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Title	Dedicated Resource Assignment for RS	
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Re:	A response to a Call for Technical Proposal, http://wirelessman.org/relay/docs/80216j-06_034.pdf	
Abstract	In this contribution, we propose the use of dedicated uplink channel as the main bandwidth resource for relay to transmit upstream control signaling and data traffic. It can provide a more effective transport mechanism in simplifying operation, minimizing delay and protocol overhead	

	when comparing with extending the existing bandwidth request and allocation mechanism for MMR network operation.
Purpose	To incorporate the proposed text into the P802.16j Baseline Document (IEEE 802.16j-06/026r1)
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Dedicated Resource Assignment for RS

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1. Introduction

The control information exchanged between an MR-BS and RSs includes channel quality information, bandwidth requests, topology change information, ranging information, and other control signaling. Excessive delay in this information transfer will have an adverse effect on the performance of the network. For efficient operation of the network (e.g., handover, improved throughput, backward compatibility with legacy MSs, etc), RSs should be able to deliver information to the MR-BS in a timely manner.

The basic mechanism by which bandwidth is allocated between the MR-BS and the RS is the contention bandwidth request and allocation procedure. The basic design of the bandwidth request and allocation procedure for 802.16e is based on the characteristics and requirements of MS. As an RS will be serving a number of MS(s), (and perhaps also a number of RSs) it will require frequent UL transmission to service the changing requirements of the subtending MSs or RSs. The RS behavior and traffic requirements are different from that of an MS.

The transport mechanisms for control messages currently provided by the IEEE 802.16e are adequate for the operation of single hop access networks, but are less well suited for the purpose of relay networks. Figure 1 shows a message flow chart between an RS and an MR-BS, where the RS is transmitting a management message created by an event between the RS and an MS using the 802.16e contention based bandwidth request and allocation procedure.

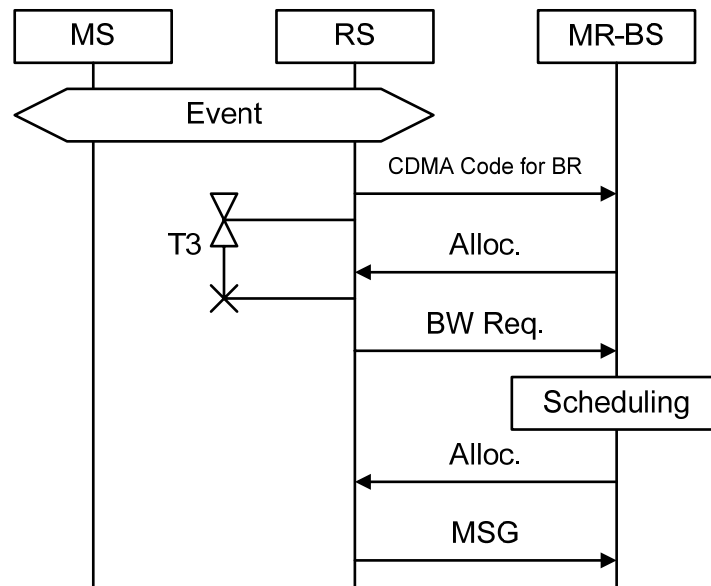


Figure 1 Contention based bandwidth allocation.

Contention based packet transmission scheme is event driven. This is very efficient in terms of resource utilization for traffic from individual MSs. However, contention based bandwidth allocation is not as efficient for aggregated traffic from multiple MSs. When an RS needs to transmit many control messages occurring periodically or randomly in time to the MR-BS, the need to send bandwidth request for every single control message is highly inefficient. In a typical access network, T3 is set to 200msec.

Proposed Solution

The proposed solution to the problem is to allocate a dedicated resource between an MR-BS and an RS for the purpose of transporting control messages or data traffic. By allocating uplink bandwidth to an RS, the RS can transmit control messages whenever necessary to the MR-BS without having to request bandwidth. Figure 2 illustrates this dedicated resource for a multi-hop network.

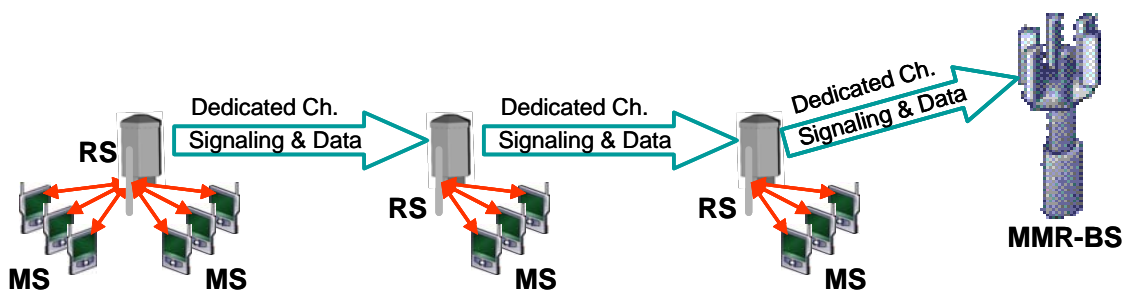


Figure 2: Multi-hop uplink transmission through dedicated channel allocation

The dedicated uplink channel enables a tight coupling between MMR-BS with its RS(s) to serve MS effectively. It is applicable to both distributed and centralized resource managements. For centralized management, it is more like a backhaul of control signaling messages and data traffic to the MMR-BS. For distributed

management, signaling that can be handled locally are managed by the RS and requests can be aggregated to further reduce the amount of signaling messages needed to go through the RS hops towards the MMR-BS.

Resource Allocation at RS Network Entry

After initial network entry procedure of an RS, a dedicated control channel will be allocated to the RS at the request of the RS or the MR-BS. If the MR-BS does not allocate a dedicated control channel to an RS, the RS can request an allocation.

The RS will be assigned the minimum or larger size of dedicated resource by its upstream serving station (MMR-BS or RS). The minimum size is large enough for a signaling message, it is available once every N frames. This initial resource is used by the RS to initiate the continuous operations of the dedicated channel. For example, the size can be updated, when appropriate, to a larger (or smaller) size for both signaling and data traffic according to the BW requirement of the relay. The BW requirement can be computed, periodically or as needed by events, by the RS to ensure adequate signaling and data traffic flows. For centralized resource management, the initial assignment and all subsequent updates are done by the MMR-BS only.

The dedicated channel allocation is assigned through R-MAP IE within the RS-Zone. The allocation is available starting in the same frame when the R-MAP IE is received by the RS. The R-MAP IE is the MAP information element used to allocate resources for the relay link.

If traffic conditions do not warrant the continued allocation of the dedicated resource, the MR-BS can terminate or decrease the bandwidth of the dedicated resource without request from the RS. The RS may request a decreased bandwidth or return the resource if it is no longer necessary.

The following figure 3 illustrates the allocation of the dedicated resource between an MR-BS and an RS. This figure indicates that a dedicated resource allocation is performed as part of the procedure whereby the RS joins the network. There is thereafter a persistent scheduling of the resource between the MR-BS and the RS. This resource may be used by the RS to respond to subsequent events with its subtending MSs.

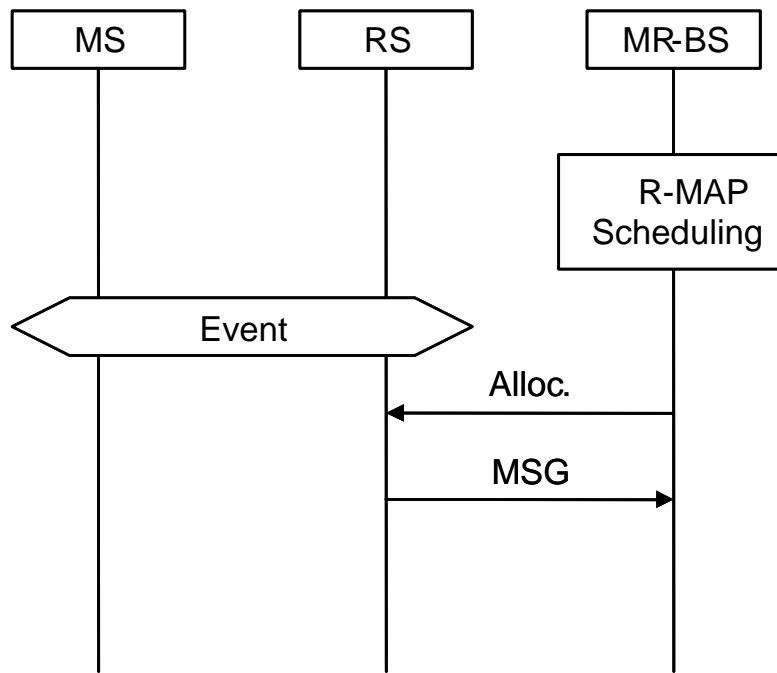


Figure 3: Allocation of dedicated resource between MR-BS and RS.

Variable Resource Allocation

The bandwidth of the dedicated resource can be updated, when appropriate, to a larger (or smaller) value according to the BW requirements of the relay. The BW requirement can be computed or estimated, periodically or as needed by events, by the RS to ensure adequate signaling and data traffic flows. These events may include, for example: changes in traffic flows, changes in signaling requirements, detection of possible handover due to approaching MS, association of new MS (etc.).

Rate based allocation

An RS may calculate the average data rate of a connection based on the traffic from the MSs. That is, the average data rate may be used to represent the long term statistics of the MSs. The dedicated resource may be set initially based on the measured statistics or adjusted at other times to match changing traffic statistics.

Due to fluctuations in the traffic there will be cases when the dedicated resource does not perfectly accommodate the traffic needs. When the dedicated resource is not large enough to handle the traffic, the bandwidth request procedure will be used to request and allocate additional resources. If the dedicated resource is greater than required, the MR-BS or the RS may reduce or return the dedicated allocation.

Note that the rate based allocation mechanism is particularly useful to the near-constant bit rate connections such as rtPS, ertPS, and nrtPS. On the other hand, since a bursty connection (e.g. a BE connection) might show a large fluctuation in BR, an RS may aggregate BRs of bursty connections from the same class.

3. Text Proposal

3.1 Dedicated relay uplink channel allocation

+++++ Start Text Proposal +++++

[Change subclause 6.3.6 as indicated]

6.3.6 Bandwidth allocation and request mechanism

Note that during network entry and initialization every SS is assigned up to three dedicated CIDs for the purpose of sending and receiving control messages. These connection pairs are used to allow differentiated levels of QoS to be applied to the different connections carrying MAC management traffic. Increasing (or decreasing) bandwidth requirement is necessary for all services except incompressible constant bit rate UGS connections. The needs of incompressible UGS connections do not change between connection establishment and termination. The requirements of compressible UGS connections, such as channelized T1, may increase or decrease depending on traffic. Demand Assigned Multiple Access (DAMA) services are given resources on a demand assignment basis, as the need arises.

When an SS needs to ask for bandwidth on a connection with BE scheduling service, it sends a message to the BS containing the immediate requirements of the DAMA connection. QoS for the connection was established at connection establishment and is looked up by the BS.

There are numerous methods by which the SS can get the bandwidth request message to the BS. The methods are listed in 6.3.6.1 through 6.3.6.6.

The method by which an RS requests a dedicated uplink resource is described in [TBD – the allocation may be requested with one of an RS message or a bandwidth request relay link MAC header or sub-header].

[Add the following section]

6.3.9.16 Network entry and initialization

6.3.9.16.1 RS network entry and initialization

6.3.9.16.1.1 Dedicated relay uplink channel allocation for control signaling and data transmission

As part of the RS network entry and initialization, the RS can be assigned the minimum or larger size of uplink dedicated channel (RS_UL_DCH) resource by its upstream serving station (MMR-BS or RS). If the MR-BS does not allocate an uplink dedicated channel to an RS, the RS may request an allocation.

The minimum size is large enough for a signaling message, it is available once every N frames. This initial resource is used by the RS to initiate the continuous operations of the dedicated channel. For example, the size

can be updated, when appropriate, to a larger (or smaller) size for both signaling and data traffic according to the BW requirement of the relay. The BW requirement can be computed, periodically or as needed by events, by the RS to ensure adequate signaling and data traffic flows. For centralized resource management, the initial assignment and all subsequent updates are done by the MMR-BS only.

To further reduce the number of 802.16e BR headers disseminated over the relay links, an RS may calculate the average data rate of a connection from its subordinate SS and sends the data rate information to its upstream serving station.

The dedicated channel allocation is assigned through MAP IE within the Relay Zone, i.e. R-MAP. The allocation is available starting in the same frame when the R-MAP IE is received by the RS.

3.2 R-MAP IE definition for dedicated relay uplink channel allocation

[Add the following section]

8.4.5.9 MAP IE (within R-MAP)

8.4.5.9.1 RS UL DCH assignment IE

This IE is used for the initial allocation and subsequent updates of the uplink dedicated channel on the relay link. The channel can be used to transmit uplink control signaling messages and data traffic.

Table XXX. RS UL DCH assignment IE format.

Syntax	Size	Notes
<u>RS UL DCH assignment IE {</u>		
<u>Type</u>	<u>4 bits</u>	
<u>RSID</u>	<u>8 bits</u>	
<u>UL region ID</u>	<u>6 bits</u>	
<u>Frequency (N)</u>	<u>6 bits</u>	<u>Allocation repeats once every N frames</u>
<u>}</u>		

The region referred by this IE is defined and broadcast in RS zone region configuration IE.

+++++ End Text Proposal +++++