Project	IEEE 802.16 Broadband Wireless Access Working Group
Title	UL Access Region Size Request for Semi-Distributed RS
Date:	2007-07-11

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Re:	This document is in response to call for technical proposals IEEE 802.16j-07/019 dated 06/07/2007. This document proposes text regarding signaling to enable UL Access Region Size Request for insertion in baseline document IEEE 802.16j-06/026r4.
Abstract	This contribution proposes signaling to enable UL Access Region Size Request from an RS to an MR-BS with semi-decentralized scheduling.
Purpose	Text is included for insertion in the IEEE 802.16j amendment to the standard.
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UL Access Region Size Request for Semi-Distributed RS

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Introduction

In this contribution, size request to enable efficient allocation of channel resources for RS-managed region of an UL Access Zone under the semi-distributed scheduling model is proposed. Under a fully decentralized scheduling model, each RS manages an entire DL and UL access zones independently of the MR-BS and other RSs deployed in its cell/sector. Although efficient with respect to signaling overhead and spatial reuse, such fully autonomous scheduling strategy may lead to significant interference between adjacent RS/MR-BS. Hence, in certain deployments it is desirable to allocate non-overlapping regions of the DL and UL Access Zones to adjacent RS/MR-BS so as to avoid interference in these zones. Specifically, the MR-BS allocates to each RS a region of the DL and UL Access Zone on a longer-term basis, whereas each RS performs frame-by-frame scheduling in its assigned regions independently of the MR-BS or neighbor RSs. Under such semi-distributed scheduling model, all major scheduling functions for the sector/cell still reside at the BS, whereas each RS only possesses limited scheduling capabilities to support access traffic in its assigned DL and UL regions. A region of the DL and UL Access Zone could be allocated to an RS according to the signaling method proposed in [1].

To ensure that sufficient resources are allocated to the RS's UL access zone region, each RS may transmit to the MR-BS an UL access zone size request. Signaling details for this request are proposed in this contribution. The required size is computed at an access RS from the legacy 16e BW requests that it receives from the MSs in its control.

Proposed UL Access Zone Size Request

As an example, consider system topology shown in Figure 1. In this scenario, an RS supports some number *N* of MS in Sector 1 that are communicating with the BS via two hops. Assume that the calls from the *N* mobiles supported by the RS in Figure 1 are ongoing. The relay operation is transparent to the mobiles and, hence, each MS proceeds to obtain channel resources from the RS via the standard 802.16e bandwidth request mechanism. As specified in IEEE 802.16-2004, Section 6.3.6.1, bandwidth requests could be aggregate, specifying the total number of bytes contained in the MS input queue, or incremental, only specifying the change in the MS input queue since the last bandwidth request. In any case, the RS obtains estimates of the UL input queue sizes of the MS that it supports based on the received bandwidth requests. The RS then uses these estimates for determining an appropriate allocation size for its region of the uplink access zone, which is then conveyed to the MR-BS in the UL access zone size request.

The algorithm for computing the allocation size for RS-managed region is outside of scope of this contribution, but in general should be based on the perceived queue depths at the MSs and the estimated spectral efficiency of the MS-to-RS links. For example, an RS could compute the size of the allocation in slots for each MS in its UL region based on the MS's queue depth and UL spectral efficiency, and then request cumulative allocation sufficient to service all MS, subject to MS QoS constraints. Note that the requested allocation size should be specified in terms of PHY layer slots, rather than in bytes, as is currently specified for the legacy MS BW request and the R-Zone BW request in [2]. A size request could be transmitted to the MR-BS in an unsolicited manner, whenever RS perceives insufficient BW allocation for its region of the UL access zone, or periodically if desired. For constant rate or nearly constant rate services, such as VoIP or real-time video, the allocation size

for an MS can be estimated at an RS based on the average or peak information rate of the connection and the UL spectral efficiency of that connection.

An example of the signaling flow is shown in Figure 2. The mobiles adhere to the standard 802.16e bandwidth request/grant process. Based on the accumulated BW requests, the RS computes an appropriate size request for its region of the UL Access Zone. The BS responds with an allocation for the RS-managed region. This allocation can be enforced at the RS by prohibiting the RS from scheduling its MS UL bursts in other portions of the frame through safety region allocations, as proposed in [1]. No additional signaling is required at the BS for scheduling MS-to-RS bursts. The RS relies on its scheduling function for managing the MS-to-RS links under its control in the region granted by the BS. Note that the BS scheduler requires no knowledge of the channel state information for the MS-to-RS links, thereby minimizing signaling overhead. Based on the MS BW requests, if the RS perceives the need to update its allocation, it may send another size request to the MR-BS.

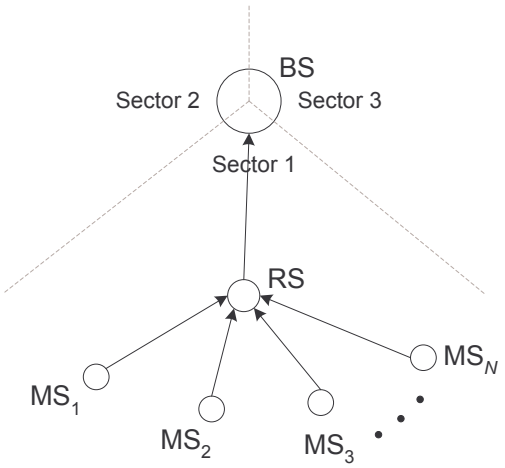

Figure 1. A topology example.

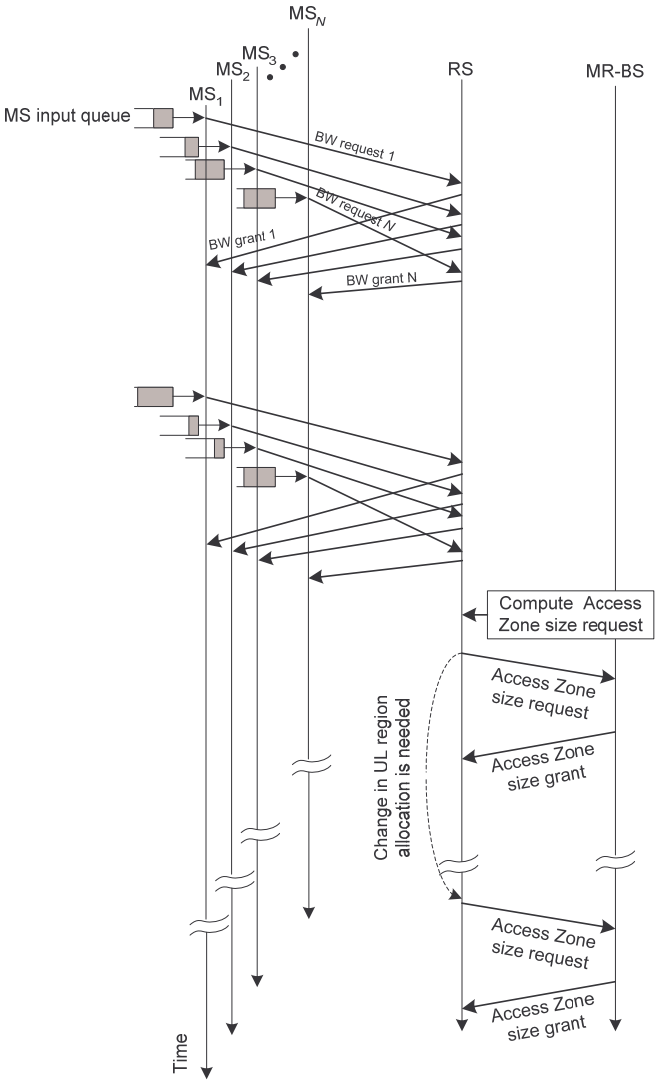

Figure 2. Example of signaling flow for the RS UL access zone size request

Proposed text changes

[Modify Table 19a at the end of Subclause 6.3.2.1.2.2.2 as follows:]

Table 19a—Extended Type field encodings for Extended MAC signaling header type II

Extended Type field	MAC header Type	Reference figure	Reference table
0	RS BR Header		
1	RS UL_DCH Request Header		
2	Acknowledgement header		
3	HARQ RS error report header		
4	RS UL Size Request Header	XXX	XXX
5-7	Reserved		

[Insert new subclause 6.3.2.1.2.2.2.5 as follows:]

6.3.2.1.2.2.2.5 RS UL Size Request Header

An RS may optionally request size for its region of the access zone from the superordinate RS/MR-BS by sending the RS UL Size Request Header. The header specifies the requested size of the RS region of the uplink access zone in ODFMA slots. The header format is as follows:

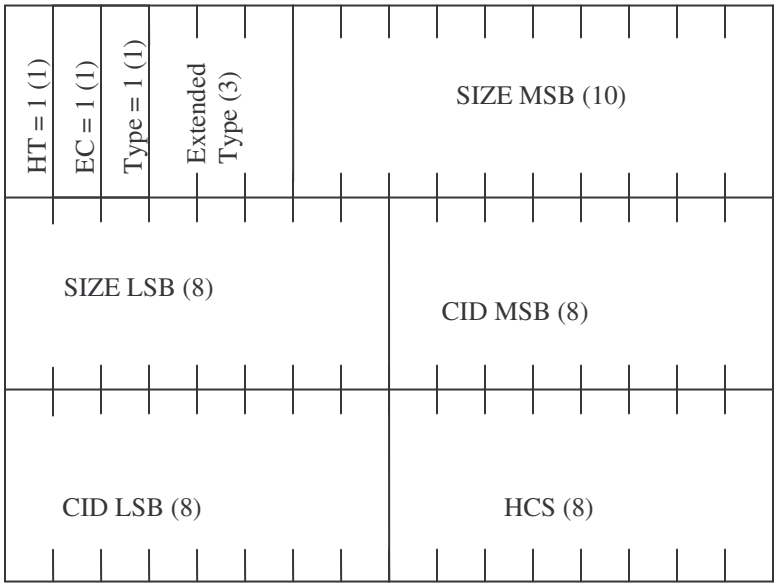

Figure XXX – RS UL Size Request Header

Syntax	Size	Notes
MAC Header(){		
HT	1 bit	Shall be set to 1
EC	1 bit	Shall be set to 1
Type	1 bit	Shall be set to 1
Extended TYPE	3 bits	Shall be set to 0100 for RS UL Size Request Header
Size	18 bits	Number of OFDMA slots requested for the RS portion of the UL access zone
CID	16 bits	Basic CID of the RS
HCS	8 bits	Header check sequence
}		

Table XXX - RS UL Size Request Header

References

[1] “RS Access Link Safety Region,” M. Hart, Y. Zhou, S. Vadgama, IEEE C802.16j-07/026r2.

[2] “P802.16j Baseline Document”, IEEE 802.16j-06/026r3, Section 6.3.6.7.1.1.