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Title	**An Enhanced scanning method using New DL Control channel FCH/ DL MAP for IEEE 802.16m**
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Re:	IEEE 802.16m-- Call for Contributions on Project 802.16m System Description Document. For protocol architecture
Abstract	This contribution proposes for DL Control Channel: FCH for IEEE 802.16m
Purpose	In this contribution, we propose two solutions to enhance the scanning method. This solution requires modification of the structure of the FCH or DL MAP. We propose that both these solutions be discussed and one solution be adopted by the working group. These solutions provide faster scanning of base stations, reduce MS battery consumption and reduce time needed for the MS to lock on to the BS.
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An Enhanced cell Scanning method using newFCH /DL MAP

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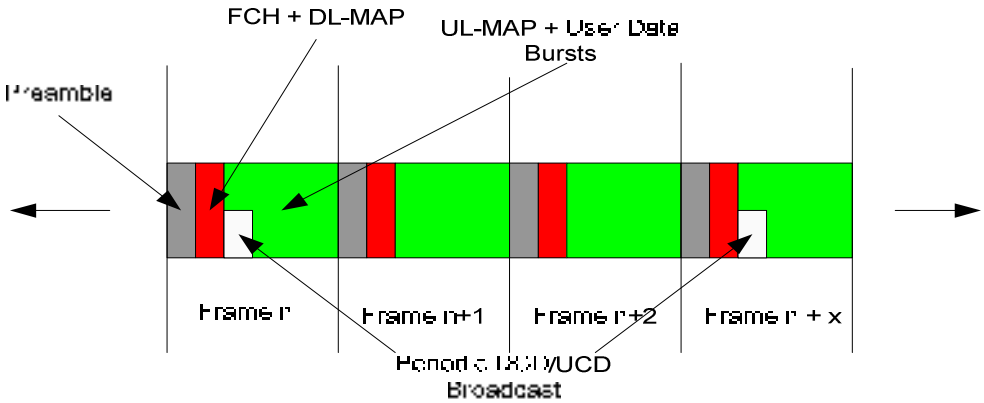
1. Introduction

In this contribution, we propose two solutions to enhance the scanning method. This solution requires modification of the structure of the FCH or DL MAP. We propose that both these solutions be discussed and one solution be adopted by the working group. These solutions provide faster scanning of base stations, reduce MS battery consumption and reduce time needed for the MS to lock on to the BS.

2. Background

When a user terminal (MS) wants to join the WiMax network [1], it follows the network entry procedures as specified in [2]. During the network entry/ cell reselection process, MS scans the possible channels of the DL frequency band of operation in the defined frequency list. On finding a DL channel, MS then acquires the preamble and synchronizes with BS. MS then read FCH. The FCH contains the DL Frame Prefix (DLFP) which provides frame configuration information, such as the modulation and coding scheme, the length of one or several DL burst immediately following the FCH and the usable sub-carriers. This information is used to decode the DL MAP /UL MAP and DCD/UCD if available. UL then reads and decodes the DL and UL map which is further followed by DCD, UCD information. DCD contains system information such as frame number, frame duration, TTG/RTG for TDD operation, DL Center frequency, MAC Version, HO Support Parameters which include Hysteresis Margin, Time to Trigger, and Trigger Type, Paging Group ID etc. UCD contains system information such as ranging parameters, modulation profile etc. Downlink Channel Descriptor (DCD) and UL Channel Descriptor (UCD) is used to broadcast the DL/UL system information periodically. This is shown in the figure 1. [1] provides the maximum value of the time between two consecutive DCD/UCD messages is 10second. MS after decoding the DCD/UCD further monitors the DL MAP/UL MAP to acquire and maintain the synchronization at the MAC level.



3. Problem Statement

MS in an active call or a MS doing the initial entry to the network needs to performs repeated scanning to acquire the connectivity to the network.
Say for example MS begins scanning a neighbor BS1, first it must synchronize with the BS1 by decoding its preamble and then decoding FCH and then the DL MAP. MS then must wait for the DCD/UCD message to

show up and this may take maximum 10second if it is lucky it make wait for 50ms by decoding the DCD/UCD count if it included and has changed. However, for a MS that is just entering the network is not aware of DCD/UCD count, thus waiting for DCD up to max 10s. If the neighbor list contains large number of BSs then MS must, sequentially scan all these base stations. Each requiring MS to lock to BS up to 10s or more to fully receive and decode DCD. Thus acquiring the system information on DCDs of each BSs may take too long time for MS. For ten BS this leads in worst case to 100second.

For a UE that is in a connection, UE scans the neighboring cells to maintain the connection. Two possibilities exists.

The BS that supports mobility functionality includes the MOB-NBR-ADV message at a periodic interval for a MS in a dedicated connection to speed up the HO process. This is to avail the MS with neighboring cell (BS) characteristics in case of cell re-selection or HO purpose. The neighbor information includes the DCD/UCD of the neighboring cell. The nominal time between the transmission of MOB-NBR-ADV messages could be as high as 30s [2]. But it is to be noted that sending the MOB-NBR-ADV message takes up the bandwidth and is a considerably higher system overhead as the message containing all the DCD/UCD of the neighbor could consume many frames. For ten neighbor BSs this is as around 4k-bytes for one UE.

Additionally, Serving BS may send the MS with selected list of neighboring BS to scan. Serving BS may schedule the scanning interval for MS to conduct the scan. MS may additionally request for scanning interval. It is well known fact that the scanning interval means degradation in quality and end user quality perception. Lessening the number of BSs to scan (for MS contemplating a HO) may resolve the issue to some extent but does not fully resolve as for example shortening the list BSs to scan may not be feasible in all deployment scenarios (especially in a dense urban deployment). For a high-speed moving mobile, this list change very frequently increasing the system overhead due to requirement of updating the list almost every couple of frames. Other solution could be that the BS may increase the periodicity of the DCD messages say every 10^{th} frame. This has consequences in terms of overhead (precious radio resource consumption).

Thus, all these patches to system improvement hardly improve the system performance and radio resource use. Thus the degradation in network entry performance and the handover performance of the WiMax system. Additionally this lead to extra battery consumption at MS.

4. Concept

The proposal allows to improve the system performance without having to increase the periodicity of the broadcast information by reducing the time for acquisition of DCD/UCD broadcast information. Additionally it allows for improving the handover performance, network entry performance by reducing the MS locking time to the BS and DCD/UCD waiting time during BS scanning process. This results in enhanced BS scanning process. This additionally leads to reduction in mobile battery usage, thus saving the mobile power.

The proposal allows to reduce the MS locking time to the BS, to acquire DCD/UCD broadcast information. This is achieved by including the frame number, frame duration and DCD-UCD-frame-offset fields just after the frame preamble. Frame number is the current frame number of the BS. Frame duration is the duration of the frame. The DCD-UCD-frame-offset is the offset from the current frame number and to the frame containing DCD-UCD message. Reading this offset MS can derive the arrival of system broadcast information.

Depending upon the DCD-UCD-offset value MS need not lock to the BS indefinitely for DCD-UCD to arrive,

thus reducing the locking time. MS then can go and search for other BS. And come to previous BS to read DCD/UCD nearer the DCD/UCD arrival time.

For example if DCD-frame-offset value is larger (in seconds say10seconds) then MS can go away and scan other BSs and if DCD transmission is just couple of frames away then it locks (wait) to this BS and decodes the DCD. Thus, the waiting duration is considerably reduced resulting in lesser scanning duration and saving battery consumption. The scanning algorithm at MS can be a proprietary algorithm and need not be specified by the standards. Nevertheless, the information needed for this shall be supported by the system.

The solution can be achieved two ways:

1. The information such as frame number, frame duration and DCD/UCD-offset fields is sent just after the frame preamble. This information could be sent by new FCH.
2. This information could be sent by modifying the current DL MAP.

5. Proposed solution 1: FCH Structure

As stated earlier, we propose the new information elements for the FCH. This new information includes the 24-bit frame number & 12-bit frame offset to cover more than 10second DCD/UCD interval. For WiMax system [1] only the 5ms frame duration is provided with a code number 5. For 16m, the number of frame duration code could be max four. Meaning 4 bits are enough for 16m systems and for backward compatibility.
So the new FCH structure includes fields as shown in table 2 below.

newFCH		size
	DLFP	24 bits
	Frame Number	24 bits
	Frame Duration	4 bits
	Frame DCD/UCD-frame-offset	12 bit

Table 1: Showing the newFCH structure

The number of repetition applied is 3 instead of 4. As no significant diversity gains are seen from 2 repetitions to 4 repetitions. We propose 3 repetitions for newFCH as this allows for efficient radio resource (sub carriers) use.

6. Proposed solution 2: DL MAP Structure

The information DCD/UCD-frame-offset field is sent just after the frame preamble. This information is sent by modifying the DL MAP. This DCD-UCD-frame-offset can be sent in physical synchronization field of DL MAP or as a separate DL MAP IE. Frame number and frame duration are not needed as they are included in the physical synchronization field of DL MAP. The ‘DCD/UCD-frame-offset’ field is needed to acquire the information on when DCD/UCD will be available.

7. Comparison of two proposed solution

This contribution proposes two solutions to reduce the MS base station locking time and hence speeds up the scanning, cell search procedure. This also results in reduced battery consumption at MS. The new FCH

structure provides additional benefits over the solution using DL MAP, as FCH based solution avoid having to receive and decode the DL MAP.
Both these solution have benefits of improving the system performance. Benefit includes faster network entry procedure, reduction in MS power consumption and efficient use of radio resources.

8. Proposal

We propose to discuss the two solutions described in this document. Additionally we propose that one of the solution proposed here be adapted by the maintenance group/16m group. We prefer the FCH based solution as the new structure fits into the existing resources allocated to the FCH, thus providing the superior benefits in terms of faster network entry procedure, reduction in MS power consumption and efficient use of radio resources of FCH.

8.1 Text Proposal for SDD for solution 1

We proposed the **section on DL Control Channel: FCH** contains the following text:
Frame preamble is followed by FCH over two symbol. FCH is QPSK modulated with ½ FEC code rate and three repetition. PUSC permutation is applied for the FCH. FCH is sent on 4 sub-channel. The FCH contains the DL Frame Prefix (DLFP) which provides frame configuration information, such as the modulation and coding scheme, the length of one or several DL burst immediately following the FCH and the usable sub-carriers. Additionally FCH contains the current frame number, frame duration and DCD/UCD-frame -offset to enhance the cell scanning method and reduce the MS locking time to BS for UCD/DCD arrival.
The FCH is shown in table 2 below.

newFCH		*Size*
	DLFP	*24 bits*
	Frame Number	*24 bits*
	Frame Duration	*4 bits*
	Frame DCD/UCD-frame-offset	*12 bit*

Table 2 OFDMA newFCH Field

8.2 Text Proposal for SDD for solution 2

We proposed the **section on DL Control Channel: DL MAP** contains the following text:
The DL MAP physical synchronization field shall include the 12 bit DCD-UCD-frame-offset indicator to indicate the arrival duration of DCD-UCD broadcast message.

9. References

[1] IEEE Std 802.16e-2005, "IEEE Standard for local and metropolitan area networks, Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems, Amendment 2: Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Bands.''

[2]. wimax_forum_mobile_system_profile_v1_40

[3] IEEE 802.16m Requirements Specification