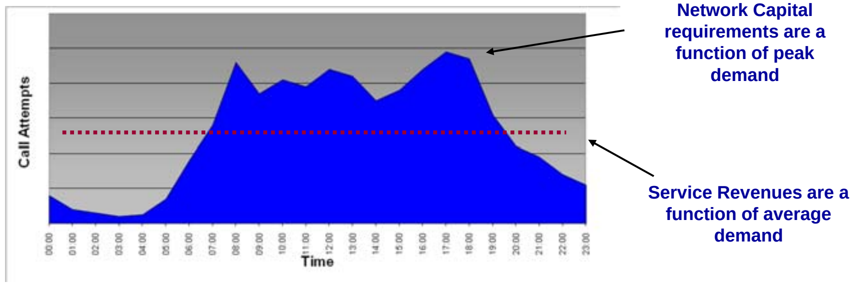
Dimensioning, configuration and deployment of Radio Access Networks.

part 2: Voice

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

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 x 5 = 150
Hours of traffic in the hour = 150 / 60 = 2.5

Traffic figure= 2.5 Erlangs

Trunking

Erlang traffic measurements are made in order to help telecommunications network designers understand traffic patterns within their voice networks. This is essential if they are to successfully design their network topology and establish the necessary trunk group sizes. The more efficient the existing lines are used the higher the Trunking Efficiency is of the network

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/

Erlang B Table

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

Blocking in Celular systems

- Typically we plan the voice capacity of our mobile phone systems for 2% blocking rate (98% availability)
- This is far worse than the typical 99.999% availability we plan our fixed line networks for.
- For data there is no QoS measure.

GSM Basic Frame Structure

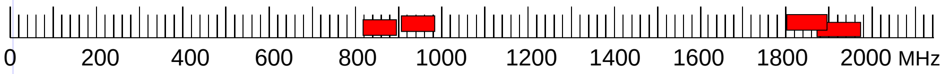
•Symbol rate 271 kbps

•8 time slots / channel
•1 time slot / cell used for signaling

Downlink Frame Structure

RF Parameters

- 200 kHz radio channel bandwidth
- Control channels planned in 4/12
- Traffic channels planned in 3/9 or tighter!



GSM Capacity

(static channel Allocation)

If we now look at a very simple GSM network with static channel allocation 5MHz of spectrum we find that:

- 5MHz divided over 200kHz per radio channel gives us 25 carriers.
- 12 of those are control channels
- The other 13 traffic channels can be allocated in a 1/3 reuse
- In total we get 5 carriers per sector

GSM Capacity

(static channel allocation)

What is then the total capacity per sector?

- Maximum 5 carriers per sector
- 5*8-1=39 voice channels
- 2% blocking
- 28 Erlangs/sector