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Title	A method to implement Inter-system communication over air
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Re:	IEEE 802.16 Working Group Letter Ballot #24a, on P802.16h/D2
Abstract	There are many messages in current P802.16h/D2 which require SS send message to its neighbor BS. But BS may not correctly receive an uplink burst without performing ranging procedure. So we propose BS schedule Inter-system communication time slot for SS. Before send any message to neighbor BS, SS should perform ranging procedure using scheduled Inter-system communication time slot.
Purpose	To solve the problem that neighbor BS can't receive a burst from foreign SS without performing ranging procedure.
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A Method to Implement the Inter-system Communication over Air

Shulan Feng
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Introduction

In P802.16h/D2[1], there are many messages which need SS to send messages to its neighbor BS. Contribution C80216h-07/006[2] has proposed a procedure to implement Inter-system communication. But it is difficult for BS to receive the foreign uplink burst correctly without performing uplink ranging. And link quality between relay SS and neighbor BS is not very good since relay SSs are always at the edge of neighbor BS coverage.

On the other side, because relay SSs always in the interference area of two BS, so they will communicate with their serving BS during their master sub-frame and will be idle during their serving BS's slave sub-frame.

So if one of SS is selected by its serving BS as relay to transmit message to its neighbor BS, it may access its neighbor during its neighbor BS's master sub-frame (that sub-frame is its serving BS's slave sub-frame at the same time) and communicate with its neighbor BS.

Since relay SS is idle in its serving BS's slave sub-frame, this scheme will not influence the normal traffic transmission between relay SS and its serving BS's.

Since serving BS and neighbor BS are working in the same channel, so it is easy for relay SS to communicate with them in time division. Relay SS can communicate with its neighbor BS during the master sub-frame of neighbor just like other neighbor BS's serving SSs except a additional IE to show the connection attribute between relay SS and neighbor SS. Figure below gives an example.

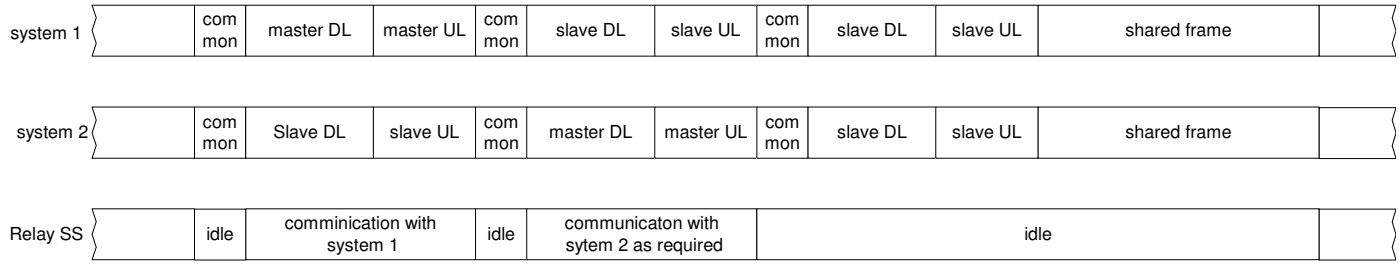

Figure 1

Procedure of Inter-system communication over air

When some messages need to send to its neighbor BS over air, serving BS may select one or more SSs as relay between two BSs. The relay SSs are always the SSs which in the overlapped area of two BSs, that is, the interference victim SSs of caused by interference neighbor BS. These SSs communicate with serving BS during the serving BS's master sub-frame and are idle during the serving BS's slave sub-frame.

System may select the relay SS according to the RSSI of neighbor BS detected by the interference victim SSs. The SSs with the higher neighbor BS RSSI will be better.

After determine the relay SS, serving BS may request relay SS to access to neighbor BS via Access-NBS-REQ message. Upon receiving the access neighbor BS request, relay SS will try to access neighbor BS during the master sub-frame of neighbor BS. It will try to establish synchronization with neighbor BS, obtain transmission

parameter, perform ranging, negotiate basic capabilities, be authorized and exchange key, perform registration. These procedures are performed during the neighbor BS's master sub-frame and just like a normal SS network entry procedure described in section 6.3.9. Neighbor BS will allocate Basic CID, primary management CID and secondary management CID to relay SS. But in the RNG-REQ message, relay SS should tell its neighbor BS it communicates with neighbor via parameter "SS attribute" just for Inter-system communication and the BSID of its serving BS via parameter "serving BSID".

If relay SS fails to access neighbor BS, it shall responses with failing access to neighbor to BS its serving BS via Access-NBS-RSP message. Serving BS will select another SS as relay SS or terminate Inter-system communication procedure over air.

If relay SS accesses neighbor BS successfully, it shall response with success to neighbor BS to its serving BS via Access-NBS-RSP message. Serving BS and its neighbor BS can communicate with the help of relay SS. Relay message request may be initiated by serving BS or neighbor BS. Relay SS will communicate with serving BS during serving BS's master sub-frame and communicate with neighbor BS during neighbor BS's master sub-frame. Relay SS shall maintained corresponding contexts for both serving BS and neighbor BS.

If the relay massage is initiated by serving BS, serving BS will send relay request message to relay SS. After receiving relay request message from serving BS, relay SS may send a response signal to its serving BS. Relay SS should ask its neighbor BS for uplink transmission opportunity and transmit messages to neighbor BS during the allocated uplink transmission resource. After receiving relay request message from relay SS, neighbor may send a response signal to relay SS. The relay procedure initiated by neighbor BS may follow similar procedure.

Serving BS and neighbor may request relay SS relay one or more messages to neighbor. During the Inter-system communication procedure, relay SS may perform necessary ranging procedure with serving BS during serving BS's master sub-frame and ranging procedure with neighbor BS's master sub-frame as described in section 6.3.10.

When Inter-system communication ends, serving BS or neighbor may send Inter-system communication end massage to relay SS. After receiving the Inter-system communication end message, relay SS and neighbor BS may release all contexts related to Inter-system communication.

Figure below gives an example of Inter-system communication procedure.

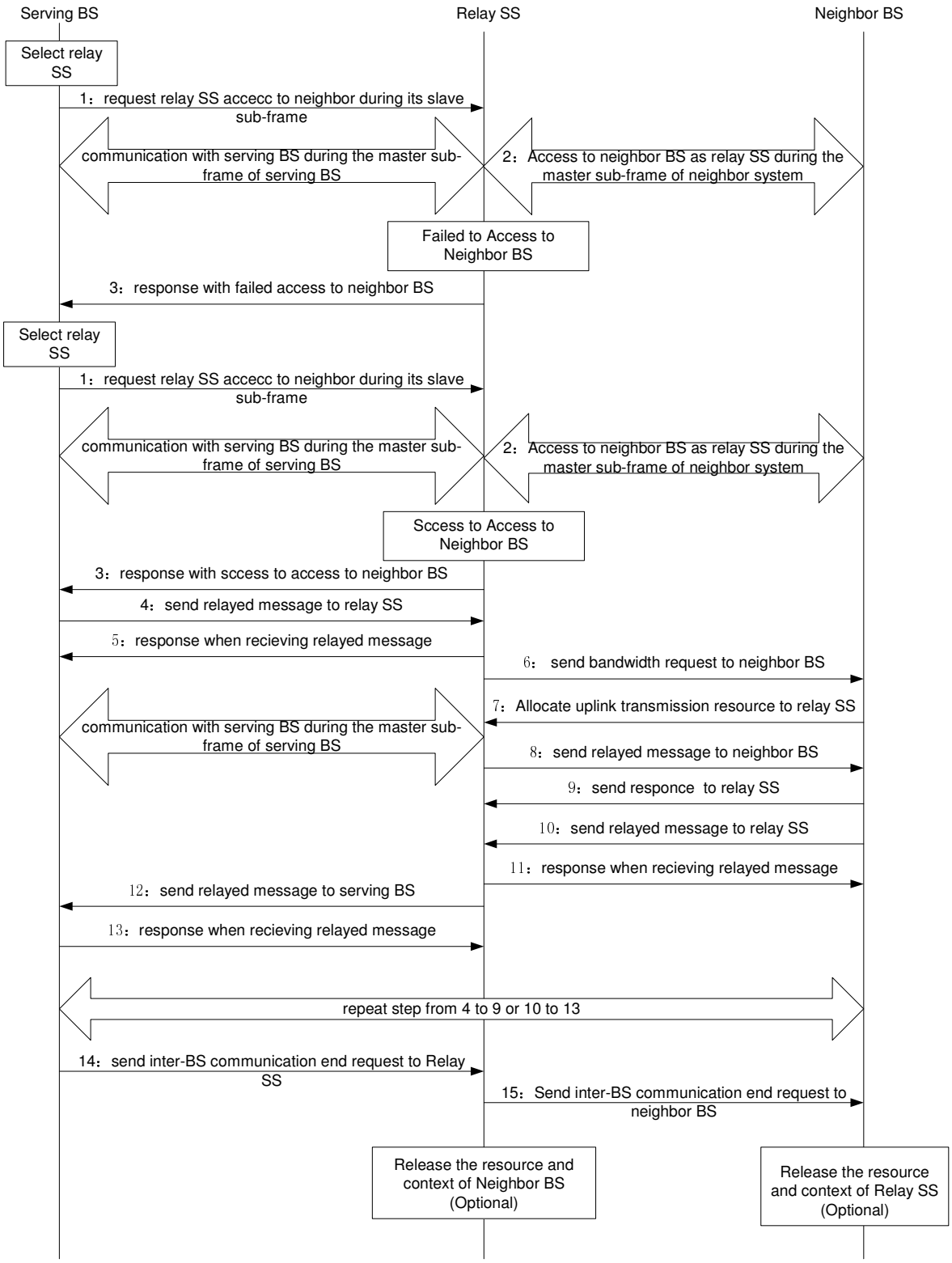

Figure 2 procedure of Inter-system communication

Proposed Text

3.3.2.3 MAC management messages

[Insert the following rows into Table-14]

Table 14 MAC management message

Type	Message Name	Message Description	Connection
67	BSD	Base Station Descriptor	Broadcast
68	SSURF	SS Uplink RF Descriptor	Basic
69	MADD	Master Advertisement Discovery Descriptor	Broadcast
70	SADD	Slave Advertisement Discovery Descriptor	Broadcast
71	ADPD	Advertisement Discovery Policy Descriptor	Broadcast
72	BS_CCID_REQ	Base Station Co-Channel Interference Detection Indication	Basic
73	BS_CCID_RSP	Base Station Co-Channel Interference Detection Response	Basic
74	CXP-REQ-MAC	Coexistence Protocol Request MAC message	Broadcast
75	CXP-RSP-MAC	Coexistence Protocol Response MAC message	Broadcast
76	OCSI-MNTR-REQ	CSI monitoring request message	Broadcast
77	OCSI-MNTR-RSP	CSI monitoring response message	Basic
78	ACCESS-NBS-REQ	Access neighbor BS requirement message	Basic
79	ACCESS-NBS-RSP	Access neighbor BS response message	Basic
80	RELAY-REQ	Relay require message	Basic
81	RELAY-RSP	Relay response message	Basic
82	RELAY-END-REQ	Relay end request message	Basic
~~78~~83-255	Reserved		

[Add a section 6.3.2.3.73 as indicate:]

6.3.2.3.73 Access Neighbor BS Request message (ACCESS-NBS-REQ)

This message is send by BS to its serving SS to request this SS to access neighbor BS during neighbor BS's master sub-frame. After receiving this message, SS tries to perform network entry procedure with neighbor BS during the neighbor BS's master sub-frame. A ACCESS-NBR-REQ message may include the following parameters:

Neighbor BSID: The BSID of neighbor BS which serving BS request SS to access to.
Master sub-frame index of neighbor BS: The master sub-frame index of the requested neighbor BS.

Table 108al ACCESS-NBS-REQ message format

Syntax	Size	Notes

ACCESS-NBR-REQ_message_Format() {		
Management Message Type =78	8bits	
Neighbor BSID	48bits	The BSID of Neighbor BS which SS will access to.
Master sub-frame index of neighbor BSID	2bits	The master sub-frame index of neighbor BSID. The requested SS will try to access to neighbor BSID during this sub-frame.
Padding Nibble	6bits	Padding to reach byte boundary.
}		

[Add a section 6.3.2.3.74 as indicate:]

6.3.2.3.74 Access Neighbor BS Response message (ACCESS-NBS-RSP)

After receiving the ACCESS-NBR-REQ message from serving BS, SS tries to perform network entry procedure with neighbor BS during the neighbor BS's master sub-frame. SS uses ACCESS-NBS-RSP to report the serving BS if it can access neighbor BS successfully.

BSID of neighbor BS: The BSID of neighbor BS which the SS accesses to.
Result of access procedure: Indicate if SS has successfully access to requested neighbor BS.

Table 108am ACCESS-NBS-RSP message format

Syntax	**Size**	**Notes**
ACCESS-NBR-RSP_message_Format() {		
Management Message Type =79	8bits	
BSID of neighbor BS	48bits	The BSID of Neighbor BS which SS tries to access to.
Result of access procedure	8bits	0: SS has successfully access to the requested neighbor BS >1: SS fail to access the requested neighbor BS 1: SS can't get PHY synchronization with neighbor BS 2: SS can't get MAC synchronization with neighbor BS 3: Ranging procedure failed 4: other reason
Padding Nibble	6bits	Padding to reach byte boundary.
}		

[Add a section 6.3.2.3.75 as indicate:]

6.3.2.3.75 Relay Request message (RELAY-REQ)

This message encapsulate the messages to be relayed and will be send from source BS to relay SS and from relay SS to destination BS.

The message parameters are:
BSID of the source BS: The BSID of BS which sends the relayed messages.
BSID of the destination BS: The BSID of BS which receives the relayed message.
Length of the relayed message: Length of the relayed message in byte.
Encapsulated Massage: Messages that need to be relayed to neighbor BS.
Request ID: A random number generated by the serving BS.

Table 108an ACCESS-NBS-RSP message format

Syntax	Size	Notes
RELAY-REQ_message_Format() {		
Management Message Type =80	8bits	
BSID of source BS	48bits	The BSID of BS which sends the relayed messages.
BSID of destination BS	48bits	The BSID of BS which receives the relayed message.
Length of the relayed message	16bits	Length of the relayed message in byte.
Encapsulated Message	variable	
Requested ID	32bits	A random number generated by the serving BS.
}		

[Add a section 6.3.2.3.76 as indicate:]

6.3.2.3.76 Relay Response message (RELAY-RSP)

This message will confirm the successful receive operation and will transmitted from destination BS to relay SS and from relay SS to source BS.
The message parameter is:

Response ID: Response ID = Request ID + 1

Table 108ao RELAY-RSP message format

Syntax	Size	Notes
RELAY-RSP_message_Format() {		
Management Message Type =81	8bits	
Response ID	32bits	
}		

[Add a section 6.3.2.3.77 as indicate:]

6.3.2.3.77 Relay end request message (RELAY-EDN-REQ)

This message will end Inter-system communication procedures via SS relay. This message is transmitted by source BS to relay SS and/or from relay SS to destination BS.

The message parameters are:
BSID of the source BS: The BSID of BS which requests to end the Inter-system communication procedure.
BSID of the destination BS: The BSID of BS which the source BS wants to end communication procedure.

Table 108ap RELAY-END-REQ message format

Syntax	Size	Notes
RELAY-RSP_message_Format() {		
Management Message Type =82	8bits	
BSID of source BS	48bits	The BSID of BS which requests to end the Inter-system communication procedure.
BSID of destination BS	48bits	The BSID of BS which the source BS wants to end communication procedure.
}		

11.5 RNG-REQ Message Encodings

[Insert the following rows into Table 364:]

Table 364 RNG-REQ message encodings

Name	Type(1 byte)	Length	Value(variable length)
SS attribute	13	1	0: normal SS 1: Relay SS

[Add a new clause 15.x]

15.x Inter-system communication over air

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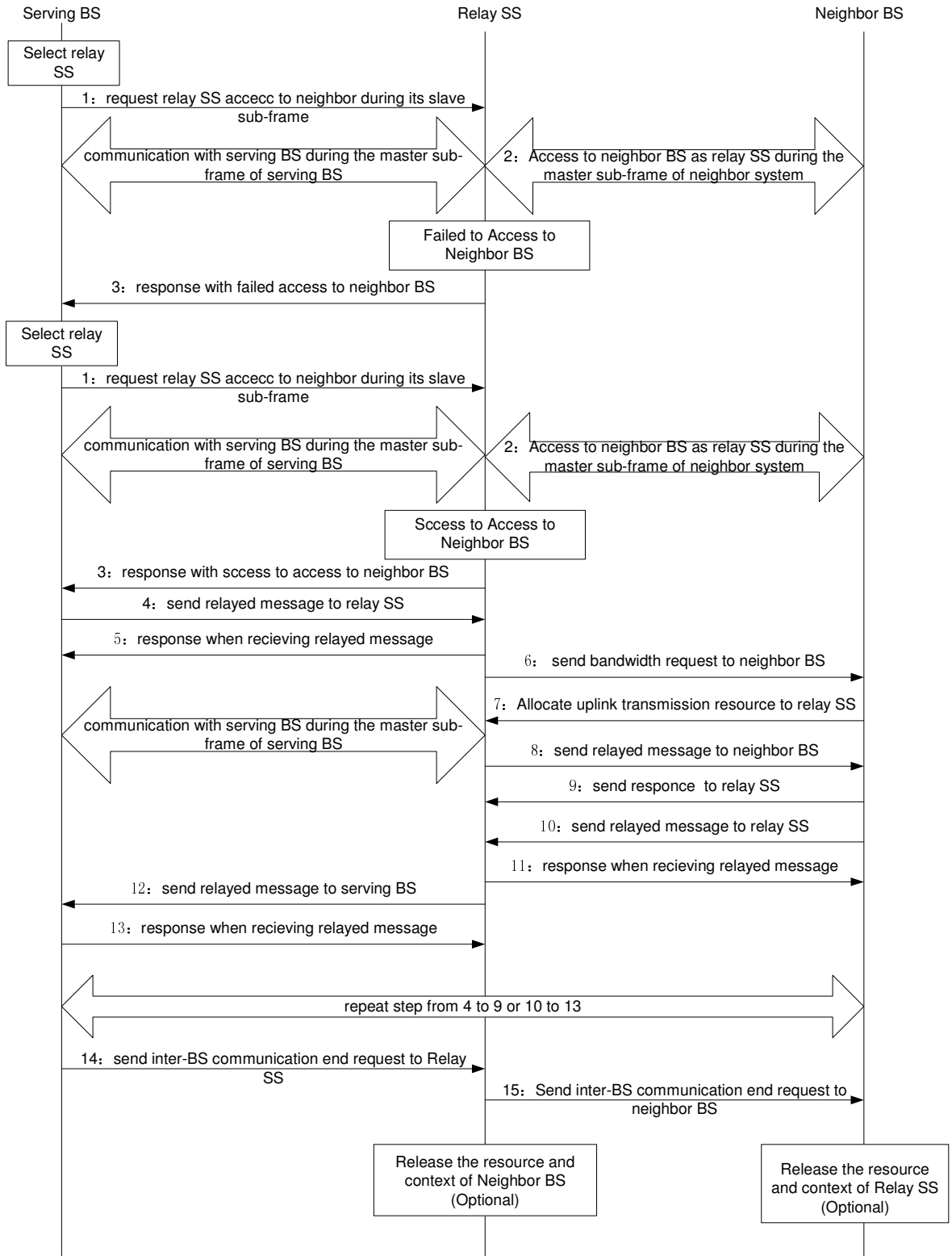

Figure 2 procedure of Inter-system communication

Conclusion

It is difficult to for neighbor BS to receive uplink burst from foreign SSs. In order to support inter-system communication over air, we propose relay SS communicates with serving BS during serving BS's master sub-frame and communicate with neighbor BS during neighbor BS's master sub-frame. Corresponding text is proposed for TG consideration.

Reference

[1] IEEE 802.16h-D2: Air Interface for Fixed Broadband Wireless Access Systems: Amendment for Improved Coexistence Mechanisms for License-Exempt Operation
[2] C802.16h-07/006, Procedures for inter-system communication over the air
[2] IEEE 802.16-2004: Air Interface for Fixed Broadband Wireless Access Systems
[3] IEEE 802.16-2005: Air Interface for Fixed Broadband Wireless Access Systems: Amendment 2: Physical Media Access Control Layers for combined fixed and mobile operation in license band