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Re:	IEEE 802.16-08/020: "IEEE 802.16 Working Group Letter Ballot Recirc. #28c: Announcement"
Abstract	This contribution proposes an optional dynamic data forwarding scheme for RS group operation in 16j.
Purpose	Discuss and adopt proposed text in TG16j
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Comments on Data Forwarding in RS group

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1 Overview

In P802-16j/D4, the data forwarding modes are (i) CID based and (ii) tunnel CID based for DL/UL, and (iii) burst-based in UL during initial ranging. While station or tunnel CID based forwarding schemes require less signaling overhead, in a dynamic environment, updating CID tables via MAC message may be resource consuming. This is particularly important in transparent RS or RS group operations. For example, in case of too many connections required to be updated or included in a dynamic manner, connection list update based on the Member List Update MAC message may pose significant overhead, which can consume valuable bandwidth.

In order to solve the data forwarding and signaling overhead problem in relatively faster varying environments, we propose to include a MAP IE in the MAP or R-MAP that will provide the connection information to the RSs. We recommend an efficient forwarding mechanism devised for RS group operation. The overhead incurred based on this method does not depend directly on the number of connections, but rather depends on number of bursts which can be minimized by proper resource allocation methods.

The proposed method optimizes the control signaling overhead for resource allocation on the R-link and enables efficient data forwarding from transparent RSs and/or RS group members to their subordinate MSs.

2 MAP-based Forwarding in RS Group

Assume we have N RS members and K connections to be served by this group. There are 2^N-1 non-empty RS group subsets. Any connection can be forwarded by any RS in the group. Thus, we can group all connections into 2^N-1 subsets, probably with overlapping connections, such that each connection group is forwarded by the members of one of the subsets.

> **Example:** Consider RS group with 2 members and 6 connections served by this group. We have 3 non-empty subsets:
>
> S_1 = {RS 0} forwards 2 connections
> S_2 = {RS 1} forwards no connection
> S_3 = {RS 0, RS 1} forwards 4 connections.
>
> The example Venn diagram in Figure 1 exhibits a sample connection served by different subsets of the RS group. For instance, some 2 connections are forwarded only by RS 0, 4 connections are only by RS 0 & RS 1.

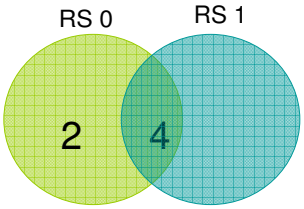

Figure 1 Three connection type according to the RSs forwarding the traffic for an RS group with 2 members.

With the classification above, we have at most 2^N-1 sets of connections. The connections served by a subset can be mapped to unique bursts in a frame, e.g., connections served by the members of subset S_k can be mapped to separate bursts. This enables an efficient forwarding scheme in which only the subset index and the length of the bursts to be forwarded by the member RSs of the corresponding subset are indicated.

According to this method, we first enumerate RSs as RS 0, RS 1, ... , RS N-1, and let A = { RS 0, RS 1,..,RS N-1} denote the set of all group members. Denote S_k the k'th subset of A, where S_k contains RS j, where {j : b_j = 1 with b_j the j'th bit of $[u_{N-1} \ldots u_1 u_0]$=binary(k,N). Here, binary(k,N) denotes the binary representation of k with N bits. Next, let L_k be the size of the bursts to be forwarded by members of Subset-k. For each subset, we provide the burst length (in slot) to be forwarded by the members of that subset. Thus, the overall information to be revealed to an RS is (i) its enumerated identity in constructing the numbered subsets, and (ii) the bursts that it shall forward, e.g., subset – connection relation. A new extended MAP IE, named MR_Forwarding_IE, is recommended to provide this information to the subordinate RSs. The size of this MAP IE is independent of number of connections carried with the bursts indicated by this MAP IE.

Example (cont'd): A sample bursts structure is depicted in Figure 2 for the connection set given in Figure 1. There are 2 connections to be forwarded only by RS 0 (Subset 1), and 4 connections to be forwarded by both RS 0 and RS 1 (Subset 3). In MR_Forwading IE, first we list basic CID of RS 0 and then that of RS 1. This listing indicates that Subset 1 contains RS 0, Subset 2 contains RS 1 and Subset 3 contains both RS 0 and RS 1. The bursts S 1 and S 3 for Subset 1 and Subset 3, respectively, can be indicated by the MAP IE(s) following the MR_Forwarding IE. We provide the size of the bursts (in slots) to be forwarded by each subset. The Number_of_Subset for this example is 2. The L_1 slots of the burst indicated by the MAP IE following the MR_Forwarding IE is forwarded by members of Subset 1, e.g., R 0, and the next L_3 slots of the burst is to be transmitted by members of S 3, e.g., RS 0 and RS 1. The way that the burst is processed is given by the MAP IEs following the MR_Forwarding IE.

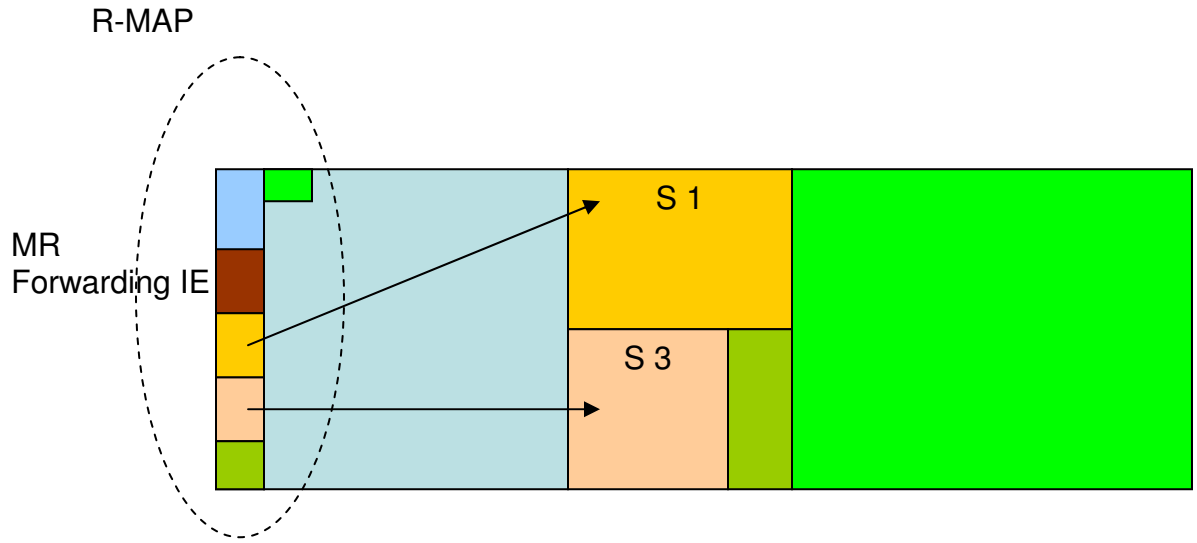

Figure 2 The MR_Forwarding IE provides the size of the bursts to be forwarded by members of the sets S 1 and S 3, where S 1 = {RS 0}, and S 3 = {RS 0, RS 1}. The bursts can be indicated by the MAP_ IEs following the MR Forwarding IE.

2 Required Text Changes

[Change the Paragraph on Page 174 as indicated]

— Data forwarding within RS group: For DL, the members of an RS group may be configured to forward traffic data for only specific subordinate terminal stations. This may be done on a per-connection basis. In this way, by specifying scheduling times, two RSs belonging to the same RS group may transmit to two different MSs/SSs at the same time. In addition, transmissions may be scheduled such that multiple RSs in the RS group may transmit to the same MS to exploit macro-diversity. This scheduling may be achieved for RSs operating in centralized scheduling mode by keeping CID list associated with each RS. Each RS would look for the data bound to its subordinated stations or data coming from the subordinate stations in the uplink and forward in the assigned times indicated in the MAP. The list may be updated by the RS_Member_List_Update message defined in 6.3.2.3.83, or optionally by MR_Forwarding_IE defined in 8.4.5.3.29. If the RS_Member_List_Update message is not provided by the superordinate ~~RS~~ station to the RSs members of the RS group, then all RSs members of the group shall transmit according to the MAPs received, without using the per CID transmission. Data forwarding may also follow the procedure defined in Section 6.3.17.7 for DL HARQ for RS groups.

[Change Row-14 of Table 385 on Line 31, Page 201 as follows]

0C	~~*Reserved*~~MR_Forwarding IE

[Forwarding List IE: Insert Subclause 8.4.5.3.29 as indicated]

8.4.5.3.29 MR_Forwarding IE

An MR-BS or RS may send MR_Forwarding_IE to the immediate subordinate RSs to indicate the bursts to be forwarded following this MAP IE. The first L_k included in the MAP IE refers to number of slots to be forwarded by Subset-k from the burst indicated by the MAP IE(s) following this MAP IE. The second L_k refers to the next L_k slots after the slots indicated by the first L_k, etc..

Syntax	Size	Note
MR_Forwarding IE() {		
Extended 2 DIUC	4 bits	
Length	8 bits	
N_RS	8 bits	Number of RSs
For (i=0.i<N_RS;i++) {		
RCID_IE(i)	variable	Reduced Basic CID of RS i.
}		
Number_of_Subset	N_RS bits	Number of subsets in the list
For (k=1; i<=Number of Subsets; k++) {		
Subset_Index	N_RS bits	The index, k, of the subset S_k.
L_k	16 bits	Burst length in slots to be forwarded by members of subset S_k.
}		
}		
}		

RS Basic CID: This field indicates the Reduced basic CID of the RS. RSs are enumerated according to the order they are listed, e.g., the first RS_Basic CID in the list becomes RS 0, etc., to be used as reference to the subset members.

Subset_Index: This field indicates the subset members of which will forward the burst indicated by L_k. Subset-k contains RS j, where {j : u_j = 1 with u_j the j'th bit of $[u_{N-1} \ldots u_1 u_0]$=binary(k,N). Here, binary(k,N) denotes the binary representation of k with N bits, e.g., for N=2, S_1 = {RS 0}, S_2 = {RS 1}, and S_3 = {RS 0, RS 1}. For example, if Subsets 1 and 3 are included, the bursts lengths L_1 and L_3 for Subsets 1 and 3, respectively, are included in the list. Subset 1 = {RS 0}, Subset 3 ={RS 0, RS 1}.