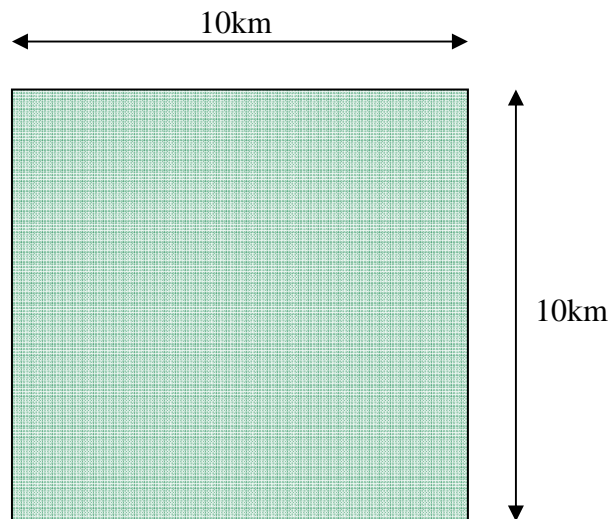


GSM network planning

Your task is to implement a GSM network on the fictitious urban area given below.

In your report you should report:

- 1) The amount of traffic generated by the subscribers on the area (in Erlang)
- 2) Calculation of the number of needed BSs based on **coverage** requirements
- 3) Calculation of the number of needed BSs based on **capacity** requirements
- 4) The locations and the number of base stations needed for the area
- 5) How many TRXs (i.e. transceivers) you need for each BS



Suggested procedure for capacity, coverage and frequency planning:

1. Calculate traffic created by the subscribers
2. Calculate maximum cell radiuses from perspective of coverage and capacity and take the smaller as the starting point for planning
3. Given the minimum re-used distance, determine clusters size and decide how to place your BSs on the "map"

The parameters for the planning are:

- Quadratic cell structure (cell radius =  $\sqrt{2} \cdot s$        $s = \text{side\_length}$ )
- Omnicell system (i.e. no sectorization)
- Number of people on the area: 20000
- Mobile phone penetration: 90%
- Average traffic per subscriber: 30 mErlang
- Max. number of TRX per base station: 5
- Blocking probability target: 0,02 (i.e. 2%)
- Time slots per TRX: 8 (of which 7 for data and 1 for signaling)
- Full-rate transmission
- Frequency: 1800 MHz
- Base station / Mobile phone sensitivity: -102 dBm
- Max. base station transmit power: 47 dBm
- Max. mobile station transmit power: 29 dBm
- BS-antenna gain = 15 dBi
- MS-antenna gain = 0 dBi
- BS mast-top amplifier effective gain: 7 dB
- Additional losses (feeder losses etc.) for link budget: -10 dB
- Base station antenna height: 50 m
- Mobile station antenna height: 1,7 m
- Minimum re-used distance: 2,7

For coverage calculations you may use Okumura-Hata      path-loss model.

**Remarks:** This exercise is highly simplified, but it gives a      n idea of what kind of issues need to be considered in real network planning. In      addition to the given parameters and just to obtain some of those (such as cluster size)      you normally would have to consider the real geography of the area, separately treat UL      and DL, consider interference caused by neighboring cells, consider probabilistic target      s for e.g. voice activity, call dropping etc. Also, the link budget for coverage planning wo      uld include plenty of additional terms such as feeder-cable losses etc. which now go under      the parameter 'Additional losses'.

Traffic causing blocking level B									Traffic causing blocking level B								
N	0.005	0.01	0.02	0.03	0.05	0.10	0.20	0.50	N	0.005	0.01	0.02	0.03	0.05	0.10	0.20	0.50
1	0.01	0.01	0.02	0.03	0.05	0.11	0.25	1.00	37	24.85	26.38	28.25	29.59	31.64	35.57	42.45	72.09
2	0.11	0.15	0.22	0.28	0.38	0.60	1.00	2.73	38	25.69	27.25	29.17	30.53	32.62	36.64	43.68	74.09
3	0.35	0.46	0.60	0.72	0.90	1.27	1.93	4.59	39	26.53	28.13	30.08	31.47	33.61	37.72	44.91	76.09
4	0.70	0.87	1.09	1.26	1.52	2.05	2.95	6.50	40	27.38	29.01	31.00	32.41	34.60	38.79	46.15	78.09
5	1.13	1.36	1.66	1.88	2.22	2.88	4.01	8.44	41	28.23	29.89	31.92	33.36	35.58	39.86	47.38	80.09
6	1.62	1.91	2.28	2.54	2.96	3.76	5.11	10.39	42	29.08	30.77	32.84	34.31	36.57	40.94	48.62	82.08
7	2.16	2.50	2.94	3.25	3.74	4.67	6.23	12.35	43	29.94	31.66	33.76	35.25	37.56	42.01	49.85	84.08
8	2.73	3.13	3.63	3.99	4.54	5.60	7.37	14.32	44	30.80	32.54	34.68	36.20	38.56	43.09	51.09	86.08
9	3.33	3.78	4.34	4.75	5.37	6.55	8.52	16.29	45	31.66	33.43	35.61	37.16	39.55	44.17	52.32	88.08
10	3.96	4.46	5.08	5.53	6.22	7.51	9.69	18.27	46	32.52	34.32	36.53	38.11	40.54	45.24	53.56	90.08
11	4.61	5.16	5.84	6.33	7.08	8.49	10.86	20.25	47	33.38	35.22	37.46	39.06	41.54	46.32	54.80	92.08
12	5.28	5.88	6.61	7.14	7.95	9.47	12.04	22.24	48	34.25	36.11	38.39	40.02	42.54	47.40	56.03	94.08
13	5.96	6.61	7.40	7.97	8.83	10.47	13.22	24.22	49	35.11	37.00	39.32	40.98	43.53	48.48	57.27	96.07
14	6.66	7.35	8.20	8.80	9.73	11.47	14.41	26.21	50	35.98	37.90	40.26	41.93	44.53	49.56	58.51	98.07
15	7.38	8.11	9.01	9.65	10.63	12.48	15.61	28.20	51	36.85	38.80	41.19	42.89	45.53	50.64	59.75	100.07
16	8.10	8.88	9.83	10.51	11.54	13.50	16.81	30.19	52	37.72	39.70	42.12	43.85	46.53	51.73	60.99	102.07
17	8.83	9.65	10.66	11.37	12.46	14.52	18.01	32.18	53	38.60	40.60	43.06	44.81	47.53	52.81	62.22	104.07
18	9.58	10.44	11.49	12.24	13.39	15.55	19.22	34.17	54	39.47	41.50	44.00	45.78	48.54	53.89	63.46	106.07
19	10.33	11.23	12.33	13.12	14.31	16.58	20.42	36.17	55	40.35	42.41	44.94	46.74	49.54	54.98	64.70	108.07
20	11.09	12.03	13.18	14.00	15.25	17.61	21.64	38.16	56	41.23	43.31	45.88	47.70	50.54	56.06	65.94	110.07
21	11.86	12.84	14.04	14.89	16.19	18.65	22.85	40.15	57	42.11	44.22	46.82	48.67	51.55	57.14	67.18	112.06
22	12.63	13.65	14.90	15.78	17.13	19.69	24.06	42.15	58	42.99	45.13	47.76	49.64	52.55	58.23	68.42	114.06
23	13.42	14.47	15.76	16.68	18.08	20.74	25.28	44.14	59	43.87	46.04	48.70	50.60	53.56	59.32	69.66	116.06
24	14.20	15.30	16.63	17.58	19.03	21.78	26.50	46.14	60	44.76	46.95	49.64	51.57	54.57	60.40	70.90	118.06
25	15.00	16.13	17.50	18.48	19.99	22.83	27.72	48.13	61	45.64	47.86	50.59	52.54	55.57	61.49	72.14	120.06
26	15.79	16.96	18.38	19.39	20.94	23.89	28.94	50.13	62	46.53	48.77	51.53	53.51	56.58	62.58	73.38	122.06
27	16.60	17.80	19.26	20.31	21.90	24.94	30.16	52.12	63	47.42	49.69	52.48	54.48	57.59	63.66	74.63	124.06
28	17.41	18.64	20.15	21.22	22.87	26.00	31.39	54.12	64	48.30	50.60	53.43	55.45	58.60	64.75	75.87	126.06
29	18.22	19.49	21.04	22.14	23.83	27.05	32.61	56.12	65	49.19	51.52	54.38	56.42	59.61	65.84	77.11	128.06
30	19.03	20.34	21.93	23.06	24.80	28.11	33.84	58.11	66	50.09	52.44	55.33	57.39	60.62	66.93	78.35	130.06
31	19.85	21.19	22.83	23.99	25.77	29.17	35.07	60.11	67	50.98	53.35	56.27	58.37	61.63	68.02	79.59	132.06
32	20.68	22.05	23.72	24.91	26.75	30.24	36.30	62.11	68	51.87	54.27	57.23	59.34	62.64	69.11	80.83	134.05
33	21.50	22.91	24.63	25.84	27.72	31.30	37.52	64.10	69	52.77	55.19	58.18	60.32	63.65	70.20	82.08	136.05
34	22.34	23.77	25.53	26.78	28.70	32.37	38.75	66.10	70	53.66	56.11	59.13	61.29	64.67	71.29	83.32	138.05
35	23.17	24.64	26.43	27.71	29.68	33.43	39.99	68.10	71	54.56	57.03	60.08	62.27	65.68	72.38	84.56	140.05
36	24.01	25.51	27.34	28.65	30.66	34.50	41.22	70.10	72	55.46	57.96	61.04	63.24	66.69	73.47	85.80	142.05

N=Numberoftrafficchannels

**Table 4.5. Reuse pattern size in different regions.**

Quadratic cell structure											
M	1	2	4	5	8	9	10	12	15	18	19
(D/R) <sub>min</sub>	1.732	2.000	2.828	3.162	4.000	4.243	4.472	5.099	5.831	6.000	6.325
Hexagonal cell structure											
M	1	3	4	7	9	12	13	16	19	21	25
(D/R) <sub>min</sub>	1.732	3.000	3.464	4.583	5.196	6.000	6.245	6.928	7.550	7.937	8.660