Project	**IEEE 802.16 Broadband Wireless Access Working Group** <http://ieee802.org/16>
Title	**Interference Mitigation for 802.16m**
Date Submitted	**2008-07-07**
Source(s)	Chang-Lan Tsai, Ren-Jr Chen, Chung-Lien Ho, Yan-Xiu Zheng, Richard Li ITRI Wern-Ho Sheen NCTU/ITRI E-mail: tsaichangl@itri.org.tw richard929@itri.org.tw
Re:	Call for Contributions of IEEE 802.16m_08/024 on the topic of "Interference Mitigation"
Abstract	Proposal of the interference mitigation schemes in 802.16m
Purpose	Discussion and approval by the task group.
Notice	*This document does not represent the agreed views of the IEEE 802.16 Working Group or any of its subgroups*. It represents only the views of the participants listed in the "Source(s)" field above. It is offered as a basis for discussion. It is not binding on the contributor(s), who reserve(s) the right to add, amend or withdraw material contained herein.
Release	The contributor grants a free, irrevocable license to the IEEE to incorporate material contained in this contribution, and any modifications thereof, in the creation of an IEEE Standards publication; to copyright in the IEEE's name any IEEE Standards publication even though it may include portions of this contribution; and at the IEEE's sole discretion to permit others to reproduce in whole or in part the resulting IEEE Standards publication. The contributor also acknowledges and accepts that this contribution may be made public by IEEE 802.16.
Patent Policy	The contributor is familiar with the IEEE-SA Patent Policy and Procedures: <http://standards.ieee.org/guides/bylaws/sect6-7.html#6> and <http://standards.ieee.org/guides/opman/sect6.html#6.3>. Further information is located at <http://standards.ieee.org/board/pat/pat-material.html> and <http://standards.ieee.org/board/pat>.

Interference Mitigation for 802.16m

Chang-Lan Tsai, Ren-Jr Chen, Chung-Lien Ho, Yan-Xiu Zheng, Richard Li
ITRI
Wern-Ho Sheen
NCTU/ITRI

1. Introduction

In the multi-cell OFDMA environment, user throughput is limited by inter-cell interference, especially for the user near the cell-edge. Frequency reuse factor of 1 results in large system spectral efficiency. However, the cell-edge user throughput is extremely low. On the other hand, frequency planning considering a large frequency reuse factor effectively reduces inter-cell interference. However, the system spectral efficiency is decreased. Fractional frequency reuse (FFR) scheme is shown to trade of between overall system throughput and average/cell-edge user throughput [1]. It should be considered as an advanced scheduling scheme to keep balance of users' throughput in 16m system.

2. Frequency Reuse Factor of 1 and 3

There are two common used frequency planning schemes. One is to reuse the total bandwidth in each sector. This frequency reuse factor is 1. It is illustrated in Figure 1. The other scheme is that the total bandwidth is reused every three sectors, and each sector uses disjoint frequency band. It is illustrated in Figure 2, where the transmit power is increased (in Figure 2, $\gamma > 1$) as the total transmit power is now allocated into 1/3 of the total bandwidth. Interference from adjacent sectors is eliminated and hence the user throughput and the packet error rate are largely improved. However, as each sector uses only 1/3 of the bandwidth, the spectral efficiency is less than that of the scheme with frequency reuse factor of 1.

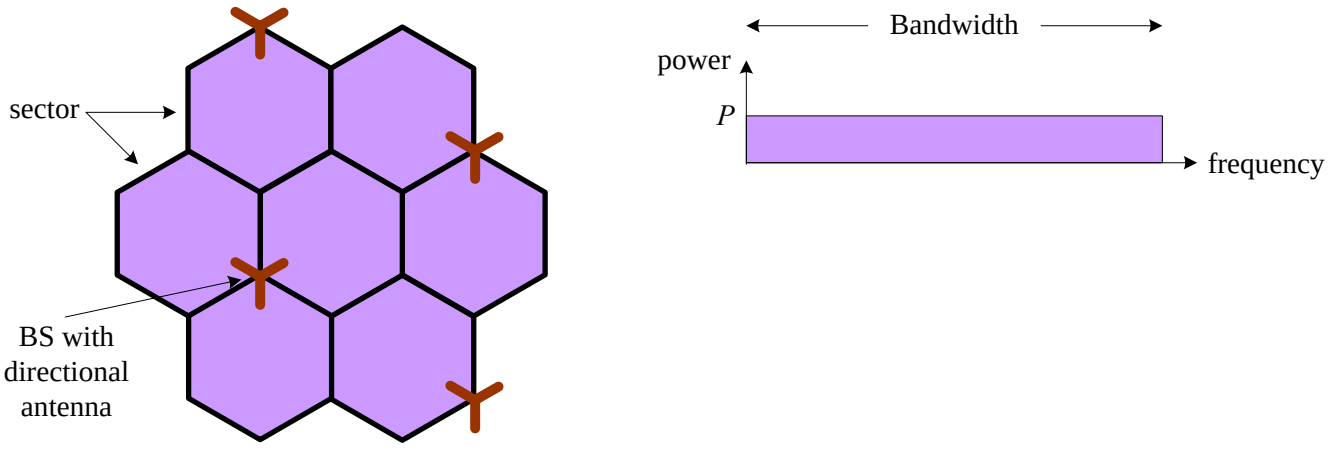

Figure 1. Frequency planning with reuse factor of 1.

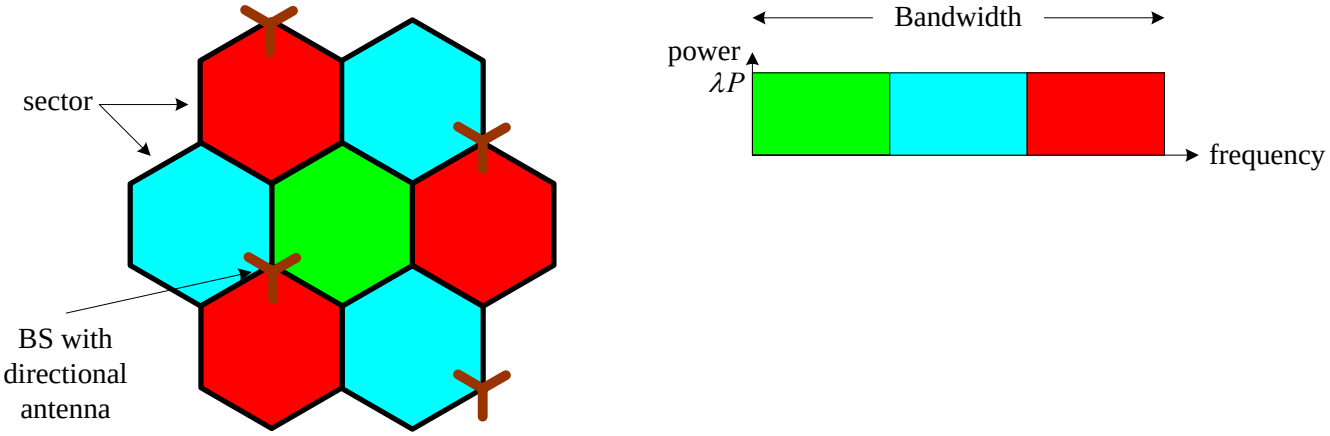

Figure 2. Frequency planning with reuse factor of 3.

3. Interference Mitigation using Fractional Frequency Reuse

In order to improve the cell-edge user throughput and at the same time retain the spectral efficiency, the scheme of fractional reuse the total bandwidth is considered. Based on the scheme of fractional reuse factor of 3, the total bandwidth is equally divided into three groups. See Figure 3 for reference, the three groups are specified by green, blue and red colors, respectively. Each group is not necessarily adjoining. However, each band should not overlap with each other, thus the interference from adjacent sectors is largely reduced. The interference-limited users (i.e., the user at the cell edge) or the users require high data rate are scheduled using this band in each sector. To further improve the spectral efficiency of the scheme using purely frequency reuse 3, the other 2/3 bandwidth in each sector can also be allocated to users in the sector, but using much smaller power level (in Figure 3, $\beta < 1$). This band with less power is allocated to the users near the base station because their distance to the base station and hence the path loss is small, thus the allocation of the users closed to the base station can maintain a certain degree of good quality and at the same time not introducing large interference to users in the neighboring sectors. Under the constraint of total transmit power, the reduced transmit power to the center users can be transferred so that the power radiated to the cell-edge users can be increased (in Figure 3, $\alpha > 1$). The increased power level can further enhance the signal quality and hence the throughput of the users at the cell-edge. Comparing to the scheme of frequency reuse factor of 1, although the overall system throughput would be slightly reduced by using fractional frequency reuse scheme, the average user throughput and the cell-edge user throughput are enhanced dramatically.

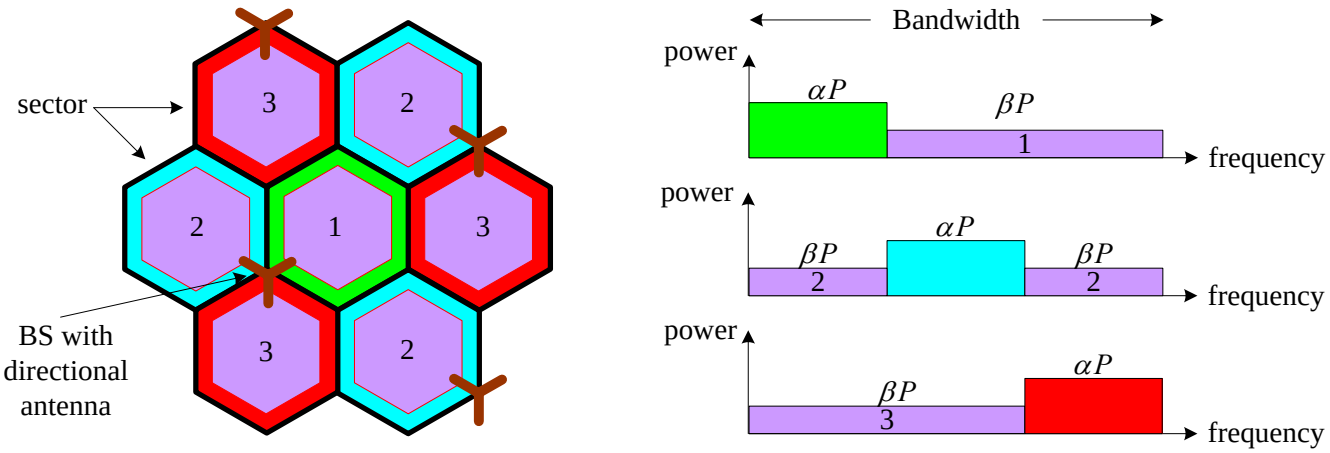

Figure 3. Frequency planning for fractional frequency reuse.

4. Conclusion

Advanced frequency partitioning provides more flexible bandwidth usage and much equal distribution of user throughput. Frequency reuse factor of 1, 3 and fractional frequency reuse schemes are adjusted more flexible to accommodate to different user deployment.

Text Proposal for the 802.16m SDD

----------Start text proposal----------

[*Adopt the following text in theP802.16m System Description Document (SDD)*]

11.x.x Interference Mitigation

11.x.x.1 Fractional Frequency Reuse

Fractional frequency reuse scheme should be supported to improve average and cell-edge user throughput. Static and semi-static configurations and the adaptation rate are FFS.

----------End text proposal----------

Reference

[1] Y. Xiang and J. Luo, “Inter-cell interference mitigation through flexible resource reuse in OFDMA based communication networks,” in Proc. European Wireless 2007, pp. 1-7, Apr. 2007.