

SIMON FRASER UNIVERSITY  
SCHOOL OF ENGINEERING SCIENCE

Spring 2013  
ENSC 427: COMMUNICATION NETWORKS

Midterm No. 2(a)  
Monday, March 18, 2013

*Duration: 50 minutes. Attempt all problems. Questions may not be equally weighted. Closed book and closed notes. Simple calculators (with no graphing/programming functions) are permitted. PDAs, laptops, and wireless phones are not permitted.*

**Please circle your answers.**

**Incorrect answers carry a penalty of 0.5 mark.**

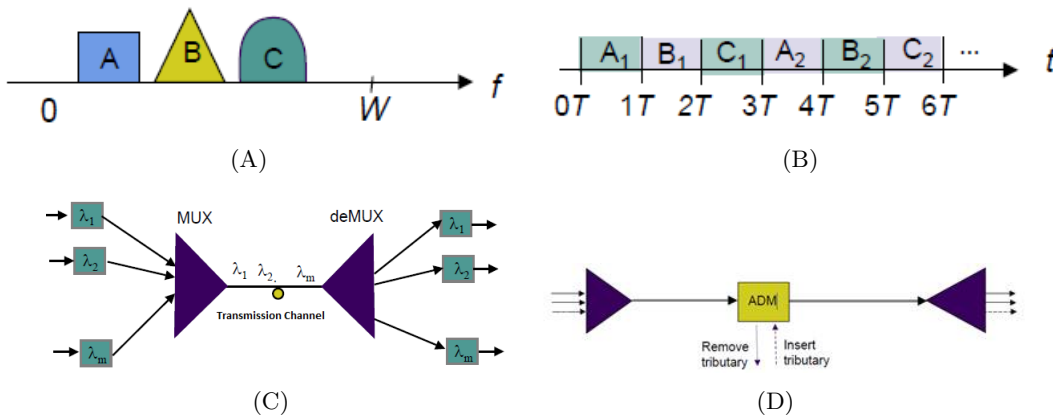


Figure 1: Question 1.

1. **Circuit-Switching Networks :**

Consider Figure 1. Select **all** statements that apply:

- (a) Figure A: Broadcast television stations employ this multiplexing method.
- (b) Figure B: This method is only used to multiplex analog signals.
- (c) Figure C: Multiplexed connections share a single high-speed analog transmission line.
- (d) Figure C: This multiplexing method is widely used in optical fiber transmission systems.
- (e) Figure D: The SONET add-drop multiplexers (ADMs) decrease the multiplexing efficiency.

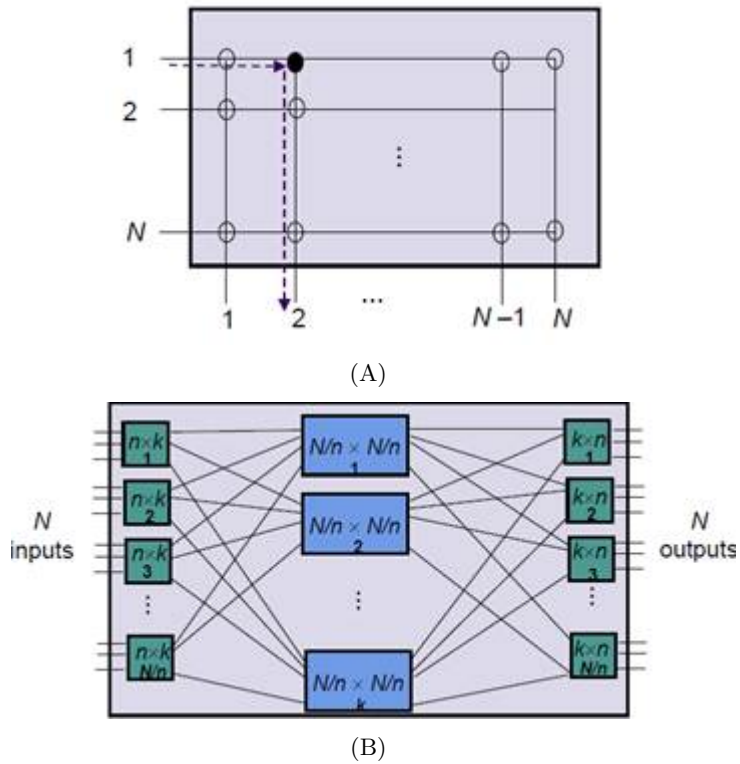


Figure 2: Question 2.

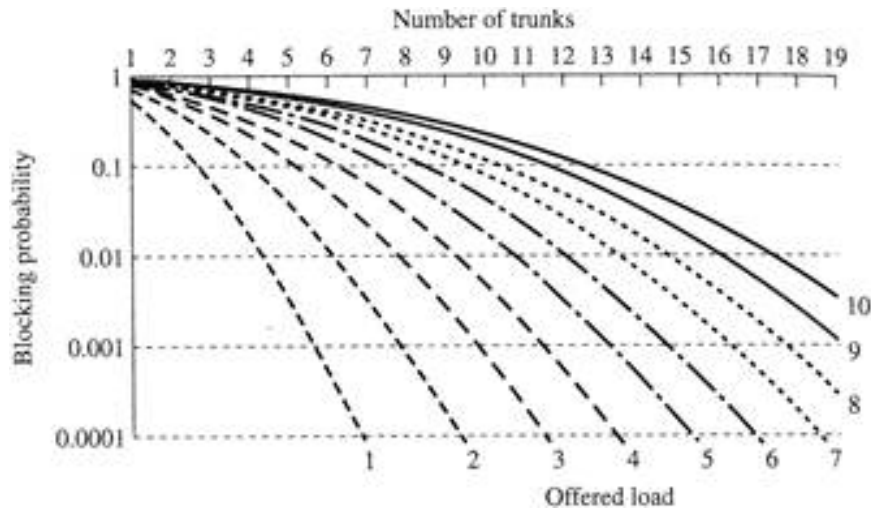
2. **Circuit-switching networks:**

Consider Figure 2. Select **all** statements that apply:

- (a) Figure A: Connection requests in this switch type are denied only when the requested outgoing switch port is busy.
- (b) Figure A: Shown is an example of time-slot interchange switching.
- (c) Figure B: Shown is a general architecture of a non-blocking switch.
- (d) Figure B: In a Clos non-blocking circuit switch  $k = n - 1$ , where  $k$  is the number of intermediate switches and  $n$  is the number of inputs.
- (e) Hybrid circuit switch combines switch types shown in Figure A and Figure B.



(A)



(B)

Figure 3: Question 3.

### 3. Circuit-switching networks:

Consider Figure 3. Select **all** statements that that apply:

- (a) Figure A: Handoff occurs when a mobile user moves from cell A to cell B.
- (b) Figure A: The frequency band used in cell 3 may be reused in cell 5.
- (c) Figure B: The offered load is defined as the total rate at which work is offered by users to the multiplexing system.
- (d) Figure B: The offered load of 5 Erlangs requires 13 trunks in order to satisfy blocking probability for a typical trunk system.
- (e) Figure B: The Erlang B formula for blocking probability of a system is

$$P_B = \frac{a^c/c}{\sum_{k=0}^c a^k/k},$$

where  $a$  is the offered load and  $c$  denotes the number of trunks.

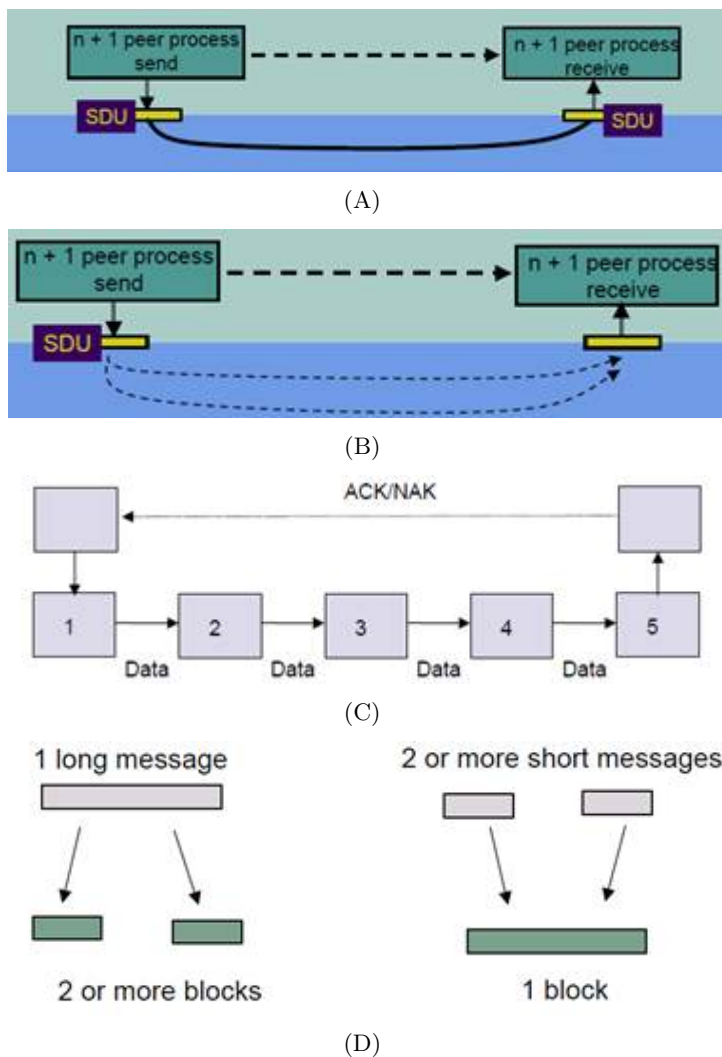


Figure 4: Question 4.

4. Peer-to-Peer Protocols and Data Link Layer:

Consider Figure 4. Select **all** statements that apply:

- (a) Figure A: Transmission control protocol (TCP) and point-to-point protocol (PPP) are examples of this transfer service.
- (b) Figure B: This is a service model where connections are established between the layer-n peers.
- (c) Figure C: The end-to-end error recovery approach is preferred when errors are more likely to occur.
- (d) Figure C: Transmission control protocol (TCP) employs the end-to-end error recovery.
- (e) Figure D: A layer breaks long messages into smaller blocks and reassembles them at the source.

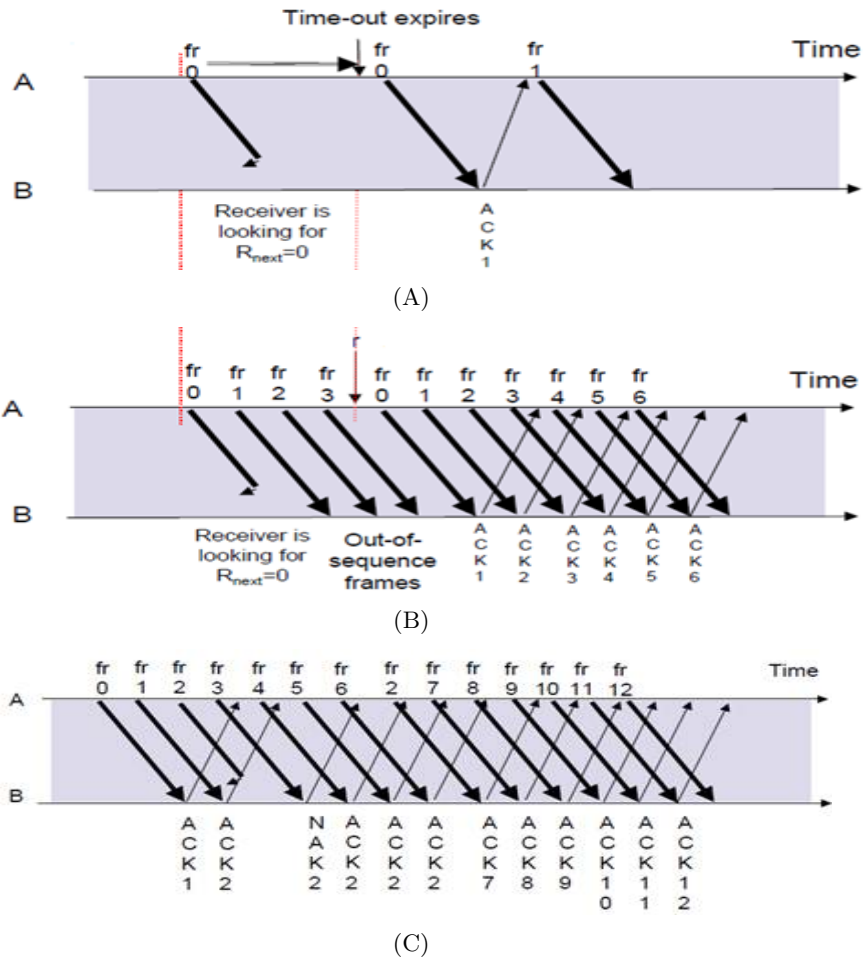


Figure 5: Question 5.

5. Peer-to-Peer Protocols and Data Link Layer:

Consider Figure 5. Select **all** statements that apply:

- (a) Figure A: If frame size is 5,000 bits, link speed is 1 Mbps, and wait time for an ACK is 2 ms. The efficiency of the scheme is 80%.
- (b) Figure B: Shown is a sequence describing the Go-Back-3 Automatic Repeat Request (ARQ) protocol.
- (c) Figure B: If  $m$  bits are used for sequence numbers, the windows size in Go-Back-N ARQ protocol should be less than  $2^m$ .
- (d) Figure C: If  $P_f$  denotes the frame loss probability. the efficiency of Selective Repeat ARQ protocol is directly proportional to  $(1 - P_f)$ .
- (e) Figure C: The maximum allowable *send window* size in the Selective Repeat ARQ protocol is  $2^m$ , where  $m$  bits are used for sequence numbers.

**6. Peer-to-Peer Protocols and Data Link Layer:**

Select **all** statements that apply:

- (a) The goodput is the amount of actual user information that is transmitted.
- (b) Transmission control protocol (TCP) uses the Go-Back-N Automatic Repeat Request protocol.
- (c) Flow control is a procedure that prevents congestion in a network.
- (d) Transmission control protocol (TCP) uses the *advertised window*  $W_A$  for the end-to-end flow control.
- (e) Average delay for the M/M/1 system is smaller than the average delay for the M/D/1 system.

**7. OPNET Tutorial: M/M/1 Queue:**

Select **all** statements that apply:

- (a) An M/M/1 queue has a last-in-first-out (LIFO) buffer.
- (b) An M/M/1 queue may have more than one server (processor) that retrieves packets from the buffer for processing.
- (c) The mean queuing delay in the simulated M/M/1 queue is close to the mathematically calculated mean delay value.
- (d) The average queuing delay in the simulated M/M/1 queue does not reach a steady-state value.
- (e) The simulated M/M/1 queue is stable because the time-average queue size does not exceed the acceptable limit of 20 seconds and the queue is not monotonically increasing.

**8. OPNET Tutorial: CSMA/CD :**

Select **all** statements that apply:

- (a) The generic Aloha transmitter node model only generates packets and sends them on the bus.
- (b) The Finite State Machine (FSM) of the generic Aloha transmitter process model has three states: `init`, `idle`, and `tx_packet`.
- (c) The FSM of the generic receiver process model transits out of the `idle` state upon receiving a packet.
- (d) Aloha performs better than CSMA in terms of throughput.
- (e) The theoretical maximum channel throughput that Aloha may achieve is  $1/(2e)$ , where  $e \approx 2.718$ .

**Case Study: WiMAX:**

A network topology shown in Figure 6 that consists of geographically separated video client and video services subnets, was employed to compare the WiMAX performance to the ADSL broadband access for streaming video applications. The video client subnet, shown in Figure 7, is located in Vancouver and consists of four video client stations that access the video on demand services from Toronto. The three fixed wireless WiMAX stations are located 2 km, 4 km, and 6 km from the WiMAX base station. The fourth video client is an ADSL station located 1 km from the carriers central office. All clients stream Constant Bit Rate (CBR) video conferencing, MPEG-2, and MPEG-4 video formats. Considering these topologies, answer Questions 7 and 8.

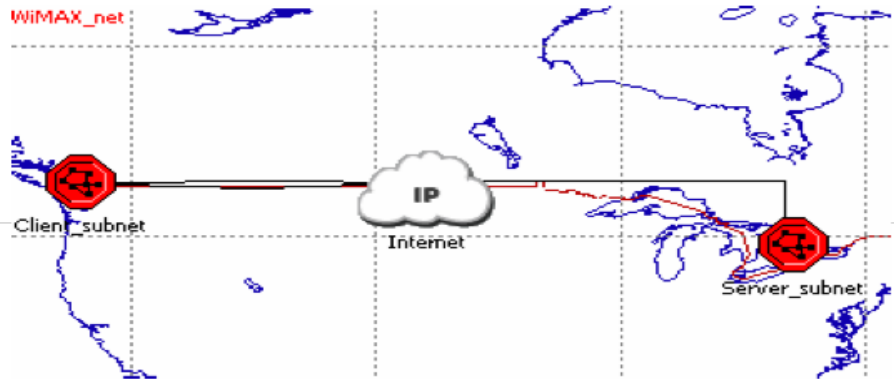


Figure 6: The network topology consisting of geographically separated video client and video services subnets.

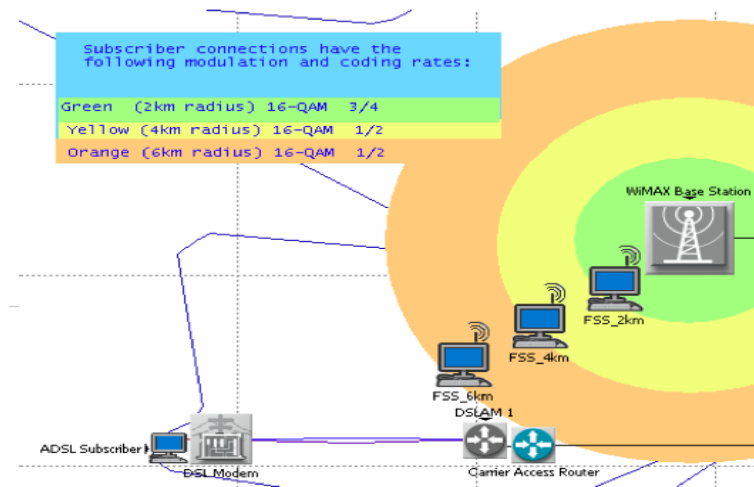


Figure 7: The video client subnet located in Vancouver.

9. Select **all** statements that apply:

- (a) Average packet jitter less than 20 ms is ideal for video streaming.
- (b) Average packet delay less than 20 ms is ideal for video streaming.
- (c) The ADSL station experiences higher video packet jitter than the WiMAX stations.
- (d) The 16-QAM modulation technique has lower SNR requirements than the 64-QAM.
- (e) The WiMAX network does not satisfy the video performance metrics.

10. Select **all** statements that apply:

- (a) The 6 km WiMAX station (FSS\_6km) has the highest down-link Signal to Noise Ratio (SNR).
- (b) It is expected that the 4 km WiMAX station experiences a higher loss rate than the 6 km station over the simulation time.
- (c) The ADSL station experiences lower end-to-end delay than the WiMAX stations.
- (d) WiMAX stations experience lower packet loss rates if the WiMAX Base Station (BS) buffer size is increased.
- (e) The WiMAX network is capable of delivering higher throughput rates than ADSL.