Project	**IEEE 802.16 Broadband Wireless Access Working Group** <http://ieee802.org/16>
Title	**Propose for Interference Mitigation in IEEE 802.16m**
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Re:	IEEE 802.16m-08/024: Call for Contributions on Project 802.16m System Description Document (SDD). Target topic: "Interference Mitigation".
Abstract	This contribution proposes for Pilot Design for Interference Mitigation
Purpose	To be discussed and adopted by TGm for the 802.16m SDD.
Notice	
Release	
Patent Policy	

Propose for Interference Mitigation in IEEE 802.16m

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1. Introduction

In wireless transmission it incurs various kinds of interference such as the MS-MS, MS-BS and BS-BS. When MS moves the distance between the MS and the BS changes, the interference level between the MS and BS changes accordingly and the MS receiving signal level will also change. We will analyze the interference level and discuss the interference environment in this contribution, and through the Interference Mitigation to introduce proper pilot patterns for the MS/BS so as to reduce the interference effect on the system performance.

Consider in a BS it consists of three sectors and the neighborhood of three BSs can be considered as the neighborhood of three sectors with each sector belonging to a BS as shown in Fig. 1.

With an MS in a sector we will simulate its interference level by using different pilot patterns that is contributed from other two sectors in other two BSs as shown in Fig. 2. We will simulate by using different pilot patterns to observe its possibility of reducing the interference levels.

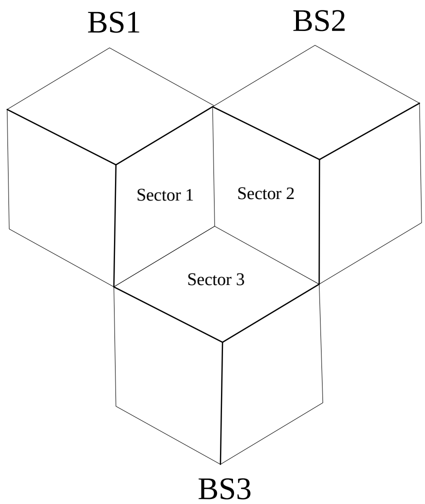


Fig. 1 Three Neighboring Sectors Comprising from Three Neighboring BSs

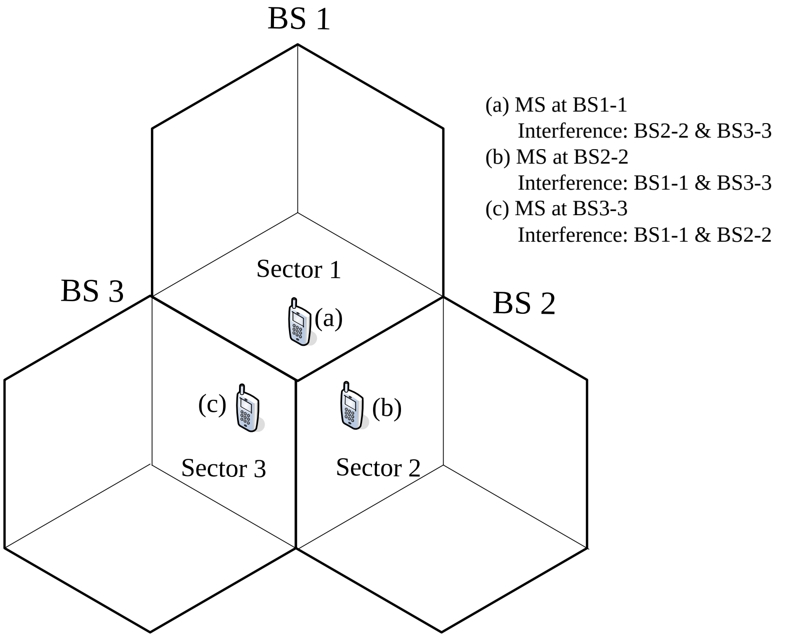


Fig. 2 When an MS in a Sector Central Area its Interference Sources Coming from the Two Sectors of other Two BSs

2. Interference Cases

Several Interference Environments are introduced in the sequel.

Case 1: MS is in Stationary

As shown in Fig. 3 is a stationary MS it stays in a fixed location of a BS, its neighboring two sectors are the interfering sources.

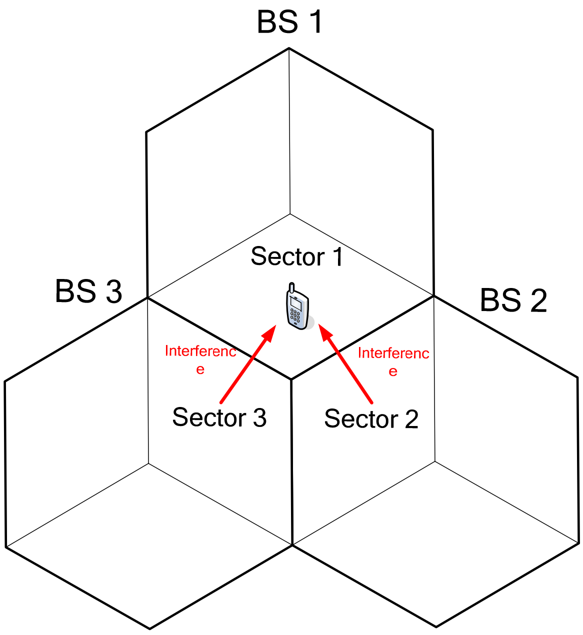


Fig.3 Neighboring BSs Sectors are the Interfering Sources

Case 2: Mobility 1

When an MS moves from one BS Sector to another BS Sector its distances between the MS and the BS Sector changes and consequently its interference level changes during the MS moves. As shown in Fig. 4 is an

MS moving from Sector 1 of BS1 (BS1-1) to Sector 3 of BS3 (BS3-3), the interference level coming from BS3-3 increases when its distance with MS decreases. By proper use of pilot patterns we can reduce the interference level resulting from BS3-3.

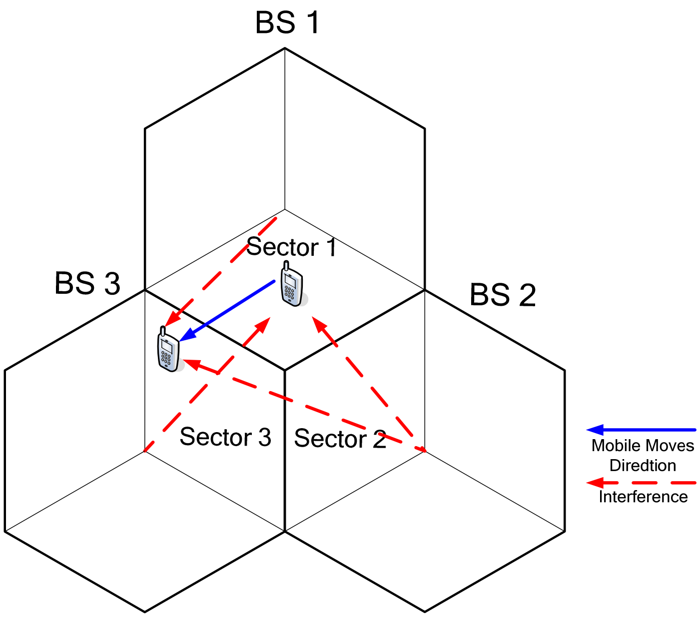


Fig. 4 An MS Moves from Sector 1 of BS1 (BS1-1) to Sector 3 of BS3 (BS3-3).

Case 3: Mobility 2

It is the same interference environment as in Case 2 but the moving path of the MS is along the cell edge as shown in Fig. 5. The MS in BS1-1 moves along the cell edges of BS2 and BS3, the interference levels coming from BS2 and BS3 are correspondingly increased. If same pilot patterns are used by all BSs, as shown in Table 1, it will have the same interference levels as shown in Table 2 during the distance changing between the MS and BSs when the MS moves.

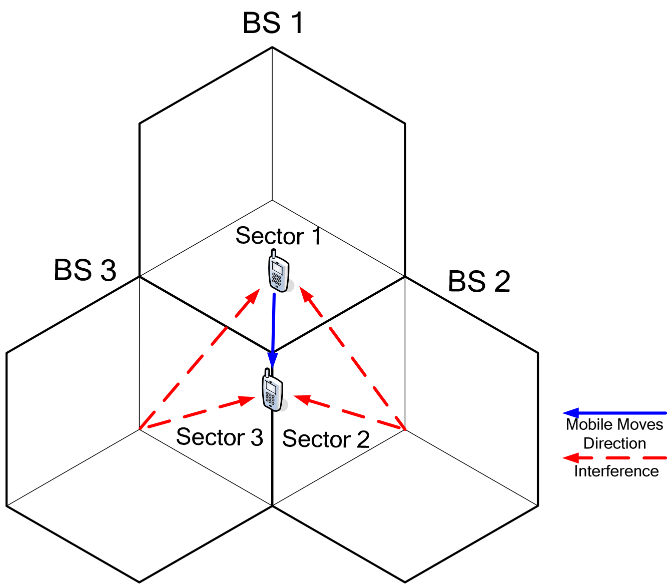


Fig. 5 MS Moves from BS1-1 along Cell Edges of BS2 and BS3

Table 1 Original Pilot Patterns for Every BS Sectors

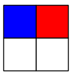
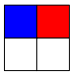
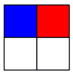
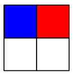
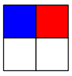
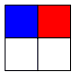
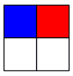
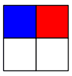
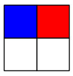
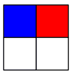
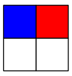
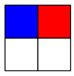
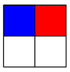
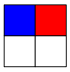
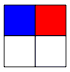
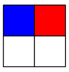
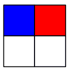
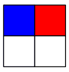
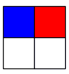
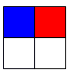
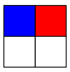
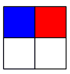
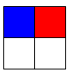
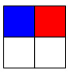
BS1-1	BS2-2	BS3-3	Interference Weihgt BS1-1 & BS2-2	Interference Weihgt BS1-1 & BS3-3	Interference Weihgt BS2-2 & BS3-3
			1	1	1
			1	1	1
			1	1	1
			1	1	1

Table 2 Pilot Patterns and Their Resulting Signal Strengths between the MS and Various BSs Sectors

BS1-1	BS2-2	BS3-3	Sensitivity (dBm) MS: BS1-1 Interference: BS2-2 & BS3-3	Sensitivity (dBm) MS: BS2-2 Interference: BS1-1 & BS3-3	Sensitivity (dBm) MS: BS3-3 Interference: BS1-1 & BS2-2
			-128.2400	-128.2400	-128.2400
			-128.2400	-128.2400	-128.2400
			-128.2400	-128.2400	-128.2400
			-128.2400	-128.2400	-128.2400

3. Interference Mitigation

Based on the Interference Mitigation consideration we propose proper pilot patterns for various interference environments to reduce the interference effect on the system performance.

This design principle is to reduce the interference level when MS moves. It mainly considers in the frequency domain to divide the pilot patterns into three classes each class has its own pilot pattern that the resulting pilot patterns between two BSs are orthogonal. Each BS has its choice of pilot pattern that is orthogonal to another BS's pilot pattern therefore when an MS moves and it realizes that its interference level becomes higher when it closes to one BS it can select that pilot pattern that is orthogonal to the pilot pattern of other BS to reduce its interference level. This design of pilot patterns can be summarized in the following:

1. When the MS is located in the central of the cell, it is far away from other BSs therefore it has less interference levels therefore the pilot patterns pay little role in the interference reducing effort as shown in Fig,6.

2. When MS moves from BS1-1 to BS2-2 the interference level generating from BS2-2 increases, then the MS selects the pilot pattern that is orthogonal to the pilot pattern of BS2-2 and simultaneously it makes the handover process so as to reduce the interference level as shown in Fig. 7.
3. When MS moves from BS1-1 to BS3-3 the interference level generating from BS3-3 increases, then the MS selects the pilot pattern that is orthogonal to the pilot pattern of BS3-3 and simultaneously it makes the handover process so as to reduce the interference level as shown in Fig. 8.

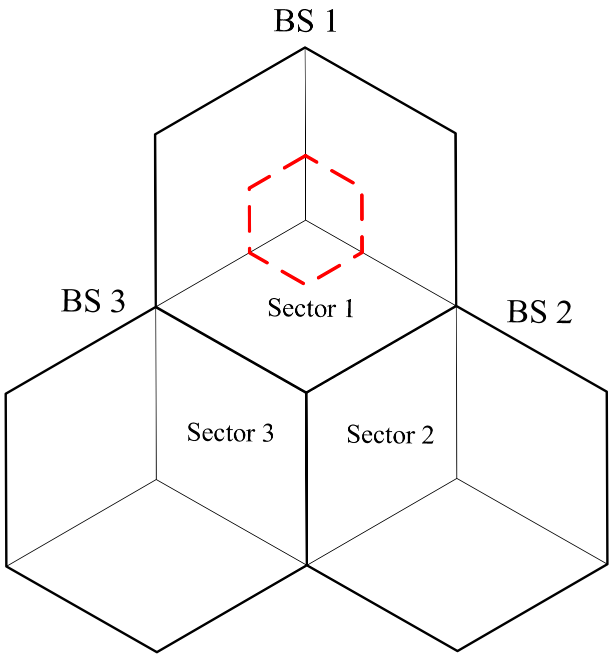


Fig.6 MS Is Located in the Central of the Cell, its Distances Are Far Away from other BSs its Resulting Interference Level is Low

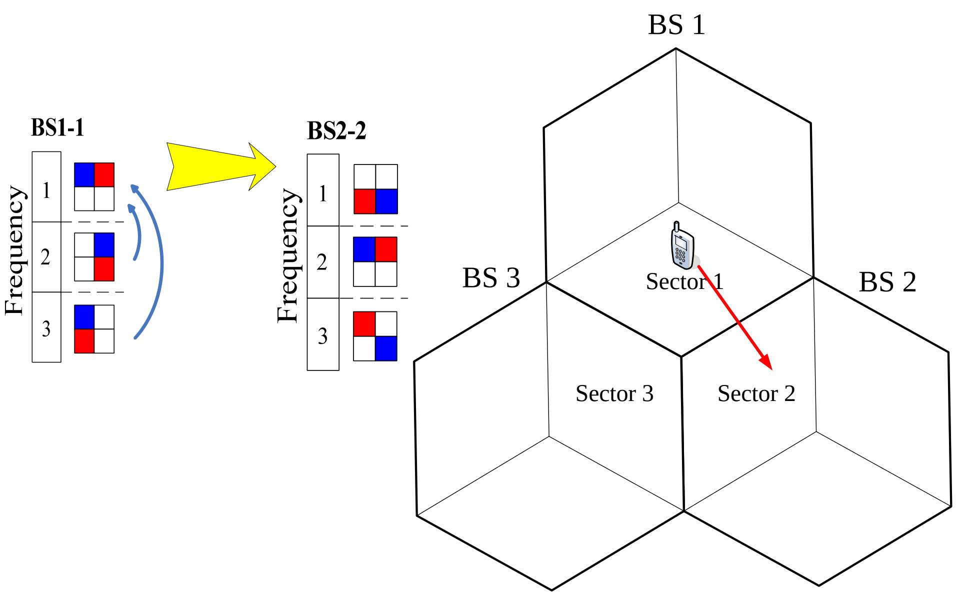


Fig. 7 MS Moves from BS1-1 to BS3-3 it Selects and Changes its Pilot Pattern Orthogonal to the Pilot Pattern of BS2-2

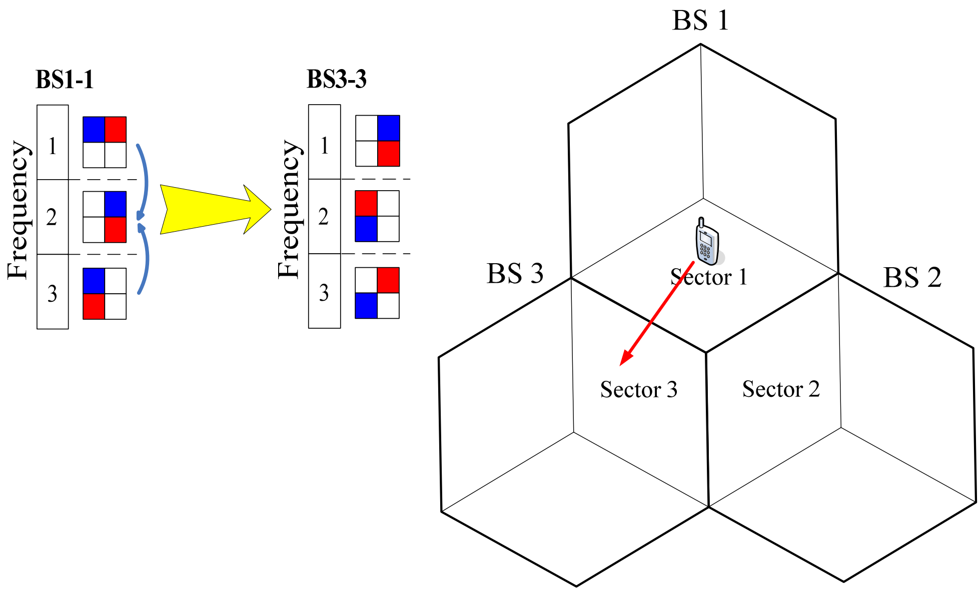


Fig. 8 MS Moves from BS1-1 to BS3-3 it Selects and Changes its Pilot Pattern Orthogonal to the Pilot Pattern of BS3-3

Similarly no matter which direction the MS moves, it is always possible to design a pilot pattern selection mechanism to reduce the resulting interference level. Although these three sectors have a dense neighborhood, its short neighboring distances resulting in high interference levels and the selection of proper pilot patterns are not obviously. We still can follow our design principle as discussed to select the pilot patterns so that its resulting interference level is smaller than that generating from the original pilot patterns as shown in Table 3. Shown in Fig. 9 is the resulting dense area of three sectors that will generate the highest interference level.

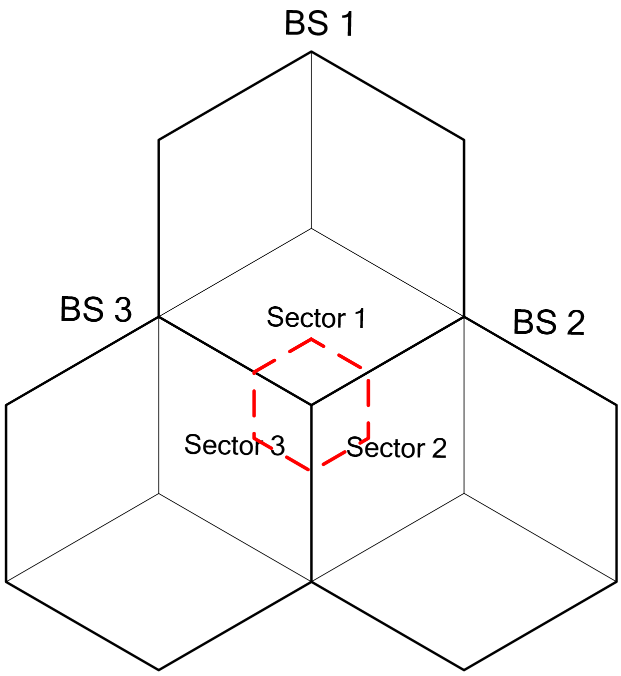
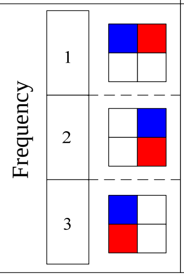
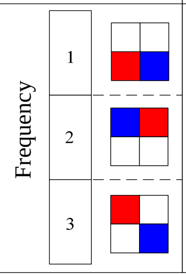
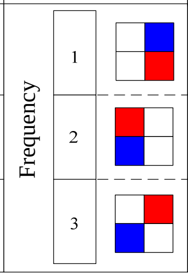


Fig.9 The Area among three Sectors Having the Highest Interference Level

Table 3 When Mobile Moves Pilot Patterns in the Frequency Domain for Different BS Sectors and the Resulting Signal Strength between the MS and BSs

BS1-1	BS2-2	BS3-3	Sensitivity (dBm) MS: BS1-1 Interference: BS2-2 & BS3-3	Sensitivity (dBm) MS: BS2-2 Interference: BS1-1 & BS3-3	Sensitivity (dBm) MS: BS3-3 Interference: BS1-1 & BS2-2
			-134.2606	-134.2606	-131.2503
			-134.2606	-131.2503	-134.2606
			-131.2503	-134.2606	-134.2606

4. Conclusion

From the simulation results no matter the MS is stationary or moves it is evident that the resulting interference levels by using our designed pilot patterns are lower than that generating from the original pilot patterns.

Text Proposal for 'Pilot Design for Interference Mitigation'

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XX.X Pilot Design for Interference Mitigation

When mobile moves the pilot patterns assigned to its serving BS and its two neighboring BSs can be considered in the following two cases:

XX.X.1. Mobile Moves with Handover

When MS moves and performs handover, e.g. from BS1-1 to BS2-2 , the pilot pattern is hanged from BS1-1 to BS2-2 as shown in Fig. X.1:

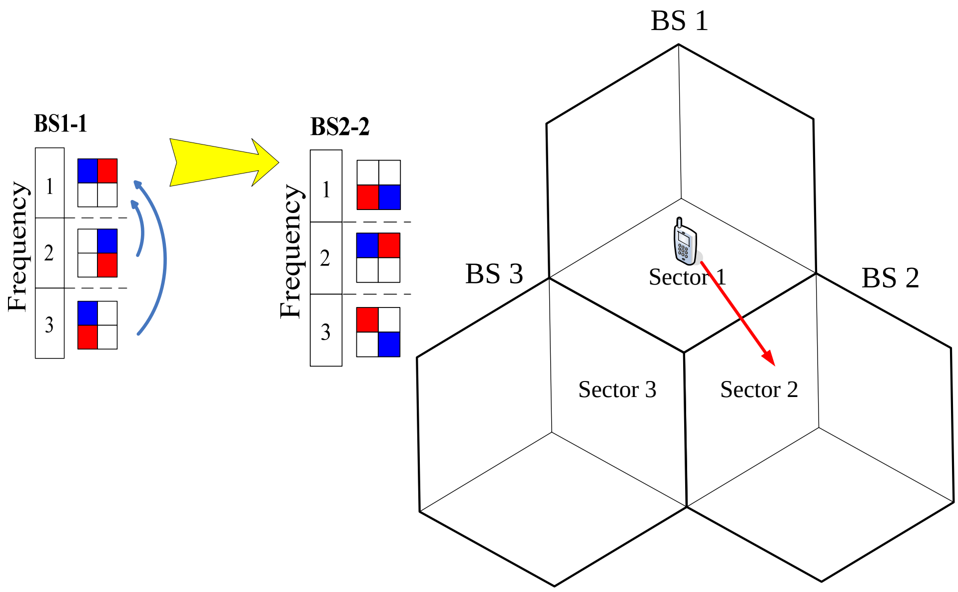


Fig.X.1 An MS Moves from BS1-1 to BS2-2 it Selects and Changes its Pilot Pattern Orthogonal to the Pilot Pattern of BS2-2

XX.X.2. Mobile is in the Cell-edge Area and Having the Highest Interference Level

When mobile moves and is located in the cell-edge area that has the highest interference level, as shown in Fig.X.2 and its pilot patterns assignment is shown in Table.X.1

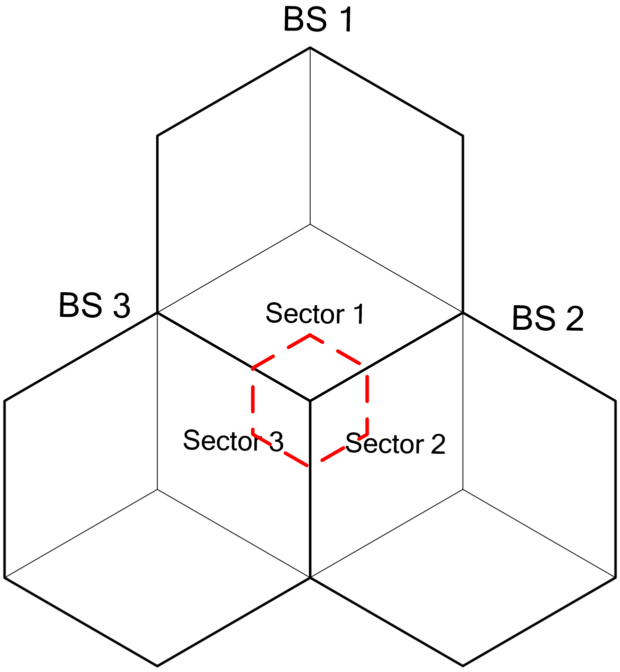
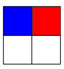
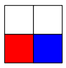
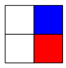
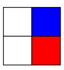
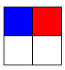
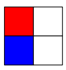
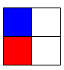
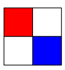
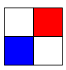


Fig.X.2 Area among three Sectors Having the Highest Interference Level

Table.X.1 When Mobile Moves Pilot Patterns Assigned for Different BS Sectors in the Frequency Domain

BS1-1			BS2-2			BS3-3			Sensitivity (dBm) MS: BS1-1 Interference: BS2-2 & BS3-3	Sensitivity (dBm) MS: BS2-2 Interference: BS1-1 & BS3-3	Sensitivity (dBm) MS: BS3-3 Interference: BS1-1 & BS2-2
Frequency	1		Frequency	1		Frequency	1		-134.2606	-134.2606	-131.2503
	2			2			2		-134.2606	-131.2503	-134.2606
	3			3			3		-131.2503	-134.2606	-134.2606

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