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Source(s)	Shulan Feng, Yanling Lu, Ting Li ,Liangliang Zhang Hisilicon Technologies Harbour Building, No.8, Dongbeiwang West Road, HaiDian District, Beijing, China Masato Okuda and Yuefeng Zhou Fujitsu Voice: 86-10-82829010 Fax: 86-10-82829075 mailto:luyanling@hisilicon.com, fengsl@huawei.com mailto: okuda@jp.fujitsu.com Yuefeng.Zhou@uk.fujitsu.com
Re:	This contribution is a response to " IEEE 802.16j-07/013 Call for Technical Comments regarding IEEE Project 802.16j" (2007-04-02) .
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

Shulan Feng, Yanling Lu , Ting Li, Liangliang Zhang
Hisilicon Technologies
Masato Okuda and Yuefeng Zhou
Fujitsu

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[1], 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 the MR system with distributed scheduling. Figure 2 is an example of the polling procedure in the MR system with distributed scheduling

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 the MR system with distributed scheduling.

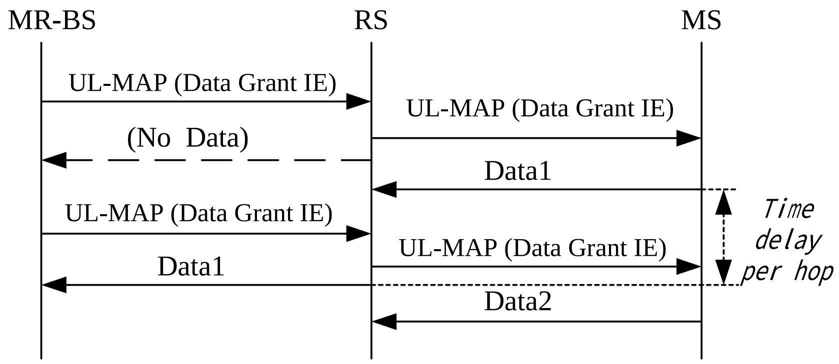

Figure 1 An example of the periodic grant procedure in the distributed scheduling system

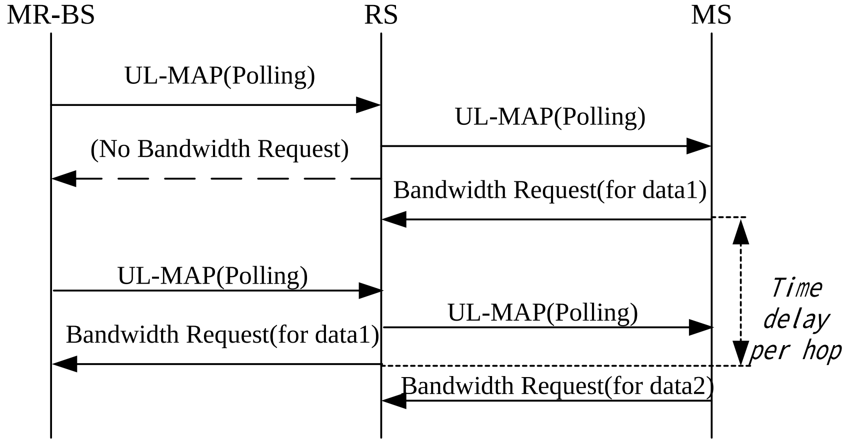

Figure 2 An example of the periodic polling procedure in a distributed scheduling MR system.

2. Optimized grant and polling mechanism for distributed scheduling

2.1 Optimized Periodic 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.

If the 802.16j system grants unsolicited bandwidth to the MS on a periodic time basis, the RS scheduling 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 may include the transport CID/ tunnel CID on which the user data traffic is carried, the frame offset to indicate when the bandwidth will be granted and the size of bandwidth allocation. When the subordinate node receives the RS_SCH_IE, it will generate 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_IE 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.

The CID type included in the RS scheduling information depends on the connection type, on which the user data is carried. It can be transport CID or tunnel CID.

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

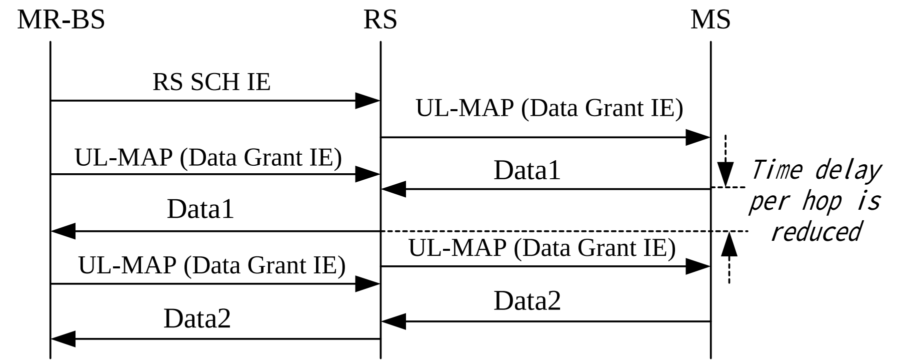

Figure 3 An example of proposed periodic grant mechanism

2.2.3 Optimized Periodic Polling

Similar to 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 on a periodic time basis, the RS_SCH_IE may also be used to accelerate bandwidth request transfer.

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

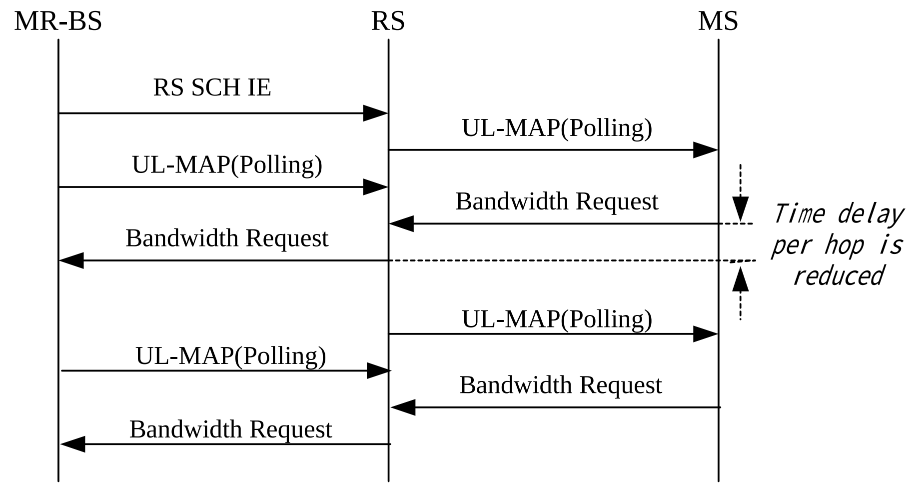

Figure 4 An example of proposed periodic polling procedure in a distributed scheduling system

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

In the multihop relay system with distributed scheduling, the MR-BS or a RS may send RS SCH IE in advance to its subordinate RS to indicate when and how much bandwidth it will schedule for the service in the future.

6.3.5.2.2 rtPS

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

In the MR system with distributed scheduling, to meet an rtPS service flow’s need, the MR- BS and RSs along the path shall shall poll its subordinate node on a real-time periodic basis. The MR-BS and RSs may send RS_SCH_IE to its subordinate RS to indicate when it will schedule a poll in the future.

6.3.5.2.2.1 Extended rtPS

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

In the MR system with distributed scheduling, to meet an Extended rtPS service’s need, the MR- BS and RSs along the path shall grant dynamic size bandwidth to its subordinate node on a real-time periodic basis. The MR-BS and RSs may send RS_SCH_ IE to its subordinate RS to indicate when and how much bandwidth it will schedule for the service in the future.

[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:]

In MR system with distributed scheduling, the MR-BS or a RS may send its RS_SCH_ IE in advance to its subordinate RS, to indicate when and how much bandwidth it will schedule for the real time service in the future. The RS_SCH_ IE includes the CID on which the user traffic is carried, the frame offset to indicate when the bandwidth will be granted and the size of bandwidth allocation. The actual grant is issued using Data Grant IE as defined for single hop case. For periodical bandwidth grant, RS_SCH_IE could be sent just once.

RS_SCH_IE is generated by the MR-BS or a RS and sent to its subordinate RS until the MS’s access station is reached. Figure 1 illustrate the bandwidth grant procedure using RS_SCH_IE.

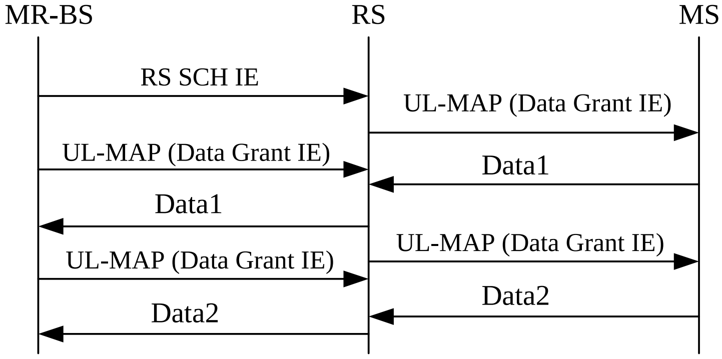

Figure 1 Periodic Bandwidth Grant with RS_SCH_IE

6.3.6.7.1.3 Polling

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

Similar to the bandwidth grant, the periodic polls issued by the MR-BS or a RS to its subordinate RS may be accompanied with a RS_SCH_IE. The RS-SCH-IE is generated by the MR-BS or a RS and sent to its subordinate RS until the access RS is reached. Figure 2 illustrates the polling procedure using RS_SCH_IE.

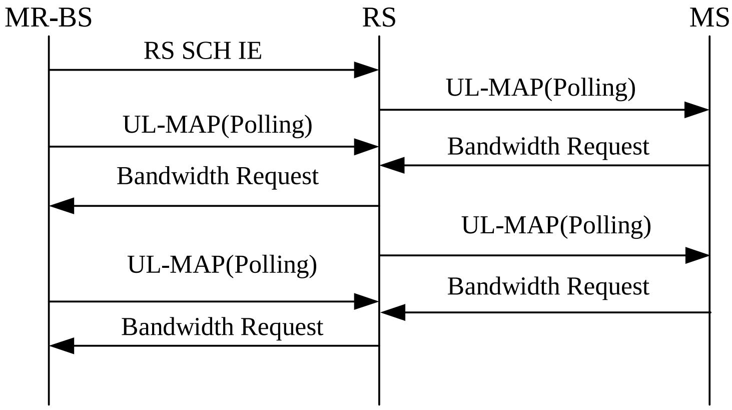

Figure 2 Periodic Polling with RS_SCH_IE

Update Table 290c as indicated in the following Table.

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

Extended UIUC (Hexadecimal)	Usage
09 – 0D	Reserved
09	RS_SCH IE

0A … 0D	Reserved

Insert new subclause 8.4.5.4.29

8.4.5.4.29 RS_SCH IE

This IE specifies the uplink allocation for the receiving RS used for relaying bursts in the distributed scheduling, and is not applicable to MS/SS.

Table T1 – RS_SCH_ IE format

Syntax	Size	Notes
RS_SCH_IE() {		
Extended-2 UIUC	8 bits	RS_SCH_IE() = TBD
Length	8 bits	
CID	16 bits	The CID for the MS
RS UL Allocation Frame Offset	8 bits	In terms of number of frames
Bandwidth	8 bits	In number of bytes
}		

CID

Indicates the CID, for which the allocation will be used. It can be transport CID or tunnel CID.

RS UL Allocation Frame Offset

Indicates the number of frame, starting from the next frame, in which the bandwidth grant for RS is valid.

Bandwidth

Indicates the size of the allocation, in units of bytes

References

[1] IEEE C802.16j-07/011r3, “Distributed Bandwidth Request and Allocation in Multi-Hop Relay”