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Title	Efficient CID to path binding/unbinding process	
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Re:	IEEE 802.16-08/007: "IEEE 802.16 Working Group Letter Ballot Recirc #28b: Announcement"	
Abstract	This contribution describes a mechanism to perform CID to path binding/unbinding efficiently	
Purpose	Text proposal for 802.16j Draft Document	
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Efficient CID to path binding/unbinding process

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Introduction

In current design, the DSA-REQ/RSP/ACK transaction is employed to establish a new connection between an MS and an MR-BS. After a connection is established, the MR-BS has to initiate another DSA-REQ/RSP/ACK transaction to perform the CID to path binding to all RSs. These two DSA-REQ/RSP/ACK transactions can be merged into a single DSA-REQ/RSP/ACK transaction to save bandwidth and delay. The merged DSA-REQ/RSP/ACK transaction is described as follows.

A service addition attempt may be initiated by an MR-BS or an MS. The operations when an MR-BS attempts to establish a connection with an MS are described below.

- When an MR-BS attempts to establish a connection with an MS, the MR-BS shall send a DSA-REQ carrying the assigned CID, the Path Addition TLV (if path establishment is required) and the Path CID Binding Update TLV along the path to the MS using the subordinate RS's primary CID. If security is required, the MR-BS adds the HMAC/CMAC with PN type = 0b00 and the HMAC/CMAC with PN type = 0b01 to the DSA-REQ.
- On receiving the DSA-REQ, the RS first verifies the correctness of the DSA-REQ. If true, the RS binds the assigned CID with the path and then forwards the DSA-REQ to the subordinate station according to the path information and starts a timer T8. If the RS is the last station on the path, it removes the Path Addition TLV, the Path CID Binding Update TLV and the HMAC/CMAC with PN type = 0b01 (if present), recalculates the MPDU header and then forwards the DSA-REQ to the MS.
- When an MS receives a DSA-REQ, it sends the MR-BS a DSA-RSP. The RSs simply forward the DSA-RSP to the MR-BS.
- On receiving the DSA-RSP generated by the MS, the MR-BS replies with a DSA-ACK containing the Path CID Binding Update TLV. If security is required, the MR-BS shall add the HMAC/CMAC with PN type = 0b00 and the HMAC/CMAC with PN type = 0b01.
- On receiving the DSA-ACK, the RS first verifies the correctness of the DSA-ACK. If true, the RS stops the timer T8 and then forwards the DSA-ACK to the subordinate station. If the RS is the last station on the path, it removes the HMAC/CMAC with PN type = 0b01 (if present) and then forwards the DSA-ACK to the MS.
- On expiration of T8, the RS shall remove the associated CID to path binding.

The operations when an MS attempts to establish a connection with an MR-BS are described below.

- When an MS attempts to establish a connection with an MR-BS, the MS shall send a DSA-REQ to the MR-BS. On receiving the DSA-REQ, the MR-BS sends the MS a DSA-RSP containing the assigned CID and the Path CID Binding Update TLV. If security is required, the MR-BS adds the HMAC/CMAC with PN type = 0b00 and the HMAC/CMAC with PN type = 0b01 to the DSA-RSP.
- On receiving the DSA-RSP, the RS first verifies the correctness of the DSA-RSP. If true, the RS binds

the assigned CID with the path and then forwards the DSA-RSP to the subordinate station and starts a timer T8. If the RS is the last station on the path, it removes the Path Addition TLV, the Path CID Binding Update TLV and the HMAC/CMAC with PN type = 0b01 (if present), and then forwards the DSA-RSP to the MS.

- When an MS receives a DSA-RSP, it sends the MR-BS a DSA-ACK. The RSs simply forward the DSA-ACK to the MR-BS.
- On receiving the DSA-ACK generated by the MS, the MR-BS sends a DSA-ACK to the RSs on the path. On receiving the DSA-ACK, the RS stops the timer T8 and then forwards the DSA-ACK to the subordinate station if exist.
- On expiration of T8, the RS shall remove the associated CID to path binding.

Similarly, service deletion and the path unbinding operations can be completed by single DSD-REQ/RSP/ACK transaction.

In order to facilitate the incorporation of this proposal into IEEE 802.16j standard, specific changes to the draft standard P802.16j/D3 are listed below.

Spec Changes

[Insert new subclausue 6.3.27.2.2.1:]

6.3.27.2.2.1 Merging CID to path binding/unbinding with service addition/deletion

The MR-BS may merge CID to path binding/unbinding with service addition/deletion operations. When an MR-BS initiates a DSA/DSD-REQ/RSP/ACK transaction, the following procedures shall be used.

- The MR-BS generates the DSA/DSD-REQ to be delivered to the MS and then adds Path CID Binding Update TLV to the DSA/DSD-REQ. If path establishment is required, a Path Additional TLV shall be added to the DSA-REQ. If security is required, the MR-BS shall add the HMAC/CMAC with PN type = 0b00 and the HMAC/CMAC with PN type = 0b01 to the DSA/DSD-REQ. Upon receiving the DSA/DSD-REQ containing binding commands, the RS performs the operation as requested in the message, starts a timer T8, and then sends the message to its subordinate RS if exist. If an RS fails to process the request, it sends a DSA/DSD-RSP directly to MR-BS with the associated confirmation code.
- When the access RS receives a DSA/DSD-REQ containing binding commands, the access RS performs the operation as requested in the message, and then removes the Path Addition TLV (if present), the Path CID Binding Update TLV and the HMAC/CMAC with PN type = 0b01 (if present), recalculate the MPDU header, and then forwards the DSA/DSD-REQ to the MS.
- When the MR-BS receives a DSA/DSD-RSP, it generates the DSA/DSD-ACK to be delivered to the MS and, if security is required, adds the HMAC/CMAC with PN type = 0b00 and the HMAC/CMAC with PN type = 0b01. Upon receiving the DSA/DSD-ACK, the RS stops timer T8 and then forwards the DSA/DSD-ACK to the subordinate station if exist.

- When the access RS receives a DSA/DSD-ACK, it stops timer T8, removes the HMAC/CMAC with PN type = 0b01 (if present), recalculate the MPDU header, and then forwards the DSA/DSD-ACK to the MS.
- On expiration of T8, the RS shall remove the associated CID to path binding.

When an MS initiates a DSA/DSD-REQ/RSP/ACK transaction, the following procedures shall be used.

- When the MR-BS receives a DSA/DSD-REQ, it generates the DSA/DSD-RSP to be delivered to the MS. The MR-BS shall add the Path CID Binding Update TLV to the DSA/DSD-RSP. If security is required, the MR-BS shall add the HMAC/CMAC with PN type = 0b00 and the HMAC/CMAC with PN type = 0b01 to the DSA/DSD-RSP. Upon receiving the DSA/DSD-REQ containing binding commands, the RS performs the operation as requested in the message, starts a timer T8, and then sends the message to its subordinate RS if exist. If an RS fails to process the request, it sends a DSA/DSD-RSP directly to MR-BS with the associated confirmation code.
- When the access RS receives a DSA/DSD-RSP containing binding commands, the access RS performs the operation as requested in the message, and then removes the Path CID Binding Update TLV and the HMAC/CMAC with PN type = 0b01 (if present), recalculate the MPDU header, and then forwards the DSA/DSD-RSP to the MS.
- When the MR-BS receives a DSA/DSD-ACK message, it shall send a DSA/DSD-ACK message to all the RSs on the path. When an RS receives the DSA/DSD-ACK, it shall stop timer T8 and then forwards the DSA/DSD-ACK to the subordinate station if exist.
- On expiration of T8, the RS shall remove the associated CID to path binding.

[Insert the following table in Page232, Line 40]

Table xxx—HMAC tuple value field

<u>Field</u>	<u>Length (bit)</u>	<u>Notes</u>
<u>Reserved</u>	<u>2 bits</u>	<u>Set to 00</u>
<u>PN type</u>	<u>2 bits</u>	<u>0b00 – HMAC PN *</u> <u>0b01 – Security zone PN</u> <u>0b10 – Relay Link PN</u> <u>0b11 – reserved</u> <u>When the tuple is sent to or by an SS, these bits shall be set to 0b00</u>
<u>HMAC Key Sequence Number</u>	<u>4 bits</u>	
<u>HMAC-Digest</u>	<u>160 bits</u>	<u>HMAC with SHA-1</u>

[Modify subclause 11.1.13.2 as follows]

11.1.13.2 Path Addition TLV

Name	Type	Length	Value	Scope
Path Addition	132	Variable	Path ID (unsigned 16-bit) Ordered list of RSs (variable)	DSA-REQ, DSA-RSP , RNG-RSP

Ordered List of RSs

The ordered list of RSs' primary management CIDs along the path in the downstream direction. The upstream direction list can be obtained by reverse this ordered list.

[Modify subclause 11.1.13.3 as follows]

11.1.13.3 Path CID Binding Update TLV

Name	Type	Length	Value	Scope
Path CID Binding Update	131	Variable	Path ID (unsigned 16-bit) List of CIDs (variable)	DSA-REQ, DSA-RSP , DSD-REQ, DSD-RSP , RNG-RSP

List of CIDs

A list of CIDs involved in the binding update operation.