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Title	Fixed and Nomadic Relay Station Preamble Segment Assignment Scheme	
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Re:	Call for Technical Proposals regarding IEEE Project P802.16j (IEEE 802.16j-07/007r2)
Abstract	This contribution proposes fixed and nomadic relay-station preamble segment assignment scheme in order to mitigate interference during the initial RS network entry.
Purpose	Propose the text regarding fixed and nomadic relay-station preamble segment assignment for multihop relay systems
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Fixed/Nomadic Relay-Station Preamble Segment Assignment Scheme

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1. INTRODUCTION

The initial network entry process for MS to BS is defined in IEEE Std. 802.16-2004 & 802.16e-2005, Section 6.3.9. In the frame structure, the first OFDMA symbol of the downlink transmission is preamble. There are three different preamble carrier-sets each using orthogonal subcarrier sets. Each segment uses a preamble that uses one of the three available carrier-sets in the following manner: segment 0 uses preamble carrier-set 0, segment 1 uses preamble carrier-set 1, and segment 2 uses preamble carrier-set 2. In the DL (DownLink) PUSC (Partial Usage of Subchannels) mode, any segment used in the preamble shall be allocated at least one group (default is 12 subchannels in case of OFDM-2048) in the DL First Zone that also contains FCH and DL-MAP. First PUSC Zone which contains at least FCH and DL-MAP can cause interference from the same segment.

In the MR-BS enabled system, a RS can be turned on at anytime/anywhere and with mobility. If the RS overlaps in coverage with its neighboring RSs/BSs and the same segment values are used, then co-channel interference (collision) may occur and MS/SS (mobile station/subscriber station) may not decode the Cell-ID and control message such as FCH and DL-MAP signals. In order to mitigate the interference, we propose RS preamble segment assignment methods during the initial RS network entry.

2. INITIAL RS PREAMBLE SEGMENT CONFIGURATION

In order to perform the initial RS preamble segment configuration, the following two steps should be considered.

2.1 Initial RS Neighbor Detection

This specification defines a relay station function that enables RS neighbor detection at initial network entry. For instance, a RS powered on in a MR-BS coverage area shall perform the initial network entry with MR-BS and try to register with the MR-BS via initial ranging. In the initial phase, the RS acts as a MS/SS, and informs the BS that it has relay capabilities, thus at this point it is only a potential (candidate) RS, not an enabled RS. After the network entry and during cell selection, the potential RS scans its neighbors searching for preambles within all possible segments. The RS can detect the presence of the RSs/BSs in its neighborhood, and can inform the MR-BS about the detection results. The preamble is transmitted using 9dB higher power than the normal data transmissions. The preamble coverage radius is therefore larger than the normal control/data signal coverage radius. The potential RS reports all the detected neighboring preambles to the MR-BS. If the potential RS is able to detect a neighboring preamble signals above a pre-defined threshold value (threshold value is implementation dependent), then the control signal coverage between the potential RS and the neighboring RS/BS may overlap, and these control signals (i.e., FCH and DL-MAP signals) can cause co-channel interfere to the serving MS/SS. In this case it is advisable for the BS to assign a different segment value to the potential RS such that the co-channel interference that a MS receives is minimized. The initial RS preamble segment assignment for the potential RS is discussed subsequently.

2.2 Initial RS Preamble Segment Assignment

MR-BS requests the potential RS to act as a mobile station and to scan its neighboring RS preambles (i.e., scanning the frequency bands for segment 0, 1, and 2). The potential RS reports all of the detectable neighboring preambles and RSS (receiver signal strengths) to the MR-BS. If the potential RS does not detect preambles in all segments (i.e., segments 0, 1 and 2), the MR-BS assigns the potential RS a segment that was not detected. On the other hand, if the potential RS detects preambles in all segments, the MR-BS may have three options. First option (Option=1) would be simply not to enable the potential RS to operate as a relay. The second option (Option=2) would be to allow the potential RS to act as a cooperative-diversity relay in the operating coverage area. The third option (Option=3) would be to allow the RS to operate in the Transparent RS (T-RS) mode, whereby the T-RS relays data and control messages on the uplink, but is not involved in DL transmissions or only relays DL data transmissions and, thereby, does not transmit its own preamble or control information. For the second option, this means that the MR-BS configures the potential RS to be fully managed (i.e., its scheduling is done in a centralized manner by the MR-BS). In this case, the MR-BS and the potential RS may transmit the same data burst simultaneously. For the third option, the centralized scheduler at the MR-BS signals to the T-RS the specific burst allocations or CID assignments to be relayed on uplink or downlink. The message signaling relating to the initial RS segment assignment is shown in Figure 1.

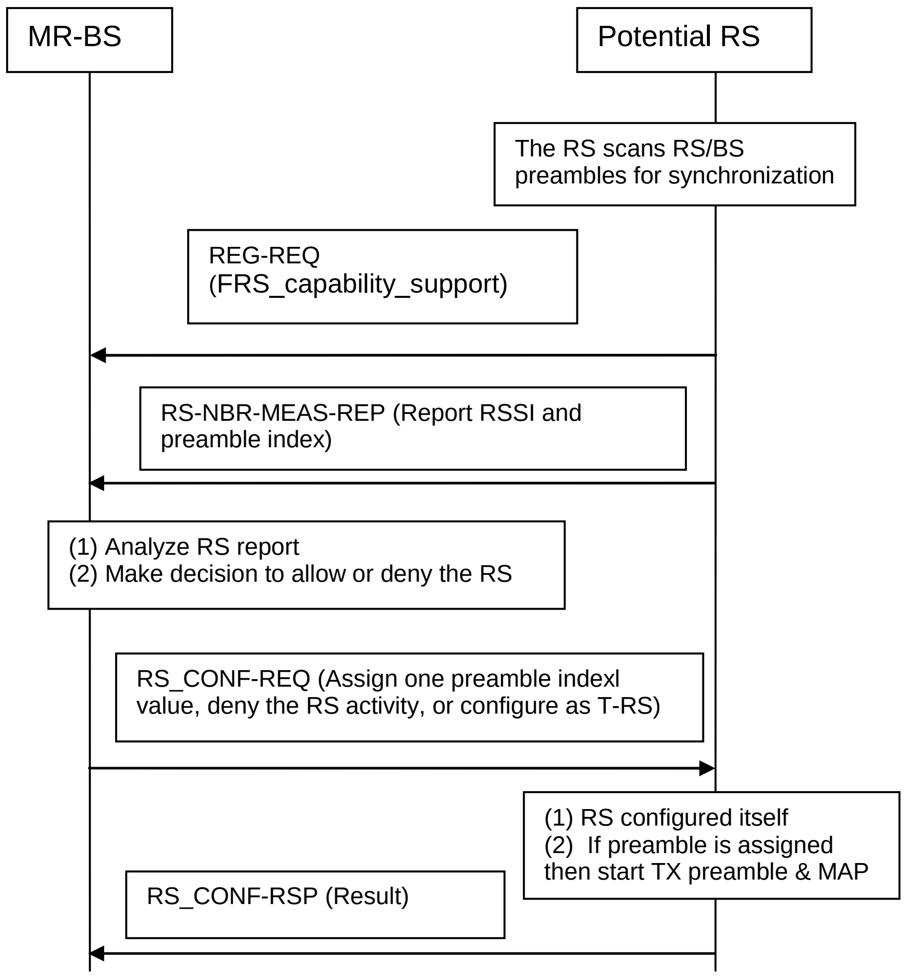

Figure 1. The message signaling for initial RS preamble segment assignment.

Note: RS can obtain its neighbor information during PHY synchronization before initial ranging. Therefore, it can send the report to MR-BS after RNG-REQ, SBC-REQ or REG-REQ.

To be more explicit, two examples are described as following:

In the first example considered, the potential RS reports to the MR-BS that it has detected two BSs or RSs in the area (labeled as RS0 and RS1, respectively), that have the following segments and IDcells : RS0 = {0, 11} and RS1 = {2, 23}. In this case the MR-BS can enable the potential RS to operate as a relay having assigned the segment 1, which has not been detected as being used in the area of operation.

In the second example, the potential RS detects the presence of the following BSs or RSs: RS_0 = {0, 11}, RS_1 = {1, 30}, and RS_2 = {2, 23}. Let's assume that the signal strengths from these RSs are relatively strong, above a certain pre-defined threshold value. The MR-BS can conclude that the area where the potential RS is located is well served by other RSs, so it may choose not to enable this potential RS. Now let's assume that the signal strength reported for the RS_0 and RS_1 are close to the threshold value mentioned above. The MR-BS chooses to enable the potential RS to operate as being fully managed, and assigns to it RS_p = {(0, 11), (1, 30)}, and at the same time reconfigures the RS_0 and RS_1 to operate also as fully managed shown in Figure 2. Note that the RS_p will be acting as a supportive relay (everything is transparent) for the MSs that are served already by RS_0 and RS_1; RS_p acts like another transmission antenna that can improve the cooperative-diversity gain.

We have considered a RS preamble segment and Cell ID assignment in the initial network entry stage by means of initial RS neighbor detection reports. Note that it is understood that in order to enable an RS, the MR-BS may consider some other issues, such as the traffic load in the area where the RS would operate, interference that it may generate to the neighbor RSs/BSs, etc.

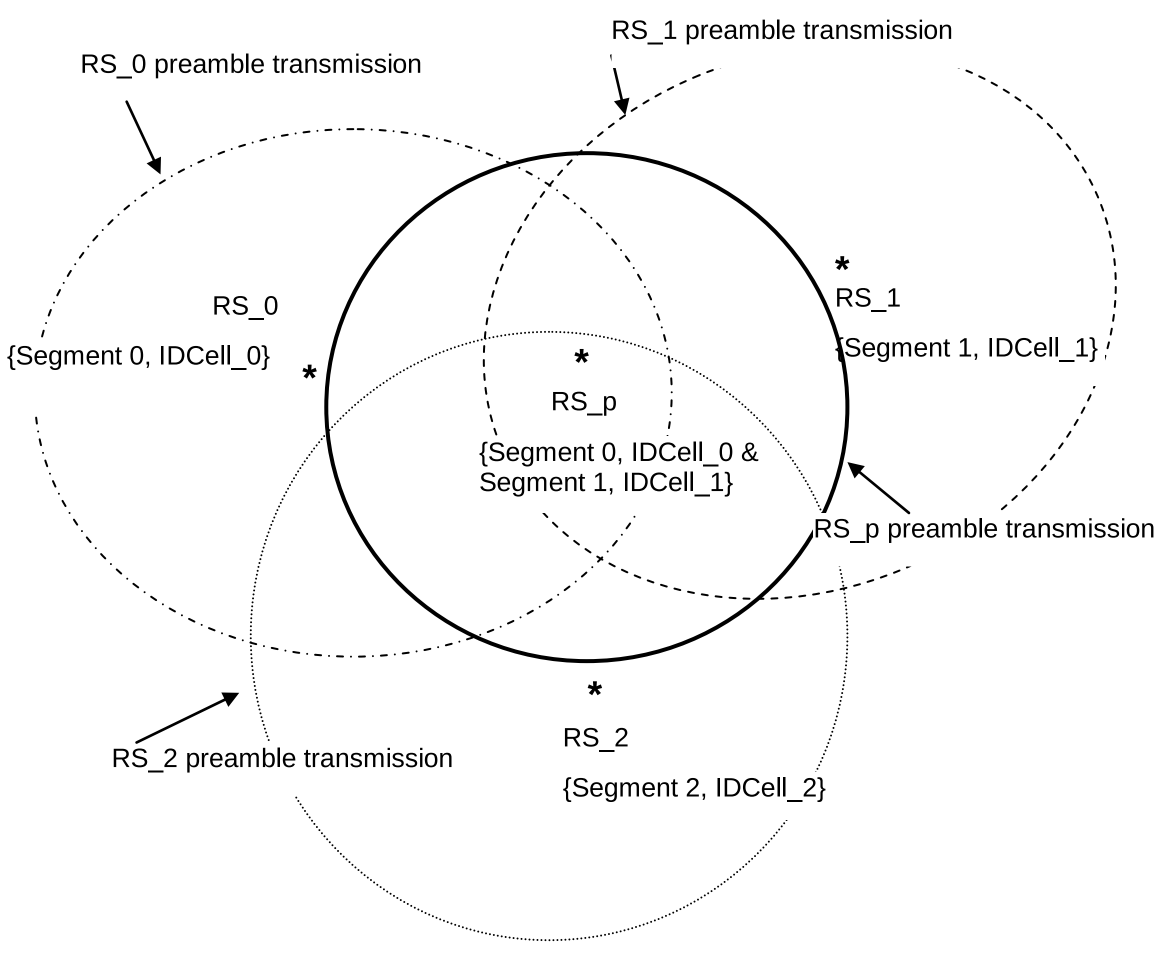

Figure 2. The RS_p relay is acting as a cooperative relay for RS_0 as well as RS_1.

3. CHANGES TO THE SPECIFICATION

Insert the new subclause 6.3.2.3.65

6.3.2.3.65. RS neighbor station measurement report (RS_NBR-MEAS-REP) message

Syntax	Size	Notes
RS_NBR-MEAS-REP_Message_Format(){		
Management Message Type =TBD		
N_Preamble_Index	8 bits	Number of preamble of neighboring RS/BS
Begin PHY Specific Section {		
For (i=0, i< N_Preamble_Index, i++){		
Preamble Index	8 bits	Scan the preamble index and RSSI values in the neighboring list
Report Response TLVs	Variable	TLV specific
}		
}		
TLV Encoded Information	Variable	TLV specific
}		

The Report Response TLV shall include physical CINR or RSSI of the preamble index.

N_Preamble_Index

Number of preamble of neighboring RS/BS.

This message shall include following TLV:

Preamble with the least signal strength

This TLV is used for a RS to report the preamble index with the least signal strength. This information will help a MR-BS to assign a preamble to a RS which would cause the least interference to its neighborhood.

Insert new subclause at the end of 6.3.9

6.3.9. During the registration process, the RS acts as a MS/SS and use RNG-REQ message to inform the MR-BS that it has relay capability to MR-BS.

Insert the text end of the subclause 6.3.9.1

6.3.9.1. Scanning and synchronization to the downlink

RS follows the scanning and synchronization procedure similar to that of the SS. In addition, however, the RS shall store preamble index and signal strength that are above a certain threshold value in order to report the stored values to the serving MR-BS after registration.

6.3.9.17. Interference report of neighboring stations to MR-BS

After registration with an MR-BS, the RS sends RS_NBR-MEAS-REP messages (see 6.3.2.3.65), containing the signal strength measurement from other stations, to the MR-BS.

Insert new subclause (6.3.2.3.66) *[Note that this is only a field in the RS_Config-REQ message to be adopted. Other fields may be provided in other adopted contributions]*

6.3.2.3.66 RS preamble configuration request (RS_Config-REQ) message

Syntax	Size	Notes
N_Preamble	2 bits	N_Preamble=0 specifies NULL preamble (e.g., Transparent RS) N_Preamble=1 assigns one preamble to the RS N_Preamble=2 assigns two preambles on different segments to the RS N_Preamble=3 assigns three preambles on different segments to the RS
Reserved	6 bits	Reserved
For (i=0, i<N_Preamble; i++){		
Preamble index	8 bits	Assign a preamble index value to the potential RS
}		
TLV Encoded Information	Variable	TLV specific

N-Preamble

N_Preamble is the number of preamble index assigned to the potential RS. For example, N-Preamble=0 means the potential RS does not transmit preamble acting as a Transparent RS. If N-Preamble=1 means the potential RS transmit one preamble index (i.e., the RS transmit one segment value and one IDCell) acting as a Non-Transparent RS. If N-Preamble=2 means the potential RS transmit two preamble index (i.e., the RS transmit two different segment values and IDCells) acting as a Non-Transparent RS.

The RS_Config-REQ shall contain the following TLVs:
HMAC/CMAC Tuple (see 11.1.2)
The HMAC/CMAC Tuple shall be the last attribute in the message.

Insert new subclause (6.3.2.3.67)

6.3.2.3.67 RS preamble configuration response (RS_Config-RSP) message

Syntax	Size	Notes
RS_Config-RSP_Message_Format() {		
Management Message Type = TBD	8 bits	
Result	1 bit	0 = Fail 1 = Success
Reserved	7 bits	
TLV Encoded Information	Variable	TLV specific
}		

Result
Result indicates the RS preamble configuration request message; a bit of 0 indicates the message fail and a bit of 1 indicates the message success.

The RS_Config-RSP shall contain the following TLVs:
HMAC/CMAC Tuple (see 11.1.2)
The HMAC/CMAC Tuple shall be the last attribute in the message.

Insert new subclause (6.3.26)

6.3.26 Relay station neighborhood discovery
During the RS neighborhood discovery procedure, the potential RS can obtain its neighbor information during PHY synchronization before initial ranging. Therefore, it can send the report to MR-BS after RNG-REQ, SBC-REQ or REQ-REQ. Then, the RS sends a RS_NBR-MEAS-REP message (6.3.2.3.65) back to the MR-BS to response the measurement report.

Insert new subclause (9.4)

9.4 RS configuration
After the measurement report from RS neighborhood discovery process, MR-BS may send a RS preamble configuration request (RS_Config-REQ) message (6.3.2.3.66) to the RS for configuring the preamble segment and IDcell values. The RS sends a RS_CONF-RSP message to the MR-BS for responding the preamble assignment result.

Insert new subclause (11.20)

11.20 Preamble index with least signal strength

Type	Length	Value	Scope
TBD	Variable	b0 – b7: num_preambles for (I = 0; I <num_preamble;i++) { preamble index (8 bits) }	RS_NBR_MEAS_ _REP