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

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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 (BS's). 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 BS's 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
- BS's 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 BS's 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

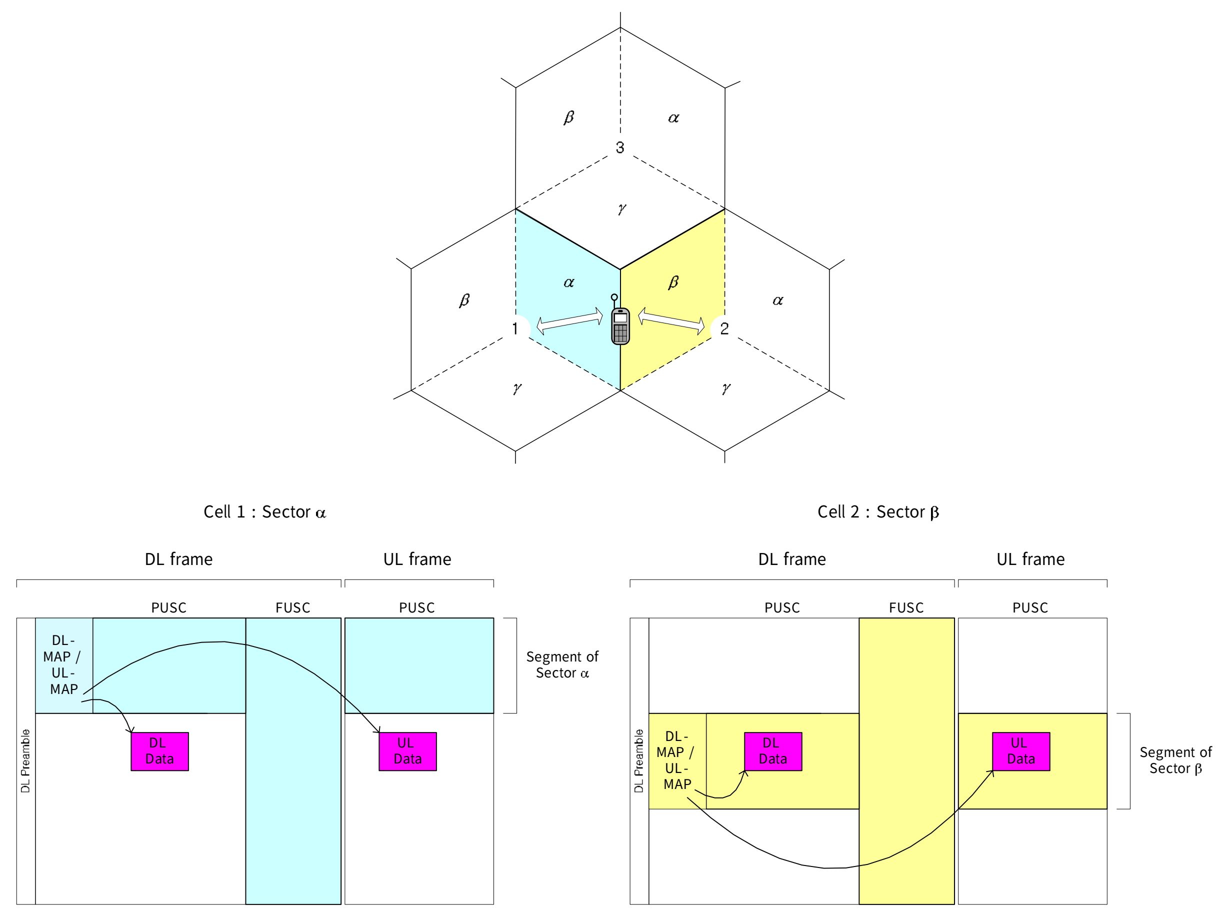

Fig. 1. Type 1 subchannel allocation in PUSC during soft handover

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.

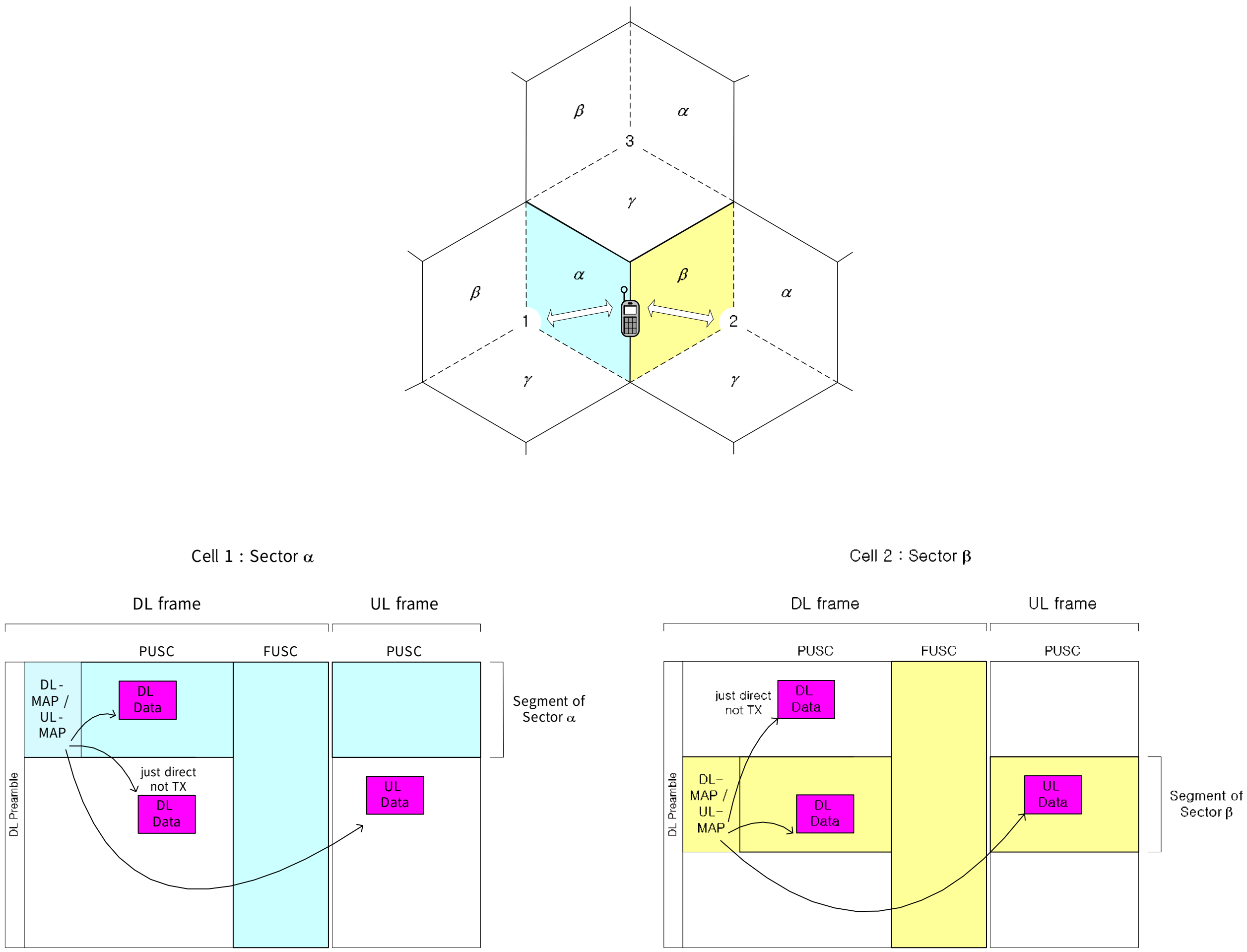

Fig. 2. Type 2 subchannel allocation in PUSC during soft handover

To operate the proposed scheme (either one) efficiently, we propose the new MAP IE which directs MS to the data burst allocated in the other segment (TBD). 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.

3 Proposed Changes in Document

(TBD)