CS 5/7-344

Computer Networks & Distributed Systems

Fall 2023

Practice Mid-term Exam

Student Name: **Key**

SMU ID:

Exam instructions

You are allowed the following resources for this exam:

- One sheet of notes (A4 – both sides)

Please put away all laptops and cell phones. You must use your own resources for this exam – sharing of resources is **not** allowed.

WHEN YOU HAVE COMPLETED THE EXAM, PLEASE SUBMIT YOUR EXAM AND NOTE SHEET. PLEASE PUT YOUR NAME ON BOTH ITEMS.

For instructor use only

Student Name: _____

SMU ID: _____

Problem	Points	Score
1	20	
2	20	
3	20	
4	20	
5	20	
Total	100	

TIME: 1 hour

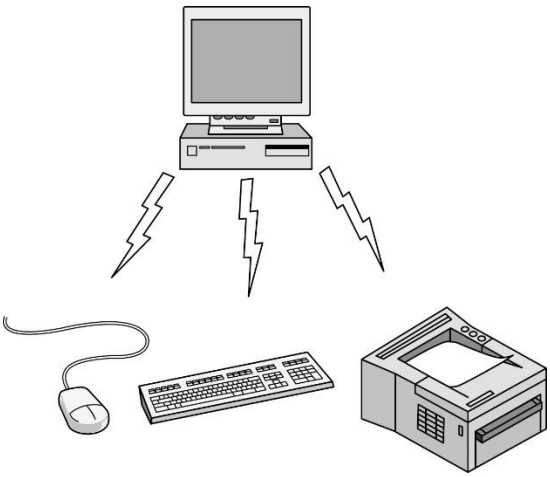
Explanation does not need to be exactly similar. If you write the key points of the answer in your own words, you should be fine.

Diagram does not need to include the details. You can represent them with boxes and proper labels.

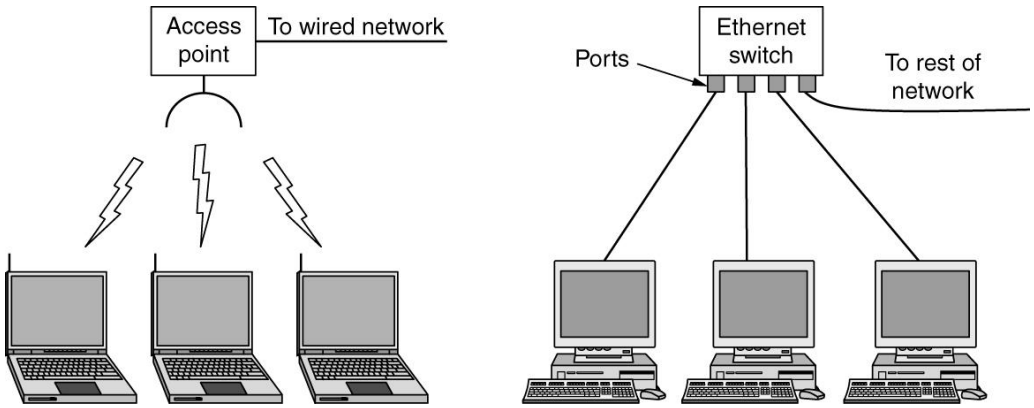
1)

A. (10 points) Define PAN and LAN? Can you provide a diagram for each?

PANs (Personal Area Networks) let devices communicate over the range of a person. A common example is a wireless network that connects a computer with its peripherals.



A LAN (Local Area Network) is a private network that operates within and near a single building such as a home, office, or factory. LANs are widely used to connect personal computers and consumer electronics to let them share resources and exchange information.



B. (5 points) Write three major flaws of TCP/IP model.

- Model does not clearly distinguish the concepts of services, interfaces, and protocols.
- The link layer is not really a layer at all in the normal sense of the term.
- Model does not distinguish between the physical and data link layers.

C. (5 points) Security is one of the major concerns that are now affecting a range of areas in Internet technology, and **Phishing** has become a serious problem for us. Can you explain how Phishing can be harmful?

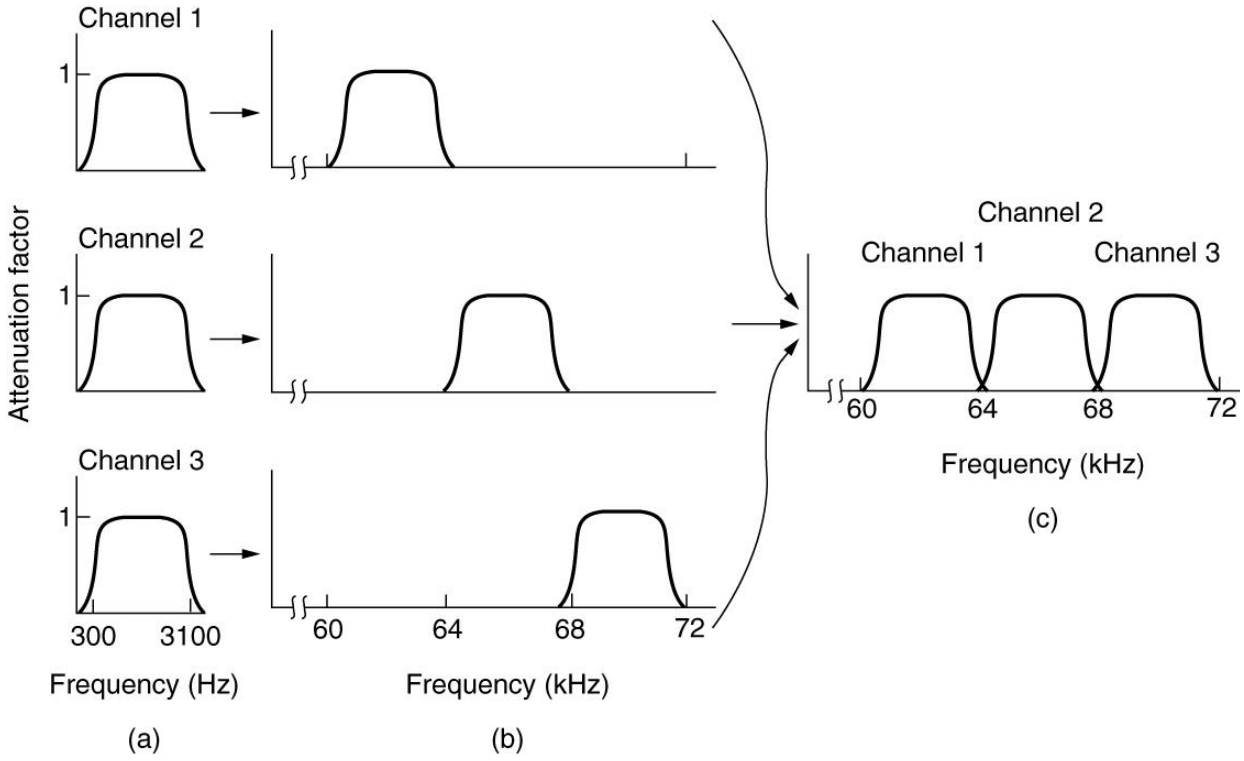
Phishing messages masquerade as originating from a trustworthy party, for example, your bank, to try to trick you into revealing sensitive information, for example, credit card numbers. Identity theft is becoming a serious problem as thieves collect enough information about a victim to obtain credit cards and other documents in the victim's name.

2)

A. (5 points) Write three advantages of Fiber over Coper.

- Handles higher bandwidth.
- Not affected by power surges, electromagnetic interference, power failures, corrosive chemicals
- Thin and lightweight

B. (15 points) Can you explain the following diagram?



(a) The original bandwidths. (b) The bandwidths raised in frequency. (c) The multiplexed channel

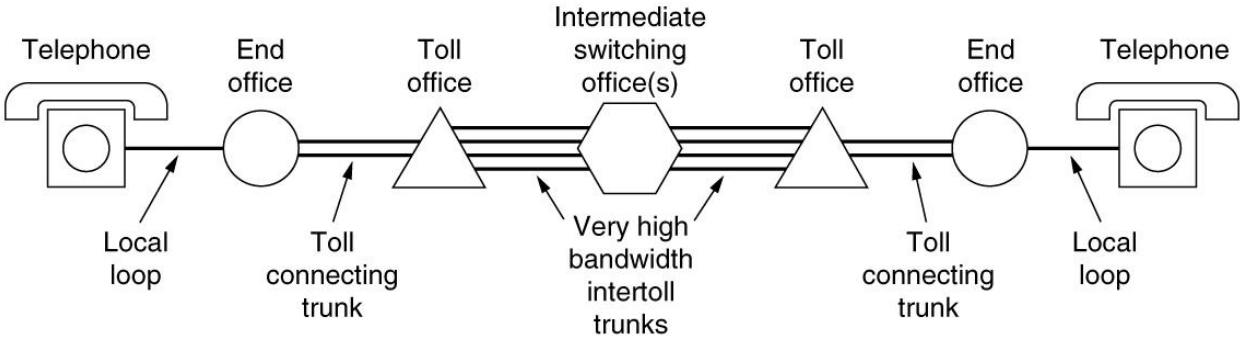
FDM (Frequency Division Multiplexing) takes advantage of passband transmission to share a channel. It divides the spectrum into frequency bands, with each user having exclusive possession of some band in which to send a signal. In this diagram, we see three voice-grade telephone channels multiplexed using FDM. Filters limit the usable bandwidth to roughly 3100 Hz per voice-grade channel. The excess bandwidth is called a guard band. It keeps the channels well separated. First, the voice channels are raised in frequency, each by a different amount. Then they can be combined because no two channels now occupy the same portion of the spectrum. Notice that even though there are gaps between the channels thanks to the guard bands, there is some overlap between adjacent channels.

3)

A. (5 points) Briefly explain the Cell concept.

In all mobile phone systems, a geographic region is divided up into cells, which is why the handsets are sometimes called cell phones. Each cell uses some set of frequencies not used by any of its neighbors. The key idea that gives cellular systems far more capacity than previous systems is the use of relatively small cells and the reuse of transmission frequencies in nearby (but not adjacent) cells.

B. (15 points) Can you explain the following diagram?



A typical circuit route for a long-distance call.

Each telephone has two copper wires coming out of it that go directly to the telephone company's nearest end office, also called a local central office. The two-wire connections between each subscriber's telephone and the end office are known in the trade as the local loop. Each end office has a number of outgoing lines to one or more nearby switching centers, called toll offices. These lines are called toll connecting trunks. The toll offices communicate with each other via high bandwidth intertoll trunks (also called interoffice trunks).

In summary, the telephone system consists of three major components:

1. Local loops (analog twisted pairs between end offices and local houses and businesses).
2. Trunks (very high-bandwidth digital fiber-optic links connecting the switching offices).
3. Switching offices (where calls are moved from one trunk to another either electrically or optically).

4)

A. (10 points) What is Piggybacking? What are the advantages of Piggybacking?

When a data frame arrives, instead of immediately sending a separate control frame, the receiver restrains itself and waits until the network layer passes the next packet. In effect, the acknowledgement gets a free ride on the next outgoing data frame. The technique of temporarily delaying outgoing acknowledgements so that they can be hooked onto the next outgoing data frame is known as piggybacking.

Advantages:

- A better use of the available channel bandwidth
- Lighter processing load at the receiver

B. (10 points) Can you explain the following code with a few sentences? Which model does this code belong to?

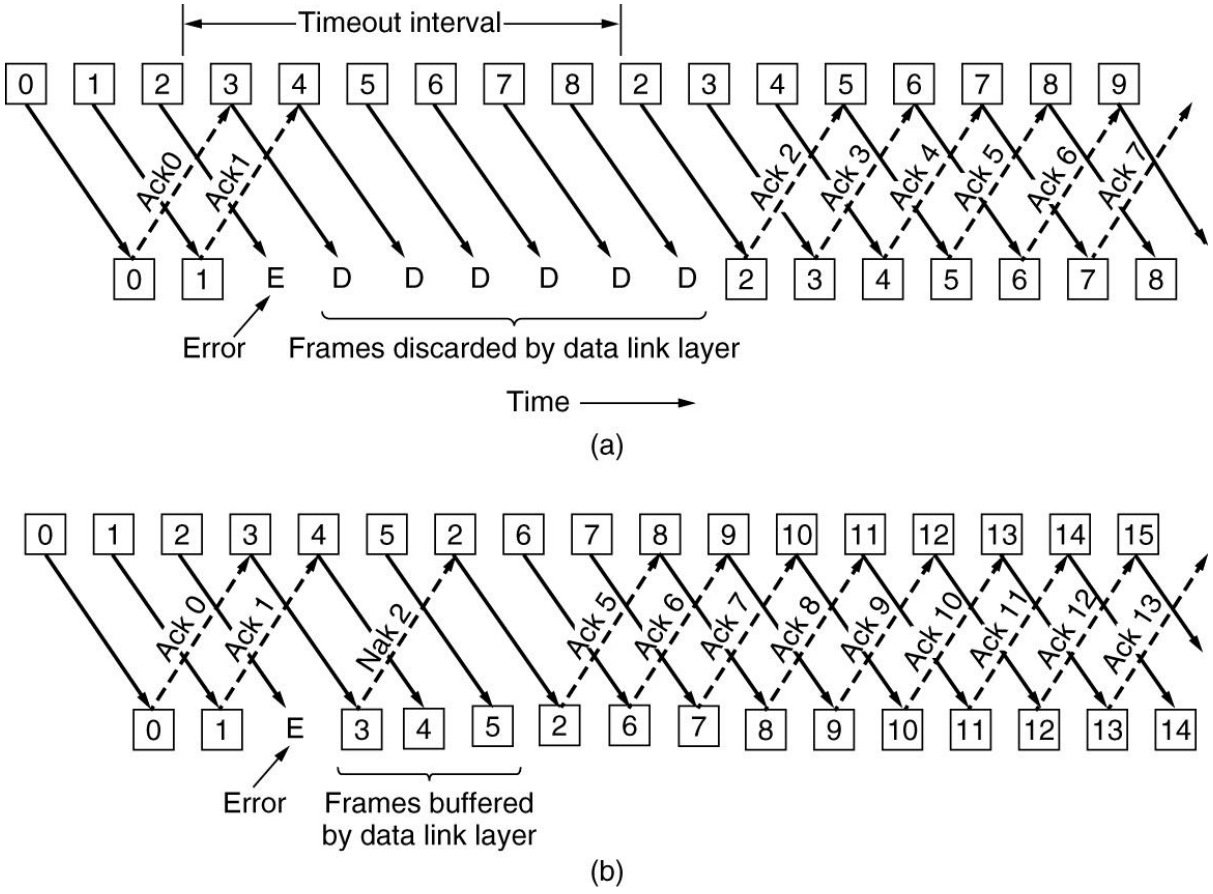
```
void receiver1(void)
{
  frame r;
  event_type event;     /* filled in by wait, but not used here */

  while (true) {
        wait_for_event(&event); /* only possibility is frame_arrival */
        from_physical_layer(&r);        /* go get the inbound frame */
        to_network_layer(&r.info);      /* pass the data to the network layer */
  }
}
```

The receiver waits for something to happen, the only possibility being the arrival of an undamaged frame. Eventually, the frame arrives and the procedure wait_for_event returns, with event set to frame_arrival (which is ignored anyway). The call to from_physical_layer removes the newly arrived frame from the hardware buffer and puts it in the variable r, where the receiver code can get at it. Finally, the data portion is passed on to the network layer, and the data link layer settles back to wait for the next frame, effectively suspending itself until the frame arrives.

This code belongs to the Utopia model.

5)

A. (20 points) Briefly explain go-back-n and selective repeat based on the following diagram.



(a) go-back-n (b) selective repeat

In go-back-n, if a frame in the middle of a long stream is damaged or lost, the receiver just discards all subsequent frames, sending no acknowledgements for the discarded frames. This strategy corresponds to a receive window of size 1. In other words, the data link layer refuses to accept any frame except the next one it must give to the network layer. If the sender's window fills up before the timer runs out, the pipeline will begin to empty. Eventually, the sender will time out and retransmit all unacknowledged frames in order, starting with the damaged or lost one. This approach can waste a lot of bandwidth if the error rate is high.

An alternative strategy, the selective repeat protocol, is to allow the receiver to accept and buffer correct frames received following a damaged or lost one. When it is used, a bad frame that is received is discarded, but any good frames received after it are accepted and buffered. When the sender times out, only the oldest unacknowledged frame is retransmitted. If that frame arrives correctly, the receiver can deliver to the network layer, in sequence, all the frames it has buffered. Selective repeat corresponds to a receiver window larger than 1. This approach can require large amounts of data link layer memory if the window is large.