EECS 563
Test 1
Fall 2006

$E[T] = 1/(\mu-\lambda) = \overline{T}_X/(1-\rho)$

$P_B = ((1-\rho)\rho^N)/(1-\rho^{N+1})$

λ=Average Arrival Rate

μ = Average Service Rate

$\overline{T}_X$ = Average Service Time

_____ _____

Name Student Number

Be sure and clearly mark your final answer.

5 pts 1. What is the difference between a WAN and LAN?

WAN is for wide areas.
LAN is for Local areas

2. Information from ground station A is sent to a geosynchronous satellite 35,782 km above the earth, the satellite sends the information on to ground station B. The link rate is 100 Mb/s and the packet size is 1000 bits. Speed of light is $3x10^8$m/s.

10 pts a) What is the end-to-end delay between station A and B for one packet if virtual circuit packet switching is used?

$\tau_{one\ way} = \frac{2x35,782x10^3}{3x10^8}$

$X = \frac{L}{C} = \frac{1000}{100x10^6}$

$3\tau + X = .717 sec$

10 pts b) What is the end-to-end delay between station A and B for one packet if datagram packet switching is used?

$\tau + X = .239$

5 pts 3. The link layer is responsible for end-to-end connections.
True
or
False
Circle the correct answer.

4. At the source a 2kByte message is passed to the transport layer (TCP) which adds 20 Bytes of transport layer protocol information (TPI), this packet is passed to the network layer (IP) which adds 20 Bytes of network protocol information (NPI), this packet is passed to the link layer (High Level Link Control-HDLC) with adds 6 bytes of link layer protocol information (LPI) to create a frame that is transported across the physical layer.

5 pts a) What % of the transported bits is used by the system to perform protocol processing functions? total = 2046

1 − 2000/2046 = 97.8%

5 pts b) What is a major use of the network protocol information (NPI)?

Routing

5 pts c) What is the size of the packet that is passed to destination transport layer for processing?

2020

5. A PBX is connected to the PSTN by N lines. Given:
i) 50 phones are connected to the PBX, where during the busy hour each phone makes 2 calls lasting 5 min on average
and
ii) a QoS requirement of a probability of blocking < 1%.

5 pts a) What is the load in Erlangs? 8.33

5 pts b) Find N.

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5 pts 6. MP3 is part of the Moving Pictures Expert Group set of standards.
True or False
Circle the correct answer.

7. Memory is inexpensive so assume the output port on the routers below have large buffers.

The network managers have determined that the load on the A-B link is 0.50 with a corresponding delay of 1 ms. The average packet size on the A-B link is 1000 bits.

10 pts a) What is the capacity of the A-B link?

$.001 = \frac{L/C}{1-\rho}$ 2 Mb/s

$L = 1000$

$\rho = .5$

5 pts b) Using the traffic parameters, i.e., arrival rate and message length from part a), determine the required capacity to reduce the delay to 0.20ms.

6 Mb/s

8. In many voice TDM systems the frame size is fixed at 125us. For this problem use a frame size of 125us.

5 pts a) If 96 voice channels are supported what is the slot time?

$$\frac{125\mu s}{96}$$

5 pts b) If each voice sample is encoded to 4 bits/sample what is the bit time?

$$\left(\frac{125\mu s}{96}\right)/4 = T_b$$

5 pts c) For the parameters in parts a) and b) what is the bit rate of this TDM signal.

$$r_b = \frac{1}{T_b} = 3.072\ Mb/s$$

10 pts 9. Specify the key components in the trade-off between the size of the jitter buffer and voice quality in VoIP systems. Then discuss the trade-off between the size of the jitter buffer and voice quality in VoIP systems

Key: Packet Loss & Delay.

Jitter buffer ↑ Loss ↓ quality ↓

Jitter buffer ↓ Loss ↑ quality ↓

Erlang B Traffic Table

Maximum Offered Load Versus B and N
B is in %

N/B	0.01	0.05	0.1	0.5	1.0	2	5	10	15	20	30
1	.0001	.0005	.0010	.0050	.0101	.0204	.0526	.1111	.1765	.2500	.4286
2	.0142	.0321	.0458	.1054	.1526	.2235	.3813	.5954	.7962	1.000	1.449
3	.0868	.1517	.1938	.3490	.4555	.6022	.8994	1.271	1.603	1.930	2.633
4	.2347	.3624	.4393	.7012	.8694	1.092	1.525	2.045	2.501	2.945	3.891
5	.4520	.6486	.7621	1.132	1.361	1.657	2.219	2.881	3.454	4.010	5.189
6	.7282	.9957	1.146	1.622	1.909	2.276	2.960	3.758	4.445	5.109	6.514
7	1.054	1.392	1.579	2.158	2.501	2.935	3.738	4.666	5.461	6.230	7.856
8	1.422	1.830	2.051	2.730	3.128	3.627	4.543	5.597	6.498	7.369	9.213
9	1.826	2.302	2.558	3.333	3.783	4.345	5.370	6.546	7.551	8.522	10.58
10	2.260	2.803	3.092	3.961	4.461	5.084	6.216	7.511	8.616	9.685	11.95
11	2.722	3.329	3.651	4.610	5.160	5.842	7.076	8.487	9.691	10.86	13.33
12	3.207	3.878	4.231	5.279	5.876	6.615	7.950	9.474	10.78	12.04	14.72
13	3.713	4.447	4.831	5.964	6.607	7.402	8.835	10.47	11.87	13.22	16.11
14	4.239	5.032	5.446	6.663	7.352	8.200	9.730	11.47	12.97	14.41	17.50
15	4.781	5.634	6.077	7.376	8.108	9.010	10.63	12.48	14.07	15.61	18.90
16	5.339	6.250	6.722	8.100	8.875	9.828	11.54	13.50	15.18	16.81	20.30
17	5.911	6.878	7.378	8.834	9.652	10.66	12.46	14.52	16.29	18.01	21.70
18	6.496	7.519	8.046	9.578	10.44	11.49	13.39	15.55	17.41	19.22	23.10
19	7.093	8.170	8.724	10.33	11.23	12.33	14.32	16.58	18.53	20.42	24.51
20	7.701	8.831	9.412	11.09	12.03	13.18	15.25	17.61	19.65	21.64	25.92
21	8.319	9.501	10.11	11.86	12.84	14.04	16.19	18.65	20.77	22.85	27.33
22	8.946	10.18	10.81	12.64	13.65	14.90	17.13	19.69	21.90	24.06	28.74
23	9.583	10.87	11.52	13.42	14.47	15.76	18.08	20.74	23.03	25.28	30.15
24	10.23	11.56	12.24	14.20	15.30	16.63	19.03	21.78	24.16	26.50	31.56
25	10.88	12.26	12.97	15.00	16.13	17.51	19.99	22.83	25.30	27.72	32.97
26	11.54	12.97	13.70	15.80	16.96	18.38	20.94	23.89	26.43	28.94	34.39
27	12.21	13.69	14.44	16.60	17.80	19.27	21.90	24.94	27.57	30.16	35.80
28	12.88	14.41	15.18	17.41	18.64	20.15	22.87	26.00	28.71	31.39	37.21
29	13.56	15.13	15.93	18.22	19.49	21.04	23.83	27.05	29.85	32.61	38.63
30	14.25	15.86	16.68	19.03	20.34	21.93	24.80	28.11	31.00	33.84	40.05
31	14.94	16.60	17.44	19.85	21.19	22.83	25.77	29.17	32.14	35.07	41.46
32	15.63	17.34	18.21	20.68	22.05	23.73	26.75	30.24	33.28	36.30	42.88
33	16.34	18.09	18.97	21.51	22.91	24.63	27.72	31.30	34.43	37.52	44.30
34	17.04	18.84	19.74	22.34	23.77	25.53	28.70	32.37	35.58	38.75	45.72
35	17.75	19.59	20.52	23.17	24.64	26.44	29.68	33.43	36.72	39.99	47.14
36	18.47	20.35	21.30	24.01	25.51	27.34	30.66	34.50	37.87	41.22	48.56
37	19.19	21.11	22.08	24.85	26.38	28.25	31.64	35.57	39.02	42.45	49.98
38	19.91	21.87	22.86	25.69	27.25	29.17	32.62	36.64	40.17	43.68	51.40
39	20.64	22.64	23.65	26.53	28.13	30.08	33.61	37.72	41.32	44.91	52.82
40	21.37	23.41	24.44	27.38	29.01	31.00	34.60	38.79	42.48	46.15	54.24