Project	IEEE 802.16 Broadband Wireless Access Working Group <***http://ieee802.org/16***>
Title	Optimized Distributed Bandwidth Request and Allocation in 802.16j system
Date Submitted	2007-03-05
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Re:	This contribution is a response to ” IEEE 802.16j-07/007r2 Call for Technical Comments and Contributions regarding IEEE Project 802.16j” (2007-02-19)
Abstract	This contribution describes a proposed distributed scheduling in 802.16j system.
Purpose	This document is provided in response for Call for Technical Comments and Contributions regarding IEEE Project 802.16j .
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Distributed Scheduling In 802.16j System

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1. Introduction

This document proposes a mechanism to reduce the time delay of data/bandwidth-request transfer and improve the uplink bandwidth utilization in a distributed scheduling MR system.

In a distributed scheduling MR system, when the MR-BS needs to grant the unsolicited bandwidth to the MS through the intermediate RSs along the multi-hop link on a periodic time basis, the bandwidth granted by the super ordinate RS may be wasted because user data doesn't reach the intermediate RS. The user data should be stored in the intermediate RS to wait for the next granted bandwidth, which leads to large latency. Obviously, the same problem exists when the MR-BS needs to poll the MS unsolicited through the intermediate RSs on a periodic basis.

Figure1 is an example of the grant procedure in a distributed scheduling MR system. Figure 2 is an example of the polling procedure in a distributed scheduling MR system.

Since the distributed scheduling should be used in some cases, for example, to extend the coverage, it is necessary to guarantee the service flow's QoS for UGS, rtPS, extended rtPS, nrtPS and BE service. We propose a mechanism to optimize the distributed scheduling in order to reduce the time delay of data/bandwidth-request transfer and improve the uplink bandwidth utilization in a distributed scheduling MR system.

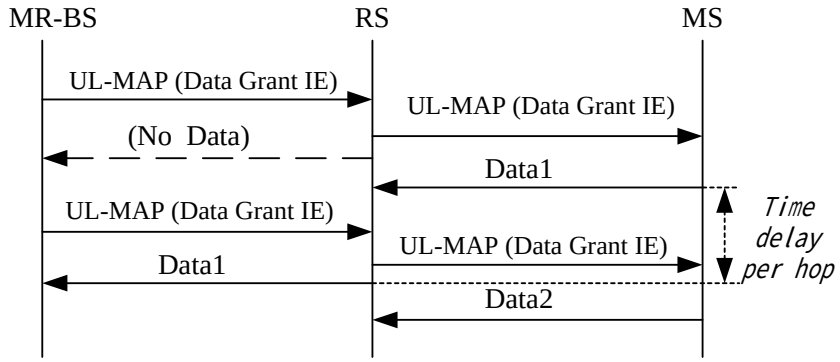

Figure 1 An example of the grant procedure in the distributed scheduling system

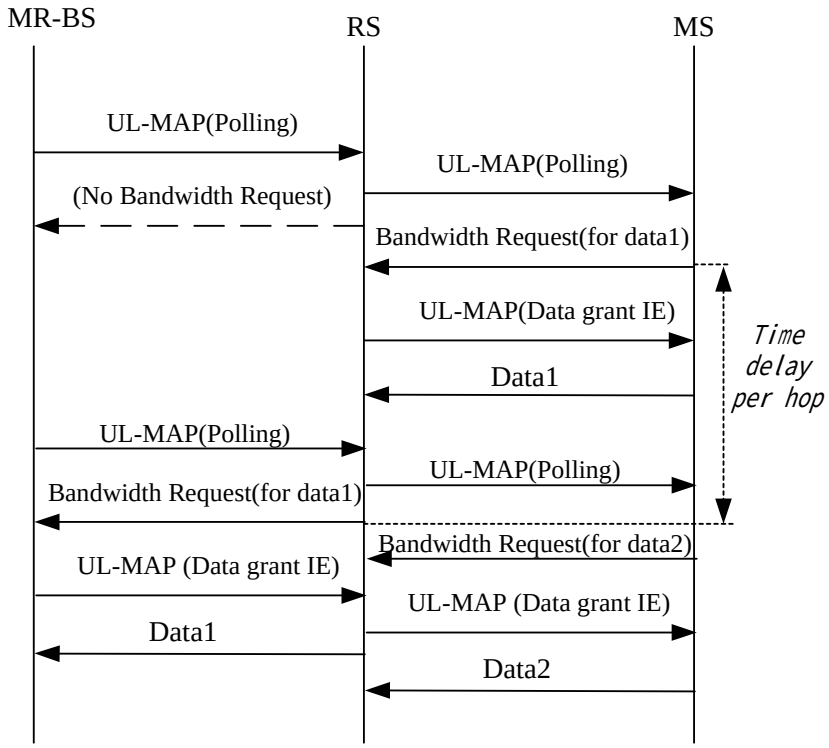

Figure 2 An example of the polling procedure in a distributed scheduling MR system.

2. Optimized grant and polling mechanism for distributed system

2.1 Optimized Bandwidth Grant

In a MR system the grant can be issued unsolicited by each link's super ordinate node or as a response to the bandwidth request from the subordinate node.

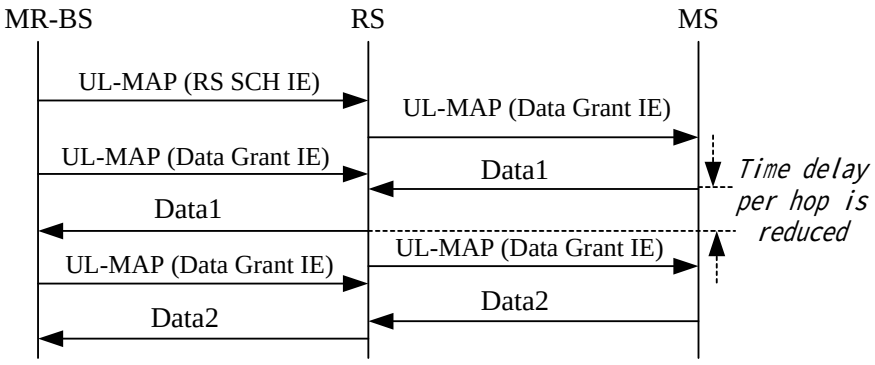

Figure 3 An example of proposed grant mechanism

If the 802.16j system grants unsolicited bandwidth to the MS, a new UL_MAP IE, RS SCH IE, is generated by the MR-BS firstly and sent to its subordinate node, based on the QoS of service flow and so on. RS SCH IE includes bandwidth information, how much bandwidth will be granted, and the number of frames, when the grant will be issued. When the subordinate node receives the RS SCH IE, it will generate a new RS SCH IE for its own subordinate node, according to the received RS SCH IE, processing delay inside and so on. In this way, RS SCH IEs will be generated by the super ordinate node and sent to the subordinate RS of each hop link in turn. However the MS's access station should not send this IE to the MS, so there is no any change for the MS.

Figure3 illustrates the proposed grant mechanism in a distributed scheduling system.

2.2.3 Polling

Similar with the bandwidth grant, the polling in the 802.16j system is not an explicit message, but a bandwidth allocation in the UL_MAP. The polling can be issued unsolicited or as a response to the Grant Management Message with PM bit set, which is set by a MS with currently active UGS connection when the MS needs to be polled to request bandwidth for non-UGS connection. When the unsolicited polling is issued, the RS SCH IE can also be used to accelerate bandwidth request transfer.

Figure 4 illustrates the proposed polling mechanism in a distributed scheduling system.

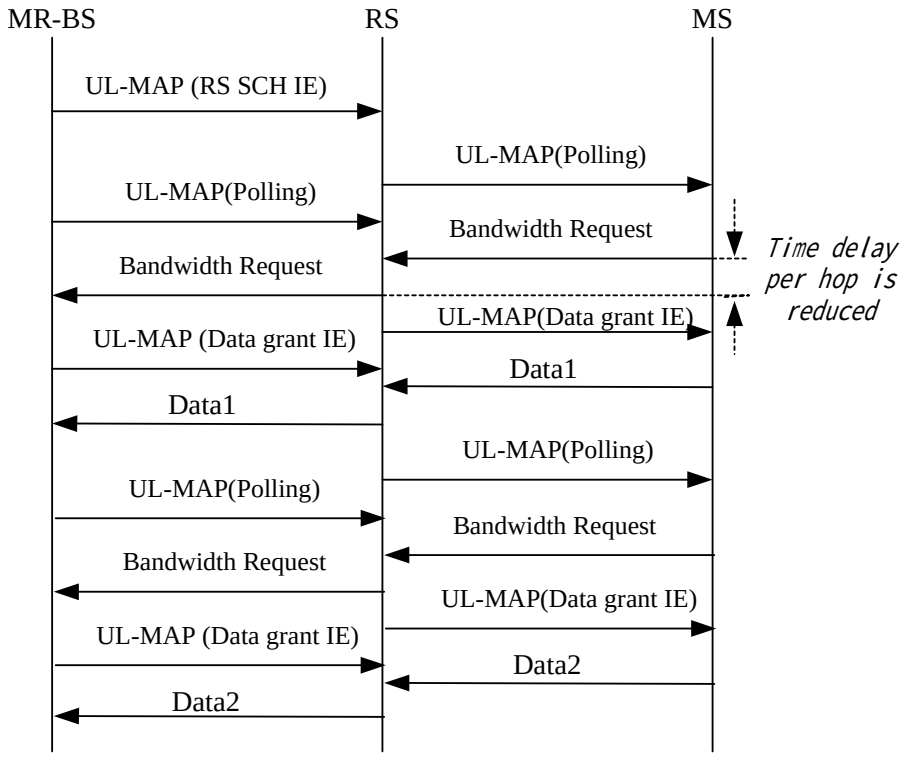

Figure 4 An example of proposed polling procedure in a distributed scheduling system

3. Proposed text

6.3.5 Scheduling services

6.3.5.2.1 UGS

[Insert the following at the end of this clause:]

In the distributed scheduling system, to meet a UGS service flow's need, the MMR- BS and RSs along the link shall grant fixed size bandwidth to its subordinate node on a real-time periodic basis.

The RS SCH IE and the bandwidth grant mechanism of distributed scheduling may be used to accelerate the data transfer.

6.3.5.2.2 rtPS

[Insert the following at the end of this clause:]

In the distributed scheduling system, to meet an rtPS service flow's need, the MMR- BS and RSs along the link shall poll its subordinate node on a real-time periodic basis.

The RS SCH IE and the polling mechanism of distributed scheduling may be used to accelerate the bandwidth request transfer.

6.3.5.2.2.1 Extended rtPS

[Insert the following at the end of this clause:]

In the distributed scheduling system, to meet an Extended rtPS service's need, the MMR- BS and RSs along the link shall grant dynamic size bandwidth to its subordinate node on a real-time periodic basis.

Before the periodic granting is issued, the MR-BS and intermediate RSs may originate the RS SCH IE in turn to accelerate the data transfer. The MS may request changing the size of the UL allocation by either using an extended piggyback request field of the Grant Management subheader or using BR field of the MAC signaling headers or sending a codeword over CQICH. The MR-BS and the intermediate RSs shall not change the size of UL allocations until receiving another bandwidth change request from the MS.

In case that no unicast bandwidth request opportunities are available, the MS may use contention request opportunities for that connection, or send the CQICH codeword to inform the MR-BS of its having the data to send. If the MR-BS receives the CQICH codeword, the MR-BS and intermediate RSs may originate the RS SCH IE again and then start allocating the UL bandwidth.

[Insert new sub clause 6.3.6.7]

6.3.6.7 Relay support for Scheduling

6.3.6.7.1 Distributed Scheduling

6.3.6.7.1.2 Grant

[Insert the following at the end of this clause:]

If the distributed scheduling system grants the unsolicited bandwidth to the MS, the RS SCH IE is generated by the MR-BS firstly and sent to its subordinate node, based on the QoS of service flow and so on. The RS SCH IE includes bandwidth information, how much bandwidth will be granted, and the number of frames, when the

grant will be issued. When the subordinate node receives the RS SCH IE, it will create a new RS SCH IE for its own subordinate node, according to the received RS SCH IE, processing delay inside and so on. In this way, RS SCH IEs will be generated by the super ordinate node and sent to the subordinate RS of each hop link in turn. However the MS's access station should not send this IE to the MS, so there is no any change for the MS.

6.3.6.7.1.3 Polling

[Insert the following at the end of this clause:]

Similar with the bandwidth grant, the polling in the distributed scheduling system can also be optimized by the RS SCH IE generated by the MR-BS and intermediate RSs to accelerate bandwidth request transfer in the condition where each super ordinate node shall poll its subordinate node unsolicited.

[Update Table 290c as indicated in the following Table]

Table 290c-Extended-2 UIUC Code Assignment for UIUC=11

Extended UIUC(Hexadecimal)	Usage
<TBD>	RS SCH IE
<TBD>	Reserved

[Insert new sub clause 8.4.5.4.29:]

8.4.5.4.29 RS SCH IE

This UL_MAP IE is sent by the MR-BS and intermediate RSs except the access RS to their subordinate node, informing the subordinate node when and how much bandwidth will be allocated.

Table T1-RS SCH IE format

Syntax	Size	Notes
RS SCH IE () {	-	-
Extended-2 UIUC	8bit	RS SCH IE()=<TBD>
Length	8bit	
Transport CID	16bit	
RS UL Allocation Frame offset	8bit	In terms of number of frames
Duration	8bit	In OFDMA slots (see 8.4.3.1)
}		

RS UL Allocation Frame offset

Indicates the number of frames, starting from the next frame, in which the bandwidth for the next hop RS is allocated.

Duration

Indicates the duration of allocation, in units of OFDMA slots.

References

[1] IEEE 802.16mmr-06/002r1, “ Draft P802.16j PAR and Five Criteria: Mobile Multihop Reply "

[2] IEEE 802.16j-06/016r1, “ Proposed Technical Requirements Guideline for IEEE 802.16 Relay TG "

[3] IEEE 802.16j-06/017r2, “ Table of Contents of Task Group Working Document "