EKSAMEN / EXAM	TTM4100	23	05	2006

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1.1

Circuit switching is a switching technique for communication networks. Circuit switching creates a direct physical connection/path between two devices. The transmission capacity on the path is exclusively reserved for the connection. *(p.147)*

1.2

Packet switching is a switching technique for communication networks. In packet switching, each packet has a header providing an address to identify the destination. In the network, packets are switched in the store-and-forward manner, i.e., at each node, packets are received and stored, before being forwarded to the next hop. *(p.150)*

1.3

Circuit switching requires a connection setup, while packet switching may not have the setup process. (ii) Packet switching uses store-and-forward transmission, while with circuit switching, the bits just flow through the path continuously. (iii) Circuit switching is completely transparent to the sender and receiver, and they can use any bit format or framing method they want to. But, with packet switching, packets have special formats in assembling bits or frames. (iv) In circuit switching, the transmission capacity on a path is dedicated to the corresponding connection, while in packet switching, the transmission capacity on a link is shared by packets from different connections. Etc. *(Table 2-40, p.151 in the textbook & the table on slide 23 of Lecture 2)*

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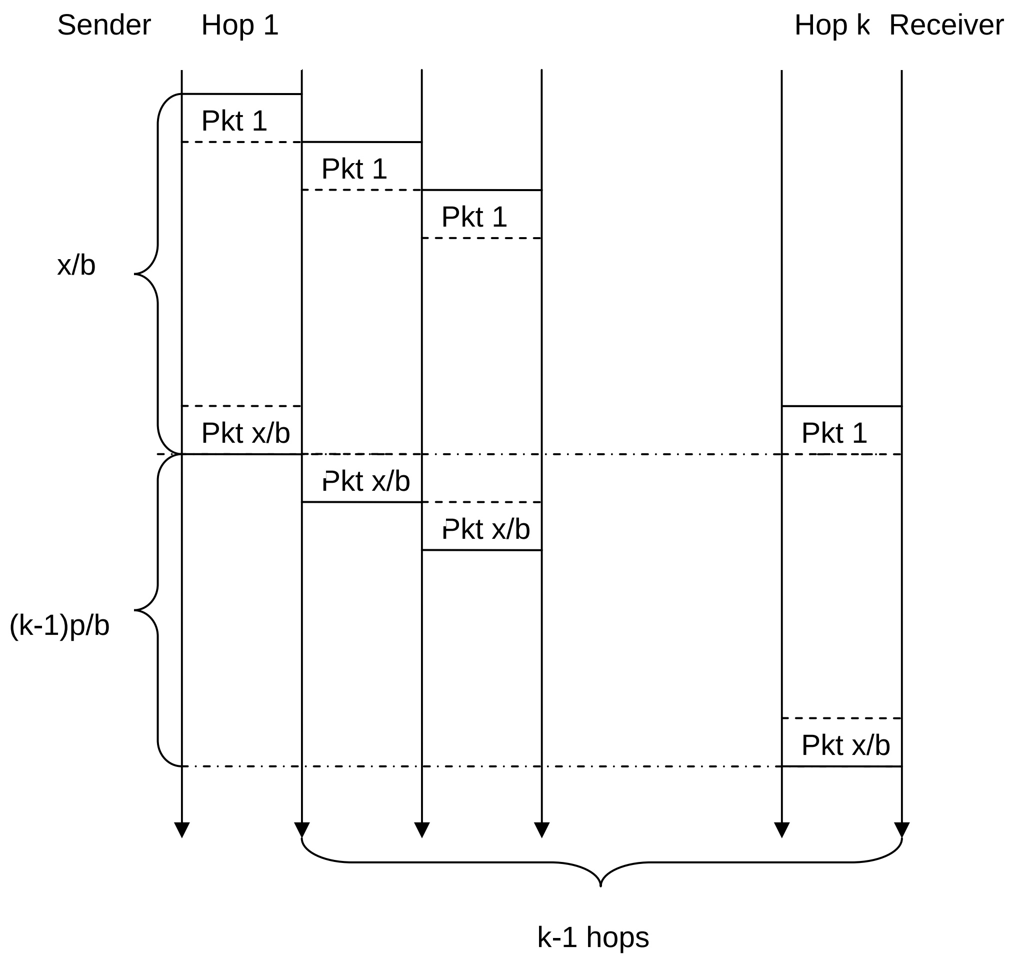
1.4.1

Over the circuit-switched network, the total delay is due to three parts: the setup time ***s***, the total propagation delay ***kd***, and the transmission time ***x/b***. So, ***the total delay = s + kd + x/b***. *(Figure 2-39, p.149, & Problem 42, p.180)*

1.4.2

Over the packet-switched network, the total delay includes two parts: the total propagation delay ***kd***, and the transmission time at each hop. For the transmission time, the ***x***-bit user data is split into (***x/p***) packets. These packets are pipelined during the transmission. It can be seen from the following illustration that the transmission time part = ***x/b + (k-1)p/b***. So, ***the total delay = kd + x/b + (k-1)p/b***. (Note: In the following illustration, the propagation delay is ignored for simplicity.)



1.4.3

With results above, when ***s > (k-1)p/b***, the packet-switched network has a lower total delay.

2.1.1

Layer 2 is the Data Link Layer. Its main function is to enhance a physical channel with a raw stream of bits to a (hopefully) error-free, flow-controlled, frame-oriented information channel. Detailed functions include framing, error control, flow control, etc. Medium access control is also done in this layer. (*p.38*)

2.1.2

Layer 3 is the Network Layer. It is concerned with getting user data from the source to the destination. Routing is the most important function of Layer 3. Other functions include addressing, congestion control, etc. (*p.39*)

2.1.3

Layer 4 is the Transport Layer. It enhances the network service to an appropriate end-to-end service. Important functions of Layer 4 include flow control, error control, addressing, etc. (*p. 40*)

2.2.1

In connection-oriented service, a connection is set up before information data transfer. All information data are transmitted along the same connection path to reach the destination. After the transmission, the connection is released. (*p. 32*)

2.2.2

In connectionless service, no connection is set up before the information data are transmitted. In addition, data are transferred as units, each with an address. Each unit is routed independently to the destination. (*p. 32*)

2.2.3

The principal difference is that the connection-oriented service needs to set up a connection before transmission and release it after transmission, while the connectionless service needs not. (*p. 32, also Problem 13 on p. 82*)

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	Riktig True	Galt False		Riktig True	Galt False		Riktig True	Galt False		Riktig True	Galt False
2.3.1	☐	☒	3.1.1	☒	☐	3.2.1	☒	☐	3.3.1	☒	☐
2.3.2	☒	☐	3.1.2	☒	☐	3.2.2	☐	☒	3.3.2	☒	☐
2.3.3	☐	☒	3.1.3	☐	☒	3.2.3	☐	☒	3.3.3	☐	☒
2.3.4	☐	☒	3.1.4	☒	☐	3.2.4	☒	☐	3.3.4	☒	☐
2.3.5	☐	☒	3.1.5	☐	☒	3.2.5	☐	☒	3.3.5	☐	☒
2.3.6	☐	☒	3.1.6	☐	☒	3.2.6	☐	☒	3.3.6	☒	☐
2.3.7	☐	☒	3.1.7	☐	☒	3.2.7	☒	☐	3.3.7	☐	☒
2.3.8	☐	☒	3.1.8	☒	☐	3.2.8	☒	☐	3.3.8	☒	☐
2.3.9	☒	☐									
2.3.10	☒	☐									

3.4

Sequence Number / *Messages/packets /signals/sub-sequence*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
a) Q.931 Telephone call											x				
b) H.225 RAS Admission					x										
c) H.225 RAS (Registration/Admission/Status)			x												
d) Q.931 CALL PROCEDURE									x						
e)H.245 Negotiation of call parameters														x	
f) Q.931 ALERT												x			
g) H.225 Gatekeeper Discovery	x														
h) H.225 Response to Gatekeeper Discovery		x													
i) H.225 Response to RAS				x											
j) H.225 Response to RAS Admission						x									
k) H.225 Establish TCP connection							x								
l) Q.931 SETUP								x		x					
m) Q.931 CONNECT													x		
n) N.245 Setup of data RTP channels															x

Or:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
g	h	c	i	b	j	k	l	d	l	a	f	m	e	n

4.1 *(p.502-505)*

Asymmetric release is abrupt and may result in data loss.

Symmetric release is needed to avoid loss of data. However, symmetric release is not simple in environments where packets are lost. The two-army problem exists in symmetric release.

To address the two-army problem, three-way hand shake, timers and retransmission are needed for connection release.

Normal procedure: (1) DR (sent by Host 1); (2) DR (sent by Host 2); (3) DC (sent by Host 1). Here, DR is short for Disconnection Request and DC for Disconnection Confirm.

When there are losses, the following actions are taken:

Case DC (sent by Host 1) lost:

Handled by disconnection timeout in Host 2.

Case DR (sent by Host 2) lost:

Handled by timeout in Host 1 and resending of DR (sent by Host 1)

Case DR (sent by Host 2) lost and all resendings of DR (sent by Host 1) are lost:

Disconnection by timeout in Host 1 and Host 2.

Case DR (sent by Host 1) lost and also the retransmissions are lost:

Give half open connection.

4.2

(Slides 36-41, Lecture 6; and p.206-211 in textbook): Flow control is the receiver controls the data flow from the sender.

In stop-and-wait flow control, the sender sends one packet and then waits for an acknowledgment from the receiver before proceeding to send the next packet. In particular, after sending a packet, the sender keeps waiting and checking if there is an acknowledgement for this packet. If a pre-defined timeout time has passed for the waiting, the sender re-sends the packet. If the acknowledgement is received, the sender sends the next packet. At the receiver side, it sends back to the sender an acknowledgement for the packet it receives correctly.

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	Riktig True	Galt False		Riktig True	Galt False		Riktig True	Galt False		Riktig True	Galt False
4.3.1	☒	☐	4.3.5	☒	☐	4.3.9	☐	☒	4.3.13	☒	☐
4.3.2	☒	☐	4.3.6	☒	☐	4.3.10	☒	☐	4.3.14	☒	☐
4.3.3	☒	☒	4.3.7	☐	☒	4.3.11	☒	☐	4.3.15	☐	☒
4.3.4	☐	☒	4.3.8	☐	☒	4.3.12	☐	☒	4.3.16	☐	☒

5.1

The optimality principle for routing states that if router ***J*** is on the optimal path from router ***O*** to router ***B***, then the optimal path from ***J*** to ***B*** also falls along the same route. *(p.352)*

	Riktig True	Galt False		Riktig True	Galt False		Riktig True	Galt False		Riktig True	Galt False
5.2.1	☒	☐	5.2.5	☒	☐	5.2.9	☒	☐	5.2.13	☒	☐
5.2.2	☐	☒	5.2.6	☐	☒	5.2.10	☐	☒	5.2.14	☒	☐
5.2.3	☐	☒	5.2.7	☐	☒	5.2.11	☐	☒			
5.2.4	☒	☐	5.2.8	☒	☐	5.2.12	☐	☒			

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6.1

The Hamming distance of this code set is 4. (The Hamming distance of a code set is the minimum Hamming distance of any two codes within the code set. And, the Hamming distance of two codes is the number of bit positions in which the two codes differ. See p. 193-194.)

	Riktig True	Galt False		Riktig True	Galt False
6.2.1	☒	☐	6.2.5	☐	☒
6.2.2	☐	☒	6.2.6	☒	☐
6.2.3	☐	☒	6.2.7	☐	☒
6.2.4	☐	☒	6.2.8	☒	☐

	Riktig True	Galt False		Riktig True	Galt False		Riktig True	Galt False		Riktig True	Galt False
6.3.1	☐	☒	6.3.5	☒	☐	6.3.9	☐	☒	6.3.13	☒	☐
6.3.2	☐	☒	6.3.6	☐	☒	6.3.10	☐	☒	6.3.14	☒	☐
6.3.3	☒	☐	6.3.7	☒	☐	6.3.11	☐	☒	6.3.15	☒	☐
6.3.4	☐	☒	6.3.8	☒	☐	6.3.12	☐	☒			

	Riktig True	Galt False		Riktig True	Galt False		Riktig True	Galt False		Riktig True	Galt False
7.1.1	☒	☐	7.2.1	☒	☐	8.1.1	☐	☒	8.1.4	☐	☒
7.1.2	☒	☐	7.2.2	☐	☒	8.1.2	☒	☐	8.1.5	☒	☐
7.1.3	☐	☒	7.2.3	☐	☒	8.1.3	☒	☐	8.1.6	☐	☒
7.1.4	☐	☒	7.2.4	☒	☐						
7.1.5	☐	☒	7.2.5	☐	☒						

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KOMMENTARER COMMENTS

Remark 1: Grading Rule for Problem 3.4

Problem 3.4 is a new type where it is asked to show the correct sequence of various messages/packets/signals/sub-sequences. The grading rule for such a problem is as follows:

Suppose the problem has maximum score ***X*** points. Also suppose the sequence includes ***M*** messages/packets/signals/sub-sequences. In this case, there are ***(M-1)*** adjacent points of messages/packets/signals/sub-sequences in the answer. Correspondingly, in the correct sequence, there are ***(M-1)*** correct adjacent pairs of messages/packets/signals/sub-sequences. For example, suppose there are 5 messages represented by ***a, .., e***, and the correct sequence is 1) ***a,*** 2) ***b,*** 3) ***c,*** 4) ***d,*** 5) ***e***. In this example, there are 4 correct adjacent pairs: (***a, b); (b, c); (c, d); (d, e)***.

When grading the problem, the number of correct pairs in the answer by a student is counted, no matter where these pairs appear in the sequence in this answer. Suppose this number is ***N***. Then, the resulting score of this problem for this student is calculated as follows:

$$\textbf{Points} = B + (X-B) * \frac{N}{M-1}$$

, where ***B (<X)*** is a basic score that any student will get.

For the example given above, assume a student's answer is 1) ***e,*** 2) ***a,*** 3) ***b,*** 4) ***c,*** 5) ***d.***
In this answer, there are 3 correct pairs: (a, b); (b, c); (c, d).
So, the student will get ***B + (X-B)*3/4*** points.

For Problem 3.4 in the Exam, May 2006, ***M=15***, ***X=8***, and ***B*** is set to be ***4***.

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KOMMENTARER COMMENTS

Remark 2 on Answer to Problem 1.4

In Problem 1.4, the total delay definition is a bit ambiguous. In the answer given above, for circuit switching, the circuit setup time is counted into the total delay. However, ***if the definition of total delay in the Problem is interpreted wordily, the circuit setup time may not be counted into the total delay in the answer to this specific Problem 1.4.*** In this case, while the total delay for the packet-switched network is still ***kd+x/b + (k-1)p/b*** for Problem 1.4.2, the total delay for the circuit-switched network is now: ***kd+x/b*** for Problem 1.4.1. Given this, for Problem 1.4.3, the answer is that there is no way for the packet-switched network to have a lower total delay, since ***kd+x/b ≤ kd+x/b + (k-1)p/b***. This answer to Problem 1.4 is also acceptable.

Remark 3 on Statement 4.3.3

Statement 4.3.3 is both true and false due to some ambiguity in the book. Particularly, the transport address is defined to be the TSAP (Transport Service Access Point) in the book, which may include the network address (e.g. see p.494-496 in the book and related lecture slides), or may not (e.g. see p.533 for TCP). In the former case, the statement could be true, while in the latter case, it should be false. Due to this ambiguity, everyone will get the corresponding point for this Statement 4.3.3.

Remark 4 on Statement 3.1.7 and Statement 3.1.8

It is easy to find many Internet addresses, such as "www.google.com", that do not follow geographical boundaries. For the "google" case, the name is mapped to "www.goole.no" in Norway, while to others in other countries. Please also note that while, maybe very often, "country" is linked to geographical area, it also is a sort of organization (particularly under DNS).