Note! The problem set consists of two parts:
- *Part I: The problem specifications pages*
- *Part II: The answer pages*

Part I: The problem specifications

NTNU
The Norwegian University of
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Page 1 of 11

English (original)

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The exam rooms will be visited in the time period between 10am and 12am.

Exam in course:

"TTM4100 COMMUNICATION – SERVICES AND NETWORKS"

10. June 2005
09:00 – 13:00

Grading results 1. July 2005
(This is the date for sending the results from the Department of telematics to the Student and Academic Division of NTNU)

Remedies:
D: No printed or handwritten remedies allowed.
   Determined, simple calculator allowed.

Rules:

The problem set consists of two parts:

- Part I, the problem specifications pages (numbered pages 1 to 11), defines the rules to follow and the questions to be answered.
- Part II, the answer pages (numbered pages 1 to13), includes "Written text" fields and the answer alternatives for multiple-choice. The rules must be followed when answering the questions. Part II also includes a page where you may give comments related to *formal issues* about Part I or Part II, or the exam in general. The page may also be used for "Written text" answers. The sensors will read and decide how to use the comments.

The answer pages (Part II) shall be delivered as your answer. Two copies of Part II are handed out. Only one copy shall be delivered as your answer.

The student number shall be written twice on all answer pages (Part II) ***with digits.*** The sheets will be read optically, except for "Written text" answers. Follow the rules below to avoid wrong interpretations.

Use blue or black ballpoint-pen, ***not a pencil.***

Check the boxes as clear as you can, like this: ☒

If you check the wrong box, fill it completely, like this: ■

Then check the correct box.

Other correction methods, e.g. use of eraser, correcting fluid, etc., are not permitted

Do not write outside the box fields or the student number fields.

Score

The maximum score for the exam is 100 points. A sub-problem has a defined maximum score X points. A sub-problem may be defined by using various types of box fields. In this exam we have three different types of box fields:

- **Written text**. *A sub-problem shall be answered by Written text. In that case the answer shall be written in the supplied marked box in the answer page. The answer can give from 0 to max X points*.
- **Check 1 out of N boxes***: You obtain 0 points if an incorrect box is checked or if none, two or more boxes are checked. For correct answer you get X points, if you only have checked one box.*
- **True or False***: Check one box per statement, or do not check. If 'True' and 'False' both are checked for a statement, it counts as an incorrect mark. If the sub-problem has M statements and the maximum score for this sub-problem is X points, then the resulting score is calculated as follows:*

$$Points = dif * \frac{X}{M},$$ *where "dif" is the difference between the number of correct marks and the number of "discounts points" and where "discount points" are found from the Table below.*

number of incorrect marks	discount points
1	0
2	1,5
i >= 3	i

Formally we have: dif =Max{(number of correct marks – discount points), 0},

This mapping between incorrect marks and discount points allows you to guess wrong once without being punished.

Note that the True or False problem does not give incorrect marks if you do not check any of the two boxes for a given statement.

1   Switching (2+2+4=8 points)

(Write the answer as Written text in the box in the answer page for the questions)

1.1	What is switching?

(Write the answer as Written text in the box in the answer page for the questions)

1.2	What is store-and forward switching?

(Write the answer as Written text in the box in the answer page for the questions)

1.3	Define different store-and-forward switching principles used for network layer switching.

2   Protocol concepts (26 points)

2.1   Define the concepts (1+1+1+1+1=5 points):

(Write the answer as Written text in the box in the answer page for the questions)

2.1.1	Protocol layer
2.1.2	Protocol entity
2.1.3	Protocol data unit (PDU)
2.1.4	Service access point (SAP)
2.1.5	Service primitive

2.2   Explain the functionality of the layers 1, 2, 3 and 7 of the ISO/OSI seven layer reference mode (1+1+1+1=4 points)

(Write the answer as Written text in the box in the answer page for the questions)

2.2.1	Layer 1
2.2.2	Layer 2
2.2.3	Layer 3
2.2.4	Layer 7

(Write the answer as Written text in the box in the answer page for the questions)

2.3	What is flow control?	(1 point)

(Write the answer as Written text in the box in the answer page for the questions)

2.4	What are the similarities and differences concerning flow control on layer 2 and layer 4 of the ISO/OSI reference model? (2 points)

(Write the answer as Written text in the box in the answer page for the questions)

2.5	Define the ISO/OSI service primitives for the transport and network service. (3 points)

(Write the answer as Written text in the box in the answer page for the questions)

2.6	Define the ISO/OSI protocol data units for the transport and network layer protocol. (3 points)

(Write the answer as Written text in the figure in the answer page for the questions)

2.7	A system is considered consisting of transport and network layers with connection oriented services and protocols. Draw a signal sequence diagram in the figure which illustrates the service primitives used between adjacent layers. Transport protocol data units carried in the network service primitive shall also be illustrated (8 points)

3   TCP service and protocol (3+3+6=12 points)

(Write the answer as Written text in the box in the answer page for the questions)

3.1	Define the procedure calls used by the applications using the TCP service. For each of the service primitives, explain which of the following entities that is the initiator of the procedure call: the application client, the application server, the TCP client entity or TCP server entity.

(Write the answer as Written text in the box in the answer page for the questions)

3.2	What are the elements of addressing involved for an application client that is making a TCP connection to a TCP server? How can the application client get the needed addresses.

(Write the answer as Written text in the box in the answer page for the questions)

3.3	Discuss the problems and solutions related to connection release in TCP.

4   The physical layer and the link layer (10 points)

4.1   Signals (2.5 points)

Which of the following statements are TRUE:
(Check one box in the answer page (1 out of 5))

A	A digital signal can not be sent over an analog channel
B	A MODEM may be used to adapt a digital signal to an analog channel
C	A digital signal is always less than 2 in amplitude
D	If a CODEC is used, the transmission errors can always be corrected
E	A sine signal contains all the frequency components necessary to represent a digital signal as a sequence of square pulses

4.2   Fourier series (2.5 points)

Which of the following statements are TRUE:
(Check one box in the answer page (1 out of 5))

A	Omitting higher order terms from a Fourier series representation of a signal reduces the amplitude of the signal
B	A signal which contain too many consecutive zeros can not be represented by a Fourier series
C	The Fourier series representation of a digital signal has an infinite number of frequency components
D	A sine wave may be represented by an infinite number of square pulses with decreasing coefficients
E	A smooth, rounded pulse travels faster through an optical fiber than a square pulse

4.3   Synchronization (2.5 points)

Which of the following statements are TRUE:
(Check one box in the answer page (1 out of 5))

A	During asynchronous transmission, there is a common clock at the sender and receiver
B	Start and stop bits are used to synchronize the clocks for synchronous transmission
C	Only short frames can be used in synchronous transmission systems to avoid loss-of-sync
D	In the data link layer, large frames can not be transmitted asynchronously
E	In an asynchronous transmission system, the data rate and the clock rate are independent of each other

4.4   Error correction (2.5 points)

Which of the following statements are TRUE:
(Check one box in the answer page (1 out of 5))

A	When using an error correcting code, all errors which are detected can be corrected
B	A parity bit in each byte is the simplest form of error correction
C	A CRC check is an efficient method for detecting errors which have occurred during transmission
D	The Hamming distance is a measure of how far an error can be sent without being detected
E	Forward error correction is always more efficient than error detection and retransmission

5   The MAC layer (8 points)

True or false about the MAC layer (8 points)

(Check in the answer page the 'true' OR the 'false' box, or do not check, for each statement)

| 5.1	Slotted Time means that time is divided into discrete intervals
5.2	In Pure ALOHA, frames are transmitted at arbitrary times
5.3	Slotted ALOHA has always higher channel utilization than 1-persistant CSMA
5.4	The problem of a wireless station not being able to detect a potential competition for medium because the competitor is too far away, is called the exposed station problem
5.5	CSMA/CA (collision avoidance). The sequence shown in Figure I.5.5-1 is a correct CSMA/CA sequence
5.6	The following is correct Differential Manchester coding 1 0 0 0 0 1 0 1 1 bit stream HL LH HL LH HL HL LH L HL coding H - high level, L - low level
5.7	Bridges are normally used to connect routers
5.8	Both bridges and switches use frame addresses for routing
5.9	The routing procedure for an incoming frame to a transparent bridge is as follows: 1. If the destination and source LANs are the same, forward the frame 2. If the destination and source LANs are different, discard the frame 3. If the destination LAN is known, use flooding
5.10	The IEEE 802.16 standard (Air Interface for Fixed Broadband Wireless Access System) is intended for mobile users
5.11	802.16 always uses equal number of timeslots for upstream and downstream traffic
5.12	802.16 services are never connection oriented
5.13	802.16 supports best-effort service
5.14	802.16 always uses the QAM (quadrature amplitude modulation) modulation method
5.15	VLAN decouples the logical topology and the physical topology
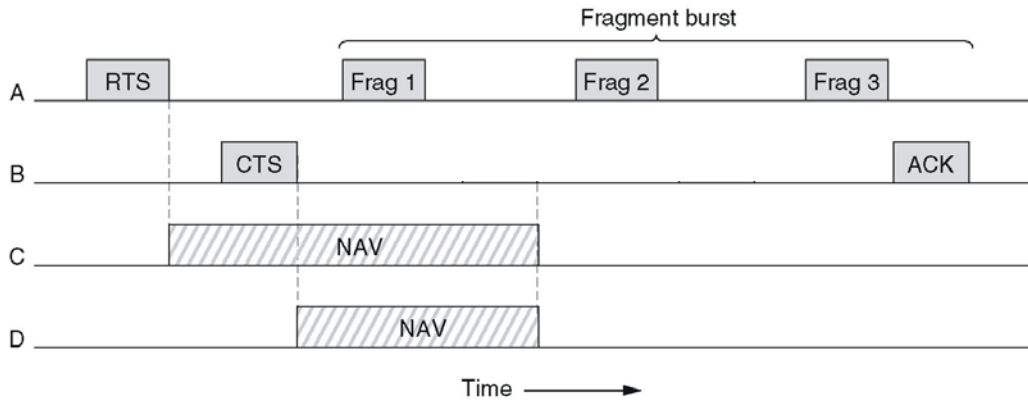
Figure I.5.5-1 CSMA/CA fragment burst

6 The network layer (8 points)

(Write the answer as Written text in the box in the answer page for the questions)

6	Describe the Classless InterDomain Routing (CIDR) principle.

7 The application layer (20 points)

7.1 True or false about World Wide Web, WWW (4.5 points)

(Check in the answer page the 'True' OR the 'False' box, or do not check, for each statement)

7.1.1	A web browser can only use one HTTP/TCP connection at the same time
7.1.2	A proxy server is always located in the same geographical location as the web server
7.1.3	A plug-in runs as an internal part of the browser software
7.1.4	A URL may contains the following parts: application protocol to be used, domain name of the web server, filename and file type
7.1.5	A URL will always start with http://
7.1.6	HTML is a scripting language
7.1.7	HTTP is a stateless protocol
7.1.8	In HTTP, the GET method is a request to store a web page

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7.2   True or false about the Domain Name System, DNS (4 points)

(Check in the answer page the 'True' OR the 'False' box, or do not check, for each statement)

7.2.1	A DNS domain name can be absolute or relative
7.2.2	DNS servers provide mapping tables consisting of resource records
7.2.3	"MX" resource record type stands for Message Extension
7.2.4	DNS is used to map hostnames to IP addresses.
7.2.5	In DNS, only primary DNS servers can have cache
7.2.6	There is no overlap in the zones of a DNS name domain
7.2.7	Naming in DNS follows geographical boundaries

7.3   True or false about email (3.5 points)

(Check in the answer page the 'True' OR the 'False' box, or do not check, for each statement)

7.3.1	E-mail does not use DNS
7.3.2	In E-mail, MIME types cannot handle multipart messages
7.3.3	In E-mail, the *64base* content transfer encoding encodes groups of 64 bits to overcome the limitations of the 7-bits ACII characters
7.3.4	IMAP is a protocol in the transport layer
7.3.5	IMAP makes it possible for the user to manage several mailboxes in the server
7.3.6	POP3 has less features than IMAP

7.4   Streaming audio (3 points)

The figure below shows sequence numbers indicating the steps that have to be taken in order to stream music from a server to a client machine.
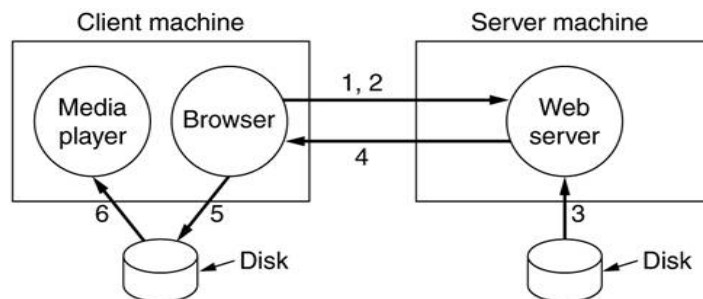

Figure I.7.4-1. Streaming audio

(Check in the table in the answer page. Only one mark per column (1 out of 6))

7.4	Fill in one mark per column in the table in the answer pages to show which steps correspond to the sequence numbers 1, 2, 3, 4, 5, 6 in Figure I.7.4-1

7.5   SIP - Session Initiation Protocol (5 points)

The figure below shows sequence numbers indicating the message sequence needed in order to perform redirection with SIP.
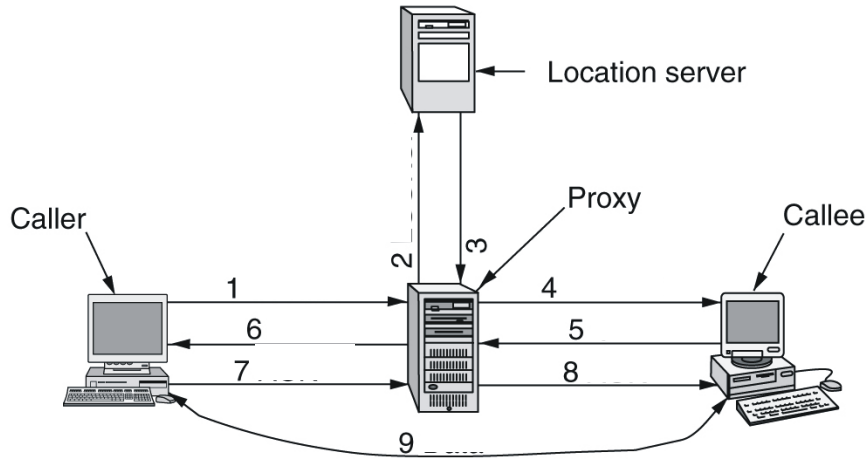

Figure I.7.5-1. Use a proxy and redirection servers with SIP.

(Check in the table in the answer page. Only one mark per column (1 out of 6))

7.5	Fill in one mark per column in the table in the answer pages to show which messages (methods) correspond to the sequence numbers 1, 2, 3, 4, 5, 6, 7, 8, 9 in Figure I.7.5-1

8 PSTN and GSM (8 points)

PSTN = Public Switched Telephony System ('fast-telefoni')

8.1 Question about areas (2 point)
(Check one box in the answer page (1 out of 4))

A	A location area (LA) has always a one-one relation with a base station
B	A location area (LA) is divided in (one or more) service area(s)
C	A location area (LA) is the area in which a subscriber is 'paged'
D	A location area (LA) has always a one-one relation with a VLR/MSC

8.2 Questions about services in GSM (2 point)
(Check one box in the answer page (1 out of 3))

A	The services offered in GSM are divided in 2: circuit switched voice telephony and packet switched voice telephony
B	The services offered in GSM are divided in 2: teleservices and bearer services
C	The teleservices offered in GSM are divided in 2: bearer services and data services

8.3 Question about handover (2 point)
(Check one box in the answer page (1 out of 3))

A	The terminal is in charge and has full control to decide when a handover between base stations shall take place. ('Terminal controlled')
B	The BTS(s) and BSC alone decide when a handover between base stations shall take place. ('Network controlled')
C	The terminal assists the network with relevant data and the network is in charge and has full control to decide when a handover between base stations shall take place. ('Terminal assisted, network controlled')

8.4 Call flow from A on PSTN/ISDN to B on GSM (2 point)

Assume a call setup from A on PSTN/ISDN to B on GSM. (Hint: Draw a sketch of the message sequence for yourself). Determine which of the following actions that will happen.

(Check one box in the answer page (1 out of 3))

A	The PSTN switch requests the routing information from the HLR.
B	The HLR requests the routing information from the VLR/MSC.
C	The Gateway-MSC (GMSC) requests the routing information from the HLR.