

## Voice services and dimensioning (Thanks to Claes Beckman)



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# GSMA<sup>®</sup>



- Specified by ETSI
- Frequency Division Duplex
- TDMA system
- Originally at 900MHz, but today also at 800, 1800, 1900 and some other bands world wide



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## Basic Frame Structure



- 8 time slots (voice channels) / TDMA carrier

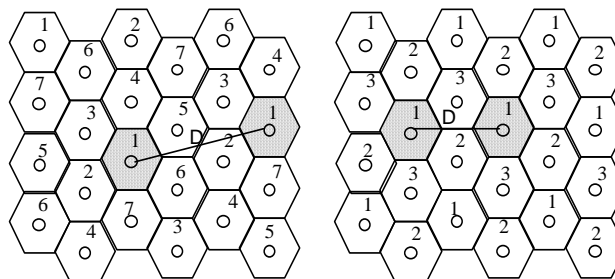


- 1 time slot / cell used for signaling (BCCH)

- Symbol rate 271 kbps 

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## Cell planning and re-use



a) K= 7

b) K= 3

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## Number of channels to use - Short exercise

How many voice channels per site in the cases



- A. Bandwidth 2,8 MHz, re-use factor 7, omni antenna
- B. Bandwidth 1,2 MHz, re-use factor 3, omni antenna

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## Number of channels to use - Short exercise

How many voice channels per site in the cases



- A. Bandwidth 2, 8MHz, re-use factor 7, omni antenna
- B. Bandwidth 1,2 MHz, re-use factor 3, omni antenna
- C. Bandwidth 2, 8MHz, re-use factor 7, three sectors
- D. Bandwidth 1,2 MHz, re-use factor 3, three sectors

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## Traffic

An *Erlang* is a unit of telecommunications traffic measurement. Strictly speaking, an Erlang represents the continuous use of one voice path. In practice, it is used to describe the total traffic volume of one hour.



Example, if a group of user made 30 calls in one hour, and each call had an average call duration of 5 minutes, then the number of Erlangs this represents is worked out as follows:

Minutes of traffic in the hour = number of calls x duration

Minutes of traffic in the hour =  $30 \times 5 = 150$

Hours of traffic in the hour =  $150 / 60 = 2.5$

**Traffic figure = 2.5 Erlangs**

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## Erlang B

Several traffic models exist which share their name with the Erlang unit of traffic. They are formulae which can be used to estimate the number of lines required in a network, or to a central office (PSTN exchange lines).

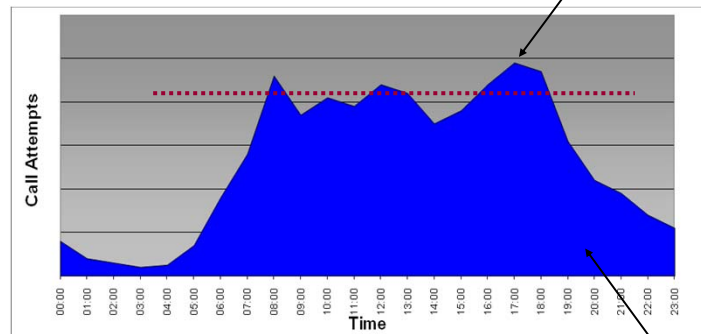


Erlang B is the most commonly used traffic model, and is used to work out how many lines are required if the traffic figure (in Erlangs) during the busiest hour and the number of blocked calls are known. The model assumes that all blocked calls are immediately cleared.

<http://www.erlang.com/calculator/erlb/>

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## Network Traffic Load



30mErlang is the statistical traffic per subscriber in busy hour.  
Minutes of use is the sum of all traffic, i.e. the blue area

Service Revenues are a function of average demand

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## Blocking in Cellular systems

- Typically we plan the voice capacity of our mobile phone systems for 2% blocking rate (98% availability)



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### Erlang B 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	.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

## Another test



- Bandwidth 1,2 MHz, re-use factor 3, three sectors
- Assume that one channel will be used for control
- 2% blocking => 9 Erlang

- How many 20mE users can be served? 450
- How many 50mE users can be served? 180

- No carriers: 2
- Total No channels: 16
- Usable No channels: 15
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