

Radio Engineering Exam

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1. Consider a GSM uplink at 900MHz. The MS has 100-mW transmit power, and the sensitivity of the BS receiver is -105 dBm. The distance between the BS and MS is 1 km. The propagation law follows the free space law up to a distance of $d_{break} = 50$ m, and for larger distances the receive power is proportional to $(d/d_{break})^{-4.2}$. Transmit antenna gain is -7dB; the receive antenna gain is 9 dB. The small scale fading is assumed to follow a Rayleigh fading distribution.
 - (a) Compute the available fading margin. 2Pt
 - (b) Compute the corresponding outage probability for one and for two antennas (using RSSI selection diversity) at the BS. 1Pt
2. Assume that a system needs a $C/I = 10$ dB to work at an acceptable quality. Further assume that the path loss decays with a path loss exponent on $\eta = 3.5$ and the system requires a fading margin of 5 dB.
 - (a) Compute the necessary reuse distance and the minimum cluster size. 1Pt
 - (b) Assume that the operator has 5 MHz spectrum and that each channel has a bandwidth of 200kHz. How many channels per cell are there available? 1Pt
 - (c) Assume an Erlang-B system with a blocking probability of 10%. What is the offered traffic in Erlang (use the table in the appendix)? 1Pt
 - (d) The city of Nice has a population density of 5000 people per km². Assuming that every person generates a traffic of 2 milli-Erlang, what is the required cell radius (assume that each cell covers a surface of $A = r^2\pi$)? 1Pt
 - (e) What methods exist to increase the capacity? 1Pt

3. Assume you want to measure the channel at a carrier frequency of 2.6GHz between a base station and a high speed train running at 300km/h. The maximum expected delay in the channel is 20 μ s. In what range can we choose the repetition time of the channel sounder such that the channel remains identifiable. 2Pts
4. (a) What different types of channel models exist and how can they be classified? 1Pt
- (b) What kind of propagation models from the previous classification are mainly used in professional network planning tools? 1Pt
- (c) What models exist to model diffraction over multiple edges? 1Pt
- (d) What is the coherence bandwidth and the rms delay spread of a channel? What is their relationship? 1Pt
- (e) What is the definition of wideband and narrowband channels? What effect can be observed in wideband channels? Give an example for a wideband channel model. 1Pt
- (f) Some modern LTE networks employ a frequency reuse of one. This is possible because¹ 1Pt
- i. LTE creates less interference,
- ii. LTE uses better channel codes,
- iii. LTE makes use of intercell interference coordination,
- iv. It is not possible to create orthogonal channels with LTE.
- (g) What kind of information can you derive from a network planning tool¹? 1Pt
- i. The expected throughput of a user at a given location,
- ii. The distribution of the received signal strength in a given area,
- iii. The load of each cell,
- iv. The optimal tilt of each antenna.
- (h) What is antenna masking and why is it important? 1Pt
- (i) What is the difference between macroscopic diversity and microscopic diversity? 1Pt
- (j) Explain the difference between mutual coupling and correlation in MIMO channels. 1Pt
- Total: 20Pts

¹This is a multiple choice question, please copy the correct answers

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	40
1	.0001	.0005	.0010	.0050	.0101	.0204	.0526	.1111	.1765	.2500	.4286	.6667
2	.0142	.0321	.0458	.1054	.1526	.2235	.3813	.5954	.7962	1.000	1.449	2.000
3	.0868	.1517	.1938	.3490	.4555	.6022	.8994	1.271	1.603	1.930	2.633	3.480
4	.2347	.3624	.4393	.7012	.8694	1.092	1.525	2.045	2.501	2.945	3.891	5.021
5	.4520	.6486	.7621	1.132	1.361	1.657	2.219	2.881	3.454	4.010	5.189	6.596
6	.7282	.9957	1.146	1.622	1.909	2.276	2.960	3.758	4.445	5.109	6.514	8.191
7	1.054	1.392	1.579	2.158	2.501	2.935	3.738	4.666	5.461	6.230	7.856	9.800
8	1.422	1.830	2.051	2.730	3.128	3.627	4.543	5.597	6.498	7.369	9.213	11.42
9	1.826	2.302	2.558	3.333	3.783	4.345	5.370	6.546	7.551	8.522	10.58	13.05
10	2.260	2.803	3.092	3.961	4.461	5.084	6.216	7.511	8.616	9.685	11.95	14.68
11	2.722	3.329	3.651	4.610	5.160	5.842	7.076	8.487	9.691	10.86	13.33	16.31
12	3.207	3.878	4.231	5.279	5.876	6.615	7.950	9.474	10.78	12.04	14.72	17.95
13	3.713	4.447	4.831	5.964	6.607	7.402	8.835	10.47	11.87	13.22	16.11	19.60
14	4.239	5.032	5.446	6.663	7.352	8.200	9.730	11.47	12.97	14.41	17.50	21.24
15	4.781	5.634	6.077	7.376	8.108	9.010	10.63	12.48	14.07	15.61	18.90	22.89
16	5.339	6.250	6.722	8.100	8.875	9.828	11.54	13.50	15.18	16.81	20.30	24.54
17	5.911	6.878	7.378	8.834	9.652	10.66	12.46	14.52	16.29	18.01	21.70	26.19
18	6.496	7.519	8.046	9.578	10.44	11.49	13.39	15.55	17.41	19.22	23.10	27.84
19	7.093	8.170	8.724	10.33	11.23	12.33	14.32	16.58	18.53	20.42	24.51	29.50
20	7.701	8.831	9.412	11.09	12.03	13.18	15.25	17.61	19.65	21.64	25.92	31.15
21	8.319	9.501	10.11	11.86	12.84	14.04	16.19	18.65	20.77	22.85	27.33	32.81
22	8.946	10.18	10.81	12.64	13.65	14.90	17.13	19.69	21.90	24.06	28.74	34.46
23	9.583	10.87	11.52	13.42	14.47	15.76	18.08	20.74	23.03	25.28	30.15	36.12
24	10.23	11.56	12.24	14.20	15.30	16.63	19.03	21.78	24.16	26.50	31.56	37.78
25	10.88	12.26	12.97	15.00	16.13	17.51	19.99	22.83	25.30	27.72	32.97	39.44
26	11.54	12.97	13.70	15.80	16.96	18.38	20.94	23.89	26.43	28.94	34.39	41.10
27	12.21	13.69	14.44	16.60	17.80	19.27	21.90	24.94	27.57	30.16	35.80	42.76
28	12.88	14.41	15.18	17.41	18.64	20.15	22.87	26.00	28.71	31.39	37.21	44.41
29	13.56	15.13	15.93	18.22	19.49	21.04	23.83	27.05	29.85	32.61	38.63	46.07
30	14.25	15.86	16.68	19.03	20.34	21.93	24.80	28.11	31.00	33.84	40.05	47.74
31	14.94	16.60	17.44	19.85	21.19	22.83	25.77	29.17	32.14	35.07	41.46	49.40
32	15.63	17.34	18.21	20.68	22.05	23.73	26.75	30.24	33.28	36.30	42.88	51.06
33	16.34	18.09	18.97	21.51	22.91	24.63	27.72	31.30	34.43	37.52	44.30	52.72
34	17.04	18.84	19.74	22.34	23.77	25.53	28.70	32.37	35.58	38.75	45.72	54.38
35	17.75	19.59	20.52	23.17	24.64	26.44	29.68	33.43	36.72	39.99	47.14	56.04
36	18.47	20.35	21.30	24.01	25.51	27.34	30.66	34.50	37.87	41.22	48.56	57.70
37	19.19	21.11	22.08	24.85	26.38	28.25	31.64	35.57	39.02	42.45	49.98	59.37
38	19.91	21.87	22.86	25.69	27.25	29.17	32.62	36.64	40.17	43.68	51.40	61.03
39	20.64	22.64	23.65	26.53	28.13	30.08	33.61	37.72	41.32	44.91	52.82	62.69
40	21.37	23.41	24.44	27.38	29.01	31.00	34.60	38.79	42.48	46.15	54.24	64.35
41	22.11	24.19	25.24	28.23	29.89	31.92	35.58	39.86	43.63	47.38	55.66	66.02
42	22.85	24.97	26.04	29.09	30.77	32.84	36.57	40.94	44.78	48.62	57.08	67.68
43	23.59	25.75	26.84	29.94	31.66	33.76	37.57	42.01	45.94	49.85	58.50	69.34

44	24.33	26.53	27.64	30.80	32.54	34.68	38.56	43.09	47.09	51.09	59.92	71.01
45	25.08	27.32	28.45	31.66	33.43	35.61	39.55	44.17	48.25	52.32	61.35	72.67
46	25.83	28.11	29.26	32.52	34.32	36.53	40.55	45.24	49.40	53.56	62.77	74.33
47	26.59	28.90	30.07	33.38	35.22	37.46	41.54	46.32	50.56	54.80	64.19	76.00
48	27.34	29.70	30.88	34.25	36.11	38.39	42.54	47.40	51.71	56.03	65.61	77.66
49	28.10	30.49	31.69	35.11	37.00	39.32	43.53	48.48	52.87	57.27	67.04	79.32
50	28.87	31.29	32.51	35.98	37.90	40.26	44.53	49.56	54.03	58.51	68.46	80.99
51	29.63	32.09	33.33	36.85	38.80	41.19	45.53	50.64	55.19	59.75	69.88	82.65
52	30.40	32.90	34.15	37.72	39.70	42.12	46.53	51.73	56.35	60.99	71.31	84.32
53	31.17	33.70	34.98	38.60	40.60	43.06	47.53	52.81	57.50	62.22	72.73	85.98
54	31.94	34.51	35.80	39.47	41.51	44.00	48.54	53.89	58.66	63.46	74.15	87.65
55	32.72	35.32	36.63	40.35	42.41	44.94	49.54	54.98	59.82	64.70	75.58	89.31
56	33.49	36.13	37.46	41.23	43.32	45.88	50.54	56.06	60.98	65.94	77.00	90.97
57	34.27	36.95	38.29	42.11	44.22	46.82	51.55	57.14	62.14	67.18	78.43	92.64
58	35.05	37.76	39.12	42.99	45.13	47.76	52.55	58.23	63.31	68.42	79.85	94.30
59	35.84	38.58	39.96	43.87	46.04	48.70	53.56	59.32	64.47	69.66	81.27	95.97
60	36.62	39.40	40.80	44.76	46.95	49.64	54.57	60.40	65.63	70.90	82.70	97.63
61	37.41	40.22	41.63	45.64	47.86	50.59	55.57	61.49	66.79	72.14	84.12	99.30
62	38.20	41.05	42.47	46.53	48.77	51.53	56.58	62.58	67.95	73.38	85.55	101.0
63	38.99	41.87	43.31	47.42	49.69	52.48	57.59	63.66	69.11	74.63	86.97	102.6
64	39.78	42.70	44.16	48.31	50.60	53.43	58.60	64.75	70.28	75.87	88.40	104.3
65	40.58	43.52	45.00	49.20	51.52	54.38	59.61	65.84	71.44	77.11	89.82	106.0
66	41.38	44.35	45.85	50.09	52.44	55.33	60.62	66.93	72.60	78.35	91.25	107.6
67	42.17	45.18	46.69	50.98	53.35	56.28	61.63	68.02	73.77	79.59	92.67	109.3
68	42.97	46.02	47.54	51.87	54.27	57.23	62.64	69.11	74.93	80.83	94.10	111.0
69	43.77	46.85	48.39	52.77	55.19	58.18	63.65	70.20	76.09	82.08	95.52	112.6
70	44.58	47.68	49.24	53.66	56.11	59.13	64.67	71.29	77.26	83.32	96.95	114.3
71	45.38	48.52	50.09	54.56	57.03	60.08	65.68	72.38	78.42	84.56	98.37	116.0
72	46.19	49.36	50.94	55.46	57.96	61.04	66.69	73.47	79.59	85.80	99.80	117.6
73	47.00	50.20	51.80	56.35	58.88	61.99	67.71	74.56	80.75	87.05	101.2	119.3
74	47.81	51.04	52.65	57.25	59.80	62.95	68.72	75.65	81.92	88.29	102.7	120.9
75	48.62	51.88	53.51	58.15	60.73	63.90	69.74	76.74	83.08	89.53	104.1	122.6
76	49.43	52.72	54.37	59.05	61.65	64.86	70.75	77.83	84.25	90.78	105.5	124.3
77	50.24	53.56	55.23	59.96	62.58	65.81	71.77	78.93	85.41	92.02	106.9	125.9
78	51.05	54.41	56.09	60.86	63.51	66.77	72.79	80.02	86.58	93.26	108.4	127.6
79	51.87	55.25	56.95	61.76	64.43	67.73	73.80	81.11	87.74	94.51	109.8	129.3
80	52.69	56.10	57.81	62.67	65.36	68.69	74.82	82.20	88.91	95.75	111.2	130.9
81	53.51	56.95	58.67	63.57	66.29	69.65	75.84	83.30	90.08	96.99	112.6	132.6
82	54.33	57.80	59.54	64.48	67.22	70.61	76.86	84.39	91.24	98.24	114.1	134.3
83	55.15	58.65	60.40	65.39	68.15	71.57	77.87	85.48	92.41	99.48	115.5	135.9
84	55.97	59.50	61.27	66.29	69.08	72.53	78.89	86.58	93.58	100.7	116.9	137.6
85	56.79	60.35	62.14	67.20	70.02	73.49	79.91	87.67	94.74	102.0	118.3	139.3
86	57.62	61.21	63.00	68.11	70.95	74.45	80.93	88.77	95.91	103.2	119.8	140.9
87	58.44	62.06	63.87	69.02	71.88	75.42	81.95	89.86	97.08	104.5	121.2	142.6
88	59.27	62.92	64.74	69.93	72.82	76.38	82.97	90.96	98.25	105.7	122.6	144.3
89	60.10	63.77	65.61	70.84	73.75	77.34	83.99	92.05	99.41	107.0	124.0	145.9
90	60.92	64.63	66.48	71.76	74.68	78.31	85.01	93.15	100.6	108.2	125.5	147.6

91	61.75	65.49	67.36	72.67	75.62	79.27	86.04	94.24	101.8	109.4	126.9	149.3
92	62.58	66.35	68.23	73.58	76.56	80.24	87.06	95.34	102.9	110.7	128.3	150.9
93	63.42	67.21	69.10	74.50	77.49	81.20	88.08	96.43	104.1	111.9	129.8	152.6
94	64.25	68.07	69.98	75.41	78.43	82.17	89.10	97.53	105.3	113.2	131.2	154.3
95	65.08	68.93	70.85	76.33	79.37	83.13	90.12	98.63	106.4	114.4	132.6	155.9
96	65.92	69.79	71.73	77.24	80.31	84.10	91.15	99.72	107.6	115.7	134.0	157.6
97	66.75	70.65	72.61	78.16	81.25	85.07	92.17	100.8	108.8	116.9	135.5	159.3
98	67.59	71.52	73.48	79.07	82.18	86.04	93.19	101.9	109.9	118.2	136.9	160.9
99	68.43	72.38	74.36	79.99	83.12	87.00	94.22	103.0	111.1	119.4	138.3	162.6
100	69.27	7~.25	75.24	80.91	84.06	87.97	95.24	104.1	112.3	120.6	139.7	164.3

N is the number of servers. The numerical column headings indicate blocking probability B in %. Table generated by Dan Dexter

Erlang C Traffic Table

Maximum Offered Load Versus B and N

N/B	B is in %											
	0.01	0.05	0.1	0.5	1.0	2	5	10	15	20	30	40
1	.0001	.0005	.0010	.0050	.0100	.0200	.0500	.1000	.1500	.2000	.3000	.4000
2	.0142	.0319	.0452	.1025	.1465	.2103	.3422	.5000	.6278	.7403	.9390	1.117
3	.0860	.1490	.1894	.3339	.4291	.5545	.7876	1.040	1.231	1.393	1.667	1.903
4	.2310	.3533	.4257	.6641	.8100	.9939	1.319	1.653	1.899	2.102	2.440	2.725
5	.4428	.6289	.7342	1.065	1.259	1.497	1.905	2.313	2.607	2.847	3.241	3.569
6	.7110	.9616	1.099	1.519	1.758	2.047	2.532	3.007	3.344	3.617	4.062	4.428
7	1.026	1.341	1.510	2.014	2.297	2.633	3.188	3.725	4.103	4.406	4.897	5.298
8	1.382	1.758	1.958	2.543	2.866	3.246	3.869	4.463	4.878	5.210	5.744	6.178
9	1.771	2.208	2.436	3.100	3.460	3.883	4.569	5.218	5.668	6.027	6.600	7.065
10	2.189	2.685	2.942	3.679	4.077	4.540	5.285	5.986	6.469	6.853	7.465	7.959
11	2.634	3.186	3.470	4.279	4.712	5.213	6.015	6.765	7.280	7.688	8.336	8.857
12	3.100	3.708	4.018	4.896	5.363	5.901	6.758	7.554	8.099	8.530	9.212	9.761
13	3.587	4.248	4.584	5.529	6.028	6.602	7.511	8.352	8.926	9.379	10.09	10.67
14	4.092	4.805	5.166	6.175	6.705	7.313	8.273	9.158	9.760	10.23	10.98	11.58
15	4.614	5.377	5.762	6.833	7.394	8.035	9.044	9.970	10.60	11.09	11.87	12.49
16	5.150	5.962	6.371	7.502	8.093	8.766	9.822	10.79	11.44	11.96	12.77	13.41
17	5.699	6.560	6.991	8.182	8.801	9.505	10.61	11.61	12.29	12.83	13.66	14.33
18	6.261	7.169	7.622	8.871	9.518	10.25	11.40	12.44	13.15	13.70	14.56	15.25
19	6.835	7.788	8.263	9.568	10.24	11.01	12.20	13.28	14.01	14.58	15.47	16.18
20	7.419	8.417	8.914	10.27	10.97	11.77	13.00	14.12	14.87	15.45	16.37	17.10
21	8.013	9.055	9.572	10.99	11.71	12.53	13.81	14.96	15.73	16.34	17.28	18.03
22	8.616	9.702	10.24	11.70	12.46	13.30	14.62	15.81	16.60	17.22	18.19	18.96
23	9.228	10.36	10.91	12.43	13.21	14.08	15.43	16.65	17.47	18.11	19.10	19.89
24	9.848	11.02	11.59	13.16	13.96	14.86	16.25	17.51	18.35	19.00	20.02	20.82
25	10.48	11.69	12.28	13.90	14.72	15.65	17.08	18.36	19.22	19.89	20.93	21.76
26	11.11	12.36	12.97	14.64	15.49	16.44	17.91	19.22	20.10	20.79	21.85	22.69
27	11.75	13.04	13.67	15.38	16.26	17.23	18.74	20.08	20.98	21.68	22.77	23.63
28	12.40	13.73	14.38	16.14	17.03	18.03	19.57	20.95	21.87	22.58	23.69	24.57
29	13.05	14.42	15.09	16.89	17.81	18.83	20.41	21.82	22.75	23.48	24.61	25.50
30	13.71	15.12	15.80	17.65	18.59	19.64	21.25	22.68	23.64	24.38	25.54	26.44
31	14.38	15.82	16.52	18.42	19.37	20.45	22.09	23.56	24.53	25.29	26.46	27.38
32	15.05	16.53	17.25	19.18	20.16	21.26	22.93	24.43	25.42	26.19	27.39	28.33
33	15.72	17.24	17.97	19.95	20.95	22.07	23.78	25.30	26.32	27.10	28.31	29.27
34	16.40	17.95	18.71	20.73	21.75	22.89	24.63	26.18	27.21	28.01	29.24	30.21
35	17.09	18.67	19.44	21.51	22.55	23.71	25.48	27.06	28.11	28.92	30.17	31.16
36	17.78	19.39	20.18	22.29	23.35	24.53	26.34	27.94	29.00	29.83	31.10	32.10
37	18.47	20.12	20.92	23.07	24.15	25.36	27.19	28.82	29.90	30.74	32.03	33.05
38	19.17	20.85	21.67	23.86	24.96	26.18	28.05	29.71	30.80	31.65	32.97	34.00
39	19.87	21.59	22.42	24.65	25.77	27.01	28.91	30.59	31.71	32.57	33.90	34.94
40	20.58	22.33	23.17	25.44	26.58	27.84	29.77	31.48	32.61	33.48	34.83	35.89
41	21.28	23.07	23.93	26.23	27.39	28.68	30.63	32.37	33.51	34.40	35.77	36.84
42	22.00	23.81	24.69	27.03	28.21	29.51	31.50	33.26	34.42	35.32	36.70	37.79
43	22.71	24.56	25.45	27.83	29.02	30.35	32.36	34.15	35.33	36.23	37.64	38.74

44	23.43	25.31	26.22	28.63	29.84	31.19	33.23	35.04	36.23	37.15	38.58	39.69
45	24.15	26.06	26.98	29.44	30.67	32.03	34.10	35.93	37.14	38.07	39.51	40.64
46	24.88	26.82	27.75	30.24	31.49	32.87	34.97	36.83	38.05	39.00	40.45	41.59
47	25.60	27.57	28.52	31.05	32.32	33.72	35.84	37.72	38.96	39.92	41.39	42.54
48	26.34	28.33	29.30	31.86	33.14	34.56	36.72	38.62	39.87	40.84	42.33	43.50
49	27.07	29.10	30.08	32.68	33.97	35.41	37.59	39.52	40.79	41.76	43.27	44.45
50	27.80	29.86	30.86	33.49	34.80	36.26	38.47	40.42	41.70	42.69	44.21	45.40
51	28.54	30.63	31.64	34.31	35.64	37.11	39.35	41.32	42.61	43.61	45.15	46.36
52	29.28	31.40	32.42	35.12	36.47	37.97	40.23	42.22	43.53	44.54	46.10	47.31
53	30.03	32.17	33.21	35.94	37.31	38.82	41.10	43.12	44.44	45.47	47.04	48.27
54	30.77	32.95	33.99	36.76	38.15	39.67	41.99	44.02	45.36	46.39	47.98	49.22
55	31.52	33.72	34.78	37.59	38.99	40.53	42.87	44.93	46.28	47.32	48.93	50.18
56	32.27	34.50	35.57	38.41	39.83	41.39	43.75	45.83	47.20	48.25	49.87	51.13
57	33.03	35.28	36.37	39.24	40.67	42.25	44.64	46.74	48.12	49.18	50.82	52.09
58	33.78	36.06	37.16	40.07	41.51	43.11	45.52	47.64	49.04	50.11	51.76	53.05
59	34.54	36.85	37.96	40.90	42.36	43.97	46.41	48.55	49.96	51.04	52.71	54.01
60	35.30	37.63	38.76	41.73	43.20	44.83	47.29	49.46	50.88	51.97	53.65	54.96
61	36.06	38.42	39.56	42.56	44.05	45.70	48.18	50.37	51.80	52.90	54.60	55.92
62	36.82	39.21	40.36	43.39	44.90	46.56	49.07	51.27	52.72	53.83	55.55	56.88
63	37.59	40.00	41.16	44.23	45.75	47.43	49.96	52.18	53.64	54.77	56.49	57.84
64	38.35	40.80	41.97	45.06	46.60	48.30	50.85	53.10	54.57	55.70	57.44	58.80
65	39.12	41.59	42.78	45.90	47.45	49.16	51.74	54.01	55.49	56.63	58.39	59.76
66	39.89	42.39	43.58	46.74	48.30	50.03	52.64	54.92	56.42	57.57	59.34	60.72
67	40.66	43.18	44.39	47.58	49.16	50.90	53.53	55.83	57.34	58.50	60.29	61.68
68	41.44	43.98	45.20	48.42	50.01	51.77	54.42	56.75	58.27	59.44	61.24	62.64
69	42.21	44.78	46.02	49.26	50.87	52.65	55.32	57.66	59.20	60.37	62.19	63.60
70	42.99	45.58	46.83	50.10	51.73	53.52	56.21	58.57	60.12	61.31	63.14	64.56
71	43.77	46.39	47.64	50.95	52.59	54.39	57.11	59.49	61.05	62.25	64.09	65.52
72	44.55	47.19	48.46	51.79	53.45	55.27	58.01	60.41	61.98	63.18	65.04	66.48
73	45.33	48.00	49.28	52.64	54.31	56.14	58.90	61.32	62.91	64.12	65.99	67.44
74	46.11	48.81	50.10	53.49	55.17	57.02	59.80	62.24	63.84	65.06	66.94	68.40
75	46.90	49.61	50.92	54.34	56.03	57.90	60.70	63.16	64.76	66.00	67.89	69.37
76	47.68	50.42	51.74	55.19	56.89	58.78	61.60	64.07	65.69	66.94	68.85	70.33
77	48.47	51.23	52.56	56.04	57.76	59.65	62.50	64.99	66.63	67.88	69.80	71.29
78	49.26	52.05	53.38	56.89	58.62	60.53	63.40	65.91	67.56	68.82	70.75	72.25
79	50.05	52.86	54.21	57.74	59.49	61.41	64.30	66.83	68.49	69.76	71.70	73.22
80	50.84	53.68	55.03	58.60	60.36	62.30	65.21	67.75	69.42	70.70	72.66	74.18
81	51.63	54.49	55.86	59.45	61.22	63.18	66.11	68.67	70.35	71.64	73.61	75.14
82	52.43	55.31	56.69	60.30	62.09	64.06	67.01	69.59	71.28	72.58	74.57	76.11
83	53.22	56.13	57.52	61.16	62.96	64.94	67.92	70.52	72.22	73.52	75.52	77.07
84	54.02	56.95	58.35	62.02	63.83	65.83	68.82	71.44	73.15	74.46	76.47	78.04
85	54.81	57.77	59.18	62.88	64.70	66.71	69.73	72.36	74.08	75.40	77.43	79.00
86	55.61	58.59	60.01	63.73	65.57	67.60	70.63	73.28	75.02	76.35	78.38	79.97
87	56.41	59.41	60.84	64.59	66.45	68.48	71.54	74.21	75.95	77.29	79.34	80.93
88	57.21	60.23	61.67	65.45	67.32	69.37	72.45	75.13	76.89	78.23	80.30	81.90
89	58.02	61.06	62.51	66.32	68.19	70.26	73.35	76.06	77.82	79.18	81.25	82.86
90	58.82	61.88	63.34	67.18	69.07	71.15	74.26	76.98	78.76	80.12	82.21	83.83

91	59.62	62.71	64.18	68.04	69.94	72.04	75.17	77.91	79.69	81.06	83.16	84.79
92	60.43	63.54	65.02	68.90	70.82	72.92	76.08	78.83	80.63	82.01	84.12	85.76
93	61.23	64.36	65.86	69.77	71.70	73.81	76.99	79.76	81.57	82.95	85.08	86.73
94	62.04	65.19	66.70	70.63	72.57	74.71	77.90	80.69	82.50	83.90	86.03	87.69
95	62.85	66.02	67.54	71.50	73.45	75.60	78.81	81.61	83.44	84.84	86.99	88.66
96	63.66	66.85	68.38	72.36	74.33	76.49	79.72	82.54	84.38	85.79	87.95	89.62
97	64.47	67.69	69.22	73.23	75.21	77.38	80.63	83.47	85.32	86.74	88.91	90.59
98	65.28	68.52	70.06	74.10	76.09	78.27	81.54	84.39	86.26	87.68	89.87	91.56
99	66.09	69.35	70.90	74.97	76.97	79.17	82.46	85.32	87.20	88.63	90.82	92.53
100	66.91	70.19	71.75	75.84	77.85	80.06	83.37	86.25	88.13	89.58	91.78	93.49

N is the number of servers. The numerical column headings indicate blocking probability B in %. Table generated by Dan Dexter

Poisson 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	40
1	.0001	.0005	.0010	.0050	.0101	.0202	.0513	.1054	.1625	.2231	.3567	.5108
2	.0142	.0320	.0454	.1035	.1486	.2147	.3554	.5318	.6832	.8244	1.097	1.376
3	.0862	.1497	.1905	.3379	.4360	.5672	.8177	1.102	1.331	1.535	1.914	2.285
4	.2318	.3552	.4286	.6722	.8232	1.016	1.366	1.745	2.039	2.297	2.764	3.211
5	1.078	1.279	1.530	1.970	2.433	2.785	3.090	3.634	4.148			
6	.7137	.9672	1.107	1.537	1.785	2.089	2.613	3.152	3.557	3.904	4.517	5.091
7	1.030	1.348	1.520	2.037	2.330	2.684	3.285	3.895	4.348	4.734	5.411	6.039
8	1.387	1.768	1.971	2.571	2.906	3.307	3.981	4.656	5.155	5.576	6.312	6.991
9	1.778	2.220	2.452	3.132	3.508	3.953	4.695	5.433	5.973	6.429	7.220	7.947
10	2.198	2.699	2.961	3.717	4.130	4.618	5.425	6.221	6.802	7.289	8.133	8.904
11	2.643	3.202	3.492	4.321	4.771	5.300	6.169	7.021	7.639	8.157	9.050	9.864
12	3.112	3.726	4.042	4.943	5.428	5.996	6.924	7.829	8.484	9.031	9.972	10.83
13	3.600	4.269	4.611	5.580	6.099	6.704	7.690	8.646	9.336	9.910	10.90	11.79
14	4.106	4.828	5.195	6.231	6.782	7.424	8.464	9.470	10.19	10.79	11.82	12.76
15	4.629	5.402	5.794	6.893	7.477	8.153	9.246	10.30	11.06	11.68	12.75	13.72
16	5.167	5.990	6.405	7.567	8.181	8.891	10.04	11.14	11.92	12.57	13.69	14.69
17	5.718	6.590	7.028	8.251	8.895	9.638	10.83	11.98	12.79	13.47	14.62	15.66
18	6.281	7.201	7.662	8.943	9.616	10.39	11.63	12.82	13.67	14.37	15.56	16.63
19	6.856	7.822	8.306	9.645	10.35	11.15	12.44	13.67	14.55	15.27	16.50	17.60
20	7.442	8.453	8.958	10.35	11.08	11.92	13.26	14.53	15.43	16.17	17.44	18.57
21	8.037	9.093	9.619	11.07	11.83	12.69	14.07	15.38	16.31	17.08	18.38	19.54
22	8.642	9.741	10.29	11.79	12.57	13.47	14.89	16.24	17.20	17.99	19.32	20.51
23	9.255	10.40	10.96	12.52	13.33	14.25	15.72	17.11	18.09	18.90	20.27	21.48
24	9.876	11.06	11.65	13.26	14.09	15.04	16.55	17.98	18.98	19.81	21.21	22.46
25	10.50	11.73	12.34	14.00	14.85	15.83	17.38	18.84	19.88	20.73	22.16	23.43
26	11.14	12.41	13.03	14.74	15.62	16.63	18.22	19.72	20.77	21.64	23.10	24.41
27	11.78	13.09	13.73	15.49	16.40	17.43	19.06	20.59	21.67	22.56	24.05	25.38
28	12.43	13.78	14.44	16.25	17.18	18.23	19.90	21.47	22.57	23.48	25.00	26.36
29	13.09	14.47	15.15	17.00	17.96	19.04	20.75	22.35	23.48	24.40	25.95	27.33
30	13.75	15.17	15.87	17.77	18.74	19.85	21.59	23.23	24.38	25.32	26.91	28.31
31	14.42	15.87	16.59	18.53	19.53	20.66	22.45	24.11	25.29	26.24	27.86	29.29
32	15.09	16.58	17.32	19.31	20.32	21.48	23.30	25.00	26.19	27.17	28.81	30.26
33	15.76	17.30	18.05	20.08	21.12	22.30	24.15	25.89	27.10	28.09	29.76	31.24
34	16.44	18.01	18.78	20.86	21.92	23.12	25.01	26.77	28.01	29.02	30.72	32.22
35	17.13	18.73	19.52	21.64	22.72	23.95	25.87	27.66	28.92	29.95	31.67	33.20
36	17.82	19.46	20.26	22.42	23.53	24.77	26.73	28.56	29.84	30.88	32.63	34.18
37	18.52	20.19	21.01	23.21	24.33	25.60	27.60	29.45	30.75	31.81	33.59	35.16
38	19.21	20.92	21.75	24.00	25.14	26.44	28.46	30.35	31.66	32.74	34.54	36.14
39	19.92	21.66	22.51	24.79	25.96	27.27	29.33	31.24	32.58	33.67	35.50	37.11
40	20.62	22.40	23.26	25.59	26.77	28.11	30.20	32.14	33.50	34.60	36.46	38.09
41	21.33	23.14	24.02	26.38	27.59	28.95	31.07	33.04	34.42	35.54	37.42	39.07
42	22.05	23.88	24.78	27.18	28.41	29.79	31.94	33.94	35.33	36.47	38.38	40.05
43	22.76	24.63	25.54	27.99	29.23	30.63	32.81	34.84	36.26	37.41	39.34	41.04

44	23.48	25.38	26.31	28.79	30.05	31.47	33.69	35.74	37.18	38.34	40.30	42.02
45	24.20	26.14	27.08	29.60	30.88	32.32	34.56	36.65	38.10	39.28	41.26	43.00
46	24.93	26.90	27.85	30.41	31.71	33.17	35.44	37.55	39.02	40.22	42.22	43.98
47	25.66	27.65	28.62	31.22	32.53	34.01	36.32	38.46	39.94	41.16	43.18	44.96
48	26.39	28.42	29.40	32.03	33.37	34.87	37.20	39.36	40.87	42.09	44.14	45.94
49	27.13	29.18	30.18	32.85	34.20	35.72	38.08	40.27	41.79	43.03	45.10	46.92
50	27.86	29.95	30.96	33.66	35.03	36.57	38.97	41.18	42.72	43.97	46.06	47.90
51	28.60	30.72	31.74	34.48	35.87	37.43	39.85	42.09	43.65	44.91	47.03	48.89
52	29.34	31.49	32.53	35.30	36.71	38.28	40.73	43.00	44.58	45.85	47.99	49.87
53	30.09	32.26	33.31	36.13	37.55	39.14	41.62	43.91	45.50	46.80	48.95	50.85
54	30.84	33.04	34.10	36.95	38.39	40.00	42.51	44.82	46.43	47.74	49.92	51.83
55	31.59	33.82	34.90	37.78	39.23	40.86	43.40	45.74	47.36	48.68	50.88	52.82
56	32.34	34.60	35.69	38.60	40.07	41.72	44.29	46.65	48.29	49.63	51.85	53.80
57	33.09	35.38	36.48	39.43	40.92	42.59	45.18	47.56	49.22	50.57	52.81	54.78
58	33.85	36.16	37.28	40.26	41.77	43.45	46.07	48.48	50.15	51.51	53.78	55.77
59	34.60	36.95	38.08	41.09	42.61	44.32	46.96	49.40	51.09	52.46	54.74	56.75
60	35.36	37.73	38.88	41.93	43.46	45.18	47.85	50.31	52.02	53.40	55.71	57.73
61	36.13	38.52	39.68	42.76	44.31	46.05	48.75	51.23	52.95	54.35	56.68	58.72
62	36.89	39.31	40.48	43.60	45.16	46.92	49.64	52.15	53.89	55.30	57.64	59.70
63	37.66	40.11	41.29	44.43	46.02	47.79	50.54	53.07	54.82	56.24	58.61	60.68
64	38.42	40.90	42.09	45.27	46.87	48.66	51.43	53.99	55.76	57.19	59.58	61.67
65	39.19	41.70	42.90	46.11	47.73	49.53	52.33	54.91	56.69	58.14	60.54	62.65
66	39.96	42.49	43.71	46.95	48.58	50.41	53.23	55.83	57.63	59.08	61.51	63.64
67	40.74	43.29	44.52	47.79	49.44	51.28	54.13	56.75	58.56	60.03	62.48	64.62
68	41.51	44.09	45.33	48.64	50.30	52.16	55.03	57.67	59.50	60.98	63.45	65.61
69	42.29	44.89	46.15	49.48	51.16	53.03	55.93	58.59	60.44	61.93	64.41	66.59
70	43.07	45.70	46.96	50.33	52.02	53.91	56.83	59.52	61.37	62.88	65.38	67.58
71	43.84	46.50	47.78	51.17	52.88	54.79	57.73	60.44	62.31	63.83	66.35	68.56
72	44.63	47.31	48.60	52.02	53.74	55.66	58.63	61.36	63.25	64.78	67.32	69.54
73	45.41	48.11	49.42	52.87	54.60	56.54	59.54	62.29	64.19	65.73	68.29	70.53
74	46.19	48.92	50.24	53.72	55.47	57.42	60.44	63.21	65.13	66.68	69.26	71.52
75	46.98	49.73	51.06	54.57	56.33	58.30	61.35	64.14	66.07	67.63	70.23	72.50
76	47.76	50.54	51.88	55.42	57.20	59.19	62.25	65.06	67.01	68.58	71.20	73.49
77	48.55	51.36	52.70	56.28	58.07	60.07	63.16	65.99	67.95	69.54	72.17	74.47
78	49.34	52.17	53.53	57.13	58.94	60.95	64.06	66.92	68.89	70.49	73.14	75.46
79	50.13	52.98	54.35	57.98	59.80	61.84	64.97	67.85	69.83	71.44	74.11	76.44
80	50.92	53.80	55.18	58.84	60.67	62.72	65.88	68.77	70.77	72.39	75.08	77.43
81	51.72	54.62	56.01	59.70	61.54	63.61	66.79	69.70	71.72	73.35	76.05	78.41
82	52.51	55.43	56.84	60.55	62.41	64.49	67.70	70.63	72.66	74.30	77.02	79.40
83	53.31	56.25	57.67	61.41	63.29	65.38	68.60	71.56	73.60	75.25	77.99	80.39
84	54.10	57.07	58.50	62.27	64.16	66.27	69.51	72.49	74.54	76.21	78.96	81.37
85	54.90	57.89	59.33	63.13	65.03	67.15	70.43	73.42	75.49	77.16	79.93	82.36
86	55.70	58.72	60.16	63.99	65.91	68.04	71.34	74.35	76.43	78.11	80.91	83.34
87	56.50	59.54	61.00	64.85	66.78	68.93	72.25	75.28	77.38	79.07	81.88	84.33
88	57.31	60.37	61.83	65.72	67.66	69.82	73.16	76.21	78.32	80.02	82.85	85.32
89	58.11	61.19	62.67	66.58	68.53	70.71	74.07	77.14	79.27	80.98	83.82	86.30
90	58.91	62.02	63.51	67.44	69.41	71.61	74.98	78.08	80.21	81.93	84.79	87.29

91	59.72	62.84	64.34	68.31	70.29	72.50	75.90	79.01	81.16	82.89	85.77	88.28
92	60.52	63.67	65.18	69.17	71.17	73.39	76.81	79.94	82.10	83.85	86.74	89.26
93	61.33	64.50	66.02	70.04	72.05	74.28	77.73	80.88	83.05	84.80	87.71	90.25
94	62.14	65.33	66.86	70.91	72.93	75.18	78.64	81.81	83.99	85.76	88.68	91.24
95	62.95	66.16	67.70	71.77	73.81	76.07	79.56	82.74	84.94	86.72	89.66	92.22
96	63.76	66.99	68.55	72.64	74.69	76.97	80.47	83.68	85.89	87.67	90.63	93.21
97	64.57	67.83	69.39	73.51	75.57	77.86	81.39	84.61	86.83	88.63	91.60	94.20
98	65.38	68.66	70.23	74.38	76.45	78.76	82.31	85.55	87.78	89.59	92.58	95.19
99	66.19	69.50	71.08	75.25	77.33	79.65	83.22	86.48	88.73	90.54	93.55	96.17
100	67.01	70.33	71.92	76.12	78.22	80.55	84.14	87.42	89.68	91.50	94.52	97.16

N is the number of servers. The numerical column headings indicate blocking probability B in %. Table generated by Dan Dexter