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Försättsblad Prov Original

Kurskod	Provkod	Tentamensdatum
DT075G	T101	2018-08-21
Kursnamn	Datateknik GR (B), Multimedie- och kommunikationssystem	
Provnamn	Tentamen	
Ort	Sundsvall	
Termin	H18	
Ämne	Datateknik	

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Exam in DT075G Multimedia and communication systems and DT137G Industrial Data Communications

Time: 8:00-13:00

Permitted tools: Arbitrary pocket calculator. An English-Swedish dictionary.

Preliminary passing requirement: DT075G: 27 out of 54 p. DT137G: 24 out of 48 p.

Only write on one side of each sheet. You may answer in Swedish or English.

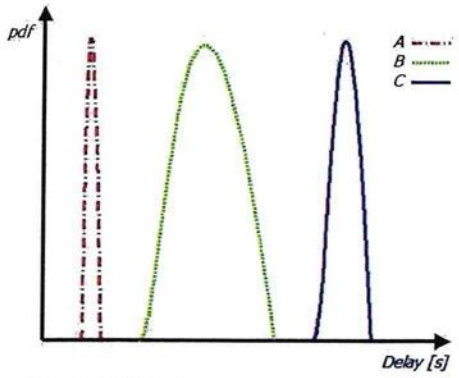
Good luck!

THEORY PART

1. 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 pakcets 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		

2. (4 p) In the figure you can see the statistical distribution of the end-to-end delay of a message transmitted using three different fieldbus technologies: Fieldbus A (red), Fieldbus B (green) and Fieldbus C (blue).



Answer the following questions:

a. Which technology has the lowest delay in s?
b. Which technology requires largest receiver side buffer to compensate for large jitter?
c. Which technology is preferable for a real time application? Why?

3. (4 p) Define and explain the following two concepts:
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?

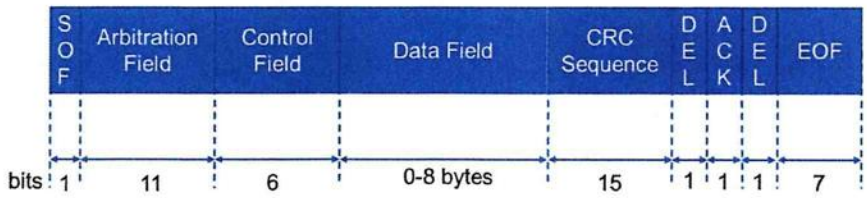
PROBLEM PART

Show all the calculations and the reasoning behind them. Show units. State any assumptions you make and factors you neglect. Indicate if a result is unreasonable.

4. (4 p) (a) Ditt företag har IP-adresser i området 182.4.8.0 till 182.4.15.255 Du ska dela in adresserna i två subnät, med utrymme för 2, resp 700 värddatorer (IP hosts). Vilka subnätadresser och subnätmaskar väljer du? Vad blir broadcastadressen i respektive subnät? Visa alla beräkningar.

(b) Ett tredje subnät skapas i adressområdet. Hur många värdar kan det bestå av, vad får det för subnätmask, nätverksadress och broadcastadress?

5. (4 p) Consider the structure of a frame for CANbus as showed in figure.



All the lengths except for the Data Field are expressed in bits.

- Calculate the Overhead in bits in the transmission of a CAN frame. (Do not consider the bit stuffing mechanism)

Consider a gross bitrate of 1 Mbit/s and a Data Field of 8 bytes;

- Calculate the useful bit rate for the data transmission. (Do not consider the bit stuffing mechanism)

6. (2 p) Assume that a bass tone (a periodic waveform with low frequency) from a musical instrument is transferred over the analog telephone network. The sound spectrum is filtered by the telephone passband channel, stopping all frequencies below 300 Hz, resulting in that only harmonics at 400 Hz, 600 Hz, 800 Hz, 1000Hz and 1200 Hz are remaining on the receiver side. What is the fundamental frequency of the (unfiltered) tone, and what is the time period of the waveform? Assume maximum possible fundamental frequency.

7. (4 p) The signal power is sometimes measured in dBm, where 0 dBm corresponds to a reference level of 1 mW, and X dBm corresponds to a signal power that is X dB stronger than 1 mW. Prove that the signal-to-noise ratio in dB is equal to $S_{\text{dBm}} - N_{\text{dBm}}$, where S_{dBm} and N_{dBm} are the signal (S) and noise (N) power measured in dBm.

8. (6 p) Antag att du sänder följande bitsekvens: 0001 1100 1100 0111 1010, men mottagaren utsätts för brus och tar emot följande: 0011 1100 1100 0111 1010.

(a) Vad är bit-error rate BER under denna period? (Detta är egentligen en väldigt kort mätperiod, men låt oss ändå anta att ditt BER-värde är en god skattning av bitfelssannolikheten p_e som du behöver veta på resten av uppgiften.)

(b) Vårt system lägger till en felupptäckande kod med kodtakt $c = 0{,}95$, dvs informationstakten I (net bit rate) är 95% av rådatatakten (gross bit rate) R. Den felupptäckande koden används för automatic repeat request (ARQ). Antag att rådatatakten R är 1,6 Mbit/s, och vi behöver överföra en fil på 570 kByte inom en minut. Hur stor packet error rate PER ≈ packet error probability p_p kan vi acceptera utan för många omsändningar, dvs utan att goodput G blir för låg? Man kan visa att goodput G vid ARQ är $G = I\,(1\text{-}p_p)$.

(c) Hur stor paketlängd kan vi högst ha för att inte få ett högre värde på paketfelssannolikheten p_p? (Du kan försumma att ARQ-protokollet lägger till overhead till varje paket, inklusive minst en bit för sekvensnummer i headern.)

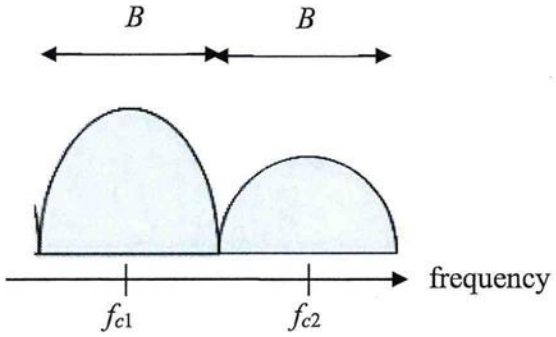
9. (6 p) Draw the amplitude spectrum for the following multicarrier signal, assuming no modulation, meaning that $\varphi_1(t) = \varphi_2(t) = 0$. The vertical axis should show the amplitude in Volt and the horizontal axis the frequency in MHz. Draw or describe a bar plot (sw. *stolpdiagram*). Do not draw time plot showing sine waves.

$v_{in}(t) = 4 \cdot \sin(2\pi \cdot 10000t + \varphi_1(t)) + 3 \cdot \sin(2\pi \cdot 30000t + \varphi_2(t))$ [Volt]

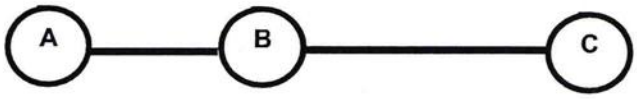
b) The signal is passing through a long wire that attentuates high frequencies more than low frequencies. The resulting signal looks like this:

$v_{out}(t) = 0.4 \cdot \sin(2\pi \cdot 10000t + 0.1 + \varphi_1(t)) + 0.03 \cdot \sin(2\pi \cdot 30000t + 0.2 + \varphi_1(t))$ [Volt]
Draw or describe a diagram that shows a conceivable amplitude characteristics of the wire, i.e. a curve showing how many dB the signal is attenuated depending on frequency. (Hint: A voltage amplification of 10 times correponds to a power attenuation of 100 times, or 20 dB attenuation.)

c) The first carrier is used for 64PSK modulation, and the second for 16PSK modulation, by varying the message signals $\varphi_1(t)$ and $\varphi_2(t)$ respectively. The combined signal forms a FDM signal. What gross bitrate can be transferred using FDM alltogether? You may assume that each of the baud rates (symbol rates) are equal to the signal bandwiths B in the illustration below. No margin is assumed in this case. (Hint: Since $\varphi_1(t)$ and $\varphi_2(t)$ are varying with time, the two modulated signals are not sine wave form. The spectrum of the modulated signals can consequently not be represented by bar plots, but by two continous non-overlapping signal spectrums according the the illustration below. The bandwidths of each signal spectrum is B. The centre frequencies are equal to the carrier frequencies f_{c1} and f_{c2} respectively.)



10. (6 p) Assume that in the picture below, A is the source of data, C is the destination and B is a switch. The A-B distance is 500 meters and the B-C distance is 1500 meters. Both links are copper cables at 10Mbps bandwidth (gross bit rate). The propagation speed of electromagnetic waves through the cables is 2.3×10^8 m/s. A message of 9800 bytes needs to be transmitted from A to C. Calculate the total end-to-end delay under the following assumptions.



a. Circuit switching is used, with time division multiplex (TDM), using 4 channels. Each TDM frame consists of 5 timeslots: One per channel plus one time slot for synchronization. The data from A uses one channel. Each timeslots consists of one octet (one byte) of data. Assume that 0.1ms is needed for setting up the connection from A to C through B. A delay of 1 TDM frame is added in A, and another TDMA frame in B.

b. Assume that store-and-forward packet switching is used and the size of packets (data frames) together with all the headers and trailers is 1500 bytes, out of which 100 bytes constitute control information. Assume that B starts transmitting as soon as it has received the whole frame, there is no other traffic in the network, no protocol for flow or error control, and the processing time is negligible.

NB! Only the DT075G course:

11. (6 p) ENDAST KURSEN DT075G: En digitaliserad videosekvens komprimeras med en MPEG2-liknande teknik. Beräkna vilken bithastighet som krävs om videosekvensen har följande egenskaper:

- 25 helbilder eller "fields" presenteras per sekund. (Egentligen 50 interlaced frames.)
- Full HDTV används, dvs varje helbild utgörs av 1920×1080 pixlar, var och en med 8 bit Y-komponent (svartvit signal = luminanssignal), 8 bit Cb- kombonent och 8 bit Cr-kompontent (krominanssignaler), som erhålls efter konvertering från RGB till YCbCr.
- 4:2:0 färgnedsampling används, dvs.upplösningen på de två färgdifferenskomponenterna Cb och Cr har minskats med häften både horisontellt och vertikalt.
- GOP-struktur (dvs ordningsföljd mellan I- B- och P-bilder): **I**BBPBBPBBPBBPBBPBBPBBPBB**I**BBPBBPBBPBBPBBPBBPBBPBB…
- Varje bildtyp komprimeras enligt kompressionsgrad I-bilder 10:1, P-bilder 25:1, och B-bilder 50:1.