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| Re: | 802.16m Amendment Working Document<br>Call for contributions on "Support for Femtocell BS" |
| Abstract | This contribution provides the interference avoidance scheme for Femtocell BS**.** |
| Purpose | For discussion and approval by IEEE 802.16m TG |
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# Interference Avoidance for Femtocell BS in IEEE 802.16m Amendment

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## 1   Introduction

Interference avoidance between macro/micro cells and Femtocells or among Femtocells is important in order to realize the high quality of indoor communications without deteriorating the quality of outdoor communications. When a Femtocell BS selects the same carrier frequency as surrounding macro/micro cells or neighbor femtocells, the mutual interference between macro/micro cells and Femtocells or among Femtocells may increase and the quality of indoor and outdoor communications may deteriorate

It is necessary to select the carrier frequency of Femtocell automatically for the interference avoidance. In this contribution, the schemes that allows adaptive selection of the carrier frequency of Femtocell is provided.

## 2   Carrier Frequency Selection

### 2.1  Interference Avoidance between Macro/Micro Cell and Single Femtocell

Femtocell BS can measure the signal strength for the carrier frequency of the neighbor macro/micro cells. In addition, the Femtocell BS can receive A-Preamble from the neighbor macro/micro cells and detect information on cell type. The Femtocell BS shall select the carrier frequency based on the measurement result on signal strength and the information on cell type.

A micro cell has higher priority for MS connecting than that of macro cell. The Femtocell BS measures the signal strength for the carrier frequency of the neighbor macro and micro cells. When the signal strength for the carrier frequency of the neighbor macro cell exceeds a certain threshold and the signal strength for the carrier frequency of the neighbor micro cell exceeds another certain threshold, the Femtocell BS selects the carrier frequency used by the cell which has the lower priority.

In Fig.1, the radio communication system comprises a macro BS, a Femtocell BS, an outdoor MS, and an indoor MS. The macro BS makes a macro cell and the Femtocell BS makes a Femtocell. Furthermore, the radio communication system has two carrier frequencies RF1 and RF2. The carrier frequency of the macro cell is RF1. In this case, the Femtocell BS selects the RF2 because the signal strength of RF1 is larger than that of RF2.
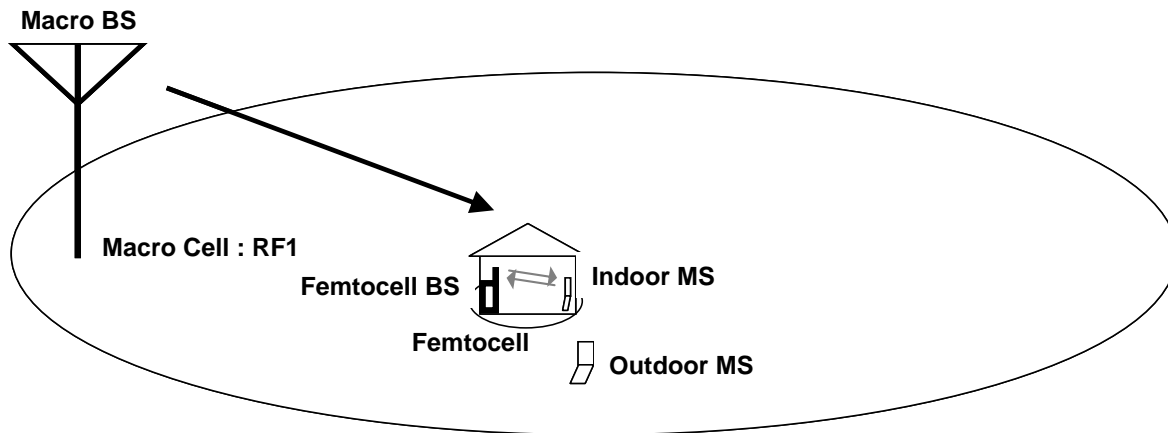
Fig.1    Carrier frequency selection when macro cell and Femtocell exist

In Fig.2, the radio communication system comprises a macro BS, a micro cell BS, a Femtocell BS, an outdoor MS, and an indoor MS. The macro BS, the micro BS, the Femtocell BS makes a macro cell, a micro cell, and a Femtocell respectively. The macro cell is overlaid by the micro cell. The micro cell is overlaid by the Femtocel BS. Furthermore, the radio communication system has two carrier frequencies RF1 and RF2. The carrier frequency of the macro cell and the micro cell is RF1 and RF2 respectively. In this case, the Femtocell BS selects the RF1 because the priority of RF1 used by the macro cell is smaller than that of RF2 used by the micro cell. When the micro cell becomes close to the edge of the macro cell, the signal strength of RF1 becomes weak. As a result, the Femtocell BS selects the RF1 and the interference between the Femtocell and the micro cell is avoided. However, when the micro cell becomes close to the center of the macro cell, the signal strength of RF1 becomes strong. As a result, with only the signal strength the Femtocell BS would select the RF2 and the interference between the Femtocell and the micro cell can not be avoided. Therefore, in that case with the cell type information used the Femtocell BS will select the RF1 and the interference between the Femtocell and the micro cell can be avoided.

By the way, when the micro cell is not overlaid by the Femtocel BS, the Femtocell BS selects the RF2 because in this case the signal strength of RF2 is smaller than that of RF1 and the mutual interference between the Femtocell BS and the micro cell is small.
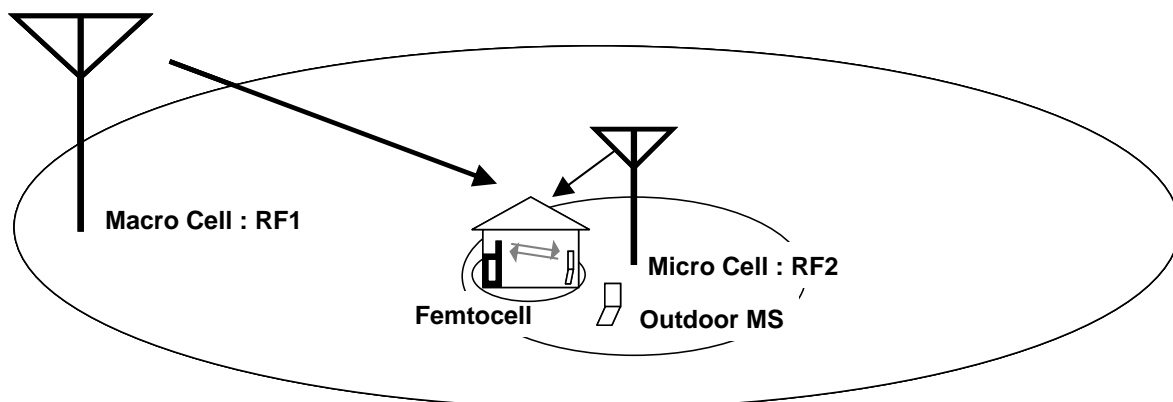
Fig.2 Carrier frequency selection when macro cell, micro cell, and Femtocell exist

## 2.2 Interference Avoidance between Macro cell and multiple Femtocells

Femtocell BS can measure the signal strength for the carrier frequency of the neighbor macro cells or the other Femtocells. In addition, the Femtocell BS can receive A-Preamble from the neighbor macro cells or the other Femtocells and obtain information on cell type. The Femtocell BS shall select the carrier frequency based on measurement result on the signal strength and the information on cell type.

The Femtocell BS measures the signal strength for the carrier frequency of the neighbor macro cells and the other Femtocells. When the signal strength for the carrier frequency of the neighbor macro cell exceeds a certain threshold and the signal strength for the carrier frequency of the other Femtocell exceeds another certain threshold, the Femtocell BS selects the carrier frequency used by the other Femtocell.

In Fig.3, the radio communication system comprises a macro BS, two Femtocell BSs (Femtocell BS1 and Femtocell BS2), an outdoor MS, and two indoor MSs. The macro BS makes a macro cell and the each Femtocell BS makes each Femtocell. Furthermore, the radio communication system has two carrier frequencies RF1 and RF2. The carrier frequency of the macro cell is RF1. And the Femtocell BS2 firstly select the carrier frequency RF2. In this case, the Femtocell BS1 selects the RF2 because the carrier frequency of the Femtocell BS2 is RF2. When the two Femtocells becomes close to the center of the macro cell, the signal strength of RF1 becomes strong. As a result, the Femtocell BS1 selects the RF2 and the interference between the Femtocell BS1 and the macro cell is avoided. However, when the two Femtocells becomes close to the edge of the macro cell, the signal strength of RF1 becomes weak. As a result, with only the signal strength the Femtocell BS would select the RF1 and the interference between the Femtocell BS1 and the macro cell can not be avoided. Therefore, in that case with the cell type information used the Femtocell BS1 will select the RF2 and the interference between the Femtocell BS1 and the macro cell can be avoided.
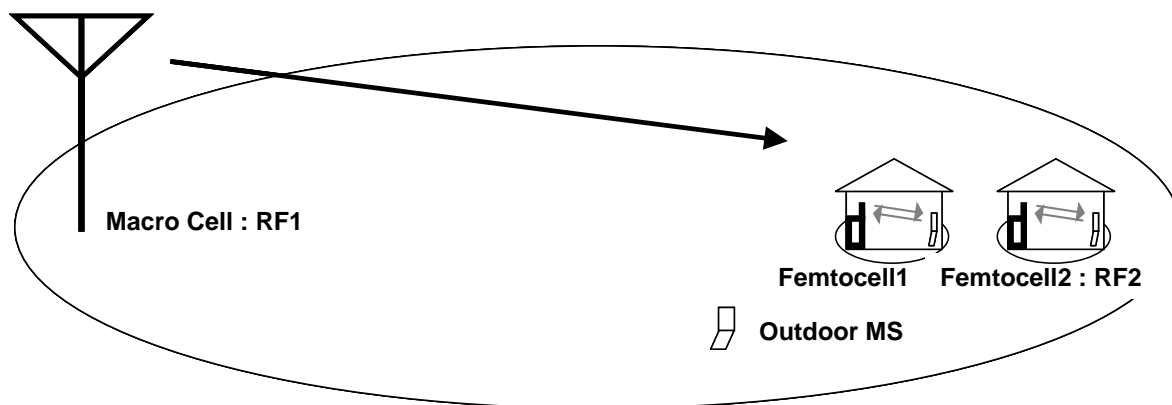


**Macro Cell : RF1**

**Femtocell1  Femtocell2 : RF2**

**Outdoor MS**

Fig.3 Carrier frequency selection when a macro cell and two Femtocells exist

-------------------------------------------- Proposed text --------------------------------------------------

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## 15.x.x Interference Avoidance for Femtocell BS (Related to Sec. 15.9 in SDD)

Femtocell BS can measure the signal strength for the carrier frequency of the neighbor macro/micro/femto cells. In addition, the Femtocell BS can receive A-Preamble from the neighbor macro/micro/femto cells and obtain information on cell type. The Femtocell BS shall select the carrier frequency based on the measurement result on signal strength and the information on cell type.

If the Femtocell is overlaid by a micro cell, when the signal strengths for the carrier frequency of both neighbor macrocell and microcell exceed certain thresholds, the Femtocell BS selects the carrier frequency used by the cell that has the lower priority (i.e. macrocell). If the Femtocell is not overlaid by a micro cell, the Femtocell selects the carrier frequency, whose signal strength is the smaller.

If there multiple neighbor femtocell BSs exist, the Femtocell BS measures the signal strength for the carrier frequency of the neighbor macro cells and the neighbor Femtocells shown by the cell type information. When the signal strengths for the carrier frequency of the neighbor macrocell and more than one femtocells exceed certain thresholds, the Femtocell BS selects the carrier frequency used by that of a neighbor Femtocell.

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