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Re:	This contribution is a response to " IEEE 802.16j-06/034 Call for Technical Proposals regarding IEEE Project 802.16j" (2006-12-12) .
Abstract	This contribution describes the proposed distributed scheduling in 802.16j system.
Purpose	This document is provided as the revised version of IEEE C802.16j-07/078.
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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 transfer in a distributed scheduling MR system.

In a distributed scheduling MR system, the intermediate RS can decide when to request/allocate the bandwidth based on the information contained only by itself. In this way, when the MR-BS grants the unsolicited bandwidth to the MS through the intermediate RSs along the multi-hop link, since user data doesn't reach the intermediate RS , the bandwidth granted by the super ordinate RS may be wasted. Obviously, the same problem exits when the MR-BS pools the MS through the intermediate RSs Figure 1 is an example of the grant procedure in a distributed scheduling MR system.

To solve the problem mentioned, we propose a mechanism to coordinate the grant/pooling sequence in the multi-hop link.

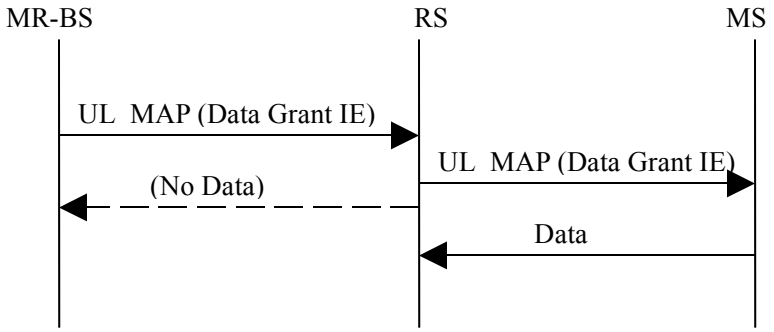

Figure 1 An example of the grant procedure in the distributed scheduling system

2. Grant and pooling mechanism for distributed system

2.1Bandwidth Grant

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

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 local and other links' information (QoS of service flow, local link resource, path information, other links' time delay). 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, the local and other links' information. The RS SCH IE will be sent to all the RSs in the relay path and the MS's access station should not send this IE to the MS, so there is no any change for the MS.

Figure2 illustrates the optimized grants mechanism in a distributed scheduling system.

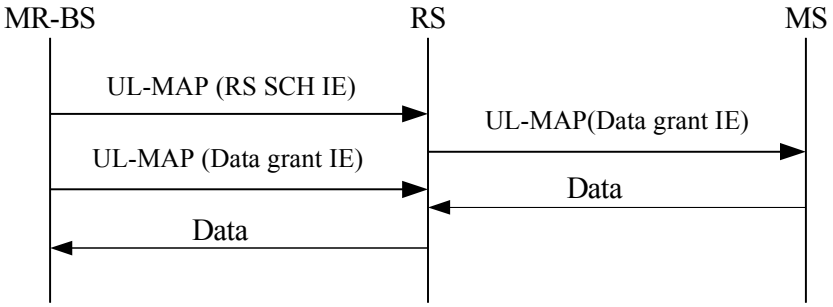

Figure 2 An example of proposed grant mechnism

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 by each link's super ordinate node 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. RS SCH IE can also be used to accelerate data transfer in the condition where each super ordinate node shall poll its subordinate node.

Figure 3 illustrates the proposed pooling mechanism in a distributed scheduling system.

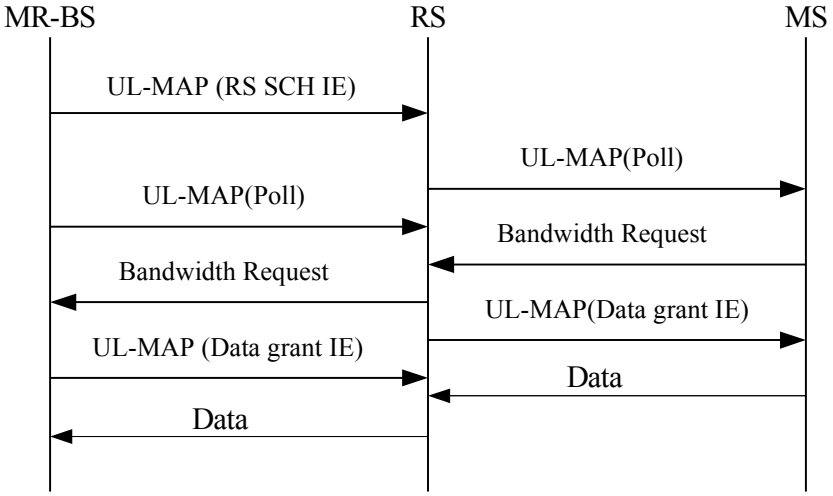

Figure 3 An example of proposed polling procedure in a distributed scheduling system

3. Proposed text

6.3.5 Scheduling services

6.3.5.2.1 UGS

Insert the follow 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 the real-time periodic basis.

The RS SCH IE and the bandwidth grant mechanism of distributed scheduling may be used to accelerate the data transfer. The RS SCH IE sequence, generated by the MR-BS and the intermediate RSs, is used only once before the periodic granting is issued. When the MS needs to be polled to request bandwidth for non-UGS connection, the RS SCH IE and the pooling mechanism of distributed scheduling may be used to accelerate the Grant Management transfer.

6.3.5.2.2 rtPS

Insert the follow 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 the real-time periodic basis.

The RS SCH IE and the pooling mechanism of distributed scheduling may be used to accelerate the bandwidth request transfer. The RS SCH IE sequence, generated by the MR-BS and the intermediate RSs, is only used once before the periodic pooling is issued.

6.3.5.2.2.1 Extended rtPS

Insert the follow 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 the real-time periodic basis.

Before the periodic granting is issued, the MR-BS may originate the RS SCH IE sequence. 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 may originate the RS SCH IE sequence again and then start allocating the UL bandwidth.

6.3.5.2.3 nrtPS

Insert the follow at the end of this clause:

In the distributed scheduling system, nrtPS shall offers unicast polls on a regular basic. The MR-BS and the intermediate RSs may poll the subordinate node independently or harmonized by the RS SCH IE.

6.3.5.2.4 BE

Insert the follow at the end of this clause:

In the distributed scheduling system, in order for BE service to work correctly, the MS may use contention request opportunities as well as be pooled and granted 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 follow 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 local and other links' information (QoS of service flow, local link resource, path information, other links' time delay). 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, the local and other links' information. The RS SCH IE will be sent to all the RSs in a relay path and 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 follow 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 sequence generated by the MR-BS and intermediate RSs to accelerate data transfer in the condition where each super ordinate node shall poll its subordinate node.

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 of 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	
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 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 "