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Title	**Distributed ARQ**
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Re:	IEEE 802.16-08/007: "IEEE 802.16 Working Group Letter Ballot Recirc #28b: Announcement"
Abstract	The distributed ARQ operation is addressed.
Purpose	To incorporate the proposed text into the P802.16j/D3
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Distributed ARQ

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Nortel

1. Instruction

For an access RS operating in distributed scheduling mode and distributed security mode, the ARQ may be implemented in a distributed mode where the ARQ of a transport connection of an MS is implemented between the access RS and the MS. In this contribution, the distributed ARQ mode is proposed.

Due to the fact that the channel quality of access links is usually less stable than that of R-links, the distributed ARQ would bring benefits such as:

- Lower ARQ ACK/NAK related overhead since the ACK/NAK information related to access links doesn't need to be relayed over R-link
- Reduced delay since faster reaction is enabled to deal with ARQ directly between MS and its access RS
- Significant resource saving over R-link for DL since ARQ retransmission could start from the access RS, instead of MR-BS, since the requested data has been successfully received by the access RS over R-links

2. Proposal

Distributed ARQ mode is one optional mode of ARQ where the ARQ is performed between an access RS and an MS for an ARQ enabled connection. This mode is applicable to the access RS with distributed security and distributed scheduling capability. The support of the distributed ARQ mode shall be negotiated during RS network entry. An access RS supporting the distributed ARQ shall perform the ARQ functionality as per 6.3.4.

When an MS performs the handover from an access RS which operates in distributed ARQ mode with the MS, the context information such as the ARQ state machine variables shall be transferred from the access RS to its MR-BS and the MR-BS may need to relay these parameters to the target access RS if the target station is an access RS implementing the distributed ARQ.

3. Proposed text change

[change 6.3.4 as following]

~~In MR systems, ARQ operation is only performed between an MR-BS and an MS.~~
In MR systems, ARQ can be implemented in two modes. In end-to-end mode, ARQ operation is only performed between an MR-BS and an MS. In distributed mode, ARQ operation is performed between an access RS and an MS. The distributed ARQ mode is optional and is performed by an access RS in distributed scheduling mode and distributed security mode. The support of the distributed ARQ shall be negotiated during RS network entry. An access RS supporting the distributed ARQ shall perform the ARQ functionality as per 6.3.4.

[Add section 6.3.22.11.3 as following]

6.3.22.11.3 Behaviors of MR-BS and access RS operating in distributed ARQ mode

In addition to the behaviors of an MR-BS and an RS during MS handover as defined in 6.3.22.11.1 and 6.3.22.11.2, the serving

access RS operating on distributed ARQ mode shall provide information to its MR-BS to enable the continuity of data flow and initialization of ARQ state machine in the target station. The information may need to be transferred to the target station, an MR-BS or another access relay station which will perform ARQ with the MS.

After an access RS receives MOB_MSHO-REQ/MOB_BSHO-REQ message, the RS shall manage the resource allocation to minimize the value ARQ_TX_NEXT_BSN – ARQ_TX_WINDOW_START and the value ARQ_RX_HIGHEST_BSN – ARQ_RX_WINDOW_START for each of ARQ enabled connections of the MS.

The serving access RS shall indicate the following information to its MR-BS through MS_ARQ_INFO-IND message after it receives the MOB_HI-IND message from an MS with the HO_IND_type field setting as 0b00 :

For DL, for each of ARQ enabled transport connections of an MS,
CID to indicate the ID of an DL ARQ enabled connection of the MS
ARQ_TX_BSN to indicate ARQ_TX_WINDOW_START of ARQ state machine of the connection in the serving access RS.
TSN and Fragment Offset to indicate a pointer in data flow of the tunnel which carried the data of the service flow to the access RS if there are data of this service flow which have been received by the access RS through a tunnel from MR-BS but have not been successfully transmitted to the MS. The BSN of the first block starting form this pointer of the service flow is corresponding to the ARQ_TX_BSN

For UL, for each of ARQ enabled transport connections of an MS,
CID to indicate the ID of an UL ARQ enabled connection of the MS
ARQ_RX_BSN to indicate ARQ_RX_HIGHEST_BSN of ARQ state machine of the connection in the serving RS

The MR-BS shall use MR_Generic-ACK message to acknowledge the reception of the MS_ARQ_INFO-IND message.

The MR-BS of the current serving station shall transfer the information to the target MR-BS or the MR-BS of the target access station through the backhaul in the same way as MS handover with a serving access station operating on end-to-end ARQ mode.

If the target station is an access station operating on the distributed ARQ mode, the MR-BS of the target access station shall transfer ARQ related information to the target station through MS_ARQ_INFO-IND message. This message shall include the following information:
For DL, for each of ARQ enabled transport connections of an MS,
CID to indicate the ID of an DL ARQ enabled connection of the MS
ARQ_TX_BSN to indicate the BSN that the target station shall use when it starts to forward the traffic of the service flow to the MS.
TSN and Fragment Offset to indicate a Starting Pointer (SP) in the data flow of the tunnel carrying the service flow from the MR-BS.

For UL, for each of ARQ enabled transport connections of an MS,
CID to indicate the ID of an UL ARQ enabled connection of the MS
ARQ_RX_BSN to indicate the BSN of the expected first block by the target station after the handover of the MS

The target access RS shall set its ARQ state machine for each of DL ARQ enabled connection of the MS by setting ARQ_TX_NEXT_BSN as ARQ_TX_BSN and set ARQ_TX_WINDOW_START = ARQ_TX_NEXT_BSN. The target station shall create first DL ARQ block of this connection of the MS by taking the data bytes starting from the SP and set corresponding BSN as ARQ_TX_NEXT_BSN. The target access station shall set its ARQ state machine for each of UL connections of the MS by setting ARQ_RX_HIGHEST_BSN as indicated ARQ_RX_BSN and set ARQ_RX_WINDOW_START = ARQ_RX_HIGHEST_BSN.

The target access RS shall response the MS_ARQ_INFO-IND message by using MR_Generic_ACK message.

[modify the table in section 11.7.8.11 as indicated]

Type	Length	Value	Scope
50	1	Bit #0: centralized scheduling mode supported Bit #1: distributed scheduling mode supported	REG-REQ

		Bit #2: centralized ARQ supported Bit #3: distributed ARQ supported Bits #~~2~~4-7: reserved	

[Modify the last row in Table 38 as follows]

Type	Message name	Message description	Connection
~~99-255~~ 99	MS_ARQ_INFO-IND	MS ARQ related information indication sent by access RS or MR-BS	Basic
100-255		Reserved	

[Add new sections 6.3.2.392]

6.3.2.3.92 MS_ARQ_INFO Indication message

This message is transmitted by an access RS to its MR-BS and used to transfer ARQ state machine parameters of an ARQ enabled connection of an MS performing handover. This message is also transmitted by an MR-BS to the target access RS of an MS to transfer the ARQ state machine parameters.

Table XXX. MS_ARQ_INFO-IND message format.

Syntax	Size	Notes
MS_ARQ_INFO-IND format {		
Management message type =99	8 bits	
Transection ID	16 bits	
Num_DL_Connections	8 bits	Number of DL connections whose ARQ state machine parameters are included.
For (i =0 , i <= Num_DL_Connections; i++) {		
CID	16 bits	
ARQ_TX_BSN	11 bits	If sent by a current access RS, This value = ARQ_TX_WINDOW_START of the ARQ state machine of the connection If sent by an MR-BS, the target station shall set its ARQ_TX_NEXT_BSN =ARQ_TX_BSN for ARQ state machine for the connection
Starting_pointer_of_tunnel_flow flag	1 bit	If set to 1, the TSN and Fragment offset fields are included
If (Starting_pointer_of_tunnel_flow flag == 1) {		
TSN	7 bits	The DL TDU SN corresponding to the BSN indicated in ARQ_TX_BSN field
Fragment offset}	12 bits	The fragment offset corresponding to the BSN indicated in ARQ_TX_BSN field
}		
Num_UL_Connections	8 bits	Number of UL connections whose ARQ state machine parameters are included.
For (i =0 , i <= Num_UL_Connections; i++) {		
CID	16 bits	
ARQ_RX_BSN}	11 bits	If sent by a current serving access RS: This value = ARQ_RX_HIGHEST_BSN of the ARQ state machine of the connection.

		If sent by an MR-BS: This value is used by a target access station to set its ARQ_RX_HIGHEST_BSN for its ARQ state machine of the connection.
}		

Num_DL_Connections

Number of DL connections whose ARQ state machine parameters are included.

ARQ_TX_BSN

If sent by a current access RS,

This value = ARQ_TX_WINDOW_START of the ARQ state machine of the connection

If sent by an MR-BS,

the target station shall set its ARQ_TX_NEXT_BSN =ARQ_TX_BSN for ARQ state machine for the connection

TSN and Fragment offset

The DL TDU SN and fragment offset corresponding to the BSN indicated in ARQ_TX_BSN field if there are any data of this service flow that have been received by the access RS but have not been successfully transmitted to the MS.

Num_UL_Connections

Number of UL connections whose ARQ state machine parameters are included.

ARQ_RX_BSN

If sent by a current serving access RS:

This value = ARQ_RX_HIGHEST_BSN of the ARQ state machine of the connection.

If sent by an MR-BS:

This value is used by a target access station to set its ARQ_RX_HIGHEST_BSN for its ARQ state machine of the connection.

This message is acknowledged by an MR-BS or an access RS using MR_Generic-ACK message.