

# HSL Femtocell BSS

## 2.75G Femtocell Network



### HSL 2.75G Femtocell Coverage – technical note

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The purpose of this document is to describe typical femtocell coverage and providing a reference for understanding the capacity with which femtocell could be deployed. Femtocells are intended to be used for dedicated indoor coverage, so the output power of the femtocell is kept considerably lower than macrocell base stations. This helps to isolate the femtocell from other cells and helps maintain a tolerable interference level. The HSL 2.75G Femtocell can operate up to 200mW or 23dBm EIRP.

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. In a building with several rooms and multiple floors the direct path between the femtocell and mobile antenna are likely to be interrupted. Brick walls, windows and obstacles such as internal partitions, furniture hinder radio waves from penetrating inside buildings. The extent to which these obstacles attenuate the signal level varies according to the construction material and radio frequency used.

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.

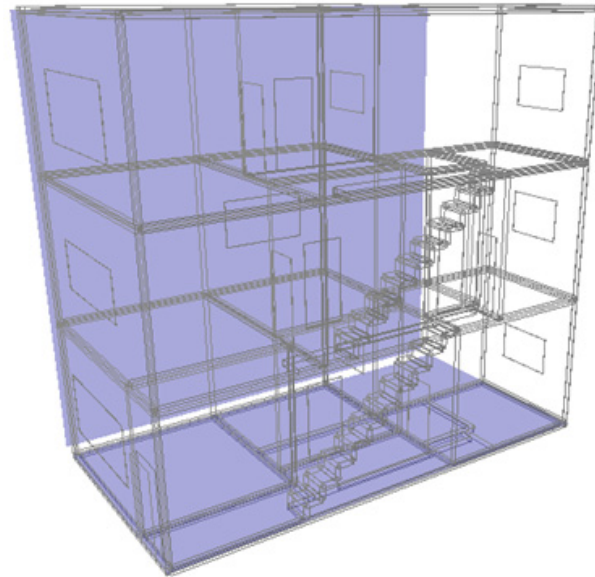
For providing indoor coverage using femtocell it is important to understand the factors that affect indoor radio propagation. The radio wave propagation are influenced by reflection, diffraction and scattering. These factors are dynamic, unpredictable and diverse in nature therefore they need to be treated appropriately to estimate the right model. Reflections are caused due to collision between the radio wave and large obstruction such as walls. These reflected radio waves can be captured constructively at the mobile device. Diffraction is shadowing and is a result of a collision between the radio wave and an obstruction that is not easy to penetrate or with sharp edges. Scattering is the result of a collision between the radio wave and obstructions which is equal to or less than the wavelength of the radio wave. Also different materials like metal, dielectric and insulators cause reflection of radio wave with different characteristics. The received signal power is affected randomly by a combination of the above mentioned facts.

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 two typical British housing using highly sophisticated and precise

indoor propagation modelling tools. These modelling tools take into account the effect of multi-path propagation, reflection, diffraction, corridor effect and material properties to obtain accurate results.

## Deployment Scenarios

### Scenario 1a: Three Floor Row House



3D view

#### Description:

#### Transmitter

Co ordinates (2.64, 4.44, 3.500)

Frequency: 1874.2 MHz

Power: 11dBm (0.013W) EIRP

#### Prediction area

Lower Left corner: (.35, 1.34, 1.50)

Upper right corner: (5.35, 10.34, 1.50)

Resolution: 1m

### Statistical Information

Minimum Value: -89.800 dBm

Maximum Value: -42.400 dBm

Mean Value: -70.013 dBm

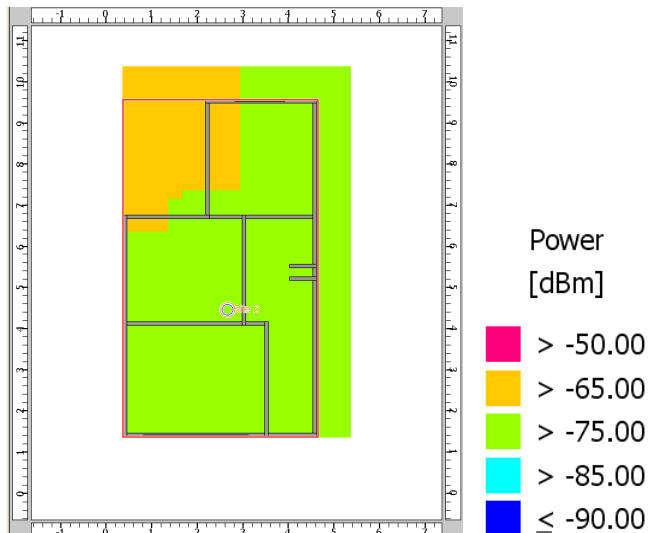
### Tabulation:

The femtocell was set at power level of 11dBm and placed at relative centre of each floor. The average received signal level at all three floors was measured and tabulated in the below table.

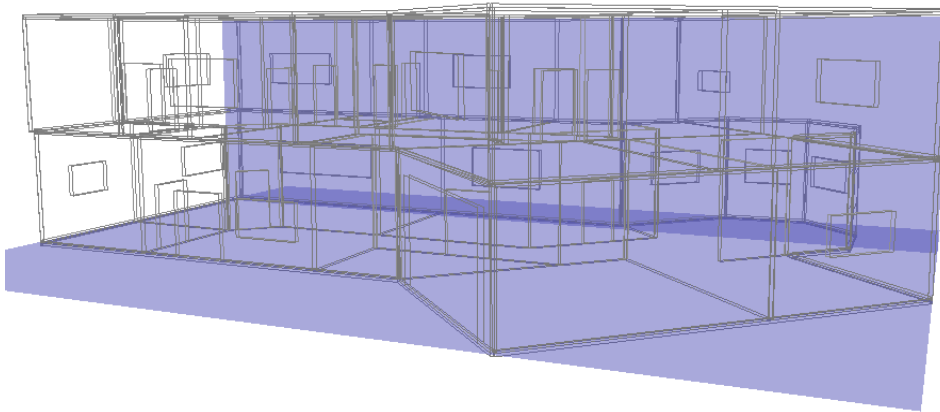
Output Power	Transmitter Height	Average Received Signal Strength		
		Ground Floor (1.5m)	First Floor (3.5m)	Second Floor (6.5m)
11 dBm	Ground Floor (1.5m)	-46 dBm	-75 dBm	-89 dBm
	First Floor (3.5m)	-72 dBm	-44 dBm	-75 dBm
	Second Floor (6.5m)	-83 dBm	-76 dBm	-45 dBm

### Result

The below result is for the femtocell placed at the relative centre of the house at first floor and radiating at 11dBm for prediction executed at ground floor.



## Scenario 1b: Detached Modern House



3D view

### Description:

#### Transmitter

Co ordinates (3.220, 24.1600, 3.500)

Frequency: 1874.2 MHz

Power: 11dBm (0.013W) EIRP

#### Prediction area

Lower Left corner: (-10.52, 9.58, 3.50)

Upper right corner: (15.48, 40.58, 3.50)

Resolution: 1m

### Statistical Information

Minimum Value: -70.640 dBm

Maximum Value: -32.460 dBm

Mean Value: -59.808 dBm

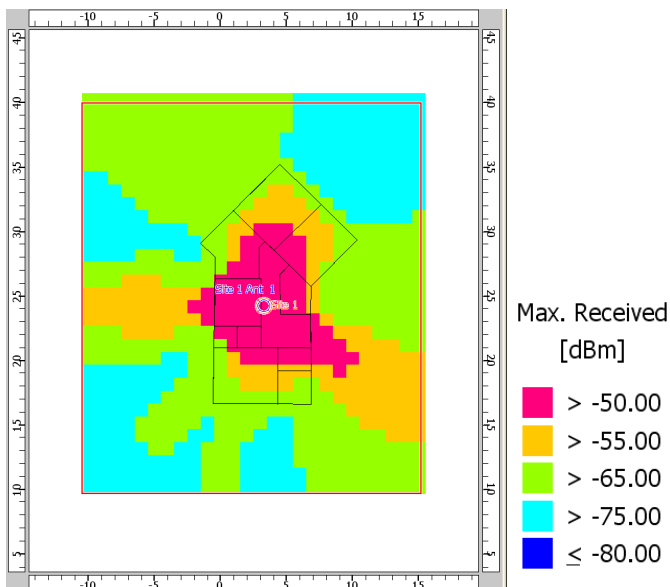
### Tabulation:

The femtocell was set at power level of 11dBm and placed at relative centre of each floor. The average received signal level at both floors was measured and tabulated in the below table.

Output Power	Transmitter Height	Average Received Signal Strength	
		Ground Floor (1.5m)	First Floor (3.5m)
11dBm	Ground Floor (1.5m)	-49 dBm	-61 dBm
	First Floor (3.5m)	-57 dBm	-46 dBm

### Result

The below result is for the femtocell placed at the relative centre of the house at first floor and radiating at 11dBm for prediction executed at first floor.



## **Conclusion**

The above two scenarios illustrate that HSL 2.75G Femtocell is capable of providing sufficient coverage even at its lowest power level for a distance over 15 meters. The femtocell has been tested in real life scenarios for providing adequate indoor coverage up to 30m while radiating at its highest output power.