



### Försättsblad Prov Original

Kurskod	Provkod	Tentamensdatum
D T O 2 4 G	T 1 0 1	2 0 1 8 - 0 8 - 2 1
Kursnamn	Datateknik GR (A), Datornätverk	
Provnamn	Tentamen	
Ort	Sundsvall	
Termin	H18	
Ämne	Datateknik	

## Exam in Computer Networks (Datornätverk)

**Course code:** DT024G

**Time:** 8:00-13:00

**Tools:** Arbitrary pocket calculator. A language dictionary, for example English-Swedish.

**Preliminary requirement for approval:** 28 of 57 points.

You may answer in Swedish or English. Only write at one side of each sheet. Start every question on a new sheet.

### THEORY PART

1. Associate each of the fields in the left column with one of the protocol headers in the right column. (One protocol may be associated with one or several fields.)  
Answer in alphabetical order. (12 p)

A. Source and destination email address	1. TCP but not UDP header
B. Virtual Path Identifier (VPI), 8 bit, and Virtual Channel Identifier (VCI), 4 bit.	2. Both TCP and UDP header
C. Source and destination MAC address, each at 48 bit.	3. ATM header
D. URL	4. MIME header
E. Time To Live (TTL), 8 bit	5. HTTP header
F. Source and destination IP address, each 32 bit.	6. IP version 4 header
G. Source and destination IP address, each 128 bit	7. IP version 6 header
H. Segment sequence number, 32 bit	8. SMTP header
I. ACK sequence number, 32 bit	9. Ethernet or IEEE 802.3 frame header
J. Source and destination ports, each at 16 bit	
K. Window size, 16 bit	
L. Content type, for example Image/JPEG, and content-transfer-encoding, for example Base64, Quoted-Printable or Binary.	

2. 8 p) For each of the following five functions or duties, (i) state which protocol **layer** in the five-layer TCP/IP model that may handle the function, and (ii) give an example of a **specific protocol** or a standard that provides the given function.
- Standardization of radio frequency and transmission power
  - End-to-end retransmission of incorrect or lost segments, indication of port number and sequence number, connection establishment, congestion avoidance by slow-start and window management

- c) Host-to-host retransmission of collided frames
- d) Start bits and stop bits in asynchronous serial communications

3. Copy this table. State "True" or "False" in each empty cell. One, both or none of the cells may be "true" on the same row. (8 p)

	(a) TCP	(b) UDP
1. SYN packets are transferred in the beginning of a session, before data packets are transferred, and FIN packets after		
2. Unreliable protocol		
3. Connection oriented protocol		
4. Provides flow control and congestion control using adaptive window size		
5. The receiver side may reorder packets that are out of order and deliver a byte stream to the application layer		
6. Packets are called datagrams		
7. Packets are called frames		
8. Several sockets may share the same server side port number		

4. What is the purpose of the timer at the sender site in systems using automatic repeat request (ARQ)? (3 p)
5. Define and explain the following two concepts: (4 p)
- a) Multiplexing
  - b) Multiple access (also known as channel-access, including media-access control protocols, MAC).

What is the aim of the two concepts? Give at least one protocol example of each. What are the similarities and differences of these two concepts? What layers in the 5 layer TCP/IP model are they handled on?

**PROBLEM PART**

Show all calculations.

6. What is the amplitude (in Volt) and the frequency (in Gigahertz) of the following sine wave? What is the phase in radians and degrees?

$$v(t) = 15 \cos(2\pi \cdot 1000\,000\,000t + \pi/4) \text{ Volt} \quad (2 \text{ p})$$

7. What is the gross data rate of a 16 voltage level PAM (pulse amplitude modulated) line code if the symbol rate is 10 Mbaud (million pulses/s)? (2 p)

8. The input power of a cable is 10 microwatt. The cable has an attenuation of 0.05 dB/meter. The output power is 100 nanowatt. How long is the cable? (2 p)

9. Ditt företag har IP-adresser i området 182.4.8.0 till 182.4.15.255 (6 p)

a) Vad är prefixet (nätverks-ID:t, dvs den konstanta delen av IP-adresserna) på binär form?

b) Vilken nätmask har företaget? Svara på punkterad decimalform.

c) Du ska dela in adressområdet i tre subnät, med utrymme för 5, 400 resp 600 värddatorer (IP hosts). Vilka nätadresser och subnätmaskar väljer du? (Tips: Börja med det största nätet, sedan det näst största, för att prefixet ska bli konstant inom nätet, och beräkna broadcastadress för varje subnät.)

d) Om du lägger in ett fjärde subnät i ovanstående nät, utan att det överlappar med befintliga tre subnät, hur stort kan det nya subnätet vara som mest? Vad blir nätadress, broadcastadress och subnätmask? (Kontrollera att prefixet är konstant inom subnätet.)

10. Assume that a 4G/LTE cellular phone receives a signal-to-noise ratio of 10 dB on a downlink radio channel with upper cut-off frequency of 2700 MHz and a lower frequency of 2600 MHz. (6 p)

(a) What is the passband bandwidth in Hertz?

(b) What symbol rate or baud rate is possible according to Nyquist theorem?

(c) Assume that 64QAM modulation is used at most, i.e. 64 symbols. What is the maximum bit rate according to Nyquist?

(d) What is the received signal level in microwatt if the noise level is 1 microwatt?

- (e) What is the maximum information bit rate (net bit rate exclusive of forward error correction codes) that can be supported by this channel, in theory, according to the Shannon-Hartley formula?
11. How long time in minutes does it take to transfer the content of a DVD disk over Ethernet, using the TFTP protocol (Trivial File Transfer Protocol), which is a file transfer protocol based on UDP over IP? You may assume a single-side single-layer DVD, which has a capacity of 4.70 gigabyte. Assume that the physical layer bit rate is 100 Mbit/s. You may also assume that the Ethernet maximum transfer unit (maximum payload size) of 1500 byte is used. Take into consideration that each Ethernet frame has an 8 byte preamble, plus a 14 byte header and a 4 Byte trailer. An additional minimum interframe gap corresponding to 12 byte is inserted after each frame. An IP packet header consists of 20 byte, and a UDP packet header of 8 Byte. (You may neglect the TFTP protocol overhead for establishing the file transfer. No other users are sharing the network capacity for the moment. The DVD drive reading speed is sufficiently high.) (4 p)

