Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	Virtual Relay Grouping Concept to Support RSs Sharing the Same Preamble ~~Relay Grouping and PUSC Segment Selection for FCH/MAP Transmission~~{Harmonized with IEEE802.16j-07_265}
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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 relay grouping to better serving the mobiles and to maintain good broadcast channel quality that allows frequency reuse amongst relay groups.
Purpose	To incorporate the proposed text into the P802.16j Baseline Document (IEEE 802.16j-06/026r1)
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1. Introduction

During the initial network entry, ~~a RS~~an RS first selects a station (either ~~a MR-BS~~an MR-BS or another RS) as its serving station. Secondly, it can select or is configured by its serving station a segment for transmitting FCH and MAP. ~~A RS~~An RS may either use the same segment as or a different segment from that of its serving station.

When ~~a RS~~an RS uses the same segment and preamble sequence as that of the serving station, it becomes a cooperative relay to the serving station and it does not have its own identity from a MS point of view. The system operation becomes simpler. When the serving station is the MR-BS, the frequency reuse gain is not optimized for this type of system operation. When ~~a RS~~an RS selects or is assigned a different preamble sequence, this RS has its identity and can transmit it own FCH and MAP. The benefit of the latter case is the potential gain from frequency reuse, compared to the first case. The issue of the latter case may result in higher co-channel interference on FCH/MAP transmission for certain scenarios as well as potential interference in the FUSC channels when two RSs are located close to each other or between MR-BS and RSs. The latter will also help to avoid handoffs which can occur when an MS moves across RS boundaries. With RSs covering small area it is expected the number of handoffs can increase several fold if each RS represents different PN sequences.

In the current definition of RSs there are two definitions. An non-transparent relay which transmits the preamble and the transparent relay which does not transmit a preamble. Since virtual group members transmits the preamble they comes under the category of non-transparent relay under the current definition. However, the difference is that they transmit the same preamble and the whole group represents a single preamble therefore appearing to MS as a single non-transparent BS-like entity when an MR-BS is not involved in the group. When an MR-BS is included in the group it appears as a single BS entity to the MS.

In this contribution, we propose a method called RS grouping (refer to Figure 1):

- A group of RSs form a Virtual RS group as decided by the MR-BS based on criteria (e.g. potential interference that they cause to each other) which is implementation dependent. The virtual group may include the MR-BS.
- Each RS is assigned an individual unicast RSID and a multicast RSID as the RS group ID. The multicast RSID is the same for all members in the group. With these two separate IDs, the RS can be managed individually or as a group. These IDs are unique within the associated MR-BS.
- When the virtual RS group include an MR-BS, all the RSs in the virtual group shall either transmit the same preamble, FCH and MAP or they all do not transmit any preamble. When an MR-BS is not included in the virtual group, one of the RSs in the virtual group is a non-transparent RS and all the others shall either transmit the preamble, FCH and MAP of the said non-transparent RS or they all do not transmit preamble, FCH and MAP. The radio resources may be shared by these RSs for data burst transmission. The existence of the group is totally transparent to its MS(s).
- Different groups transmit different preambles..
- Removal of an RS from the group: During normal operation of the RS group, each RS continues to monitor the radio environment (e.g. the interference). One example is that for an RS that is located at the edge of the group coverage area, it could detect strong segment interference from other nearby RS(s) or RS groups. When this happens, it can request to be removed from the RS group and operate on its own using a different segment.
- Addition of an RS to an existing group or forming a new group: An RS, at network entry, can a) operate on its own, i.e., it selects or is assigned a dedicated preamble index (implying the segment), b) form a new group or c) join an existing group. The RS can perform measurements such as radio signals from the neighbors and then report to MR-BS regarding the preferred preamble index (implying the segment). The MR-BS replies by either confirming the preamble sequence index selected by the RS or

assigning a different one, indicating whether it should transmit the preamble, and at the same time, providing the corresponding RS group ID.

- ~~A group of RSs form a Virtual RS group as decided by the MR-BS based on different criteria (e.g. the potential interference that they cause to each other.) The criteria are implementation dependent. RS group may consist of one MMR-BS and one or more RS(s), or two or more RS(s) with at least one RS being a non-transparent RS. .~~
- ~~Each RS is assigned an individual unicast RSID and a multicast RSID as the RS group ID. The multicast RSID is the same for all members in the group. With these two separate IDs, the RS can be managed individually or as a group. These IDs are unique within the associated MMR-BS. For details on the definitions of RSID, please refer to contribution [1].~~
- ~~All RS(s) in the same group shall transmit the identical preamble, FCH and MAP or do not transmit the frame start preamble. The existence of the group is totally transparent to its MS(s).~~
- ~~Either the MR-BS or the upstream serving station of the group is responsible for managing the FCH and MAP of the group as well as other processes such as scheduling and handover of MSs within the group.~~
- ~~Different groups transmit different preambles, the same or different FCH and MAP from that of the associated upstream serving station.~~
- ~~Removal of an RS from the group: During normal operation of the RS group, each RS continues to monitor the radio environment (e.g. the interference). For a RS that is located at the edge of the group coverage area, it could detect strong segment interference from other nearby RS(s) or RS groups. When this happens, it can request to be removed from the RS group and operate on its own using a different segment.~~

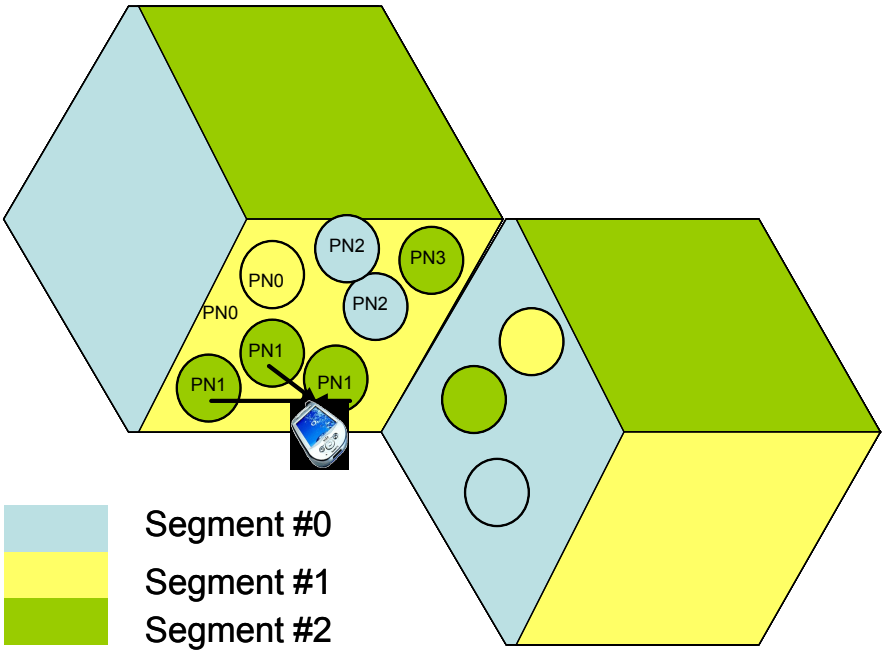

Figure 1: RS grouping

- ~~Addition of an RS to the group: A RS, at network entry, can a) operate on its own, i.e., it selects or is~~

~~assigned a dedicated preamble index (implying the segment), b) form a new group or c) join an existing group. The RS can perform the measurement of radio environment and then report to MMR-BS regarding the preferred preamble index (implying the segment). The MR-BS replies by either confirming the preamble sequence index selected by the RS or assigning a different one, indicating whether it should transmit the preamble, and at the same time, providing the corresponding RS group ID.~~

2. FCH/MAP Interference Evaluation

2.1 Parameters and assumptions

19 Umbrella macro cells (2 km cell to cell separation)
Tri-sector cell with cell site wrap around
Random drop relay locations
Number of relays per sector: 15 relays
Carrier frequency: 2.5 GHz
Beam Tx power is 20 watts. Relay Tx power is 600mW or 3W
Antenna gain: base = 15 dBi; relay = -1 dBi
Antenna pattern: base (3dB width) = 70 degrees (20 dB front to back ratio); relay = Omni
Noise figure: 9 dB for base, relay and MS
Thermal noise: -174 dBm/Hz
CIR Limit: 30 dB
Same pathloss model for base to relay, base to MS, relay to relay and relay to MS
Shadowing: 10 dB standard deviation; 0.5 correlation
Minimum distance: 35 m for base to relay & base to MS; No minimum between relay to relay & relay to MS
Average CIR curves plotted are as observed by MS on the best segment reception.

2.2 Scenarios

Scenario 1 (No RS Grouping):

Each RS selects a PUSC segment which is different from the segment of its associated ~~MMR-BS~~MR-BS
Each RS measures the combined segment power of the remaining two segments from all cells/sectors including its own sector
RS selects the segment with the lower combined power

Scenario 2 (Simple RS Grouping):

Each RS group assigns a PUSC segment which is different from the segment of its associated ~~MMR-BS~~MR-BS

Each RS measures the combined segment power of the remaining two segments from external cells/sectors only

RS report the segment with the lower combined power

All RSs that report the same segment are assigned to the same RS group by ~~MMR-BS~~MR-BS

2.3 Results

For individual relay case with no RS grouping, as shown in Figure 2, a degraded average FCH/MAP CIR statistics at MS are observed. However, with RS grouping, there is no degradation on average CIR statistics. In fact, it provides additional improvements in the low CIR region.

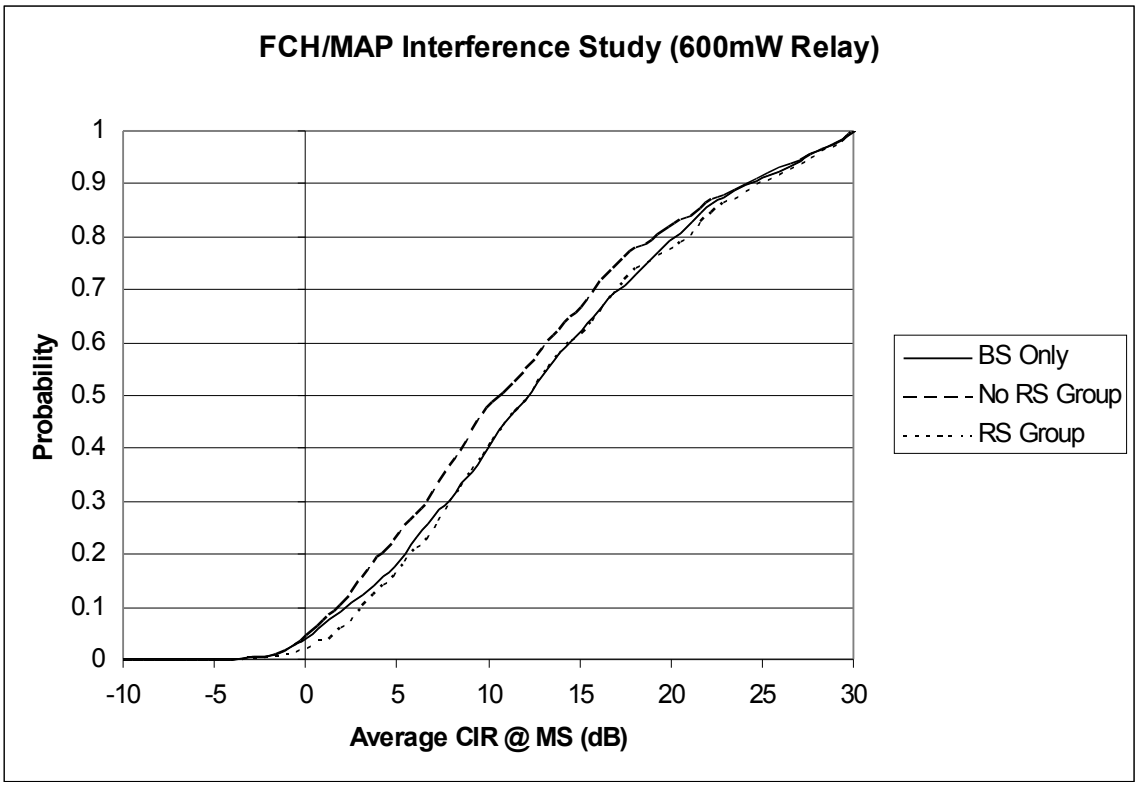

Figure 2: FCH/MAP Interference Study (600mW Relay)

For higher power relay and with no RS grouping, the results from Figure 3 indicate a further degradation in the average CIR statistics. On the other hand, with RS grouping, an improvement in slightly shifting the curve to higher CIR is observed.

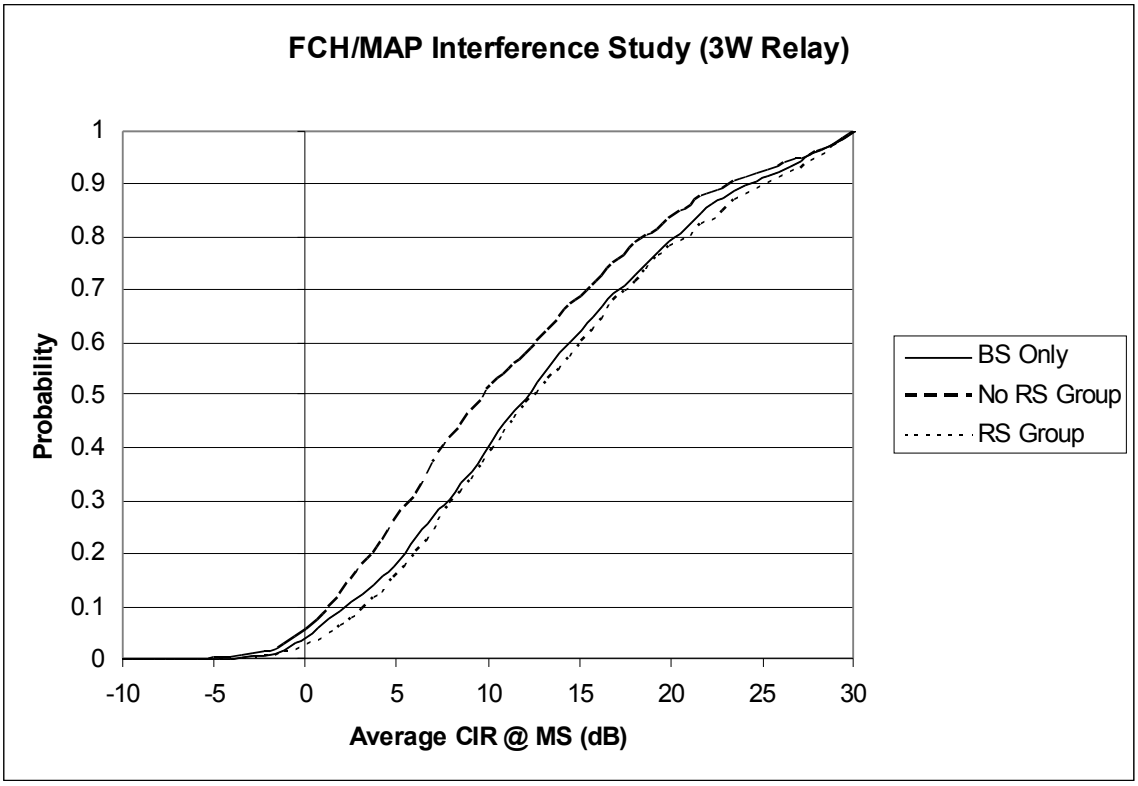

Figure 3: FCH/MAP Interference Study (3W Relay)

2.4 Evaluation Summary

In this study on RS grouping and PUSC segment selection:

There is no degradation in average FCH/MAP CIR received at MS. In fact, there is a slight improvement especially at the lower CIR region. Without RS grouping, the CIR degraded. Frequency reuse is possible amongst the RS groups as each group can transmit different FCH/MAP and potentially enable higher capacity in the relaying network.

3. Proposed text change

++++++++++++++ Start Text ++

3.1 RS grouping procedure

[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 RS grouping

RS grouping method includes the following characteristics:

- A group of RSs form a Virtual RS group as decided by the MR-BS based on criteria (e.g. potential interference that they cause to each other) which is ~~such as the potential interference that they cause to each other, and the criteria are~~ implementation dependent. The virtual group may include the MR-BS. ~~RS group may consist of one MR-BS and one or more RS(s), or two or more RS(s) with at least one RS being a non-transparent RS. .~~
- Each RS is assigned an individual unicast RSID and a multicast RSID as the RS group ID. The multicast RSID is the same for all members in the group. With these two separate IDs, the RS can be managed individually or as a group. These IDs are unique within the associated MR-BS. ~~For details on the definitions of RSID, please refer to contribution [1].~~
- When the virtual RS group include an MR-BS, all the RSs in the virtual group shall either transmit the same preamble as the MR-BS, FCH and MAP or they all do not transmit any preamble. When an MR-BS is not included in the virtual group, one of the RSs in the virtual group is a non-transparent RS and all the others shall either transmit the preamble, FCH and MAP of the said non-transparent RS or they all do not transmit preamble, FCH and MAP~~All RS(s) in the same group shall transmit the identical preamble, FCH and MAP, or do not transmit the frame start preamble~~ ,FCH and MAP. The radio resources may be shared by these RSs for data burst transmission. The existence of the group is totally transparent to its MS(s).
- ~~Either the MR-BS or the upstream serving station of the group is responsible for managing the FCH and MAP of the group as well as other processes such as scheduling and handover of MSs within the group.~~
- Different groups transmit different preambles~~., the same or different FCH and MAP from that of the associated upstream serving station~~.
- Removal of an RS from the group: During normal operation of the RS group, each RS continues to monitor the radio environment (e.g. the interference). One example is that for ~~For a RS~~an RS that is located at the edge of the group coverage area, it could detect strong segment interference from other nearby RS(s) or RS groups. When this happens, it can request to be removed from the RS group and operate on its own using a different segment.
- Addition of an RS to an existing group or forming a new group: ~~A RS~~An RS, at network entry, can a) operate on its own, i.e., it selects or is assigned a dedicated preamble index (implying the segment), b)

form a new group or c) join an existing group. The RS can perform ~~the~~ measurements such as ~~of~~ radio signals from the neighbors ~~environment~~ and then report to ~~MMR-BS~~MR-BS regarding the preferred preamble index (implying the segment). The ~~MMR-BS~~MR-BS replies by either confirming the preamble sequence index selected by the RS or assigning a different one, indicating whether it should transmit the preamble, and at the same time, providing the corresponding RS group ID.

3.2 MAC management message to enable the RS grouping configuration

{Insert the following section as a new section}

6.3.2.3.62 RS configuration request message

This message may be transmitted by ~~a RS~~an RS to request some physical layer operation parameters. ~~A RS~~An RS may use this message to report information to facilitate the determination of an ~~MMR-BS~~MR-BS on configuration of RS operation parameters.

Table XXX. RS_Config-REQ message format.

Syntax	Size	Notes
RS_Config-REQ format {		
Management message type = 67	8 bits	
Configuration_para_type	8 bits	b0 = 1: preamble configuration is included; b1 = 1: request to be removed from RS group; b2 – b7: reserved
If (b0 of Configured_para_type == 1) {		
reserved	1 bits	Shall be zero
Preamble_index	7 bits	Preamble index
}		
}		

Configuration_para_type

The first bit is used as preamble index indicator to indicate the preamble_index field is present in this message

The second bit is used as indicator to indicate the intent to be removed from the current RS group

Preamble_index

This field is used to indicate the preamble index

6.3.2.3.63 ~~MMR-BS~~MR-BS configuration response message

This message may be transmitted by an ~~MMR-BS~~MR-BS for the purpose of RS configuration. An ~~MMR-BS~~MR-BS may use this message to set operation parameters for ~~a RS~~an RS. ~~MMR-BS~~MR-BS may transmit this message as a response to RS–Config-RSREQ or as an unsolicited message.

Syntax	Size	Notes
RS_Config-REQ~~SP~~ format {		

Management message type = 68	8 bits	

Configured_para_type	8 bits	b0 = 1: preamble configuration is included;
		b1 = 1: remove multicast RSID to disassociate from the RS group;
		b2 = 1: Unicast RSID is included;
		b3 = 1: Multicast RSID is included;
		b4 = 0; Do not transmit preamble; 1: transmit the assigned preamble.
		B5 – b7: reserved

If (b0 of Configured_para_type == 1) {		
reserved	1 bits	Shall be zero
Preamble_index }	7 bits	Preamble index
If (b2 of Configured_para_type == 1) {		
Unicast RSID }	8 bits	Unicast RSID
If (b3 of Configured_para_type == 1) {		
Multicast RSID }	8 bits	Multicast RSID as the RS Group ID
}		

Configuration_para_type

The first bit is used as preamble index indicator to indicate the preamble_index field is present in this message

The second bit is used as the indicator to instruct the RS to remove its multicast RSID so that it is disassociate from the current RS group

The third bit is used as the Unicast RSID indicator to indicate the Unicast RSID field is present in this message

The fourth bit is used as the Multicast RSID indicator to indicate the Multicast RSID field is present in this message

Preamble_index

This field is used to indicate the preamble index

Unicast RSID

This field is used to indicate the Unicast RSID

Multicast RSID

This field is used to indicate the Multicast RSID for RS group operations

++++++++++++++ End Text ++

4. References

[1] Hang Zhang, et. al., “Introduction of RS ID”, IEEE C802.16j-07/095, IEEE 802.16 meeting, January 2007.