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Re:	IEEE 802.16-08/028: "IEEE 802.16 Working Group Letter Ballot Recirc #28d: Announcement"	
Abstract	Comment on forwarding schemes for transparent RS	
Purpose	Text proposal for 802.16j Draft Document.	
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Comment on data forwarding schemes for transparent RS

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Problem Statement

There are three basic data forwarding schemes defined in P802-16j/D5 (1) CID based forwarding for DL/UL, (2) CID based forwarding assisted by inserting DL Allocation Reference IEs in the MAPs for RS with centralized scheduling and variable forwarding delay (3) burst-based forwarding for UL during IR, BR and HR.

The CID based forwarding schemes require CID forwarding rules for DL/UL maintains at each RS, which has the benefit of zero signaling overhead to execute the forwarding operation. However, in a dynamic environment where the CID forwarding rules require frequent changes, updating CID tables via DSx messages incurs overheads and causes disruption in the service. The service outage increases forwarding latency that is proportional to the frame duration, the RS hop count and the message lost probability. This is particularly troublesome for transparent RSs and the RS group. In both environments, the frequent changes of connections for an MS, which requires updating CID forwarding rules, could be caused by either the MS mobility or the CDMA ranging (PR and BR). Every time the MS sends a CDMA code for PR or BR, the access station (transparent RS or member of the RS group) may be re-selected by the MR-BS.

Proposed Solution

In order to solve the data forwarding and signaling overhead problems in relatively faster varying environments, the burst-based forwarding scheme is proposed. This contribution proposes following optimizations for the CID based forwarding scheme with the transparent RS.

1. For transparent RSs, the MR-BS utilize the RS_Member_List_Update (see 6.3.2.3.83) instead of DSx messages to update the CID list of the transparent RSs for CID based forwarding in both DL and UL. The DSx messages require three-way handshake messages exchange whereas RS_Member_List_Update require two-way handshake messages exchange only.
2. Before the MR-BS successfully receive the ACK message from all RSs designated in the RS_Member_List_Update message, the burst based forwarding scheme may be used to substitute RS's original forwarding rules to forward the data to the MS such that there is no disruption in the services.

The burst based forwarding scheme optimize the CID based forwarding by eliminating at least one round-trip message latency caused by MR-BS sending RS_Member_List_Update and receiving all required ACK messages.

Many optional features in 16j/D5 have been designed for optimization by just eliminating the round-trip message latency. For example, the RS-assisted HARQ as described in section 6.3.17.4.2.2 was designed to reduce the re-transmission latency of the HARQ, whose latency reduction is even less than the tow-way handshake latency eliminated by the burst-based forwarding. Another example is the dedicated BR that intends

to reduce just one round-trip message delay during the BR process through RS, whose latency reduction is equivalent to the tow-way handshake latency eliminated by the BB forwarding for the two hops case. There are many other features in 16j that were designed to reduce just one round-trip message latency.

In summary, we believe that the BB forwarding is a viable optional feature to optimize the data forwarding in 16j for the transparent RS, whose cost/benefit justification is better or equal to many existing optional features in 16j/D5.

In order to facilitate the incorporation of this proposal into IEEE 802.16j standard, specific changes to the draft standard P802.16j/D5 are listed below.

Spec changes

6.3.3.8.2 Transmission using station CID

[Change the following text in line 3 of page 86 as indicated]

There are two schemes for RS to forward received data without using tunnels. The first one is called CID based forwarding and the other is burst based forwarding. In CID based forwarding scheme, the forwarding of MAC PDUs by each RS is performed based on the CID contained in the MAC PDU header. When forwarding using this scheme, the inclusion of CID in the DL-MAP is optional.

When operating in centralized scheduling mode, if the RS DL fixed forwarding delay TLV or the RS UL fixed forwarding delay TLV is included in RCD message, the RS shall forward each MAC PDU at the frame determined by the receiving frame of the MAC PDU plus the fixed delay specified in the TLV. If the RS DL fixed forwarding delay TLV is not included in RCD, the MR-BS shall include DL Allocation Reference IEs in RS_Relay-MAP and RS_Access-MAP messages.

For transparent RSs, the MR-BS shall send the RS Member List Update (see 6.3.2.3.83) to update the CID list of the transparent RSs for CID based forwarding in both DL and UL. If the MR-BS does not receive MR Generic-ACK message from all RSs designated in the RS Member List Update message after the Frame Action Number, the burst based forwarding scheme may be used to replace its original forwarding rules to forward the data to the MS.

In burst-based forwarding scheme, the forwarding of the bursts is performed by encoding the forwarding rules in MAP IEs. In DL, the data burst that are scheduled to be relayed by the RS is described by the DL-MAP IE with the RS primary management CID. The MR-BS shall send the forwarding rules to the RS via R-MAP including the DL Burst Transmit IE (see 8.4.5.10.1.11). The RS shall forward the data in allocations defined by those DL MAP IEs indicated by the DL Burst Transmit IE. In UL, the data burst that are scheduled to be relayed by the RS(s) is described by the UL-MAP IE with UL Burst Receive IE (see 8.4.5.4.29). The RS shall receive the data in allocations defined by those UL MAP IEs following the UL Burst Receive IE and forward to its superordinate station in the next available allocation, defined by the UL-MAP IE, in UL relay zone.

[Modified Table 496a in Line 37, Page 228 as follows]

R-link specific IE	variable	For non-transparent mode RSs only
	e	

[Modified Table 496c in Line 47, Page 229 as follows]

0D	DL Burst Transmit IE
0E 0E-1F	Reserved

[Add the following subclause 8.4.5.10.1.12 in line 51 of page 244 as indicated]

8.4.5.10.1.12 DL Burst Transmit IE

An MR-BS may send R-MAP including [DL Burst Transmit IE](#) to the subordinate RSs to indicate the bursts to be forwarded by N_s and N_r in the IE. The L_k included in [DL Burst Transmit IE](#) refers to number of bytes in the burst which is forwarded by the RS.

Table 496o—DL Burst Transmit IE format

<u>Syntax</u>	<u>Size</u>	<u>Notes</u>
DL Burst Transmit IE {	=	=
<u>Type</u>	4 bits	DL Burst Transmit IE = 0x0D
<u>Length</u>	8 bits	
<u>RCID IE()</u>	variable	Reduced RS basic CID
<u>N_s</u>	8 bits	The first DL-MAP IE number in DL-MAP the transparent RS shall forward
<u>N_r</u>	8 bits	Indicate the number of MAP IEs in DL-MAP the transparent RS shall forward
for(k=1;k<=N_r;k++){	=	=
<u>L_k</u>	16 bits	Burst length in bytes to be forwarded
}		
<u>Padding</u>	variable	Shall be set to 0
}		

11.7.8.10 MR-BS and RS MAC feature support

[Change the following text in line 18 of page 264 as indicated]

Type	Length	Value	Scope
49	23	Bit #16: Burst-based forwarding support Bit #17-#23: Reserved	REG-REQ REG-RSP

11.25 RS_Config-CMD message TLV encoding

Insert new subclause 11.25.1:

11.25.1 Generic configuration

[Change the following text in line 4 of page 292 as indicated]

Name	Type	Length	Value	Scope
RS operational mode	1	2	Bit #11: Burst-based forwarding Bit #1112-15: Reserved	RS_Config_CMD