

Project	IEEE 802.16 Broadband Wireless Access Working Group < http://ieee802.org/16 >	
Title	Subchannel Allocation Schemes in PUSC Zone for Soft Handover in OFDMA PHY mode - r2	
Date Submitted	2004-06-18	
Source(s)	JaeWeon Cho, PanYuh Joo, SeungJoo Maeng, MyungKwang Byun, ChangHoi Koo Samsung Electronics Suwon P.O.Box 105, 416, Maetan-3dong, Yeongtong-gu, Suwon-si, Gyeonggido, Korea 442-742	Mail to: jaeweon.cho@samsung.com , panyuh@samsung.com , sjmaeng@samsung.com , mk.byun@samsung.com , chkoo@samsung.com
Re:	IEEE P802.16e/D3-2004	
Abstract	This contribution describes Subchannel Allocation in PUSC Zone for Soft Handover in OFDMA PHY mode	
Purpose	Adoption as part of Handover Adhoc recommendation to IEEE802.16e	
Notice	This document has been prepared to assist IEEE 802.16. It is offered as a basis for discussion and is not binding on the contributing individual(s) or organization(s). The material in this document is subject to change in form and content after further study. The contributor(s) 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 and Procedures	The contributor is familiar with the IEEE 802.16 Patent Policy and Procedures < http://ieee802.org/16/ipr/patents/policy.html >, including the statement "IEEE standards may include the known use of patent(s), including patent applications, provided the IEEE receives assurance from the patent holder or applicant with respect to patents essential for compliance with both mandatory and optional portions of the standard." Early disclosure to the Working Group of patent information that might be relevant to the standard is essential to reduce the possibility for delays in the development process and increase the likelihood that the draft publication will be approved for publication. Please notify the Chair < mailto:chair@wirelessman.org > as early as possible, in written or electronic form, if patented technology (or technology under patent application) might be incorporated into a draft standard being developed within the IEEE 802.16 Working Group. The Chair will disclose this notification via the IEEE 802.16 web site < http://ieee802.org/16/ipr/patents/notices >.	

Subchannel Allocation Schemes in PUSC Zone for Soft Handover in OFDMA PHY mode

JaeWeon Cho, PanYuh Joo, SeungJoo Maeng, MyungKwang Byun, and ChangHoi Koo
Samsung Electronics Co., Ltd.

1 Introduction

It is well known that soft handover provides macro-diversity gain through the concurrent communications between mobile station (MS) and multiple base stations (BSs). To support soft handover on downlink, multiple BSs should transmit simultaneously the same data burst to MS, and the MS should be able to combine the receiving multiple data bursts. On uplink, the multiple BSs should be able to demodulate and decode the data burst sent by the MS.

This contribution proposes the subchannel allocation schemes in PUSC (partial usage of subchannel) zone to support soft handover in OFDMA PHY mode. We consider the multi-sector operation where each BS has multiple sectors and a subdivision of the set of available OFDMA (i.e. segment) is assigned to each sector: The segments within a BS are disjoint. In our proposal, two types of the subchannel allocation schemes in PUSC (partial usage of subchannel) zone are proposed to support soft handover in OFDMA PHY mode. Both two schemes do not impact on the current subchannel structure in 802.16d D5.

2 Proposed Scheme

Our proposed subchannel allocation schemes have been devised to support soft handover in PUSC zone. The assumptions and considerations for the soft handover in this document are the following:

- OFDMA PHY mode
- Handover occurs between multi-sector BSs and also between sectors of a multi-sector BS
- Soft handover in PUSC zone.
I.e., Every sector is at a same frequency, but the different segment is assigned to each sector
- BSs in the active set are synchronized through the backbone communications
- Consider delay-sensitive service such as VoIP, rather than delay-tolerant service
- H-ARQ is turned off during soft handover
- The arrival time difference of the signals from BSs in the active set is less than CP (cyclic prefix) time

We note that the proposed two schemes do not impact on the current subchannel structures as well as permutation schemes in 802.16d D5.

2.1 Subchannel allocation scheme: Type 1

During the soft handover with the type 1 scheme, each sector in the active set is allowed to transmit and receive the data burst in the segment that is assigned to other sector. Hence the sectors in the active set can concurrently transmit/ receive the data burst to/from MS on the same subchannel comprised of the same subcarriers.

We explain the proposed type 1 scheme with the example shown in Fig. 1. In Fig. 1, MS communicates with the α sector of BS 1 and the β sector of BS 2 at the same time, i.e. the two sectors are in the active set. In order to open concurrent communication links between the two sectors and the MS, each sector allocates the same data region to the data burst. In the example of Fig. 1, both the α sector of BS 1 and the β sector of BS 2 allocate the same data burst region in the segment of the β sector of BS 2.

On downlink, two sectors simultaneously transmit the same data burst on the same subcarriers. Hence the two bursts from two sectors are merged into one on the radio channel. If the arrival time difference of the two OFDM symbols of two bursts is less than CP (cyclic prefix) of OFDM symbol, the two OFDM symbols can be fitted into a FFT window duration. Thus, MS can see just only the merged one OFDM symbol (it appears to the MS that the signal from other sector is just another multi-path signal). Therefore, the receiver of MS does not need any special function to combine the two signals, and it just receives the data burst like as normal operation.

On uplink, two sectors simultaneously receive the same data burst sent by the MS on the same subcarriers. Similar to the case of downlink, the MS transmits the data burst like as normal operation

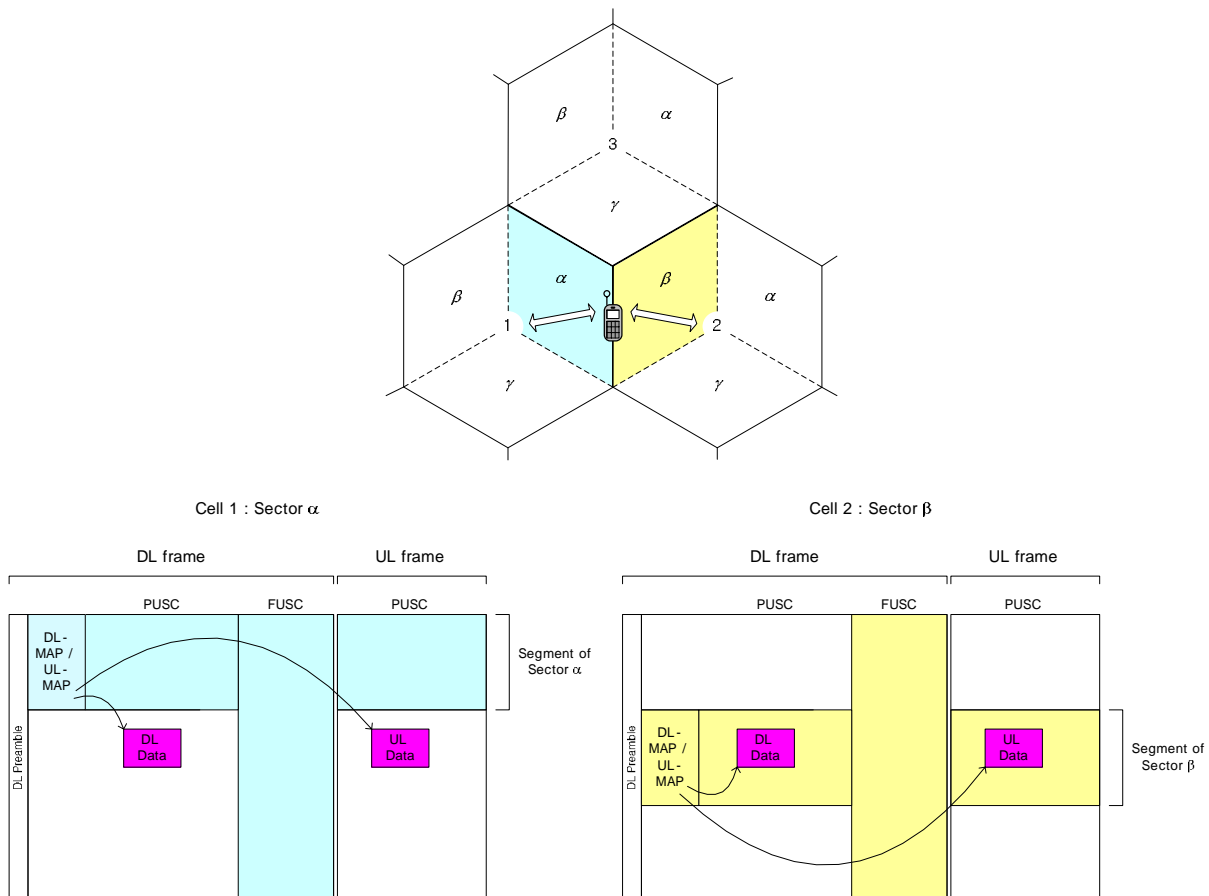


Fig. 1. Type 1 subchannel allocation in PUSC during soft handover

The proposed type 1 scheme offers the following benefits:

- On downlink
 - The received signal quality can be improved through the summing of the multiple signals on radio channel.
- On uplink
 - Macro diversity can be exploited by the best packet selection (at network side) among the multiple packets from the sectors of different BSs.

2.2 Subchannel allocation scheme: Type 2

During the soft handover with the type 2 scheme, each sector in the active set transmits the data burst on downlink in its own segment, so MS receives the multiple data bursts on the different subchannels within a frame. On uplink, the sector is allowed to receive the data burst in the segment that is assigned to other sector, so that MS has only to transmit the data burst on one subchannel.

We explain the proposed type 2 scheme with the example shown in Fig. 2. The network topology shown in Fig. 2 is the same as that in Fig. 1, i.e. the α sector of BS 1 and the β sector of BS 2 are in the active set.

As described above, each sector allocates the downlink data burst in its own segment. Hence, the two data bursts are sent on the different subchannels. If the arrival time difference of the two OFDM symbols of two bursts is less than CP of OFDM symbol, the two OFDM symbols can be fitted into a FFT window duration. Therefore, by one FFT operation the two data bursts can be extracted from the received signal, and then by using independent channel estimators and combiner the two data burst can be coherently combined.

The uplink subchannel allocation scheme of type 2 is the same as that of type 1. The MS transmits the uplink data burst on the assigned region in the segment of the β sector of BS 2. Two sectors simultaneously receive the same data burst sent by the MS on the same subcarriers.

The proposed type 2 scheme offers the following benefits:

- On downlink
 - The received signal quality can be improved through the coherent combining of the multiple signals.
- On uplink
 - Macro diversity can be exploited by the best packet selection (at network side) among the multiple packets from the sectors of different BSs.

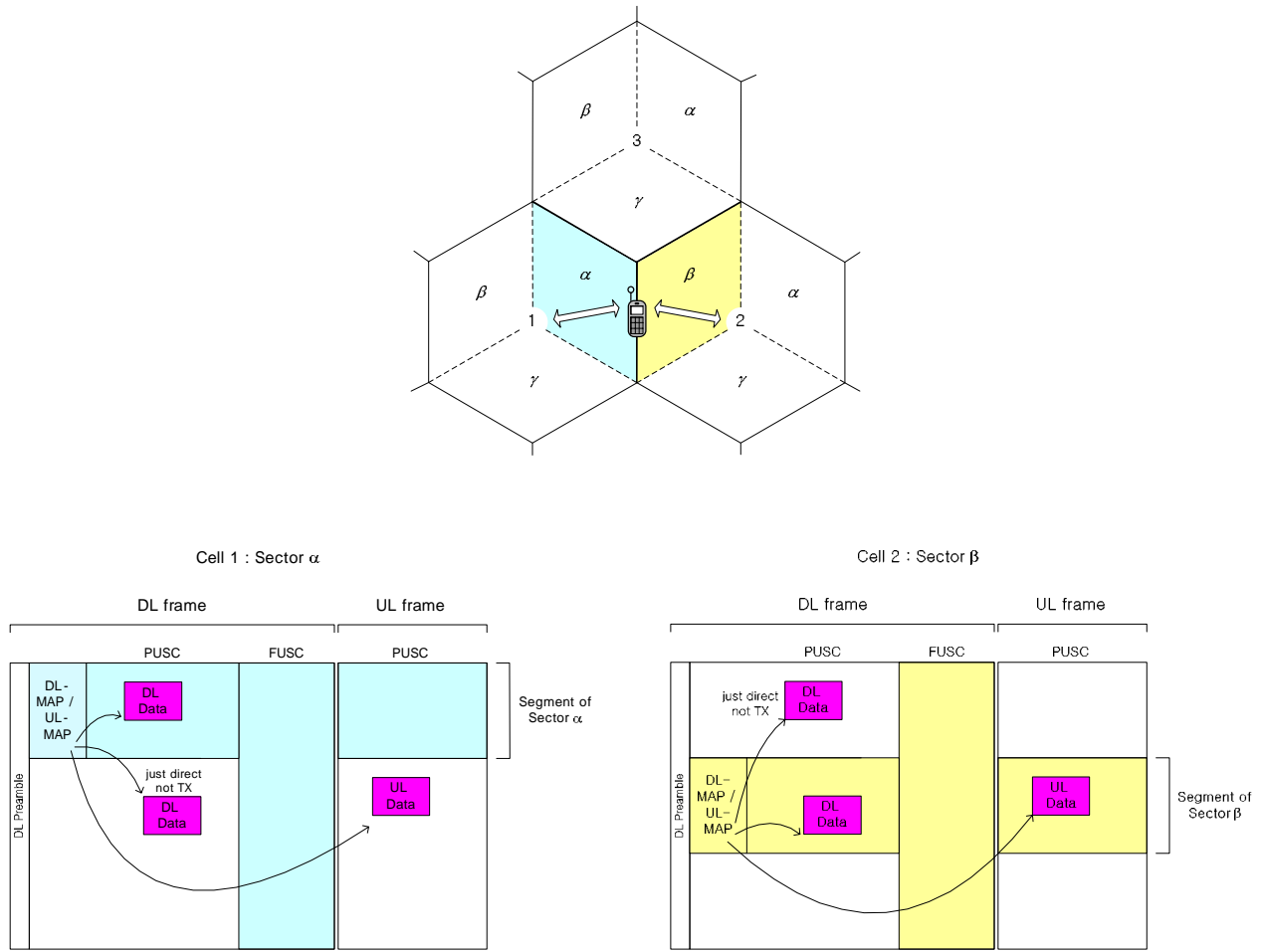


Fig. 2. Type 2 subchannel allocation in PUSC during soft handover

3 Proposed Changes in Document

To operate the proposed schemes efficiently, we propose the new MAP IE which directs MS to the data burst allocated in another segment. In the both examples of Fig 1 and 2, MAP message in the α sector of BS 1 lets the MS know the location of the data burst which is allocated in the β sector of BS 2. Such MAP information allows the selection of the best MAP message at MS. The MS may see either MAP message of the α sector of BS 1 or MAP message of the β sector of BS 2, because both MAP IEs direct to the same data burst allocation. Hence, the MS may choose any MAP message having higher quality during the soft handover. E.g., it selects MAP message in the segment of which preamble has higher received signal level or CINR.

[Add following section on line 46 page 76]

[Insert the following text before section 8.4.5.4]

8.4.5.3.12 Downlink PUSC Burst Allocation in Other Segment IE

In the DL-MAP, a BS may transmit DIUC=15 with the Downlink PUSC Burst Allocation in Other Segment IE () to indicate that data is transmitted to the SS in other segment through other BS.

Table xxx. OFDMA Downlink PUSC Data Allocation in Another BS IE

<u>Syntax</u>	<u>Size</u>	<u>Notes</u>
<u>Downlink PUSC Burst Allocation in Other Segment IE () {</u>		
<u>Extended DIUC</u>	<u>4bits</u>	<u>Downlink PUSC Burst Allocation in Other Segment IE () == 0x0B</u>
<u>Length</u>	<u>4bits</u>	<u>Length=0x0A</u>
<u>CID</u>	<u>16bits</u>	
<u>DIUC</u>	<u>4bits</u>	
<u>Segment</u>	<u>2bits</u>	<u>Segment number for other BS' sector</u>
<u>IDcell</u>	<u>5bits</u>	<u>Cell ID for other BS' sector</u>
<u>Used Subchannels</u>	<u>6bits</u>	<u>Used subchannels at other BS' sector</u> <u>Bit #0: 0-11</u> <u>Bit #1: 12-19</u> <u>Bit #2: 20-31</u> <u>Bit #3: 32-39</u> <u>Bit #4: 40-51</u> <u>Bit #5: 52-59</u>
<u>OFDMA symbol offset</u>	<u>8bits</u>	
<u>Subchannel offset</u>	<u>6bits</u>	
<u>No. OFDMA symbols</u>	<u>7bits</u>	
<u>No. Subchannels</u>	<u>6bits</u>	
<u>Boosting</u>	<u>3bits</u>	<u>000: normal (not boosted);</u> <u>001: +6dB; 010: - 6dB; 011: +9dB;</u> <u>100: +3dB; 101: -3dB; 110: -9dB;</u> <u>111: -12dB;</u>
<u>Repetition coding indication</u>	<u>2bits</u>	<u>00 - No repetition coding</u> <u>01 - Repetition coding of 2 used</u> <u>10 - Repetition coding of 4 used</u> <u>11 - Repetition coding of 6 used</u>
<u>reserved</u>	<u>7bits</u>	<u>shall be set to zero</u>
<u>}</u>		

[Add following section at the end of page 78]

[Insert the following text before section 8.4.5.5]

8.4.5.4.17 Uplink PUSC Burst Allocation in Other Segment IE

In the UL-MAP, a BS may transmit UIUC=15 with the Uplink PUSC Burst Allocation in Other Segment IE () to define uplink bandwidth allocation in other segment.

Table xxx. OFDMA Uplink PUSC Data Allocation in Another BS IE

<u>Syntax</u>	<u>Size</u>	<u>Notes</u>
<u>Uplink PUSC Burst Allocation in Other Segment IE () {</u>		
<u> Extended UIUC</u>	<u>4bits</u>	<u>Uplink PUSC Burst Allocation in Other Segment IE () == 0x08</u>
<u> Length</u>	<u>4bits</u>	<u>Length=0x08</u>
<u> CID</u>	<u>16bits</u>	
<u> UIUC</u>	<u>4bits</u>	
<u> Segment</u>	<u>2bits</u>	<u>Segment number for other BS' sector</u>
<u> UL_IDcell</u>	<u>7bits</u>	<u>Cell ID for other BS' sector</u>
<u> OFDMA symbol offset</u>	<u>8bits</u>	
<u> Subchannel offset</u>	<u>6bits</u>	
<u> Duration</u>	<u>10bits</u>	
<u> Repetition coding indication</u>	<u>2bits</u>	<u>00 - No repetition coding</u> <u>01 - Repetition coding of 2 used</u> <u>10 - Repetition coding of 4 used</u> <u>11 - Repetition coding of 6 used</u>
<u> reserved</u>	<u>1bits</u>	<u>shall be set to zero</u>
<u>}</u>		