Project	**IEEE 802.16 Broadband Wireless Access Working Group** <http://ieee802.org/16>
Title	**Adaptive Frequency Reuse in Project 802.16m SDD**
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Source(s)	I-Kang Fu, Pei-Kai Liao and Paul Cheng. MediaTek Inc. No.1, Dusing Road 1, Science-Based Industrial Park, Hsinchu, Taiwan 300, R.O.C. IKang.Fu@gmail.com pk.liao@mediatek.com paul.cheng@mediatek.com
Re:	IEEE 802.16m-07/040, "Call for Contributions on Project 802.16m System Description Document (SDD)"
Abstract	This contribution proposes to have a section "Adaptive Frequency Reuse" in P802.16m SDD and introduce how this mechanism can improve the capacity of IEEE 802.16m system.
Purpose	Propose TGm SDD to have a section "Adaptive Frequency Reuse".
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Adaptive Frequency Reuse in Project 802.16m SDD

I-Kang Fu, Pei-Kai Liao and Paul Cheng
MediaTek Inc.

I. Introduction

In mobile cellular systems, frequency reuse is an important technique to improve the overall system capacity by reusing the scarce spectrum resource and the cellular structure is the tool to facilitate the frequency planning. Few years ago, the idea of reuse partitioning was introduced in the literature [1] to apply different frequency reuse factors within the same cell. Recently, the IEEE 802.16 based mobile WiMAX system [2] has implemented this technique in the real system. In this contribution, the idea of reuse partitioning is further extended as a kind of adaptive frequency reuse and a simple example is given to introduce how to realize this technique in IEEE 802.16m system. Then, some text input for TGm SDD is proposed to consider the adaptive frequency reuse as a topic for further development in P802.16m.

II. System Model

The system model begins from a typical cellular structure as shown in Figure 1. The reference base station (BS) is denoted as BS_0, and the interfering BSs are denoted as BS_q, q = 1, 2 … Q, where Q is the number of the interfering BSs. Cell radius R is the same for every BS, and the distance between adjacent interfering BSs is given by $D = \sqrt{3K} \cdot R$, where K is the reuse factor (cluster size) [3]. K is a key system parameter that balances link performance and system capacity.

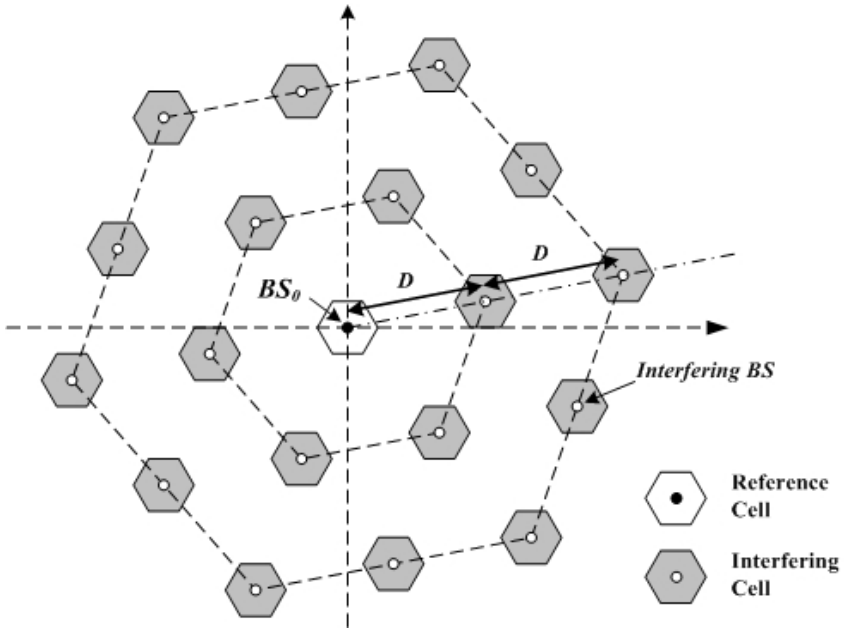

Fig. 1 Geometry of interfering cells ($Q = 18$) by given a frequency reuse factor (cluster size) K

- Adaptive Frequency Reuse

The typical reuse partitioning cell structure is given here as an example of adaptive frequency reuse, where a regular cell is divided (ideally) into two or more concentric cell-regions, each with a different frequency reuse factor (K) [2]. By allowing the inner cell-regions to use a smaller reuse factor leads to a higher system capacity, as compared to the regular cell structure where the same reuse factor is used for the entire cell. Note that the reuse factor, size of each frame zone and the user served by each zone may be adapted from time to time. In order to achieve this, some kind of measurement and inter-cell coordination mechanisms will be necessary to enable adaptive frequency reuse.

Figure 2 illustrates its concept with a TDD frame structure. In Figure 2(a), a regular cell is divided into Z cell-regions with the z-th region denoted by $\{\omega_{z-1}R < r_0 \le \omega_z R,\ 0 < \theta_0 \le 2\pi\}$, where $\omega_{z-1} \le \omega_z$, $\omega_0 = 0$, $\omega_Z = 1$, and $1 \le z \le Z$. Then, the TDD frame is partitioned into Z resource-zones (or frame-zones), and within a resource-zone, the radio resource is further divided into K_z resource-regions as shown in Figure 2(b), where K_z is the reuse factor for z-th cell-region. Finally, each of the resource-region is allotted to BSs according to the designated reuse factor and cell regions.

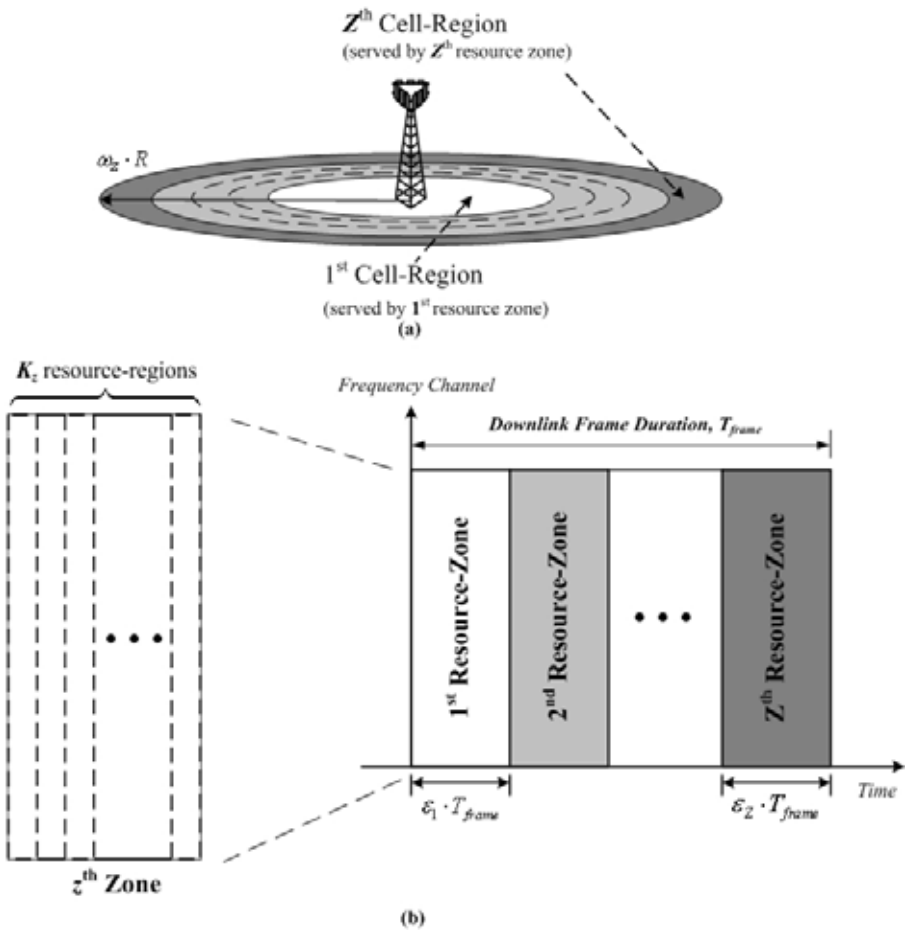

Fig. 2 An example [4] of adaptive frequency reuse: (a) divide the cell into Z concentric regions and (b) serve each region by corresponding frame zone with different K_z

III. Proposed Sections/Subsections in the Table of Content (ToC)

----------Start of the Text----------

[*Adopt the following text in the ToC of P802.16m System Description Document (SDD)*]

x.y Adaptive Frequency Reuse

[*In IEEE 802.16m system, the frequency reuse factor applied in each frame zone may be different. For the users in different location or under different interference level, system may serve them by appropriate frequency reuse factor by the corresponding frame zone. In order to enable the adaptive frequency reuse factor in IEEE 802.16m system, a measurement mechanism and inter-cell coordination mechanism will be required.*]

x.y.1 Measurement mechanism for adaptive frequency reuse

x.y.2 Inter-cell coordination for adaptive frequency reuse

----------End of the Text----------

References

[1] T-Po Chu and Stephen S. Rappaport, “Overlapping Coverage with Reuse Partitioning in Cellular Communication Systems,” *IEEE Transactions on Vehicular Technology*, Vol. 46, No. 1, pp.41-54, Feb. 1997.

[2] WiMAX White Paper, “Mobile WiMAX-Part I: A technical overview and performance evaluation,” http://www.wimaxforum.org/technology/downloads/, Feb. 2006.

[3] T. S. Rappaport, “Wireless communications: principles & practice,” ISBN: 0133755363, Prentice Hall, 1999.

[4] I-Kang Fu, “Performance Improvement Techniques for Cellular OFDMA Systems,” Ph.D Dissertation, National Chiao Tung University, Sep. 2007.