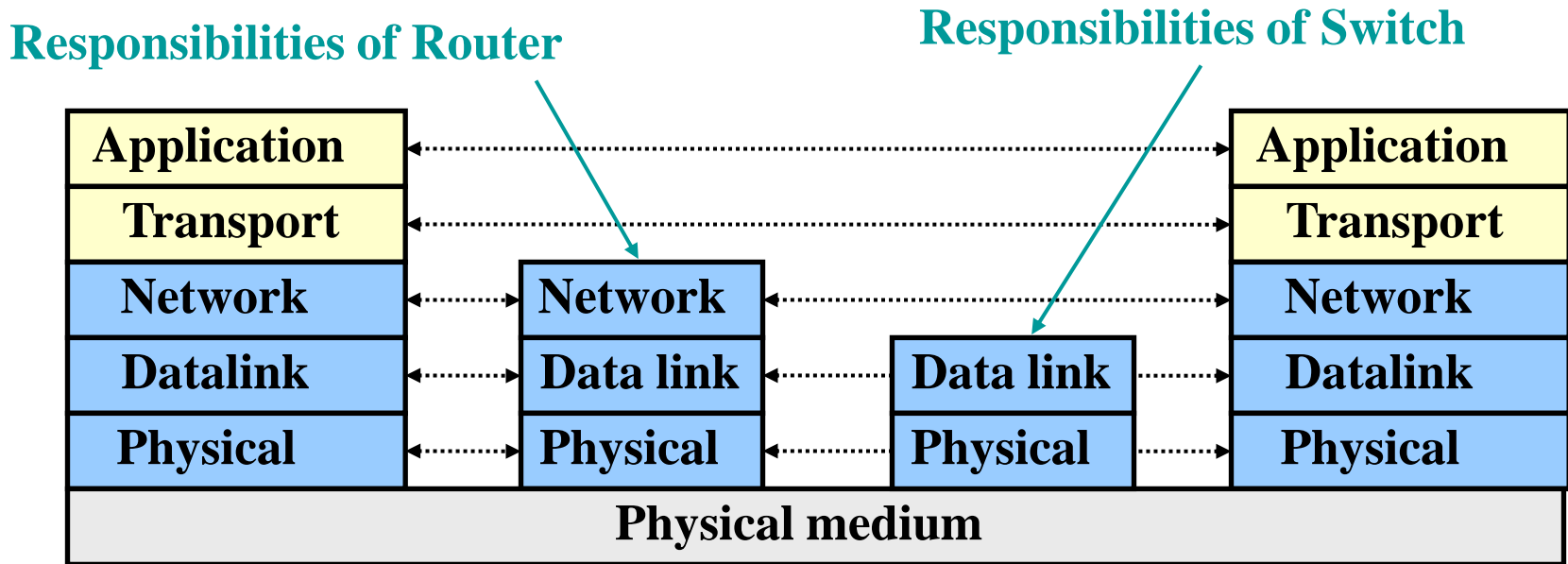# Exercise 1

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1. The five layers

- A switch processes up to layer 2. It uses the physical and the link layer.

- Advantages: Isolation, transparent to changes in other layers

- Disadvantages: Isolation ;), cannot optimize across layers

application
transport
network
link
physical

1. The five layers

Responsibilities of Router

Responsibilities of Switch

Application			Application
Transport			Transport
Network	Network		Network
Datalink	Data link	Data link	Datalink
Physical	Physical	Physical	Physical

Physical medium

2. ISO/OSI

o Adds Session layer that is responsible for synchronization and recovery of data exchange.

  o Today's Internet does typically not implement Session layer and nodes are identified by IP addresses. If connection breaks or IP changes, session typically fails.

o Presentation layer takes care of data interpretation, e.g. compression, en- and decryption etc.

3. Client/Server and P2P

o Client/Server: Client requests, server delivers (typically always-on!).

  o Examples: Web browser and server, email client and server

o Peer-to-Peer model: Everybody serves as client and server. Typical setup of filesharing systems, but also used in Skype. No always-on etc.

  o (Often P2P operates between end hosts and is not or only lightly infrastructure supported.)

4. Circuit vs. Packet switching

o If sources are bursty they do use the bandwidth only for short timeslots. The burst-process is random.

  o Randomness: Hard to deal with in circuit switching but easy to do with packet switching.

  o Circuit switching has lots of wasted bandwidth with bursty sources, packet switching scales better.

o Even if the sources are bursty, QoS reason can make it indispensible to use circuit switching

5. FDMA and TDMA

o Only in shared media, Multiple Access protocols to guarantee resource allocation via channel partitioning

o Divides a shared channel in fixed timeslots or frequency slots.

FDMA and TDMA are used in circuit switching.

6. Statistical multiplexing

o Occurs in packet switching

o Statistical multiplexing: Sequence of sending packets does not have a fixed pattern

  o No definite prediction possible

  o This has implications for router queues etc.

7. 4 Sources of packet delay

o Nodal processing: Error checks and link determination

o Queuing: Congestion at router? Time wait at output link (e.g. when shared channel is busy)

o Transmission delay: Writing data to the link

o Propagation delay: Typically the speed of light and level 1 processing.

7. Loss

○ If router queues are full, new packets are just dropped

○ Physical influences: Interruption in communication, especially in wireless communications