CS 447-003 Networks and Data Communications
Spring 2024
Quiz #3 on January 25, 2023 (SOLUTIONS)

Your Last Three Digits: _____
(please do NOT write all of your student ID or your name)

Grade: _____

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(1) If network protocols are implemented without "packet encapsulation", what problems would we have?

At least the following problems:

- We can not combine different protocols
- When anything in a protocol needs to be changed, it requires everything else to be updated.
- Trouble-shooting bugs may not be easy (we need to look for a problem in a huge protocol implementation).

Ideally, you can describe more details, such as:

- When anything in a protocol suite needs to be updated (e.g., for bug fixes), the entire protocol needs to be updated (or replaced).
- When different protocol service(s)/function(s) are needed, the entire protocol suite needs to be replaced. For example, the same "IP" protocol can not be used when "UDP" is used instead of "TCP".

(2) What are the major advantages in using "network protocols"? What are the major disadvantages in using "network protocols"?

The followings are the three possible reasons we discussed in the classroom on 1/23:

- Application programmers (network applications, such as browsers, streaming-videos, emails, and etc.) can focus on their application developments (they do not have to spend time to develop their own network functions) – thus developing network applications will be easier and cheaper.
- Universal communication by network applications developed by different application programmers. Since the existing network protocols are the standards known to many network programmers, using existing protocols let the network applications developed by

different network application programmers possible (even if they never have a chance to see/meet/discuss).

- Since most of the existing network protocols have been used by many network application programmers, they are more reliable.

Note 1: The underlined concept needs to be described/emphasized for full credit.

Note 2: At least three different "problems" are expected for full credit.

(3) What is the primary weakness in "stop-and-wait flow control"?

Since a sender has to wait for a positive acknowledgement to come back from a receiver, the sender has to stop after each time it finishes transmitting a packet. This causes relatively long time waste, which lowers the link utilization ("poor link utilization").

Note: the underlined concept needs to be described/emphasized (i.e., just writing "flexibility" without a decent description of the key concept will not earn credit for this question).

(4) What is "link utilization"? How is "link utilization" calculated for stop-and-wait flow control (show the formula)?

The link utilization is defined as the ratio of the time a sender uses to actually send its payload to the total amount of the time to perform the payload transmission.

For the stop-and-wait flow-control, its expected link utilization can be calculated as*:

U = (the packet transmission delay)/(the packet transmission delay) + (2 × (the signal propagation delay))

Note *: the packet transmission delay for transmitting an acknowledge message by a receiver is ignored

(5) Name each layer of the OSI seven-layer model (from low level (= layer 1) to high level).

Layer 1: Physical layer
Layer 2: Data-link layer
Layer 3: Network layer
Layer 4: Transport layer
Layer 5: Session layer
Layer 6: Presentation layer
Layer 7: Application layer