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Re:	IEEE 802.16j-06/034:"Call for Technical Proposals regarding IEEE Project P802.16j"
Abstract	This contribution proposes a RS grouping technique for enhancing 802.16j system
Purpose	Proposes a RS grouping technique for enhancing 802.16j system
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A Grouping Scheme of Relay Station for 802.16j

I. INTRODUCTION

In IEEE 802.16j, RSs (relay stations) are developed to provide user-throughput enhancement, coverage extension and/or capacity enhancement to IEEE 802.16e. Deployment of relays, however, may incur issues that are not encountered in IEEE 802.16e. For example, an MS (mobile station) may perform handover more frequently than in the IEEE 802.16e system due to a smaller RS coverage. Also, if RSs are configured to broadcast control signals such as preamble, FCH and MAP in a frame, over-the-air overhead might consume too large a part of the MR-BS's radio resource. This problem is particularly serious if the number of relays in an MR-cell (multi-hop relay cell) is large. Finally, if a predefined resource is allocated to a specific RS, the resource utilization in an MR-BS would lack of flexibility, and the system trucking efficiency would become lower. In this contribution, a grouping scheme of RSs is proposed for IEEE 802.16j to ease the above-mentioned issues.

II. PROBLEM DEFINITION

In IEEE 802.16j, RSs are developed to provide user throughput enhancement, coverage extension and/or capacity enhancement to IEEE 802.16. Some usage models of RSs were suggested in [1], including fixed infrastructure, in-building coverage, temporary coverage, and coverage on mobile vehicle. In real applications, deployment of RSs may be subject to limitation on the RS transmit power, geography of the service area, etc. For example, two or more RSs in the vicinity of each other may be deployed to provide throughput enhancement over a large urban area and/or to provide coverage extension to a large hole or in an underground. In addition, it would not be uncommon to deploy adjacent RSs along a tunnel or a highway in order to provide complete coverage. Figure 1 illustrates these deployment scenarios, including coverage and/or throughput enhancement (a) to a large urban area, (b) in a tunnel, (c) in an underground, and (d) along a highway.

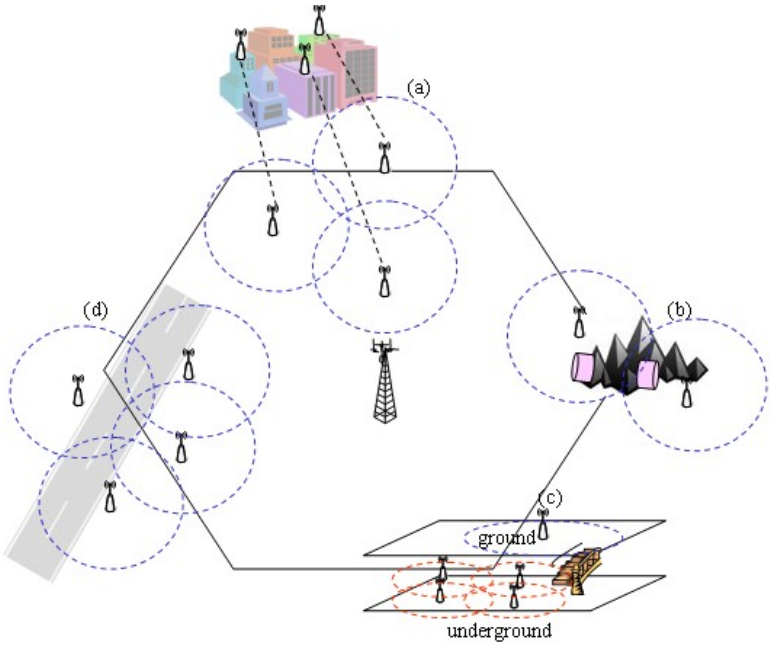

Figure 1. Deployment scenarios of RSs in IEEE 802.16j

Deployment of RSs may encounter issues that are not met in the traditional cellular systems, including frequent handovers, undue overhead and low system trucking efficiency. The issues are discussed in more detail as follows.

- Frequent Handovers: In the IEEE 802.16e system, no handover will be triggered for an MS moving within the cell coverage. In an MR network, however, handover may be initiated when an MS moves across the boundary of RSs. Take Figure 2 as an example, an MS might trigger more than one handover when walking along path (a), (b) or (c). Too often happened handovers would degrade the connection and network performance.

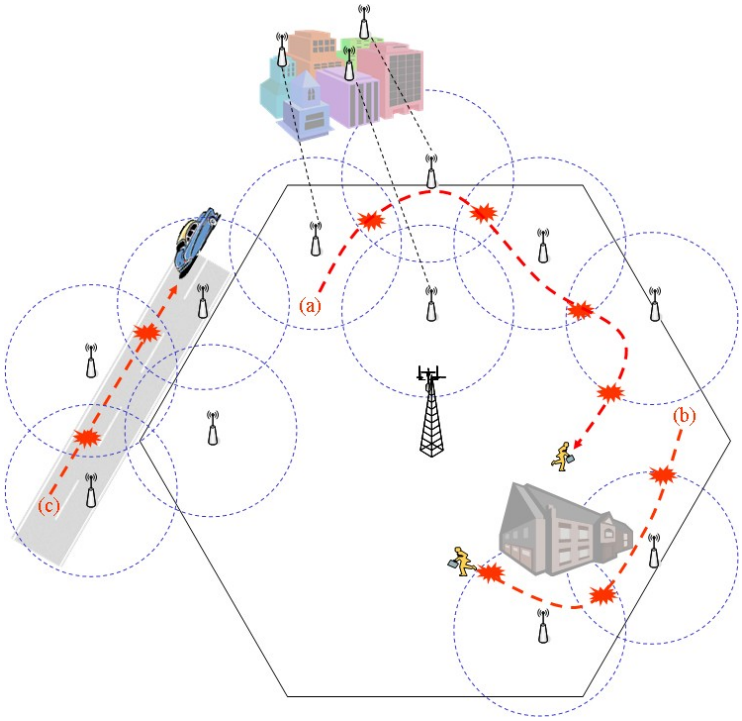

Figure 2. Example handover scenarios in an MR-cell

- Undue overhead: In 802.16j, RSs may need to broadcast control signals such as Preamble, FCH and MAP for the application of coverage extension. Figure 3 illustrates the potential issue with one BS and six RSs in a MR-cell, where P and M stand for Preamble and MAP, respectively. As is obvious, the undue overhead may eat up quite a part of the radio resource.

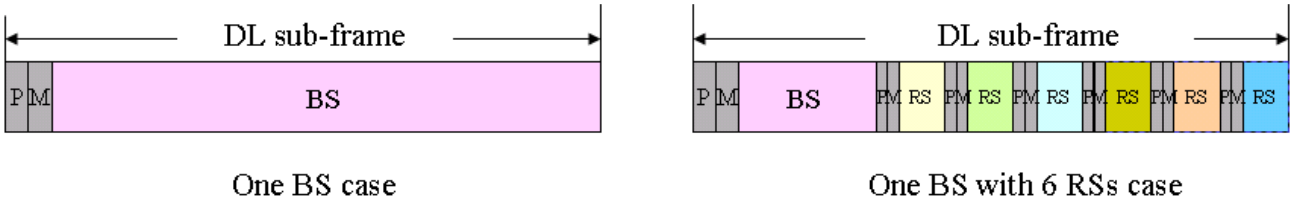

Figure 3. Overheads for six RSs in an MR-cell

- Low trucking efficiency: In IEEE 802.16j, radio resource may be allotted to RSs in a pre-determined and

fixed way. In this case, an RS may starve for radio resource because a large number of MSs, while one other may leave its radio resource wasted due to not having enough number of MSs. That is, the radio resource of an MR-BS is fragmented and is not fully utilized, and that leads a lower trucking efficiency.

III. THE CONCEPT OF RS GROUPING

A set RSs is said to form a RS Group if they transmit the same down-link signals. (A single RS can be considered as a special RS Group which has only one member RS.) For the up-link, each member RS in a RS Group acts like a regular RS. The basic idea behind the grouping is that adjacent RSs could be grouped together as a RS Group that acts like a regular RS in the down-link to its associated MSs or RSs. Since the coverage of a RS Group is larger than the regular member RS, there would be a lower handover frequency. In addition, only one copy of control signal in a frame is needed for a RS Group, the overhead is thus reduced. Finally, the down-link radio resource of each member RS can be aggregated and shared by all the MSs under the grouped RS so that the trucking efficiency is improved.

Figure 4 shows an example MR network incorporating the concept of RS grouping, where the solid line connecting two RS Groups says that they have a direct communication between them. In this example, RS Group 1 consists of RS-1 and RS-2, RS Group 2 consists of RS-5 and RS-6, and RS Group 3 and RS Group 4 are the single-element RS Groups. Note that RS-4 cannot be grouped with RS-5 and RS-6 as a new RS Group because they don't have same superordinate RS Group.

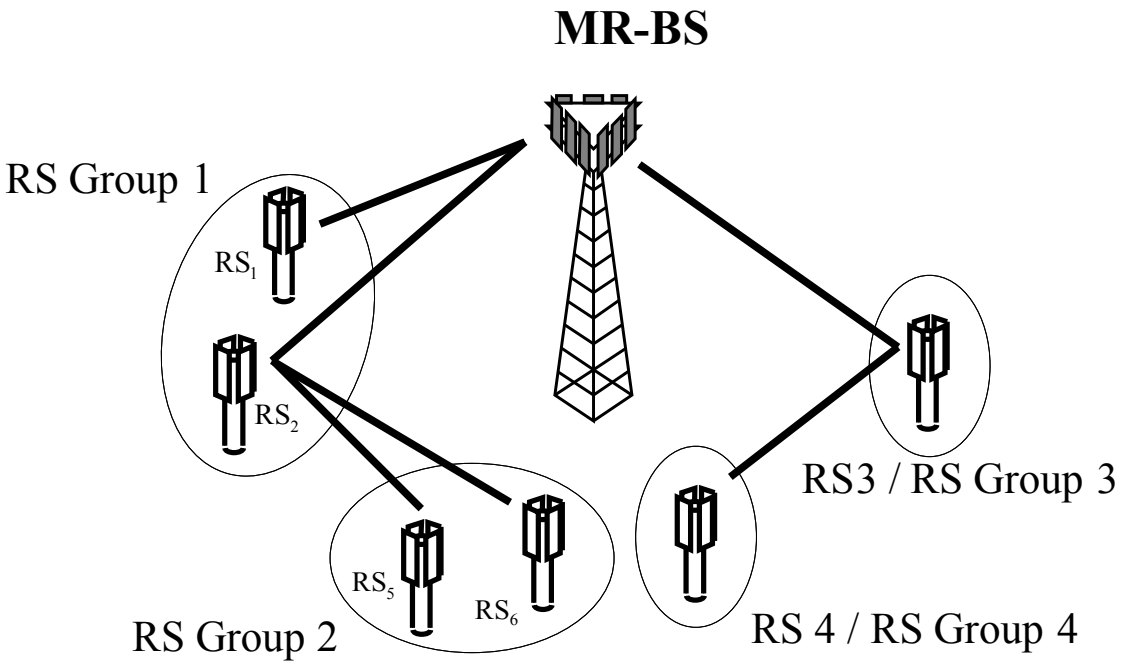

Figure 4. An example MR-network with RS Grouping

IV. THE MOBILITY MANAGEMENTS FOR RS GROUPING

For reducing handover occurrences and overheads, a RS Group (e.g. RS Group1) transmits the same preamble and MAP, and the ranging channel in the frame is shared among the RSs in a group in this design.

Besides, MS roams in cell of a grouped RS without initiating HO procedures when changing association from one RS to another. A MS CDMA periodic ranging process with aggregated ranging sub-channel allocation [2] can be employed to handle the RS reselection within coverage of RS Group. Due to the backward compatibility of MS, a RS Group shall act as legacy BS to SSs so that inter-RS Group handover shall be identical to inter-BS handover and the legacy handover procedure can be applied. As a result, handover shall only be triggered in inter-group-RS handover case, not in intra-group-RS case, and handover occurrences and overheads are reduced

V. POPOSED TEXT

----------Start of Text----------

[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.x RS grouping

RS grouping method includes the following characteristics:

RSs are grouped based on the segments selected (or assigned)
Each group is identified as RS group ID (RS_Group_ID), which is the same format as BS-ID.
All RSs in the same group shall transmit the identical preamble, FCH. MAP, and Bursts (if necessary).
A group is viewed as a virtual Station by a MS, and use radio resource, including downlink and uplink traffic, by the indication from BS.
Different RS groups transmit different preamble, same or different FCH and MAP from that of the associated MR-BS
A MS and RS shall identify its access point by the indication from MR-BS during network entry.

A relay, at network entry, can either create a new group, i.e., it selects or is assigned a dedicated preamble index (implying the segment) or joins an existing group. The RS can perform measurement of radio environment and then report to MR-BS regarding the preferred preamble index (implying the segment) using a MAC management message. The MR-BS replies by either confirming the preamble selected by the RS or assigning a different one, and at the same time, providing the corresponding RS group ID using a MAC management message.

[Add two new section 6.3.2.3.62 as described]

6.3.2.3.62 RS configuration request (RS_CONF-REQ) message

Syntax	Size	Notes
RS_CONF-REQ_Message_Format() {		
Management Message Type = TBD	8 bits	

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_CONF-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.

[Add a new section 6.3.2.3.63 as described]

6.3.2.3.63 RS configuration response (RS_CONF-RSP) message

Syntax	Size	Notes
RS_CONF-RSP_Message_Format() {		
Management Message Type = TBD	8 bits	
Result	2 bits	00 : Failure 01 : Accept 10 : Deny 11 : reserved
Reserved	6 bits	
TLV Encoded Information	Variable	TLV Specific
}		

The RS_CONF-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.

[Add a new section 9.4 as described]

9.4 RS configuration

After the measurement report from RS neighborhood discovery process, MR-BS may sends a RS preamble configuration request (RS_CONF-REQ) message (6.3.2.3.62) to the RS for configuring the preamble segment and ID-Cell values. The RS sends a RS_CONF-RSP message to the MR-BS for responding the preamble assignment result.

[Add a new section11.7.27 as described]

11.7.27 RS_capability_support

The "RS_capability_support" field indicates the potential RS capability. A bit of 1 indicates "support RS capability".

Type	Length	Value	Scope
TBD	1	Bit #0=1; Support RS Grouping capability. Bit#1- bit #7; Reserved	REG-REQ

----------End of Text----------

VI. REFERENCES

[1] IEEE 802.16j-06/015, "Harmonized Contribution on 802.16j (Mobile Multihop Relay) Usage Models".
[2] IEEE 802.16j-06/172, "Ranging process for IEEE 802.16j".
[3] IEEE 802.16j-06/017r2, "Table of Contents of Task Group Working Document"
[4] IEEE C802.16j-06/167, "RS Network Entry, Topology Establishment and Initialization for IEEE 802.16j".