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Title	Optimized Distributed Bandwidth Request and Allocation in 802.16j system	
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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[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 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.

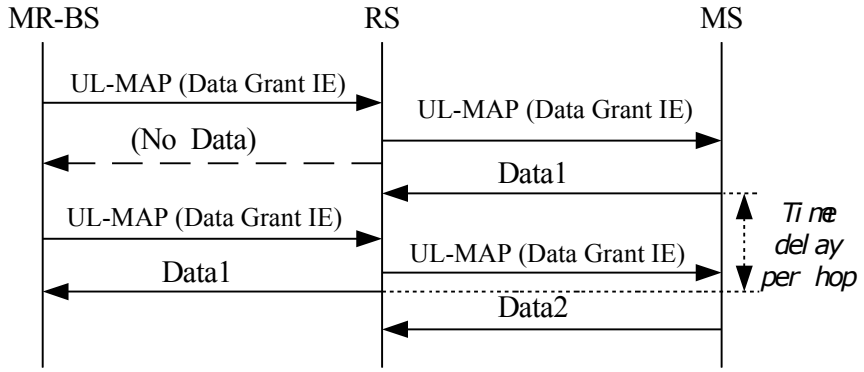

Figure 1 An example of the grant procedure in the distributed scheduling system

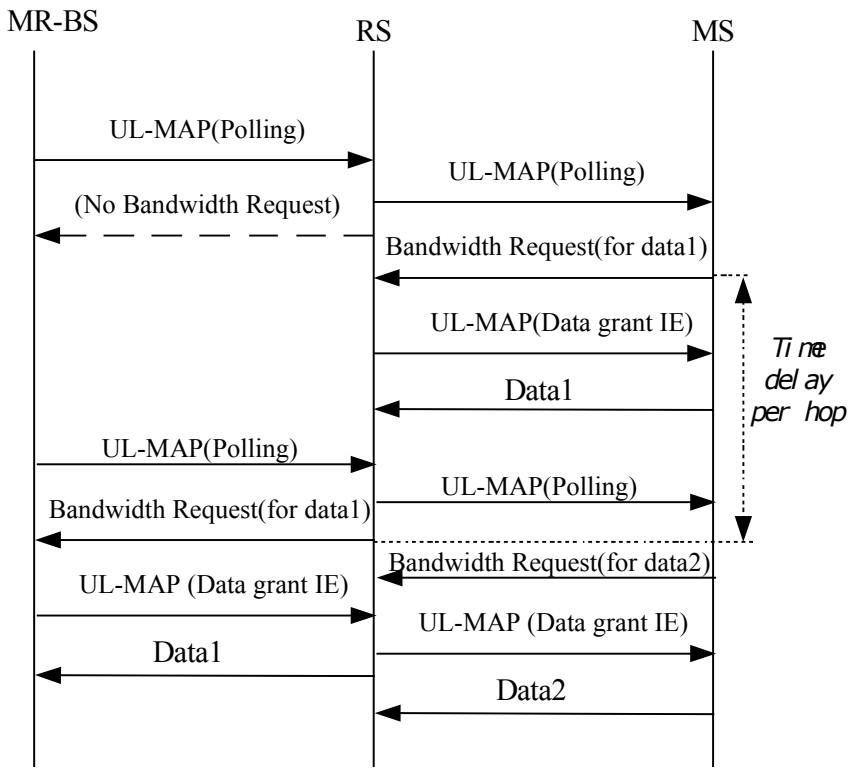

Figure 2 An example of the polling procedure in a distributed scheduling MR system.

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.

If the 802.16j system grants unsolicited bandwidth to the MS, the RS scheduling information is generated by the MR-BS firstly and sent to its subordinate node, based on the QoS of service flow and so on. RS scheduling information may include the transport CID/ tunnel CID which connection's CID the user data traffic is carried on, the frame offset to indicate when the bandwidth will be granted and the size of bandwidth allocation. When the subordinate node receives the RS scheduling information, it will generate new RS scheduling information for its own subordinate node, according to the received RS scheduling information, processing delay inside and so on. In this way, RS scheduling information 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 information 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. The RS scheduling information may be transmitted in the form of MAP IE, management message, MAC header and so on. How to transmit the RS scheduling information will be determined by considering other new signals' format, which have not been decided, to optimize the 16j system performance

the furthest.

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

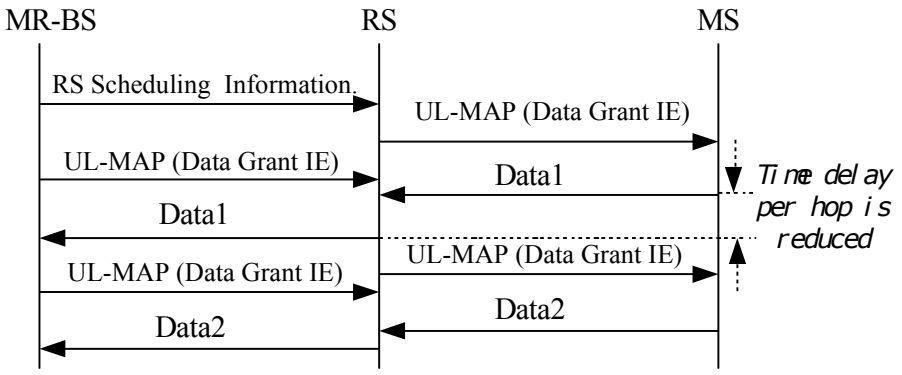

Figure 3 An example of proposed grant mechanism

[Note: How the RS scheduling information is transmitted will be determined when the signaling format, for example, MAP IE, Management message, MAC header and so on, has been decided.]

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 scheduling information can also be used to accelerate bandwidth request transfer.

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

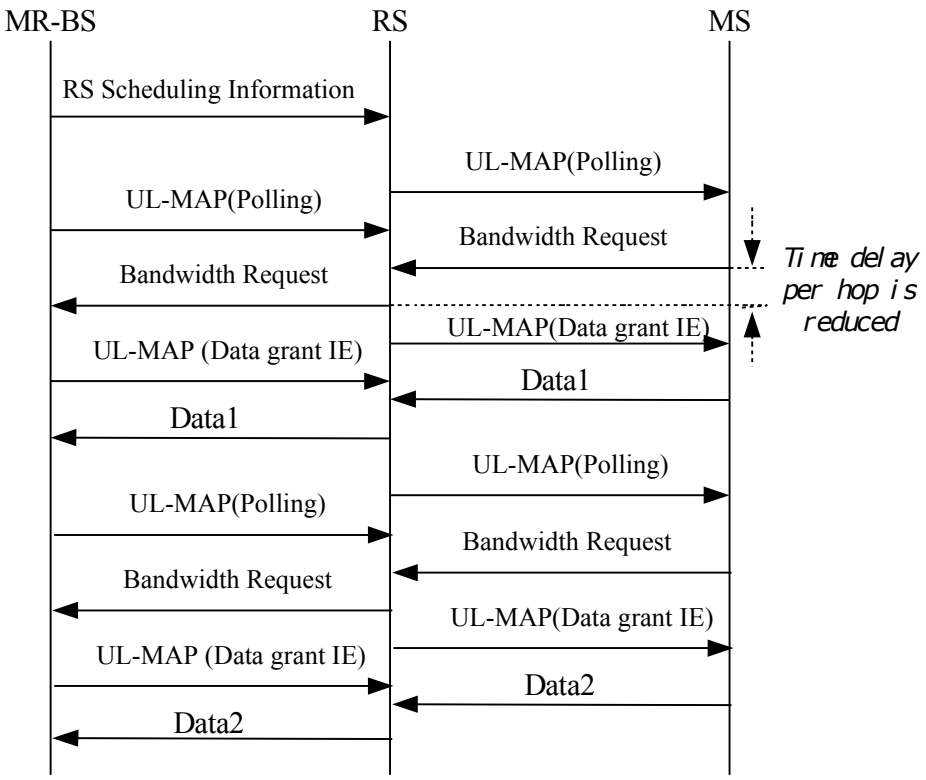

Figure 4 An example of proposed polling procedure in a distributed scheduling system

[Note: How the RS scheduling information is transmitted will be determined when the signaling format, for example, MAP IE, Management message, MAC header and so on, has been decided.]

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 MR- BS and RSs along the path shall grant fixed size bandwidth to its subordinate node on a real-time periodic basis.

To reduce time delay in relay system, super node may send RS scheduling information in advance to its subordinate node. RS scheduling information may include the transport CID/ tunnel CID which connection's CID the user traffic is carried on, the frame offset to indicate when the bandwidth will be granted and the size of bandwidth allocation. RS scheduling information is generated by the super ordinate node and sent to the subordinate RS of each hop link in turn until the MS's access station.

[Note: How the RS scheduling information is transmitted will be determined when the signaling format, for example, MAP IE, Management message, MAC header and so on, has been decided..]

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 MR- BS and RSs along the path shall poll its subordinate node on a real-time periodic basis.

To reduce time delay in relay system, RS scheduling information may be generated by the super ordinate node and sent to the subordinate RS of each hop link in turn until the MS's access station.

[Note: How the RS scheduling information is transmitted will be decided when the signaling format, for example, MAP IE, Management message, MAC header and so on, has been decided..]

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 MR- BS and RSs along the path 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 scheduling information 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 scheduling information and then start allocating the UL bandwidth.

[Note: How the RS scheduling information is transmitted will be determined when the signaling format, for example, MAP IE, Management message, MAC header and so on, has been decided.]

[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, to reduce time delay in relay system, super ordinate node may send RS scheduling information in advance to its subordinate node. RS scheduling information may include the transport CID/ tunnel CID which connection's CID the user traffic is carried on, the frame offset to indicate when the bandwidth will be granted and the size of bandwidth allocation. RS scheduling information is generated by the super ordinate node and sent to the subordinate RS of each hop link in turn until the MS's access station.

[Note: How the RS scheduling information is transmitted will be determined when the signaling format, for example, MAP IE, Management message, MAC header and so on, has been decided.]

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 scheduling information 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.

[Note: How the RS scheduling information is transmitted will be determined when the signaling format, for example, MAP IE, Management message, MAC header and so on, has been decided.]

References

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