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NB! Dette oppgavesettet (hvitt papir) skal studenten levere inn som eksamensbesvarelse

NTNU
The Norwegian University of
Science and Technology
Department of Telematics

Side 1 av 18

Engelsk

Faglig kontakt under eksamen:

Navn: Leif Arne Rønningen
Tlf.: 92665
Det vil bli besøk på salene i perioden kl. 10 – 12.

EKSAMEN I EMNE SIE5003 KOMMUNIKASJON – TJENESTER OG NETT
EKSAMEN I EMNE SIE5003 TELEMATIKK – TJENESTER OG NETT

10. mai 2003
Kl: 0900 – 1300

Sensurdato: 2. juni 2003

Hjelpemidler:
D: Bestemt, enkel kalkulator tillatt.
Ingen trykte eller håndskrevne hjelpemidler tillatt.

☒

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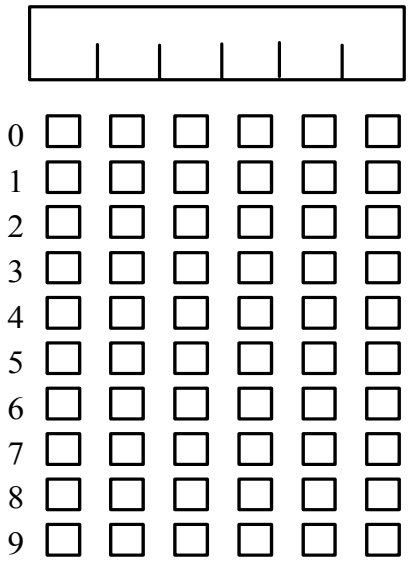

Rules

This problem set (white paper) shall be delivered as your answer.
The yellow set shall be used for scratching, and you shall take it with you after the examination (it will not be evaluated).

The following rules apply for the white problem set:

The student number shall be written on all pages ***with digits.*** In addition, on this page (2) ***each digit shall be checked in the boxes below the digits*** for control (one mark per column).

The sheets will be read optically. Follow the rules below to avoid wrong interpretations.

Use blue or black ball-pen, not a pencil.

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

If you need to correct, ask for a new sheet.
You are not allowed to use rubber or other correcting means, for example scratching.

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

A sub-problem may consist of one or more box fields. In this exam we have three different cases:

- *Check 1 of 5 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.*
- *Check 1 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.*
- *'correct – incorrect': Check one box per statement, or do not check.*

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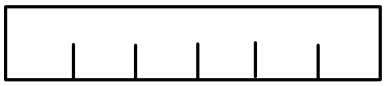

Score calculation:
M –the number of statements.
Count the number of correct marks, max M, min 0.
Count the number of incorrect marks, max M, min 0.
If 'correct' and 'incorrect' both are checked for a statement, it counts as an incorrect mark.
Find the discount points from Table 1, and calculate:

dif = (number of correct marks) – (discount points)

$$Points = dif * \frac{maximum\ points\ for\ the\ sub\text{-}problem}{M} \qquad (1)$$

If Points < 0 then Points := 0.

Table 1:

number of incorrect marks	***discount points***
1	*0*
2	*0.5*
3	*1.5*
4	*3.0*
5	*5.0*
6	*7.0*
>=7	*10.0*

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1 THE PHYSICAL LAYER (Questions to: Leif Arne Rønningen)

a) The Nyquist theorem for a noiseless channel is given by: maximum data rate=2Hlog$_2$V bits/second. If the bandwidth H=30 kHz and the maximum data rate is 180 kbps, how many discrete levels V does the signal have? (check one box)

- ☐ 32
- ☐ 1
- ☐ 17
- ☐ 8
- ☐ 3

b) Multipath fading has one of the following characteristics: (check one box)

- ☐ All electromagnetic waves arrive in phase.
- ☐ Is weather-dependent.
- ☐ Is a big problem in twisted pair cables.
- ☐ Is not frequency-dependent.
- ☐ Always makes transmission in the frequency band between 100 MHz and 1 GHz impossible.

c) Frequency Division Multiplexing, FDM, has the following characteristics: (check one box)

- ☐ The frequency band is divided into a number of smaller frequency bands.
- ☐ Is the same as Time Division Multiplexing.
- ☐ Cannot be used for frequencies above 1 GHz.
- ☐ The whole frequency band is used by all users simultaneously.
- ☐ Signals cannot be disturbed by electromagnetic noise.

d) *Code Division Multiple Access, CDMA.*
The chip sequences {+1,-1,+1,+1} and {-1,-1,+1,-1} are sent synchronously from two sources onto a medium and are added. The chip elements are represented by either +1 or –1 volt. The voltages on the medium are then {+0,-2,+2,+0} volts.
A receiver listens (measures) on the medium, and wants to receive from the source sending the chip-sequence {-1,-1,+1,-1}. The receiver finds the right source by calculating the inner product, denoted {}{} below. Check one box to show the right inner product:*

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☐ {+1,-1,+1,+4}*{-2,+2,+0,-1}
☐ {-2,+2,+0,-2}*{+1,-1,+1,+1}
☐ {-1,-1,+3,-2}*{-1,-1,+1,-1}
☐ {+0,-2,+2,+0}*{-1,-1,+1,-1}
☐ {-2,+2,+0,-2}*{-2,+2,+0,-2}

e) A signal is modulated as shown in figure 1.1 below using the following modulation method: (check one box)

☐ Frequency modulation only
☐ Amplitude modulation only
☐ Phase modulation only
☐ Frequency modulation **and** amplitude modulation
☐ None of the above

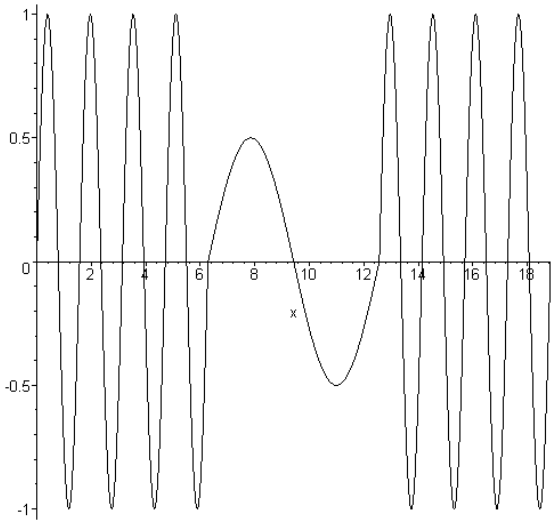

Figure 1.1 Modulated signal

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2 THE LINK LAYER (Questions to: Per Hovde)

a) Framing and error control, Hamming code

Check the 'correct' OR the 'incorrect' box, or do not check, for each statement:

correct	incorrect	
☐	☐	Bit-stuffing in the link layer is required to support framing synchronisation in bit-oriented protocols.
☐	☐	Bit-stuffing is a mechanism used to avoid that a sequence of data bits equal to a flag pattern used to delimit frames is interpreted as the frame delimiter.
☐	☐	Generator polynomials are used to generate checksums (CRC – Cyclic Redundancy Check) that are used to detect bit errors. The generator polynomials G(x) used by the sender and the receiver does not need to be the same.
☐	☐	A generator polynomial G(x) of degree 16 consists of 16 bits.
☐	☐	Suppose that a parity bit is used to detect single bit errors in a bitstring of 7 bits. If **odd parity** is used and the controlled bit-string has the value **0100101**, the value of the parity bit is set to 0, i.e. final bitstring with parity bit = 01001010.
☐	☐	Error correcting codes are seldom used in wireless networks.
☐	☐	To correct *d* single bit errors in any codeword from a set of legal codewords, the Hamming distance of the set of codewords must be at least (d + 1).
☐	☐	In a received codeword using Hamming code for error detection and correction, the check-bits in bit-positions 2 and 4 have wrong parity while all other check-bits are correct. This implies that the bit in bit-position 6 should be inverted.
☐	☐	The High-level Data Link Control (HDLC) protocol is a byte-oriented protocol.
☐	☐	The Point-to-Point Protocol (PPP) supports mechanisms to support different network protocols.

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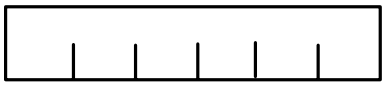

b) Hamming distance (check one box)

What is the Hamming distance in the following complete set of codewords?

Codeword 1: 00000000
Codeword 2: 00110011
Codeword 3: 11001100
Codeword 4: 11111111

☐ 0
☐ 2
☐ 4
☐ 6
☐ 8

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3 THE MAC LAYER (Questions to: Leif Arne Rønningen)

CSMA/CD – Carrier Sense Multiple Access/Collision Detection.
CSMA/CA – Carrier Sense Multiple Access/Collision Avoidance

Check the 'correct' OR the 'incorrect' box, or do not check, for each statement:

correct	incorrect	
☐	☐	The concept 'carrier sense' of CSMA/CD can normally be interpreted as: the ability of a station to check if the channel is busy before trying to use it.
☐	☐	The maximum theoretical throughput of Pure ALOHA is larger than maximum throughput of Slotted ALOHA.
☐	☐	p-persistent CSMA: when a station becomes ready to send, it senses the channel, and if it is idle the station transmits with probability p.
☐	☐	CSMA/CD systems can be in one of five states: contention, waiting, transmission, idle, retransmission.
☐	☐	If collision occurs when using wireless CSMA/CA, retransmission is carried out after a random time.
☐	☐	The 802.11 wireless LAN never uses central control.
☐	☐	The Multiple Access with Collision Avoidance (MACAW) protocol for wireless LANs uses acknowledgement frames (ACK).
☐	☐	The Network Allocation Vector (NAV) is used to reserve a physical channel in wireless LANs.
☐	☐	The 802.11 wireless LAN service 'Distribution', handles the translation from 802.11 format to a non-802.11 format.
☐	☐	The 802.16 Metropolitan Area Network standard supports dynamic allocation of time slots for the upstream and downstream traffic.
☐	☐	A switch cannot be used on the data link layer.
☐	☐	Transparent bridges use the backward learning algorithm.
☐	☐	The routing procedure for the transparent bridge goes as follows: 1. If 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 unknown, use flooding.
☐	☐	The following is not correct Manchester coding: 1 0 0 0 0 1 0 1 1 bit stream HL LH LH LH LH HL LH HL HL coding H-high, L-low
☐	☐	The following is not correct Differencial 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, L-low

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4 THE NETWORK LAYER (Questions to: Leif Arne Rønningen)

a) General

Check the 'correct' OR the 'incorrect' box, or do not check, for each statement:

correct	incorrect	
☐	☐	The network layer transfers packets from their source to their destination.
☐	☐	An IP packet cannot contain TCP header bytes in its data field
☐	☐	In Internet, packet switches are overlayed heterogenous networks.
☐	☐	In packet switches the routing protocol finds the ouput port for each packet to be forwarded.
☐	☐	The IPv4 packet header identifies TCP connections.
☐	☐	Before a router can forward a packet on an Ethernet, it must have issued a broadcast message.
☐	☐	There is no functionality in IP packets for error correction.

b) Connectionless Internetworks: (check one box)

☐ Network services are independent of underlying network technologies.
☐ The transport layer must know the number of, the type, or the topology of underlying subnetworks.
☐ A network address is global and uniform across different LANs and WANs.
☐ Fragmentation and reassembly are done in underlying networks.
☐ Routing establishes state information to be used on connection set-up.

c) Routing (check one box)

When forwarding packets, a router:

☐ Needs to have an overview of all nodes.
☐ Updates the IP address with the address of the next-hop router.
☐ Compares the complete destination IP-address with entries in the routing table.
☐ Updates the TTL (time to live) field.
☐ Always forwards all packets with identical destination address on the same output port.

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5 TRANSPORT LAYER and FLOW CONTROL

(Questions to: Finn Arve Aagesen)

a) Flow Control

Some definitions and formulas are given in Figure 5.1, which is a slide that has been used in the lectures. Round-trip time is the time from a packet is sent from the sender until the acknowledgment is received.

- **U = Maximum channel utilisation**
  (= relativ part of time where "user data" is transmitted)
- **X/C = Transmission time for a frame**
  (= length (in bits) / channel capacity (in bits/sec)
- **τ = Speed of light delay**
  (= physical length (in m)/ speed of light (m/sec)
- **a = τ/(X/C)= τ C/X**
  (= max number of information units on the channel)

Stop-and-wait: $U = (X/C)/[(X/C)+2\tau] = 1/(1+2a)$

Go-back-N:
$$\begin{cases} U = 1, & W \geq 2a+1 \\ U = W/(1+2a), & W \leq 2a+1 \end{cases}$$

where **W** is the maximum window size

Figure 5.1 Stop-and-wait and Go-back-N.

Check the 'correct' OR the 'incorrect' box, or do not check, for each statement:

correct	incorrect	
☐	☐	Flow control is a mechanism that the receiver can use to limit the information flow from the sender.
☐	☐	Sliding window flow control is a mechanism that gives the sender freedom to send a number of packets before waiting for acknowledgments.
☐	☐	Increasing the window size will always give an increased round-trip time.
☐	☐	For a slow channel (C is low), increasing the window will always increase the error probability.
☐	☐	Assume long packets. For a channel with low C and short delay (τ), Selective-repeat must always be used to avoid long round-trip times in error cases.
☐	☐	The TCP Credit TPDU is used at connection setup to set the maximum window for the whole duration of the connection.

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correct	incorrect	
☐	☐	For the use of TCP over a noisy geostationary satellite channel, Selective-repeat is never preferable to Go-back-N.
☐	☐	Assume that X and C are fixed. A link with a long speed of light delay (τ), must always have a smaller window than a link that has a smaller delay if the utilization shall be the same.
☐	☐	Assume that the sequence number space is 32 bits. The maximum window for Go-back-N is larger than the maximum window for Selective repeat .
☐	☐	Selective repeat needs less buffering capacity at the receiver than Go-back-N.

b) Transport Protocol with Stop-and-wait flow control

Figure 5.2 and 5.3 give the behavior of a transport protocol based on stop-and-wait flow control. Figure 5.4, which has been used in the lectures for a stop and wait link protocol illustrates the use of timers.

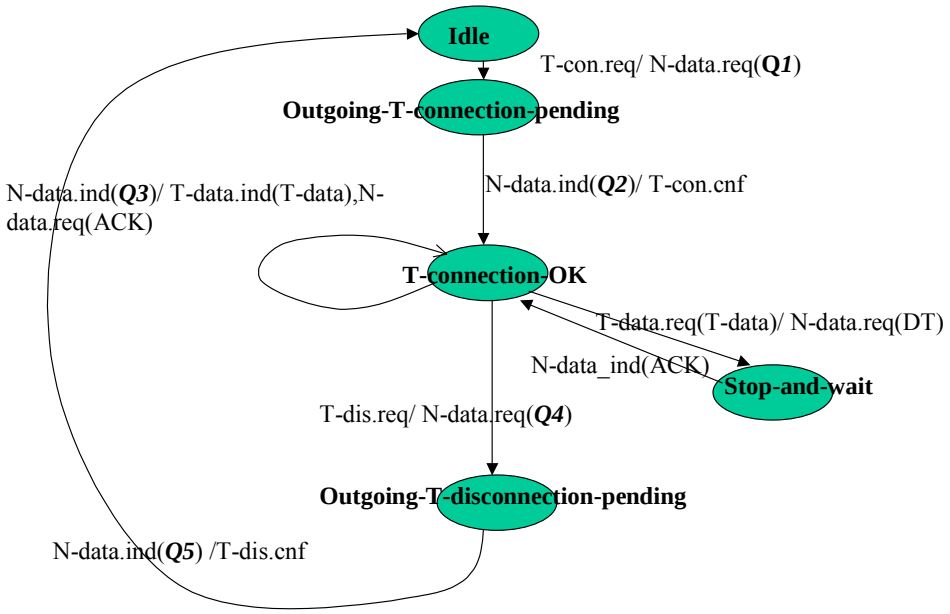

Figure 5.2. A simple version of a transport entity.

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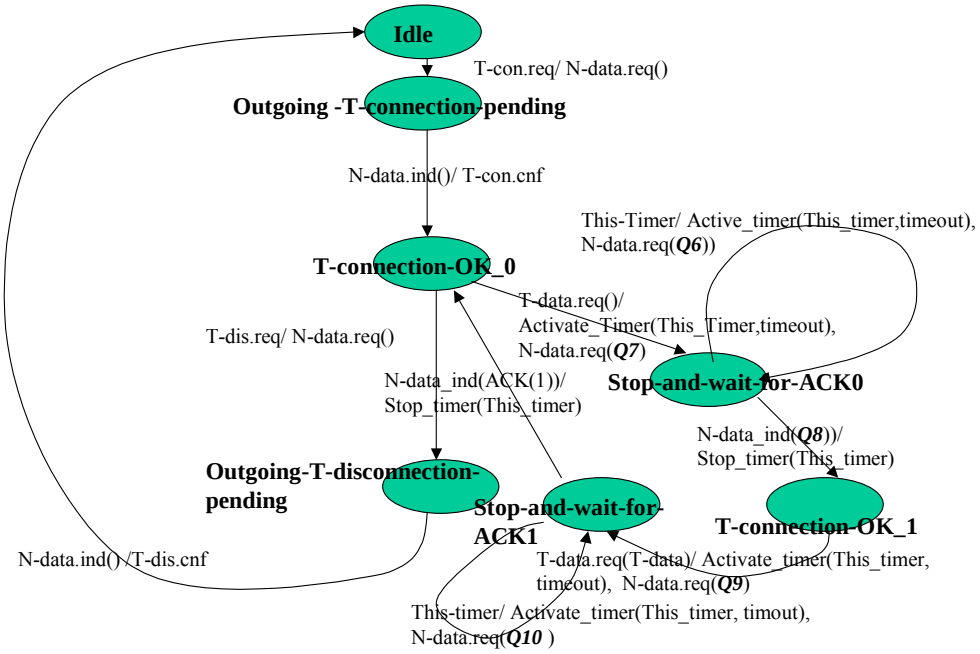

Figure 5.3. A more detailed version of a transport entity.

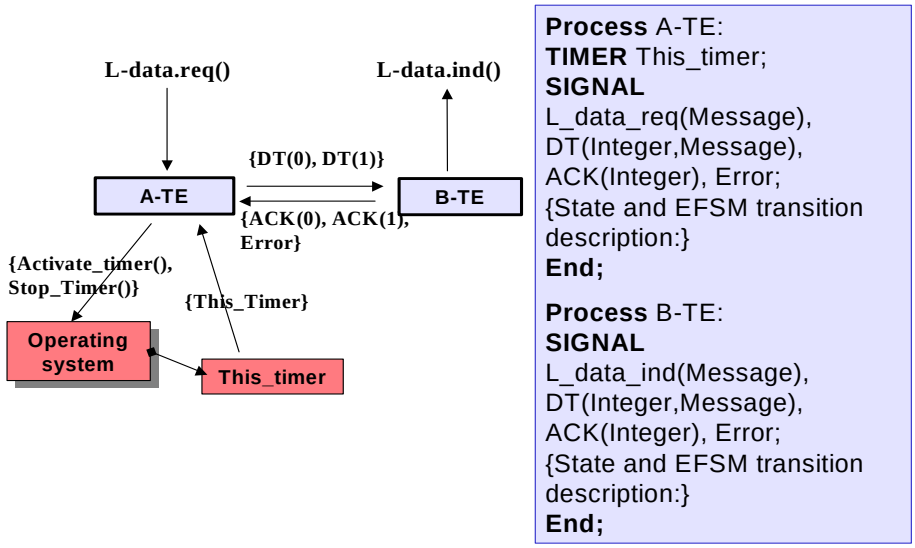

Figure 5.4. Stop-and-wait link protocol – A quasi specification.

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Fill in Table 5.1 and 5.2 below (one mark only per line). ***Q1 – Q10*** *are referred in figure 5.2 and 5.3. Abbreviations TPDU types used in table 5.1 and 5.2:*

CR*: Connection Request (Call Request)*
CC*: Connection Confirmation (Call Accepted)*
DT*: Data*
ACK*: ACKnowledge*
DR*: Disconnection Request (Clear Request)*
DC*: Disconnection Confirmation (Clear Confirmation*

Table 5.1:

For ***Q1 – Q5****, see figure 5.2.*

	CR	CC	DT	ACK	DR	DC
Q1	☐	☐	☐	☐	☐	☐
Q2	☐	☐	☐	☐	☐	☐
Q3	☐	☐	☐	☐	☐	☐
Q4	☐	☐	☐	☐	☐	☐
Q5	☐	☐	☐	☐	☐	☐

Table 5.2:

For ***Q6 – Q10****, see figure 5.3.*

	CR	CC	DT(0)	DT(1)	ACK(0)	ACK(1)	DR	DC
Q6	☐	☐	☐	☐	☐	☐	☐	☐
Q7	☐	☐	☐	☐	☐	☐	☐	☐
Q8	☐	☐	☐	☐	☐	☐	☐	☐
Q9	☐	☐	☐	☐	☐	☐	☐	☐
Q10	☐	☐	☐	☐	☐	☐	☐	☐

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6 THE APPLICATION LAYER

6.1 DNS and email (Questions to: Per Hovde)

c) DNS

DNS: Domain Name System.

Check the 'correct' OR the 'incorrect' box, or do not check, for each statement:

correct	incorrect	
☐	☐	DNS is a hierarchical naming system.
☐	☐	DNS maps domain names to IP-addresses.
☐	☐	DNS uses always TCP.
☐	☐	The DNS naming scheme follows physical boundaries.
☐	☐	Domains *xxx.yyy.com* and *aaa.bbb.com* must be located on the same server.
☐	☐	The domain *xxx.yyy.com* does not need any external authorization to create a domain *xxx.yyy.zzz.com.*
☐	☐	A resource record contains mapping information used by DNS.
☐	☐	A resource record may be cached on several name servers.
☐	☐	An authorative resource record is always correct.

b) email
MIME: Multipurpose Internet Mail Extensions
MTA: Message Transfer Agent
POP3: Post Office Protocol Version 3
IMAP: Internet Message Access Protocol

*An email message is organised into **envelop**e and **content.** The content is further organised into two parts: **header** and **body.***

Check the 'correct' OR the 'incorrect' box, or do not check, for each statement:

correct	incorrect	
☐	☐	MIME info describes the context of the message body (i.e. how the body should be interpreted).
☐	☐	MIME info in an email is part of the message envelope.
☐	☐	Message priority information of an email message is part of the message envelope.
☐	☐	Bcc addressees in an email are disclosed to all other addressees.
☐	☐	Content Transfer Encoding is used to represent characters with ASCII values above 127.

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correct	incorrect	
☐	☐	A message specifying <MIME type / subtype> = <Multipart / Alternative>, implies that the same message content is provided in different formats.
☐	☐	The Simple Mail Transfer Protocol (SMTP) uses ASN.1 message encoding.
☐	☐	POP3 and IMAP are mail protocols used between Message Transfer Agents (MTAs).
☐	☐	The POP3 protocol requires less server resources than the IMAP protocol.
☐	☐	POP3 protocol is an ASCII-based protocol.

6.2 HTTP and World Wide Web (WWW) (Questions to: Per Hovde)

HTTP: HyperText Transfer Protocol

Check the 'correct' OR the 'incorrect' box, or do not check, for each statement:

correct	incorrect	
☐	☐	HTTP is an ASCII-based protocol.
☐	☐	HTTP uses always TCP.
☐	☐	HTTP is a request / response based protocol.
☐	☐	A plug-in runs in a separate process, i.e. not in the same process as the browser.
☐	☐	A helper application is a standalone application invoked by the Web browser.
☐	☐	Cookies can be used by a Web server to "remember" a client (user) from one session to the next.
☐	☐	Cookies are maintained by the Web browser.
☐	☐	Static Web pages are static files stored on the web server and retrieved and presented as they are by the browser.
☐	☐	Dynamic web pages are generated on the Web server before being downloaded to the client.
☐	☐	Active Server Pages (ASP) and Java Server Pages (JSP) are used on the Web server to generate web pages.

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6.2: STREAMING (Questions to: Leif Arne Rønningen)

The State-Transition Diagram as shown in Figure 1 shows the behavior of an RTSP (Real Time Streaming Protocol) Player.
Figure 6.2 shows a Message Sequence Chart for User Interface, the same RTSP Player as in Figure 6.1, and the RTSP Server, with message names M1 to M14.

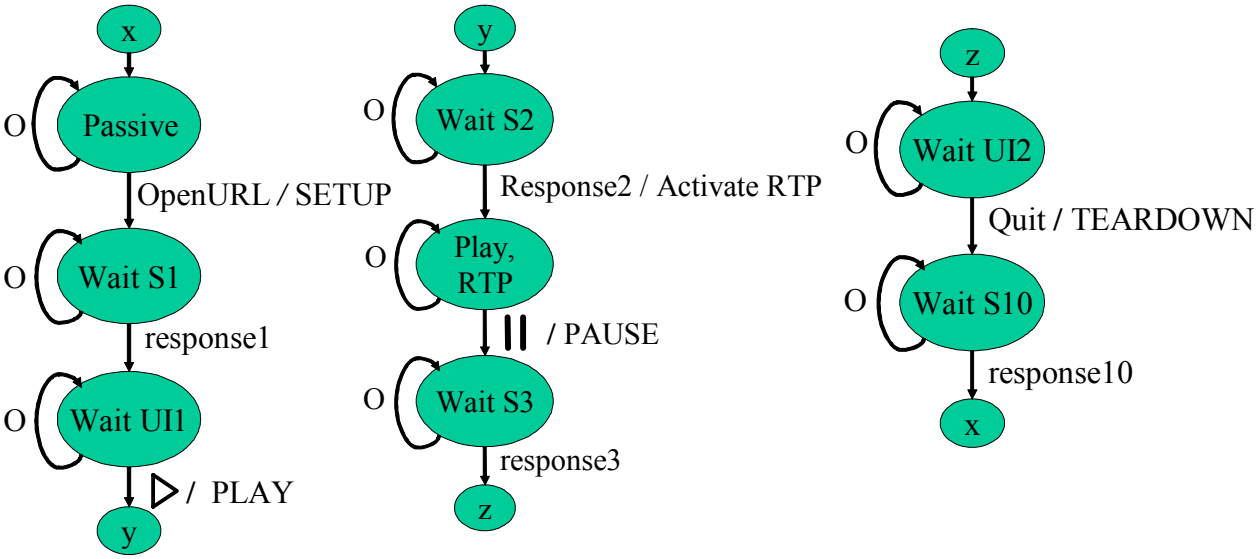

Figure 6.1. State-Transition Diagram for an RTSP Player

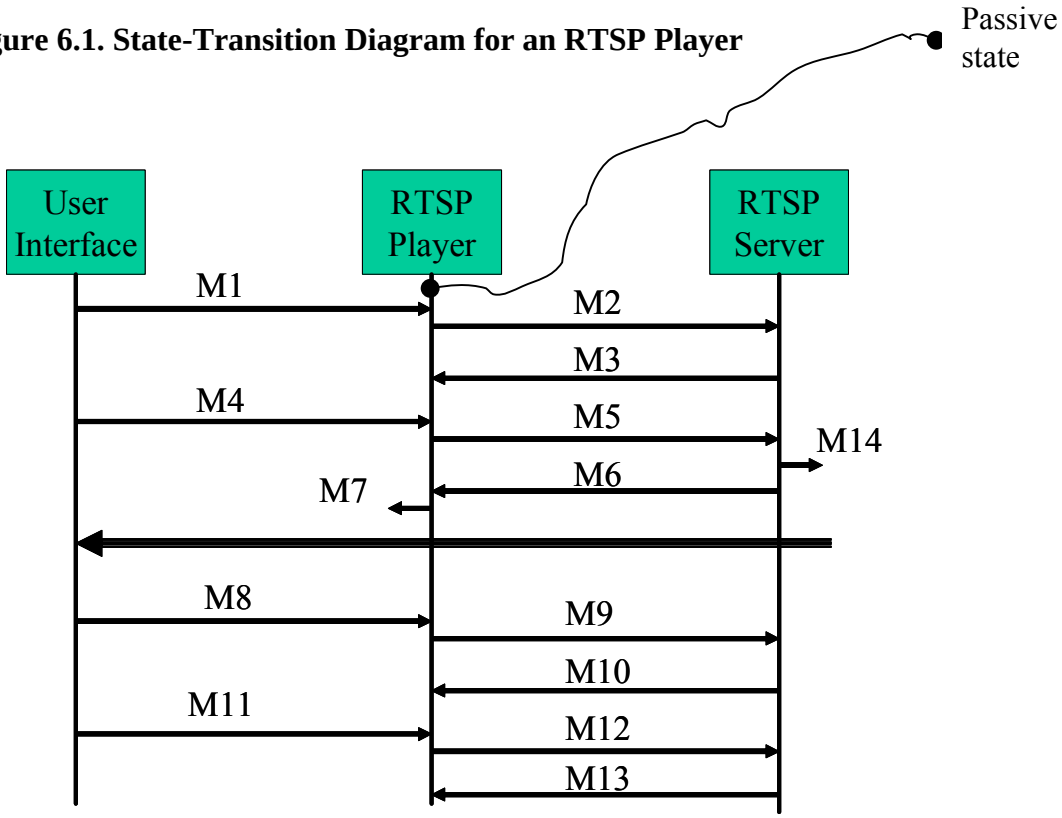

Figure 6.2. Message Sequence Chart for User Interface, RTSP Player, RTSP Server

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To show which Messages M1 to M10 in Figure 6.2 that are equivalent to the messages in the State-Transition Diagram in Figure 6.1, fill in the table below (check one box per column only and one or none box per row).

	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10
Response1	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Response2	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Response3	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
SETUP	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
OpenURL	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
PLAY	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
ActivateRTP	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
PAUSE	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
TEARDOWN	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Quit	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
▷	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
⏸	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

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7 GSM / UMTS (Questions to: Per Hovde)

GSM: Global System for Mobile communications
GPRS: General Packet Radio Service
UMTS: Universal Mobile Telecommunications System

Check the 'correct' OR the 'incorrect' box, or do not check, for each statement:

correct	incorrect	
☐	☐	GSM belongs to the 2nd generation (2G) mobile communications system.
☐	☐	GSM uses Time Division Multiple Access (TDMA) for the radio interface.
☐	☐	GSM supports packet-switched connections.
☐	☐	The Visitor Location Register (VLR) contains all permanent subscriber data.
☐	☐	GPRS is an add-on to GSM supporting packet-switched services.
☐	☐	GPRS requires a total rebuild of the GSM Network Architecture.
☐	☐	UMTS is backward compatible with GSM.
☐	☐	UMTS uses Time Division Multiple Access for the radio interface.
☐	☐	UMTS uses GSM and GPRS as Core Network backbone.