527 — Computer Networks and Distributed Systems — Tutorial: Introduction and Physical Layer

Note that the solution notes below only briefly list (some of) the key points that should be included in an answer. They are by no means complete. In an exam, you are expected to spell out the solution more fully and include a detailed explanation of your reasoning.

Introduction

Question: Which Is Faster?

Which is faster (i.e. has a higher data rate) to transfer a 1 GByte tape?

1. A 56 kbps modem
2. Next day delivery through the postal system

What about the expected latency?

- The post gets 1 GByte delivered faster:
  24 hours for post
  1GB * 8bits / (56kbps * 3600) = 39.7 hours for modem
- The post has higher bandwidth:
  1GB * 8bits / (24h * 3600) = 92.6kbps for post
  56kbps for modem
- But it also has a much higher latency: Delay for post is 24 h. For the modem, the first data will arrive within a minute, including dialling.
- *Note that for storage media,* $1\,\mathrm{GB} = 10^9\,\mathrm{bytes}$ *is normally used. For memory, the binary definition is more common:* $1\,\mathrm{GiB} = 2^{30}\,\mathrm{bytes}$.

Question: Connectionless or Connection-oriented?

Would you use a *connectionless* (CL) or *connection-oriented* (CO) network

1. if the underlying network suffers from frequent congested paths?
2. for a video conferencing application?
3. for a short message transfer?

Explain why.

1. CL — for routing flexibility to find paths around congestion spots (if the application doesn't mind varying bandwidth)
2. CO — planned, long-term connection with low-latency during use; need guaranteed resources. CL could also be used but packets may be lost.
3. CL — no setup overhead of a connection

Question: Mapping OSI Layers

Determine which layers of the *ISO OSI Reference Model* (if any) are relevant to these three environments:

1. The network environment, which is concerned with protocols and standards of the underlying communication channel.
2. The OSI environment, which adds application-oriented protocols and standards to allow end-to-end communication in an "open" way.
3. The actual system environment which deals with the user's software developed to perform specific function.

1. Physical Layer to Transport Layer
2. Session Layer to Application Layer
3. Trick question—no layers defined here! Applications are not part of the OSI model.

Physical Layer

Question: Data and Modulation

Gives several examples of an existing technology that uses a modulation scheme to send

1. *analogue* data over an *analogue* signal.
2. *analogue* data over a *digital* signal.
3. *digital* data over an *analogue* signal.
4. *digital* data over a *digital signal*.

	Analogue Data	**Digital Data**
Analogue Signal	Old TV, radio, audio tape, ...	Modems, Teletext, ...
Digital Signal	Music CD, DVD, digital TV & radio, ...	Baseband networks e.g. Ethernet, Token Ring, ...

Question: Network Technologies

Discuss the advantages and disadvantages of

1. IEEE 802.3 100Base-TX
2. IEEE 802.3 100Base (fibre optics)
3. IEEE 802.11b

in terms of (a) *data rates*, (b) *installation costs*, and (c) *security*.

	100Base-TX	**100Base (fibre optics)**	**802.11b**
Data Rate	Fast enough most of the time (100Mbps)	For high bandwidth use (quality video streams, servers); potentially for upgrade	A bit slow (11Mbps); walls may limit range and speed
Cost	Cheap equipment and cables; costs for each new connection	Expensive equipment and cables; easiest to damage	No cabling cost or effort per connection; fairly expensive equipment
Security	Fairly secure	Good security; hard to tap	Simplest to physically tap; must use good encryption