HSL Femtocell BSS
2.75G Femtocell Network

Enterprise Capacity and Coverage – technical note

The purpose of this document is to illustrate typical requirement for an enterprise in terms of capacity and coverage that a femtocell could be deployed with. In an ideal outdoor situation on a flat surface without any obstacles a femtocell radiating at its full power of 23dBm will be able to cover area greater than 500m but in an indoor deployment where femtocell is designed for, there would be multiple obstacles every few meters reducing the effective coverage of the femtocell. To illustrate the distance and coverage that could be obtained using HSL 2.75G Femtocell, we have modelled a typical modern office building using highly precise indoor propagation modelling tools. These modelling tools take into account the effect of multi-path propagation, reflection, diffraction and shadowing to obtain accurate results.

Coverage is usually defined in terms of received signal level and the area for which certain signal level criteria is met. The extent of coverage for a given building is represented in the form of percentage of the area covered at a certain height above the ground level. 98% coverage for a planned indoor environment is considered sufficient, however the behaviour of indoor factors such as rooms, multiple floors, windows and obstacles such as internal partitions, furniture hinder radio waves from penetrating different areas of the building, which results in unpredictable effects on the radio signals and the achieved coverage.

The femtocell should produce a signal level in excess of the signal that is required to meet the coverage criteria in each of the respective parts of the building, at the same time the femtocell should radiate power such that the signal strength produced outside the building by the femtocell is minimised in order to permit the same radio frequency to be used outdoors, without causing significant interference.

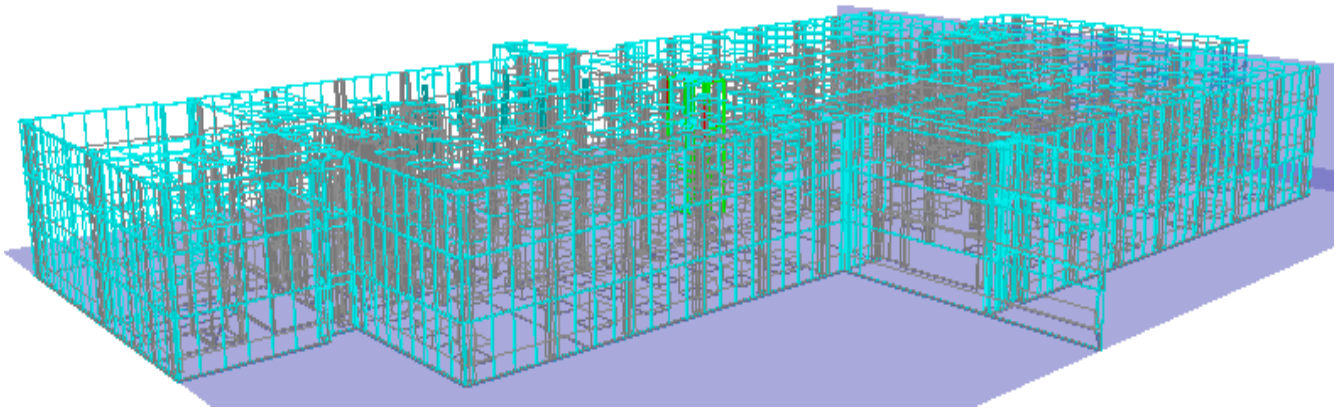
As a general guideline the indoor signal level should be 10-15dB higher than outside macrocell coverage, however depending on the macrocell coverage in the building and height of the building the target signal level might vary from -65 dBm to -85 dBm. Isolation of the indoor and outdoor network is also an important aspect of indoor network planning. Modern office building like the one used below to simulate the enterprise capacity and coverage has aluminium coated exterior walls which attenuates the signal level thus reducing the leakage from the building into the nearby macro cell coverage. Also considerably lower output power of the femtocell than macrocell base stations, helps to isolate the femtocell coverage and helps maintain a tolerable interference level.

Obtaining 100% coverage is not the only target for an enterprise deployment. The heaviest users might be located on a single floor, so there must be sufficient capacity as well to handle the total traffic during busy hours. For providing sufficient capacity, information about number of people, their usage and expected grade of service is required to calculate the traffic that would be generated and thereby deploying uniform number of traffic channels.

Deployment Scenarios

Scenario : Modern Office Building

Description



3d View

Transmitter

Frequency: 1877.0 MHz, 1877.2 MHz, 1877.4 MHz, 1877.6 MHz, 1877.8 MHz, 1878.0 MHz, 1878.2 MHz, 1878.4 MHz

Power: 11dBm (0.013W) EIRP

Building characteristics

Building width: 50m

Building length: 100m

Population: 600

Blocking probability: 0.5%

Statistical Information

Minimum Value: -83.6900 dBm

Maximum Value: -30.530 dBm

Mean Value: -59.414 dBm

Capacity Calculation

The number of femtocells required to ensure adequate coverage and traffic carrying capacity were calculated based on the following assumptions. The peak traffic assumptions is, 50% of people are involved in active calls of 5 minutes duration during the busy hour. For an office building the grade of service (blocking probability) offered should be 0.5%.

The required traffic capacity was estimated using the following criteria:

N = Number of people per floor

P = Proportion engaged on a call during the busy hour = 50%

D = Duration of the call, minutes = 5

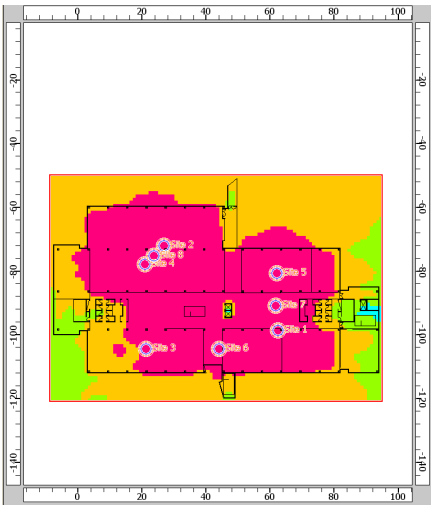
T = Total minutes of traffic during busy hour = NPD

Calculated traffic capacity is given by the following formula

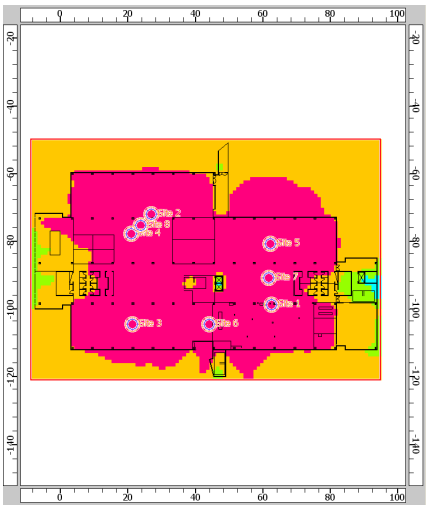
Traffic capacity (E) = T/60

Floor	Population	Grade of Service	Traffic (E)	No. of Traffic Channels	No. of Femtocells
First	250	0.5	10.474	20	3
Second	275	0.5	11.458	21	3
Third	75	0.5	3.0125	9	2

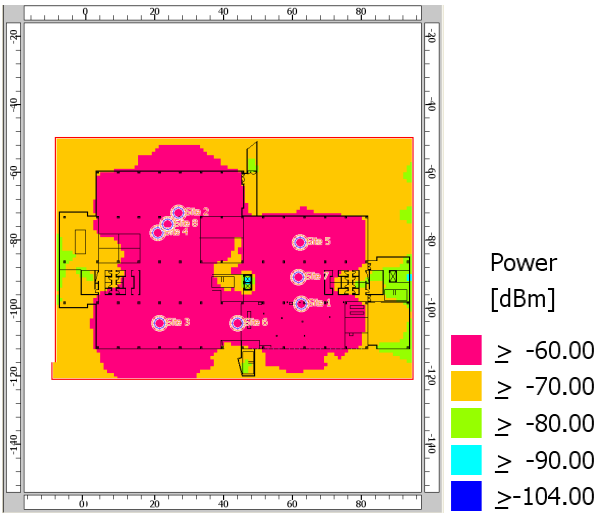
Prediction Result:



Coverage on ground floor



Coverage on first floor



Coverage on second floor

Coverage:

The above prediction results are for the three floors indicating there is ample amount of coverage in the building. 8 femtocells operating at 11dBm power level can provide sufficient coverage in a multi-storey office building.

Capacity:

For the building population modelled, the peak traffic requirement is 24.944 Erlangs, from the traffic calculation it is observed that 8 femtocells would meet the traffic requirements of the building.