Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**	
Title	Relay Grouping and PUSC Segment Selection for FCH/MAP Transmission	
Date Submitted	**2007-01-08**	
Source(s)	Hang Zhang, Derek Yu, Peiying Zhu, Wen Tong, David Steer, Gamini Senarath, Mark Naden, G.Q. Wang Nortel 3500 Carling Avenue Ottawa, Ontario K2H 8E9	Voice: +1 613 763-1315 [mailto:wentong@nortel.com] [mailto:pyzhu@nortel.com]
	Kanchei (Ken) Loa, Yung-Ting Lee, Yi-Hsueh Tsai, Chih-Chiang Hsieh, Heng-Iang Hsu, Shiann-Tsong Sheu Institute for Information Industry 8F., No. 218, Sec. 2, Dunhua S. Rd., Taipei City, Taiwan.	loa@nmi.iii.org.tw
	D. J. Shyy MITRE McLean, VA, USA	Voice: +1 703 983-6515 djshyy@mitre.org
	Tzu-Ming Lin, I-Kang Fu, Fang-Ching Ren, Chie-Ming Chou and Wern-Ho Sheen ITRI / NCTU M100, ICL/ITRI, Bldg. 14, 195, Sec. 4, Chung Hsin Rd. Chutung, Hsinchu, Taiwan 310, R.O.C.	IKFu@itri.org.tw
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)	
Notice	This document has been prepared to assist IEEE 802.16. It is offered as a basis for discussion and is not binding on the contributing individual(s) or organization(s). The material in this document is subject to change in form and content after further study. The contributor(s) reserve(s) the right to add, amend or withdraw material contained	

	herein.
Release	The contributor grants a free, irrevocable license to the IEEE to incorporate material contained in this contribution, and any modifications thereof, in the creation of an IEEE Standards publication; to copyright in the IEEE's name any IEEE Standards publication even though it may include portions of this contribution; and at the IEEE's sole discretion to permit others to reproduce in whole or in part the resulting IEEE Standards publication. The contributor also acknowledges and accepts that this contribution may be made public by IEEE 802.16.
Patent Policy and Procedures	The contributor is familiar with the IEEE 802.16 Patent Policy and Procedures <http://ieee802.org/16/ipr/patents/policy.html>, including the statement "IEEE standards may include the known use of patent(s), including patent applications, provided the IEEE receives assurance from the patent holder or applicant with respect to patents essential for compliance with both mandatory and optional portions of the standard." Early disclosure to the Working Group of patent information that might be relevant to the standard is essential to reduce the possibility for delays in the development process and increase the likelihood that the draft publication will be approved for publication. Please notify the Chair <mailto:chair@wirelessman.org> as early as possible, in written or electronic form, if patented technology (or technology under patent application) might be incorporated into a draft standard being developed within the IEEE 802.16 Working Group. The Chair will disclose this notification via the IEEE 802.16 web site <http://ieee802.org/16/ipr/patents/notices>.

Relay Grouping and PUSC Segment Selection for FCH/MAP Transmission

Hang Zhang, Derek Yu, Peiying Zhu, Wen Tong, David Steer, Gamini Senarath, Mark Naden, G.Q. Wang

Nortel

Kanchei (Ken) Loa, Yung-Ting Lee, Yi-Hsueh Tsai, Heng-Iang Hsu, Shiann-Tsong Sheu

Institute for Information Industry

D. J. Shyy

MITRE

Tzu-Ming Lin, I-Kang Fu, Fang-Ching Ren, Chie-Ming Chou and Wern-Ho Sheen

ITRI / NCTU

1. Introduction

During the initial network entry, a RS first selects a station (either a MMR-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 may either use the same segment as or a different segment from that of its serving station.

When a RS uses the same segment and preamble sequence as that of the MMR-BS, it becomes a cooperative relay to the MMR-BS and it does not have its own identity from a MS point of view. The system operation may be simpler, but the frequency reuse gain is not optimized. When a 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.

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

- RS(s) are grouped based on the segment selected (or assigned). A RS group consists of one MMR-BS and one or more RS(s), or two or more RS(s). A RS cannot belong to more than one group.
- 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. The existence of the group is totally transparent to its MS(s).
- The upstream serving station of the group is responsible for managing the FCH and MAP of the group.

> Different groups transmit different preambles, the same or different FCH and MAP from that of the associated upstream serving station.
> More than one RS groups can be formed under the same upstream serving station (MMR-BS or RS).
> In the case of fully centralized control, the MMR-BS generates MAP(s) and distributes to each RS or RS group.
> During normal operation of the RS group, each RS continues monitoring the interference environment. 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.

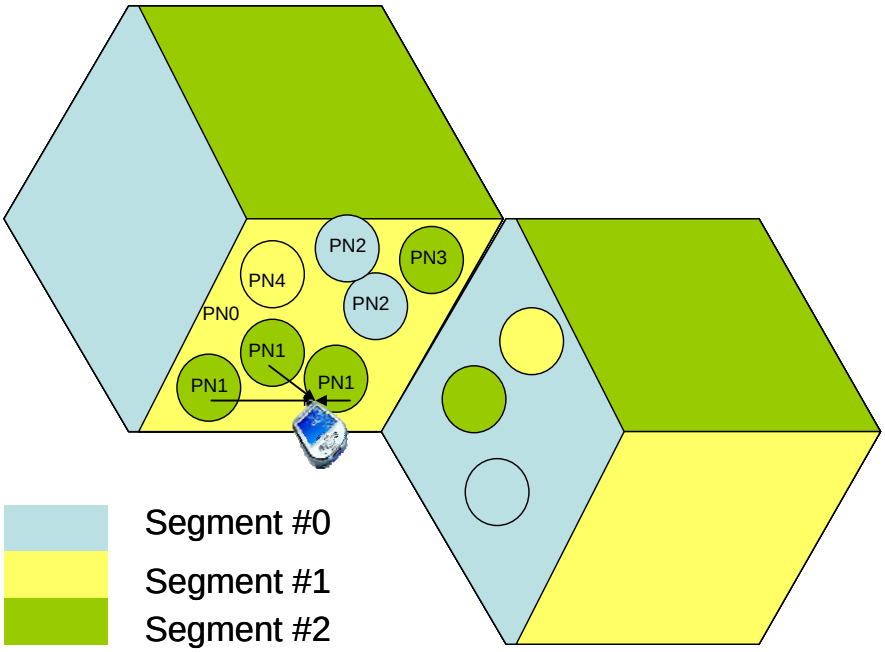

Figure 1: RS grouping

A RS, at network entry, can either operate on its own, i.e., it selects or is assigned a dedicated preamble index (implying the segment), form a new group or 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 MMR-BS replies by either confirming the preamble sequence index selected by the RS or assigning a different one, 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 (2Km 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

- 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

- 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

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.

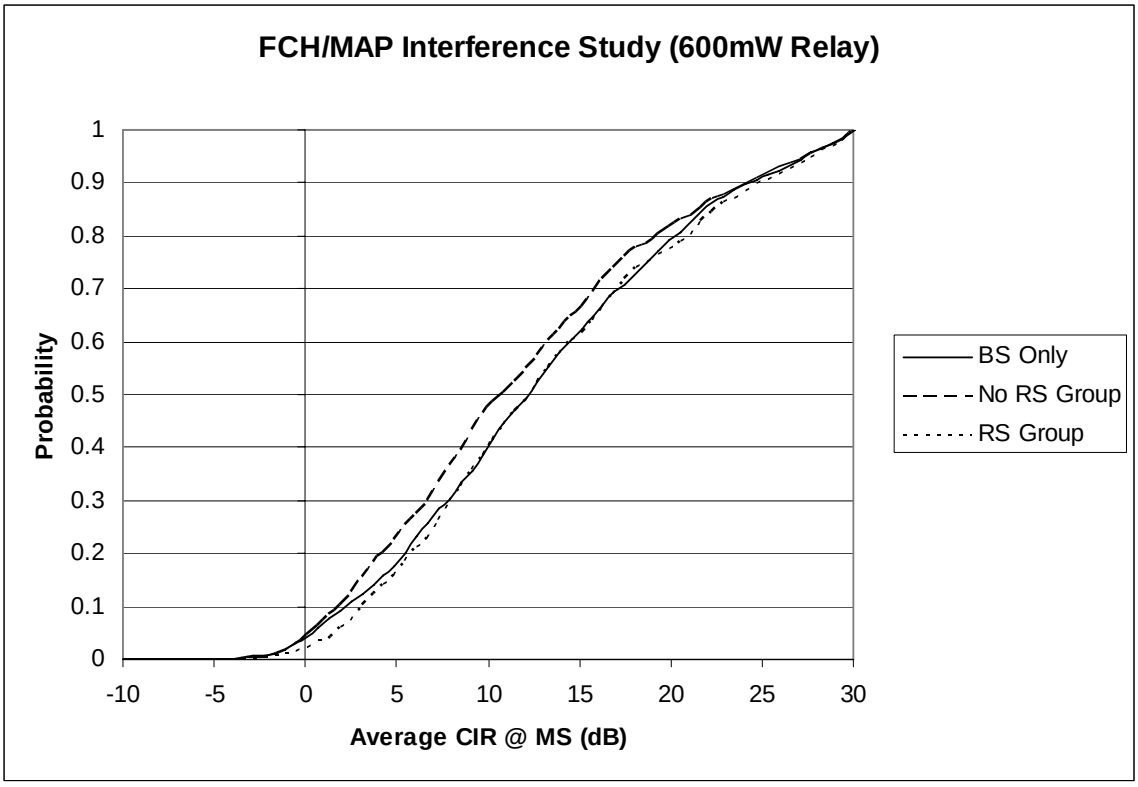

Figure 2: FCH/MAP Interference Study (600mW Relay)

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.

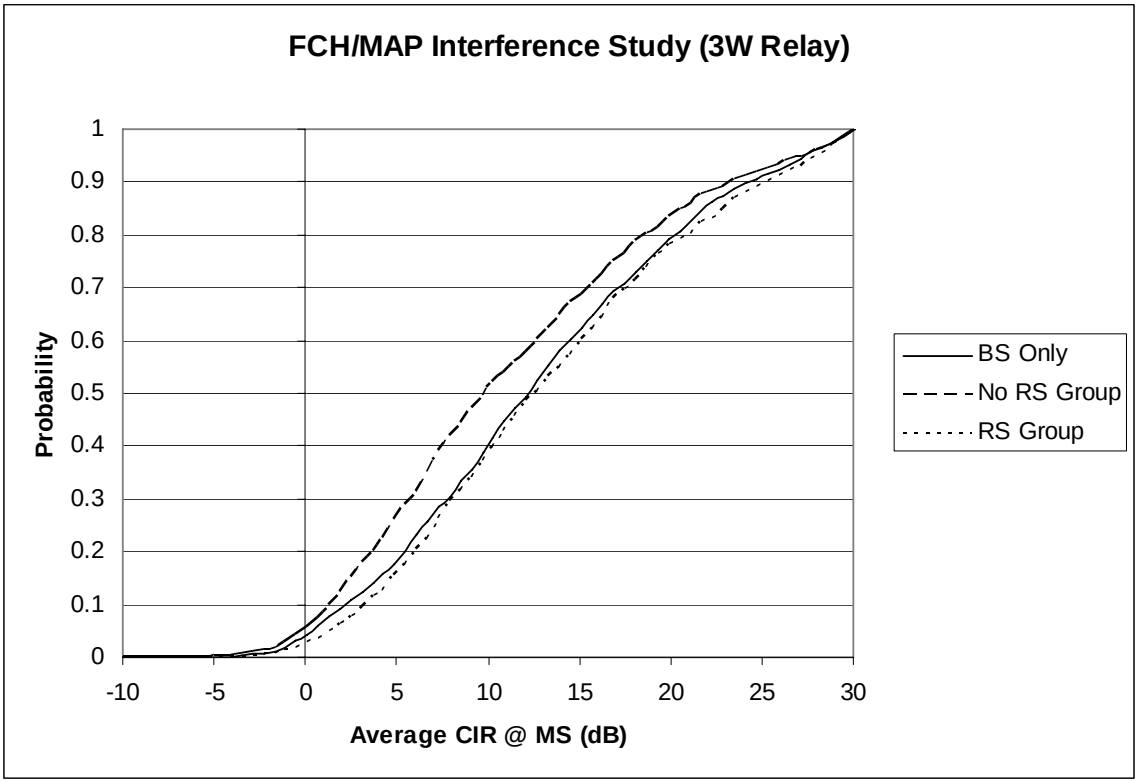

Figure 3: FCH/MAP Interference Study (3W Relay)

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:

- RSs are grouped based on the segments selected (or assigned). A RS group consists of one MMR-BS and one or more RSs, or two or more RSs. A RS cannot belong to more than one group.
- 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.
- Each group has a different RS Group ID.
- All RSs in the same group shall transmit the identical preamble, FCH and MAP. The existence of the group is totally transparent to its MSs.
- The upstream serving station of the group is responsible for managing the FCH and MAP of the group.
- Different groups transmit different preambles, the same or different FCH and MAP from that of the associated upstream serving station.
- More than one RS groups can be formed under the same upstream serving station (MMR-BS or RS).
- In the case of fully centralized control, the MMR-BS generates MAPs and distributes to each RS or RS group.
- During normal operation of the RS group, each RS continues monitoring the interference environment. For a RS that is located at the edge of the group coverage area, it could detect strong segment interference from other nearby RSs 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.

A RS, at network entry, can either operate on its own, i.e., it selects or is assigned a dedicated preamble index (implying the segment), form a new group or 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) using a MAC management message. The MMR-BS replies by either confirming the preamble selected by the RS or assigning a different one, and at the same time, providing the corresponding multicast RSID as the RS Group ID using a MAC management message.

3.2 MAC management message to enable the RS grouping operation

3.2.1 Reuse REG-REQ/RSP

REG_REQ/RES is modified to include preamble index TLV.

[Insert the following text to the end of section 6.3.2.3.7 in Page 56]

The REG-REQ may include the following TLV:

Preamble selection
This TLV is used by a RS to indicate the preamble index to MMRBS.

[Insert the following text to the end of section 6.3.2.3.8 in Page 58]

The REG-RSP may include the following TLV:

Preamble selection
This TLV is used by a MMRBS to indicate the preamble assignment to a RS.

[Add one type in Table 369a in page 685 of IEEE std 802,16e-2005]

Type	Parameter
45	Preamble selection

[Add a new section 11.7.27 as described]

11.7.27 Preamble selection

This field in REG-REQ message is used by a RS to report suggested preamble index to a MMRBS for the purpose of selection of a preamble (implying the segment) to be used by the RS after it assumes a RS function.

This field in REG-RSP message is used by a MMRBS to indicate to a RS regarding the preamble assigned.

Type	Length	Value	Scope
45	1	A preamble index	REG-REQ/RSP

3.2.2 Use RS_Config-REQ/RSP message

[Add two new section 6.3.2.3.62 and 6.3.2.3.63 as described]

6.3.2.3.62 RS configuration request message

This message may be transmitted by a RS to request some physical layer operation parameters. A RS may use this message to report information to facilitate the determination of a MMR-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) {		
__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 configuration response message

This message may be transmitted by a MMR-BS for the purpose of RS configuration. A MMR-BS may use this message to set operation parameters for a RS. MMR-BS may transmit this message as a response to RS_Config-REQ or as an unsolicited message.

Syntax	Size	Notes
RS_Config-RSP 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 – b7: reserved

_If (b0 of Configured_para_type == 1) {		
__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.