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Abstract	Transmission of synchronous ACK/NAK in multi-hop DL HARQ process
Purpose	Review and adopt
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Transmission of synchronous ACK/NAK in multi-hop DL HARQ

Introduction

During the IEEE 802.16 #49 (May 2007) meeting, the concept of HARQ process for multi-hop relay has been introduced in [2]. In section 8.4.5.4.25, transmission of ACK/NAK is described. However, the transmission of synchronous ACK/NAK by RS is not clear.

Transmission of ACK/NAK in multi-hop DL HARQ

Transmission of ACK/NAK in case of DL HARQ for non-transparent RS is defined in section 8.4.5.4.25 of the baseline document. The corresponding text is shown below for discussion.

"When RS receives HARQ DL sub-burst for relaying to MS at frame i, it shall transmit the encoded ACK/ NAK signal through ACK Channel in the ACKCH region at frame (i + n) where n is calculated at each RS according to the following equation.

$$n = H*p + (H+1)*j$$

H is defined by "number of hops RS is away from the MS".
p is defined by the "static delay at the RS in number of frames"
j is defined by the "HARQ_ACK_Delay for DL Burst" field in the DCD messages. "

In order for RS to send the ACK/NAK, it requires to know the value of 'H' and 'p'. Though 'p' can be defined as static delay and transmit in the DCD similar to "HARQ_ACK_Delay for DL burst" but to get the value of 'H' for each HARQ sub-burst and corrsoponding mapping of ACK/NAK signals may be complex. MR-BS is aware of the SS attachment and knows the network topology, therefore, BS can send the value of 'H to all the RS in the path or RS get this information during path management. We think that this scheme is complex and bandwidth inefficient.

Proposed scheme for transmission of ACK/NAK from RS for DL HARQ:
BS when transmit HARQ sub-burst using RS HARQ DL MAP IE, it shall combine the bursts transmitted on different hops into different HARQ region. i.e. all the burst transmitted on 2nd hop (tier) should be sent in one HARQ region and burst transmitted on 3rd hop (tier) should be sent in different HARQ region. Similarly when MR-BS schedules the ACK/NAK channel using HARQ ACKCH region allocation for Relay Data IE, it shall schedule the ACK/NAK for each hop (tier) separately. MR-BS shall indicate the "hop_depth~~id~~" in the both RS HARQ DL MAP IE and HARQ_ACKCH region allocation for Relay ~~burst~~ data IE so that RS can map the HARQ burst and HARQ ACK/NAK accordingly.

Proposed scheme is very simple to implement and does not require RS to calculate or maintain information about how many hops MS is away from itself.

Specification changes

[Insert the following text as a new paragraph at the end of subclause 6.3.17.4.1]
MR-BS shall allocate the bursts destined to MSs which are same number of hops away into one HARQ region using RS HARQ DL MAP IE. ~~MR-BS shall combine the bursts transmitted on different hops into different HARQ region~~.

Similarly when MR-BS transmits the HARQ_ACKCH region allocation for Relay Data IE ~~in the UL MAP~~, it shall schedule the ACK/NAK channels for each hop separately. MR-BS shall indicate the "hop_depth~~id~~" in RS HARQ DL MAP IE as well as in corresponding HARQ_ACKCH region allocation for Relay ~~burst~~data IE so that RS can map the HARQ burst and HARQ ACK/NAK accordingly.

[change the subclause 8.4.5.4.25 as indicated]

Table 484a—HARQ ACKCH region allocation for ~~UL~~ Relay Data IE

Syntax	Size	Notes
HARQ ACKCH_Region_for ~~UL~~ Relay Data IE() {		
Extended-2 UIUC	4 bits	0xYY
Length	8 bits	Length in bytes
Direction	1 bit	0 = IE is related to UL HARQ Data IE 1 = IE is related to DL HARQ Data IE
If (direction == 1) {		
N_hop	4 bits	
for (i = 0; i < N_hop; i++) {		
hop_depth~~id~~	~~4~~3 bits	B0000 and b0001 are invalid. When MR-BS/RS transmits HARQ burst for the n^{th} hop away MSs, it shall set hop_depth~~id~~ = n.
ACKCH_offset	8 bits	ACHCH_offset indicates the starting point in the ACKCH region for sending HARQ ACK/NAK for corresponding hop_depth.
}		
} else {		
Reserved	3 bits	
}		
OFDMA Symbol offset	8 bits	
Subchannel offset	7 bits	
No.OFDMA symbols	~~7~~5 bits	
No.subchannels	~~10~~4 bits	
}		

n = (H - 1) *p + (H+1)*j
H is defined by "number of hops RS is away from the MS" equal to "hop_depthid" transmitted in RS HARQ DL MAP IE and HARQ_ACKCH region allocation for relay burstData IE. It represents number of hops MR-BS/RS is away from the MS.
p is defined by the "static delay at the RS in number of frames" "HARQ_burst_Delay for DL Burst" field in the DCD messages

j is defined by the "HARQ_ACK_Delay for DL Burst" field in the DCD messages. It is applicable to both RS and MS.

If the frame structure allows relaying either HARQ DL sub-burst or encoded ACK/NAK in the same frame, then the above equation will change. If encoded ACK/NAK is relayed in the same frame, then n=H*p+j. Similarly, if RS can relay the HARQ DL Sub-burst signal in the same frame, then n=p+ (H+1)*j.

[Insert table 286xx – "RS HARQ DL MAP IE format on Relay links" after table 286i in subclause 8.4.5.3.21]

Table 286xx – RS HARQ DL MAP IE format on Relay links

Syntax	Size	Notes
RS HARQ DL MAP IE {	-	-
Extended-2 DIUC	4 bits	RS HARQ_DL_MAP_IE() = 0xXX
Length	8 bits	Length in bytes
RCID_Type	2 bits	0b00 = Normal CID 0b01 = RCID11 0b10 = RCID7 0b11 = RCID3
Reserved	2 bits	-
While (data remains) {	-	-
Boosting	3 bits	0b000: normal (not boosted) 0b001: +6dB 0b010: –6dB 0b011: +9dB 0b100: +3dB 0b101: –3dB 0b110: –9dB 0b111: –12dB;
Region_ID use indicator	1 bit	0: not use Region_ID 1: use Region_ID

If (Region_ID use indicator == 0) {		
OFDMA symbol offset	8 bits	Offset from the start symbol of DL subframe
Subchannel offset	7 bits	-
Number of OFDMA symbols	7 bits	-
Number of subchannels	7 bits	-
Reserved	3 bits	-
} else {		
Region_ID	8 bits	Index to the DL region defined in DL region definition TLV in DCD
}	-	-
hop_depth~~id~~	4 bits	B0000 and b0001 are invalid. When MR-BS/RS transmits HARQ burst for the n^{th} hop away MSs, it shall set hop_depth~~id~~ = n. hop_depth~~id~~ represents the value of H defined in subcluase 8.4.5.4.25.
Mode	4 bits	Indicates the mode of this HARQ region 0b0000 = Chase HARQ 0b0001 = Incremental redundancy HARQ for CTC 0b0010 = Incremental redundancy HARQ for Con- volutional Code 0b0011 = MIMO Chase HARQ 0b0100 = MIMO IR HARQ 0b0101 = MIMO IR HARQ for Convolutional Code 0b0110 = MIMO STC HARQ 0b0111-0b1111 Reserved
Sub-burst IE Length	8 bits	Length, in nibbles, to indicate the size of the sub-burst IE in this HARQ mode. The MS may skip DL HARQ sub-burst IE if it does not support the HARQ Mode. However, the MS shall decode NACK Channel field from each DL HARQ sub-burst IE to determine the UL ACK channel it shall use for its DL HARQ burst.

If (Mode == 0b0000) {	-	-
DL HARQ Chase sub-burst IE()	Variable	-
} else if (Mode == 0b0001) {	-	-
DL HARQ IR CTC sub-burst IE()	Variable	-
} else if (Mode == 0b0010) {	-	-
DL HARQ IR CC sub-burst IE() {	Variable	-
} else if (Mode==0b0011) {	-	-
MIMO DL Chase HARQ Sub-Burst IE ()	Variable	-
} else if (Mode==0b0100) {	-	-
MIMO DL IR HARQ Sub-Burst IE ()	Variable	-
} else if (Mode==0b0101) {	-	-
MIMO DL IR HARQ for CC Sub-Burst IE ()	Variable	-
} else if (Mode == 0b0110) {	-	-
MIMO DL STC HARQ Sub-Burst IE ()	Variable	-
}	-	-
}	-	-
Padding	Variable	Padding to byte; shall be set to 0
}	-	-

[Insert the following TLV at the end of Table 358 of subclause 11.4.1]

HARQ burst delay for the DL burst	TBA	1	0 – 0 frame offset 1 – 1 frame offset 2 – 2 frame offset 3 – 3 frame offset	OFDMA

[*Insert the following row in table 290c of subcluase 8.4.5.4.4.2*]

0xXX	HARQ ACKCH Region for Relay Data IE

[*Insert the following row in table 277c of subcluase 8.4.5.3.2.2*]

0xXX	RS HARQ DL MAP IE

[Note: Following changes provide fix to the issue of compact_DL-MAP Monitor IE/compact_UL-MAP Monitor IE/HARQ Control IE]

[remove sub-clause 6.3.2.3.43.4 (HARQ control IE – merged with MR_DL/UL-MAP Monitor IE)]
[move sub-clause 6.3.2.3.43.6.10 to 8.4.5.3.xx and change the sub-clause ~~Compact~~ MR_DL-MAP Monitor IE as follows]

8.4.5.3.xx ~~Compact~~ MR_DL-MAP Monitor IE
In RS-assisted relay case, MR-BS sends the ~~Compact~~ MR_DL-MAP MONITOR IE to RS. The ~~Compact~~ MR_DL-MAP MONITOR IE provides the list of CIDs of the MS whose transmissions need to be monitored in the DL part of the current frame and relayed in the next frame to the MS.

Table ~~149a~~xxx—~~Compact~~ MR_DL-MAP MONITOR IE format

Syntax	Size	Notes
~~Compact~~ MR_DL-MAP Monitor IE() {		
~~DL-MAP Type =7~~	~~3 bits~~	
~~DL-MAP subtype~~	~~5 bits~~	
Extended 2 DIUC	4 bits	TBA
Length	8 bits	Length in bytes
N_CID_encoded	4 bits	Number of CIDs for which RS uses the encoded ACK/NAK
N_CID_direct	4 bits	Number of CIDs for which RS uses the direct feedback
For(i=0; i<N_CID_encoded + N_CID_direct; i++){		
RCID_IE(i)	~~16~~ Variable	The CIDs of the connections that RS shall monitor in the current frame
}		
RSH	1 bit	0=RS-assisted HARQ is enabled 1=RS-assisted HARQ is disabled
Reserved	3 bits	
}		

[move sub-clause 6.3.2.3.43.6.11 to 8.4.5.4.xx and change the name of the sub-clause ~~Compact~~ MR_UL-MAP Monitor IE as follows]
8.4.5.4.xx ~~Compact~~ MR_UL-MAP Monitor IE
The ~~Compact~~ MR_UL-MAP MONITOR IE provides the list of CIDs of the MS whose transmissions need to be monitored in the UL part of the current frame and relayed in the next frame to the MS.

Table ~~149b~~xxx—~~Compact~~ MR_UL-MAP MONITOR IE format

Syntax	Size	Notes
~~Compact~~ MR_UL-MAP Monitor IE(){		
~~UL-MAP Type = 7~~	~~3 bits~~	
~~UL-MAP subtype~~	~~5 bits~~	
Extended 2 UIUC	4 bits	TBA
Length	8 bits	Length in bytes

Number of CIDs	4 bits	Number of CIDs in the IE
For(i=0; i<Number of CIDs; i++){		
RCID_IE(i)	~~16 bits~~ Variable	The CIDs of the connections that RS shall monitor in the current frame
}		
RSH	1 bit	0=RS-assisted HARQ is enabled 1=RS-assisted HARQ is disabled
Reserved	3 bits	
}		

[replace Compact DL-MAP Monitor IE to MR_DL-MAP Monitor IE in subclause 6.3.17.4.2.2]
[replace Compact UL-MAP Monitor IE to MR_UL-MAP Monitor IE in subclause 6.3.17.4.3]

[*Insert the following row in table 277c of subcluase 8.4.5.3.2.2*]

0xXX	MR_DL-MAP Monitor IE

[*Insert the following row in table 290c of subcluase 8.4.5.4.4.2*]

0xXX	MR_UL-MAP Monitor IE