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Re:	802.16e/D5a
Abstract	This document contains new Group TEK management for Multicast and Broadcast Service
Purpose	Adopt
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The enhancement of PKM message for replay attack

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1. Problem Statements

There is not description how to prevent replay attack of PKM messages in BS and MSS in IEEE 802.16e/D5a. An attacker can intercept the PKM message and save it when the MSS sends the PKM request message to the BS or the BS sends the PKM response message to the MSS. If the attacker replays the reserved message to the BS or the MSS, it will bring the consumption of resource in the BS and MSS. So we add a 4-byte packer counter in PKM message to protect against replay attacks of PKM message in this contribution.

[add the following as show]

2. Proposed Text adds

6.3.2.3.9 Privacy key management (PKM) messages (PKM-REQ/PKM-RSP)

PKM employs two MAC message types: PKM Request (PKM-REQ) and PKM Response (PKM-RSP), as described in Table Table 23—.

Table 23—PKM MAC messages

Type Value	Message name	Message description
9	PKM-REQ	Privacy Key Management Request [SS -> BS]
10	PKM-RSP	Privacy Key Management Response [BS -> SS]

These MAC management message types distinguish between PKM requests (SS–to–BS) and PKM responses (BS–to–SS). Each message encapsulates one PKM message in the Management Message Payload.

PKM protocol messages transmitted from the SS to the BS shall use the form shown in Table Table 24—. They are transmitted on the SSs Primary Management Connection.

Table 24—PKM request (PKM-REQ) message format

Syntax	Size	Notes
PKM-REQ_Message_Format() {		
Management Message Type = 9	8 bits	
Code	8 bits	
PKM Packet Counter	32 bits	
PKM Identifier	8 bits	
TLV Encoded Attributes	*variable*	TLV specific
}		

[Insert the following text directly below Table 24 - PKM request (PKM-REQ) message format table as shown]

PKM protocol messages transmitted from the BS to the SS shall use the form shown in Table 25. They are transmitted on the SSs Primary Management Connection. When the BS sends PKM-RSP message in key push mode for the multicast service or the broadcast service, it may be carried on the Broadcast connection.

Table 25—PKM response (PKM-RSP) message format

Syntax	Size	Notes
PKM-RSP_Message_Format() {		
Management Message Type = 10	8 bits	
Code	8 bits	
PKM Packet Counter	32 bits	
PKM Identifier	8 bits	
TLV Encoded Attributes	*variable*	TLV specific
}		

[Change the text between Table 25 and Table 26 as indicated:]

The parameters shall be set as follows:
Code
The Code is one byte and identifies the type of PKM packet. When a packet is received with an invalid Code, it shall be silently discarded. The code values are defined in Table 26.

PKM Packet Counter
The field of PKM Packet Counter is 4 bytes. The PKM Packet Counter is different between uplink and downlink. There is a pair of PKM Packet Counter in the BS and each its client MSS. An SS can use the downlink PKM Packet Counter to protect against replay attack of downlink PKM message. A BS can use the uplink PKM Packet Counter to protect against replay attack of uplink PKM message for each MSS.

The SS shall increment the PKM Packet Counter field whenever it issues a new PKM-REQ message. The BS shall increment the PKM Packet Counter field whenever it issues a new PKM-RSP message. For retransmissions, the PKM Packet Counter field shall remain unchanged.

The SS shall record the downlink counter field of its latest, receiving PKM-RSP message. The BS shall record the uplink counter field of its latest, receiving PKM-REQ message for each MSS. If the SS receives a PKM-RSP message with a packet counter number that is not greater than the downlink counter number of previous latest PKM message it will drop that message. If the BS receives a PKM-REQ message with a packet counter number that is not greater than the uplink counter number of previous latest PKM message it will drop that message.

PKM Identifier
The Identifier field is one byte. An SS uses the identifier to match a BS response to the SS's requests.

The SS shall increment (modulo 256) the Identifier field whenever it issues a new PKM message. A "new" message is an Authorization Request or Key Request that is not a retransmission being sent in response to a

Timeout event. For retransmissions, the Identifier field shall remain unchanged.

The Identifier field in Authentication Information messages, which are informative and do not effect any response messaging, shall be set to zero. The Identifier field in a BS's PKM-RSP message shall match the Identifier field of the PKMREQ message the BS is responding to. The Identifier field in TEK Invalid messages, which are not sent in response to PKMREQs, shall be set to zero. The Identifier field in unsolicited Authorization Invalid messages shall be set to zero. The Identifier field in Key Update Command messages, which are used to distribute the updated GTEK and traffic keying material, shall be set to zero.

On reception of a PKM-RSP message, the SS associates the message with a particular state machine (the Authorization state machine in the case of Authorization Replies, Authorization Rejects, and Authorization Invalids; a particular TEK state machine in the case of Key Replies, Key Rejects, TEK Invalids, Key Update Commands).
An SS shall keep track of the identifier of its latest, pending Authorization Request. The SS shall discard Authorization Reply and Authorization Reject messages with Identifier fields not matching that of the pending Authorization Request.

An SS shall keep track of the identifiers of its latest, pending Key Request for each SA. The SS shall discard Key Reply and Key Reject messages with Identifier fields not matching those of the pending Key Request messages.

Attributes
PKM attributes carry the specific authentication, authorization, and key management data exchanged between client and server. Each PKM packet type has its own set of required and optional attributes. Unless explicitly stated, there are no requirements on the ordering of attributes within a PKM message. The end of the list of attributes is indicated by the LEN field of the MAC PDU header.