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Source(s)	Eugene Visotsky eugenev@motorola.com Roger Peterson Motorola Labs 1301 E. Algonquin Road, Schaumburg, IL 60196 USA	Shyamal Ramachandran shyamal.ramachandran@motorola.com Motorola Inc. 1064 Greenwood Blvd. Suite 400 Lake Mary, FL 32746 USA

Re:	This document is in response to call for technical proposals IEEE 802.16j-07/013 dated 04/02/2007. This document proposes text regarding signaling for efficient routing for insertion in baseline document IEEE 802.16j-06/026r3.
Abstract	This contribution proposes signaling to enable UL Access Zone BW Request from an RS to an MR-BS with decentralized scheduling.
Purpose	Text is included for insertion in the IEEE 802.16j amendment to the standard.
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UL Access Zone BW Request for Distributed RS

E. Visotsky, R. Peterson, S. Ramachandran

Motorola

Introduction

In this contribution, BW request to enable efficient allocation of channel resources for an UL Access Zone managed by an RS under the distributed scheduling model is proposed. For this contribution, it is assumed that all major scheduling functions for the sector/cell reside at the BS, whereas each RS only possesses limited scheduling capabilities. Thereby, it is envisioned that the MR-BS allocates an RS UL Access Zone on a longer-term basis, whereas an RS performs frame-by-frame scheduling in its UL Access Zone independently of the MR-BS. An UL Access Zone for an RS could be allocated according to the signaling method proposed in [1]. To ensure that sufficient resources are allocated for the UL Access Zone at the RS, each RS transmits to the MR-BS periodically, or as needed, an UL Access Zone BW request. As explained below, this BW request is derived at an access RS from the legacy 16e BW requests that it receives from its MSs. As the access RS processes and reads the legacy 16e BW requests, this contribution assumes a decentralized security model to the extent necessary.

Proposed UL Access Zone BW 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. It then uses these estimates for determining an appropriate longer-term allocation size for the uplink RS-managed zone, which is then conveyed to the MR-BS in the RS UL Access Zone BW request.

The algorithm for computing the allocation size for the RS Access Zone 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. Note that the requested allocation size for the RS UL Access Zone should be specified in 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]. In general, an RS could compute the size of the allocation in slots for each MS in its UL zone based on the MS's queue depth and UL spectral efficiency, and then request cumulative allocation (again in slots) sufficient to service all MS, subject to MS QoS constraints. An RS Access Zone BW request could be transmitted to the MR-BS periodically (possibly much less frequently then in every frame) or in an unsolicited manner, if an RS perceives insufficient BW in its UL Access Zone. 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 overall BW request for its UL Access Zone entire for the next *P* frames. The BS responds with the RS-managed zone bandwidth grant valid for the next *P* frames. No additional signaling is required at the BS for scheduling the MS-to-RS bursts.

The RS relies on its scheduling function for managing the MS-to-RS links under its control in the bandwidth granted by the BS. The parameter *P* could be optimized to minimize signaling complexity while maintaining ability to react to the changing traffic demands at the MS. Note that with this proposed solution, the BS scheduler requires no knowledge of the channel state information for the MS-to-RS links, further minimizing signaling overhead.

The MR-BS is not constrained to sending the UL Access Zone BW grant only in response to the RS UL Access Zone BW request. Based on bandwidth requests received from single-hop MSs or possibly from other RSs, the MR- BS may alter bandwidth allocation of any relay zone under its control at any time by sending an unsolicited RS-managed zone bandwidth grant. Any RS receiving a fresh bandwidth grant is obligated to abide by the most current relay zone allocation. If necessary, the BS may suspend operation of the RS by sending a null bandwidth grant for the RS-managed zone or it may specify the entire DL subframe as the RS UL safety region as proposed in [1].

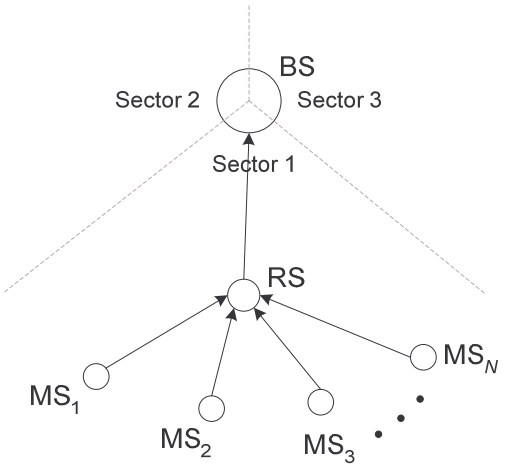

Figure 1. A topology example.

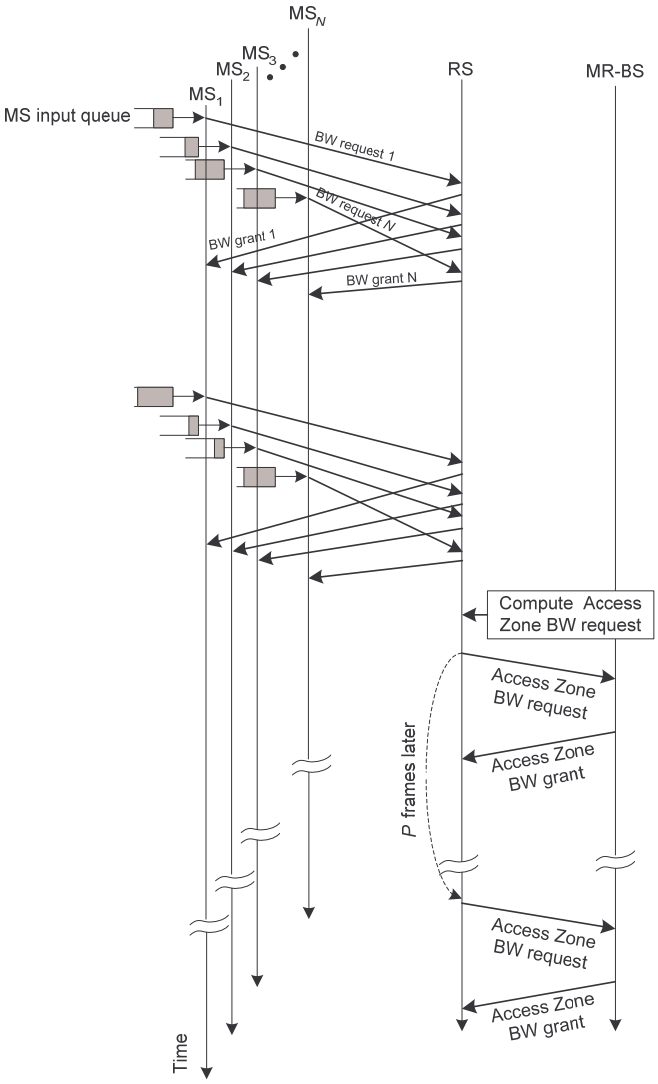

Figure 2. Example of signaling flow for the RS UL Access Zone BW request

Proposed text changes

[Modify Table <X1> at the end of Subclause 6.3.2.1.2.2.2 as follows:]

Table <X1>—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	RS UL_AZ Request Header	XXX	XXX
3-7	Reserved		

[Insert new subclause 6.3.2.1.2.2.2.3 as follows:]

6.3.2.1.2.2.2.3 RS UL AZ Request Header

An RS may optionally request BW for its access zone from the superordinate RS/MR-BS by sending the RS UL_AZ Request Header. The header specified the requested size of the RS access zone in ODFMA slots. The header also specifies the periodicity in frames of the access zone BW request. The header is as follows:

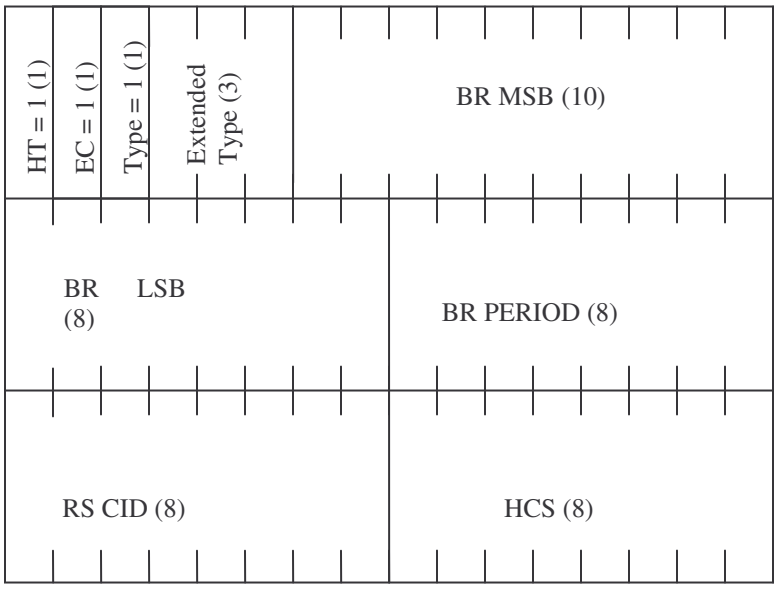

Figure XXX – RS UL_AZ Request Header

Table XXX - Description of fields in Relay Access Zone Bandwidth Request header

Name	Size	Description
BR	18 bits	Bandwidth Request: The number of OFDMA physical layer slots requested for the RS access zone
BR PERIOD	8 bits	Indicates periodicity in frames of the access zone BW request
CID	8 bits	Reduced Basic CID of the RS
HCS	8 bits	Header Check Sequence (same usage as HCS entry in Table 5).

References

[1] “RS Access Link Safety Region,” M. Hart, Y. Zhou, S. Vadgama, IEEE C802.16j-07/026r1.

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