Computer Networks WS20/21

Exercise 1

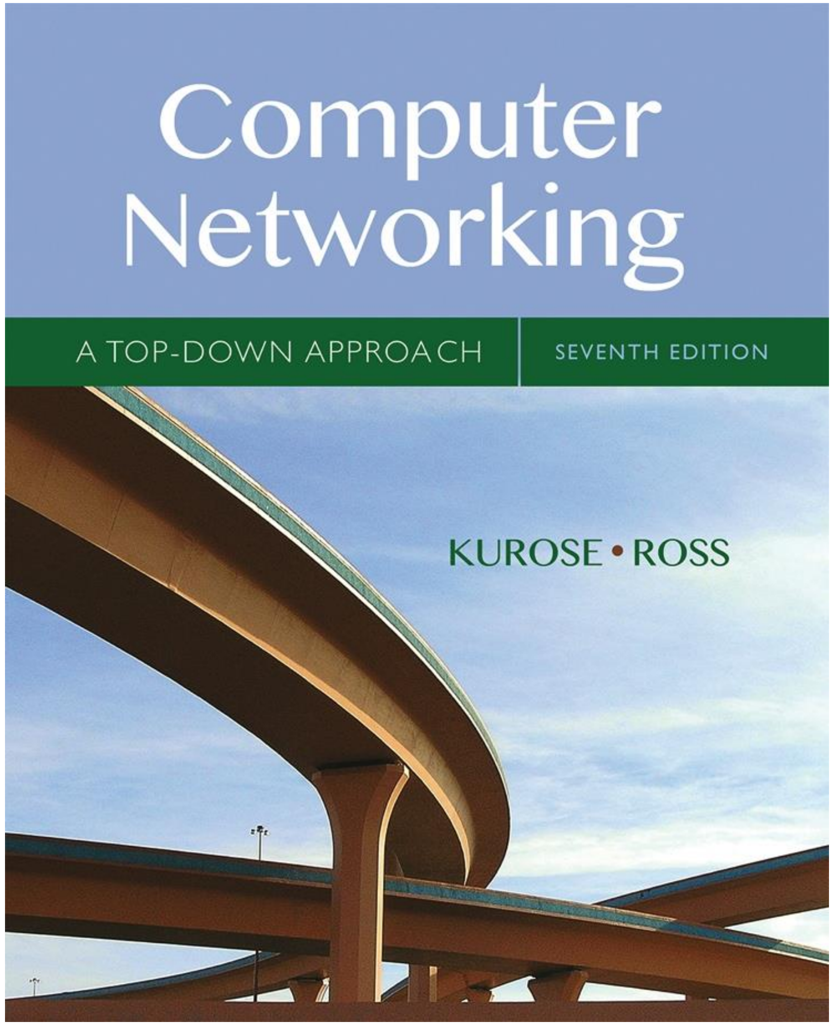
Recommendation

Try to borrow (or buy) this book:

Computer Networking: A Top Down Approach

7th edition. Jim Kurose, Keith Ross, Pearson, 2019.

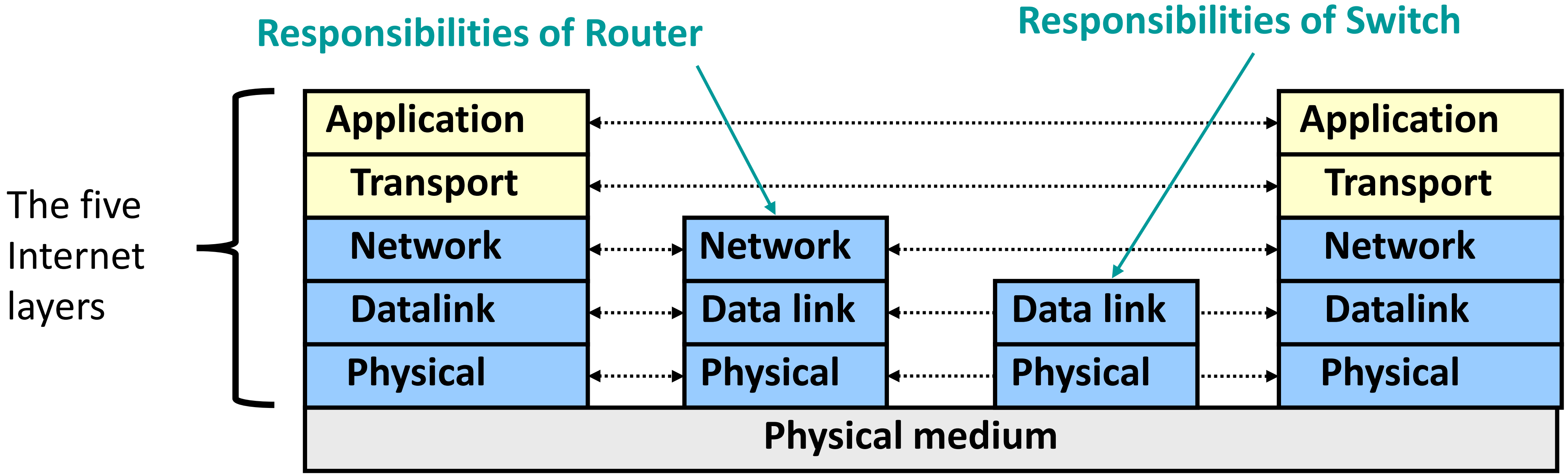
It is very good to understand!



Q1

In the Internet, what are the five layers, from top to bottom, in the Internet protocol stack? Till which layer does a switch process? Please make sure you understand the concept of layering and also think about advantages and disadvantages of layering.

1. The five layers



A switch connects computers within one network, but does not have a connection to other networks. It processes up to layer 2. It uses the physical and the link layer.

1. The five layers

- Advantages of layering:
  - Gives an organized structure to complex architecture: simplified by dividing architecture into smaller pieces which are responsible for specific services
  - Less complexity in each layer -> better to understand, maintain and update
  - Each layer does not have to care about other layers‘ implementation
    - Implementation of one layer can be changed without affecting other layers, as long as it provides the same service to layer above and uses the same service from layer below
  - Every protocol provides only communication within one layer

- Disadvantages of layering:
  - Layers may unnecessarily duplicate lower-layer functionality (e.g. error recovery)
  - Functionality at one layer may need information (for example, a timestamp value) that is present only in another layer. This violates the goal of separation of layers.

Q2

The ISO/OSI reference model adds two layers. What is the purpose of the session layer? Does the current Internet implement a session layer?

2. ISO/OSI

- Session layer: provides for delimiting and synchronization of data exchange, including the means to build a checkpointing and recovery scheme to keep a permanent communication
- Today's Internet does not typically implement Session layer. If such service is wanted, it must be implemented by the application programmer: in the application layer

- Second additional ISO/OSI layer: Presentation layer:
  - provides services that allow communicating applications to interpret the meaning of data exchanged, e.g.
    - data compression
    - data encryption/decryption
    - data description: applications do not have to worry about the internal format in which data are represented/stored (formats may differ from one computer to another)
  - Also not implemented in current internet

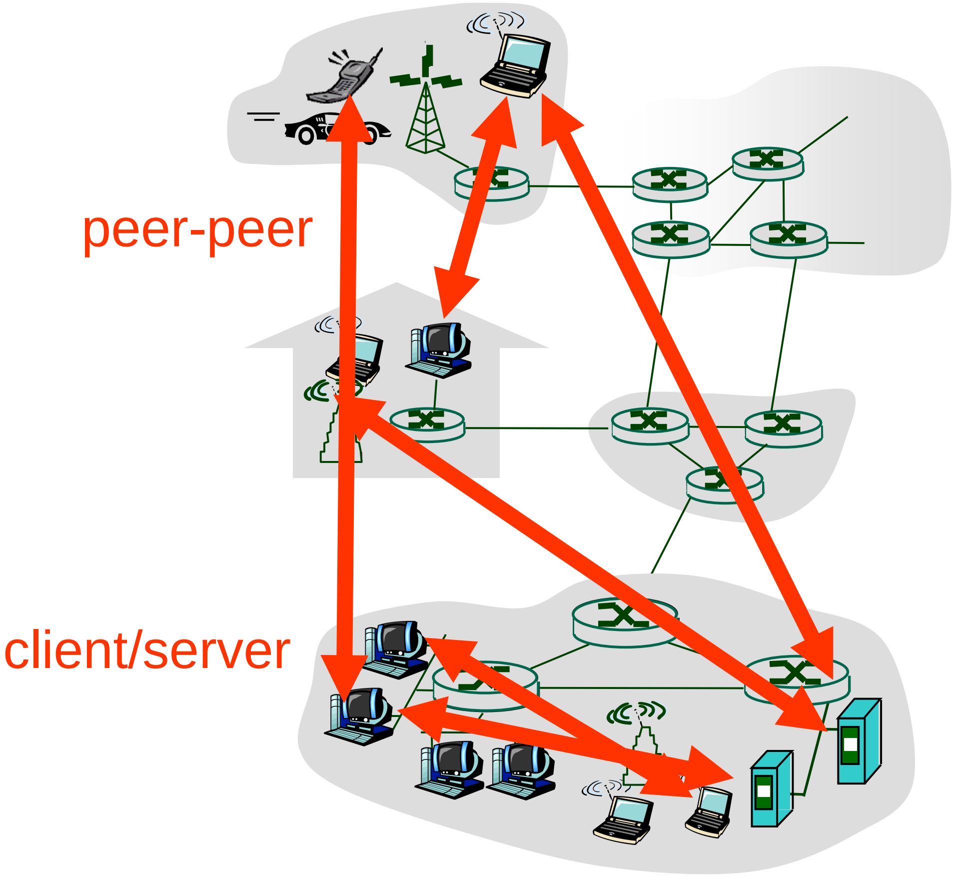
Q3

What is the difference between the client/server model and the peer-to-peer model?

3. Client/Server and P2P

- Client/Server model:
  - Client:
    - Sends request to a server whenever a communication is wanted
    - Not always-on
    - Examples: Web browser, E-Mail client
  - Server:
    - Waits for requests from clients, delivers data according to the client's request
    - (Usually) always-on
    - Examples: Web server, E-Mail server

- Peer-to-Peer model:
  - Every host is client and server at the same time
  - Client when requesting data
  - Server when providing data
  - Not always-on
  - Examples: File sharing systems (e.g. BitTorrent), Skype



Q4

Circuit switching versus packet switching: Assume all traffic sources to be bursty: what switching technology is preferable? What are the advantages of the other technique?

4. Circuit vs. Packet switching

- Circuit switching: resources of connections from host to host are reserved for a limited amount of users, can not be used by other uses
- Packet switching: no reservation of resources, data is divided into small packets. Packets from different sources will be sent one after another to their destinations with full bandwidth

- Traffic sources are bursty: traffic is inconsistent and unpredictable. At some points there will be only few or no data incoming, at other points there will be lots of data incoming. The sources use the bandwidth only from time to time for short timeslots
- The burst-process is random: Hard to deal with in circuit switching but easy to do with packet switching
- Because of the reservation of bandwidth segments for specific connections, circuit switching wastes a lot of bandwidth when there is no data coming from the source for which the bandwidth segment is reserved, because other sources can not use these segments. With bursty sources, packet switching scales better

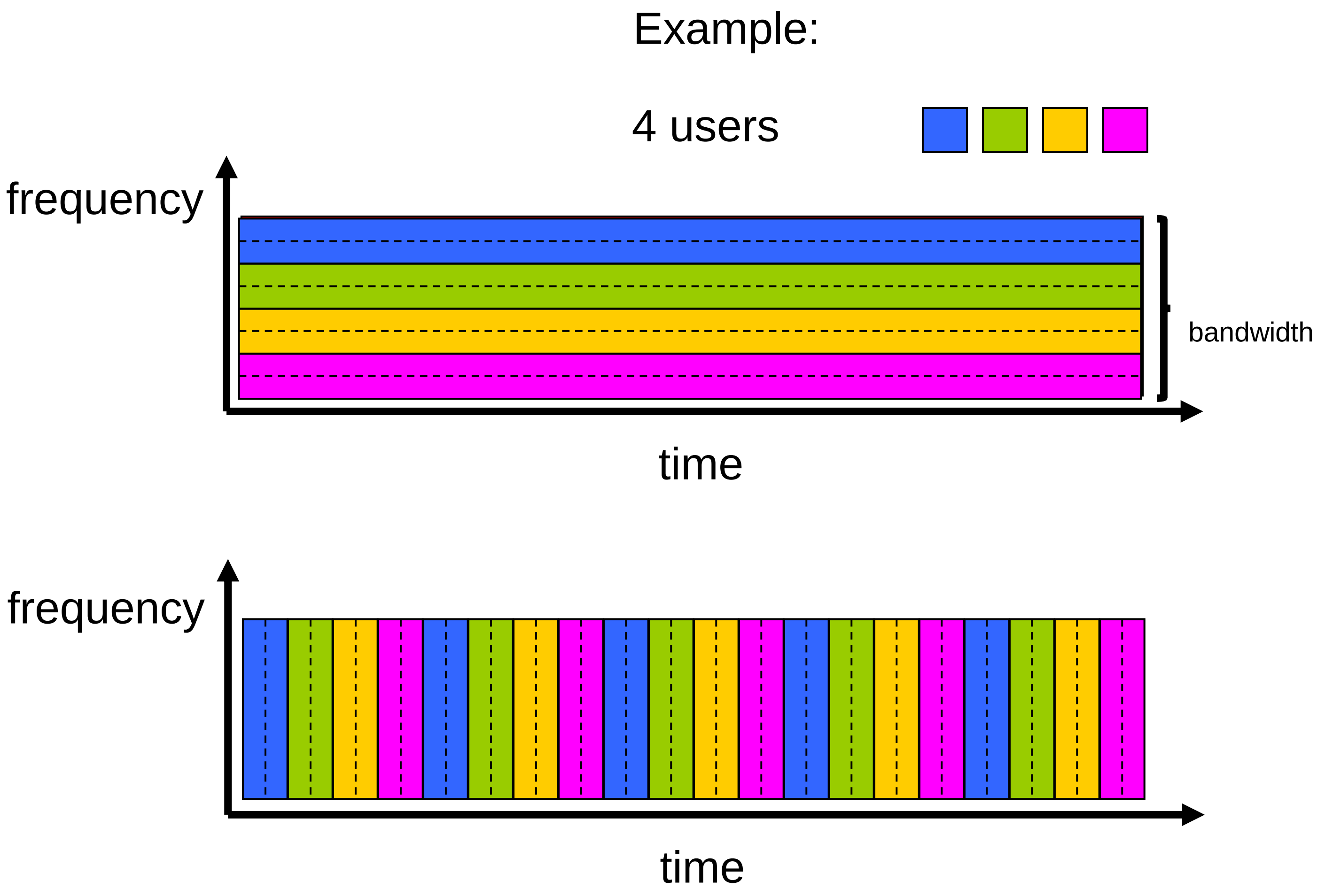
- Advantages of Circuit Switching: Reservation of resources results in very low delay and loss of data

Q5

In what switching technology is Frequency or Time Division Multiplexing used?

5. FDM and TDM

- FDM and TDM are used in circuit switching
- Frequency Division Multiplexing: bandwidth is divided for multiple users, which use their segment of the bandwidth all the time
- Time Division Multiplexing: the complete bandwidth can be used by one user after another for a certain time slot. After time slot is over, user has to wait until his next time slot

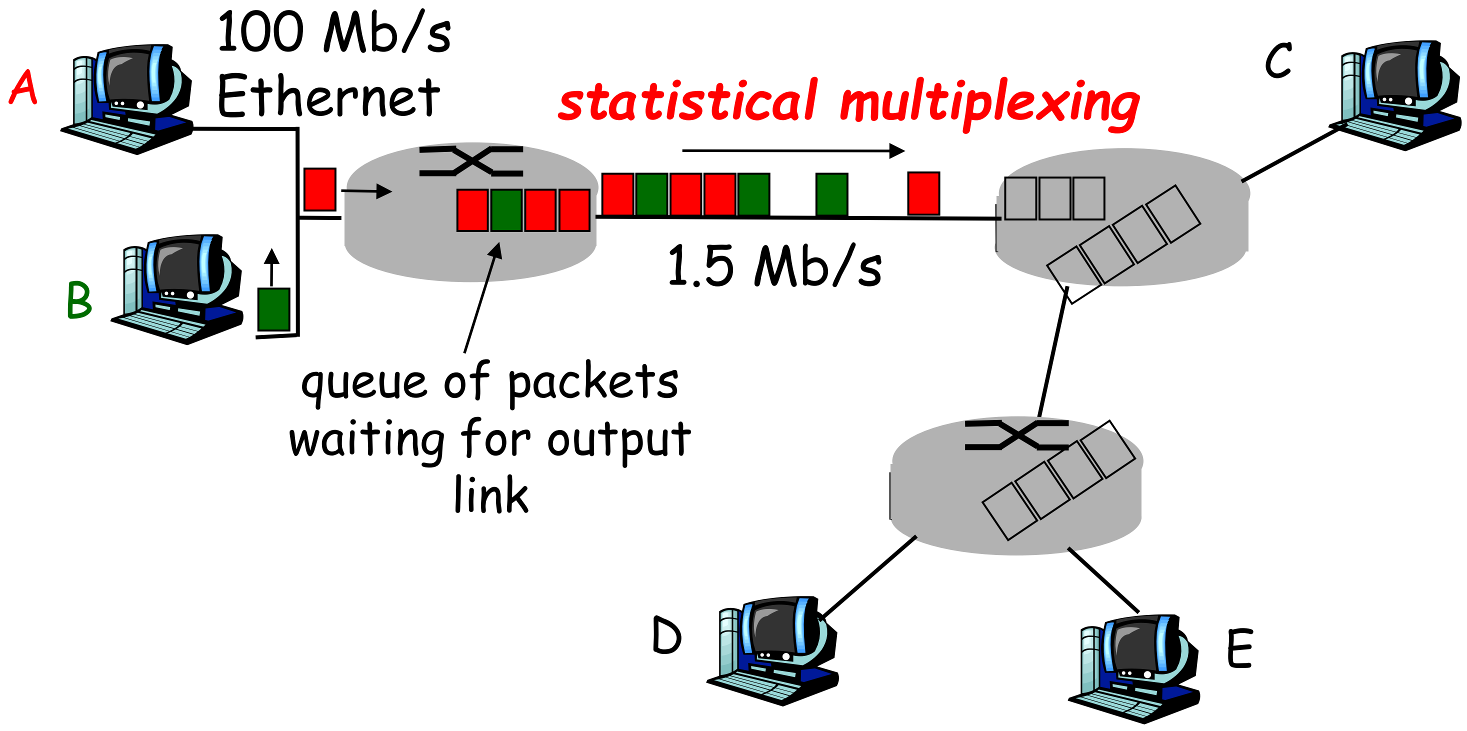


Q6

What is “statistical multiplexing”?

6. Statistical multiplexing

- Occurs in packet switching
- Statistical multiplexing: Sequence of sending packets does not have a fixed pattern
  - In packet switching resources are not reserved for specific users, thus every packet will be processed when it arrives
  - No definite prediction possible when a packet from a source arrives, it is a random process



Q7

What are the four sources of packet delay? How does loss occur?

7. 4 Sources of packet delay

- Nodal processing: Arriving packets have to be checked (Bit Error checks) and output link for packet must be determined
- Queuing: Congestion at router. Router buffer is already (but not completely!) filled with other packets waiting to be transmitted. Also packets have to wait at output link e.g. when shared channel is busy
- Transmission delay: Data can only be written to link with a certain rate (bits per second). Takes some time until all data is written to the link
- Propagation delay: Time the packet needs to be transmitted from one end of the physical link to the other. Depends on the propagation speed of the link's medium (e.g. fiber optics, twisted-pair copper wire, etc.). Propagation delay is the distance of the link ends divided by the propagation speed ((close to) the speed of light)

7. Loss

- Router queues have a finite capacity of packets they can store. If they are full, new arriving packets will just be dropped
- Physical influences: Interruption in communication, especially in wireless communications

Any Questions?

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