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Source(s)	Hyunjeong Kang, HyoungKyu Lim, Jungje Son, Changhoi Koo PanYuh Joo, ChiWoo Lim Sijun Cho, SeungJoo Maeng Samsung Electronics. Phillip Barber, Broadband Mobile Tech.	Voice: +82-31-279-5091 Fax:+82-31-279-5130 hyunjeong.kang@samsung.com hk03.lim@samsung.com jungje.son@samsung.com chkoo@samsung.com panyuh@samsung.com chiwoo.lim@samsung.com sijun.cho@samsung.com sjmaeng@samsung.com pbarber@BroadbandMobileTech.com

Re:	This contribution is for call for contribution IEEEP802.16e
Abstract	This contribution proposes the safety channel switching procedure
Purpose	Propose the safety channel switching mechanism for the IEEE802.16e Handoff Ad hoc group
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~~Safety Channel Handover Procedure~~ Channel Switching Procedure to Safety Zone

Hyunjeong Kang, Hyoungkyu Lim, Changhoi Koo, Jungje Son, Panyuh Joo, Chiwoo Lim, Sijun Cho, SeungJoo Maeng, Phillip Barber*

Samsung Electronics, Broadband Mobile Technologies*

Introduction

In order to reduce the interference caused by a neighboring BS, an MSS moving toward its Serving cell boundary or remaining in the cell boundary region may be switched from its current channel to the safety channel (or safety zone) defined for the neighboring BS. Since any MSS belonging to the neighboring BS is not allowed to use the safety channel, the MSS using the corresponding channel in the Serving BS can be served with less interference. This is the reason why the safety zone is also called a reduced interference zone, which facilitates the effective coverage extension of the Serving BS.

An MSS reports its CINR levels from its neighboring BSs. This transition to the safety channel is triggered based on the MSS report, which includes some neighboring BSs with their CINR levels within a predefined Safety Channel Allocation Threshold range from that of the Serving BS. Then the Serving BS chooses a BS with the highest CINR level and requests the safety channel information of the BS. If the corresponding channel in the Serving BS is available, it is allocated to the MSS. Otherwise the BS should force the MSS to perform a handover to the neighbor BS.

Proposed Mechanism

We propose the safety channel operation in the following two cases.

- ~~Case 1: Safety channel allocation in serving cell~~
- ~~Case 2: After performing a safety channel handover, Safety channel allocation in target cell~~
- Case 1: Switching to Safety zone in serving cell
- Case 2: Switching to Safety zone in target cell using BS-initiated handover

1) Case 1: Switching to Safety zone in serving cell

Due to the increasing interference caused by its neighbor BSs, an MSS in the cell boundary region may suffer from severe degradation of its channel signal quality. If the safety zone is supported, the MSS can trigger “switching to safety zone” procedure by reporting the CINRs of its neighboring BSs. The triggering condition is based on whether the CINR of a neighbor BS is within a range - say, Safety Channel Allocation Threshold - from that of the serving BS.

Upon receiving the report, the Serving BS may request the safety channel information of the neighbor BS which has the highest CINR value. After receiving the information through SafetyCH-Info messages, the serving BS switch the current channel used by the MSS to the available safety channel of the neighbor BS. The Serving B

S may inform the neighbor BS of the success of the switching to safety zone by sending a SafetyCH-Alloc-Info message with Alloc flag set to 1.

The example of switching to safety zone in serving cell is depicted in figure 1 and figure 2.

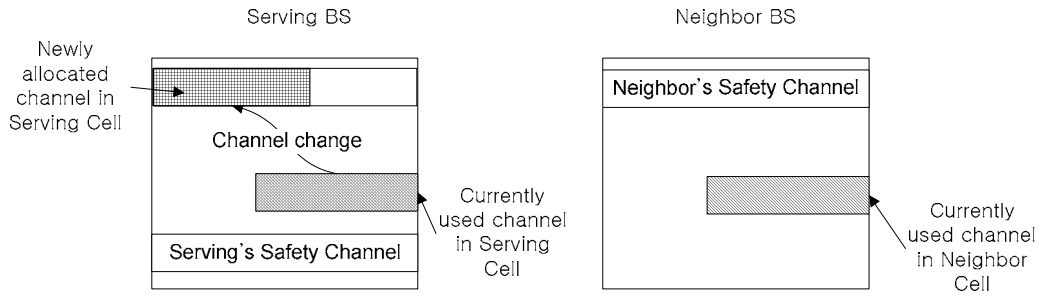

Figure 1.Example of Case 1 operation

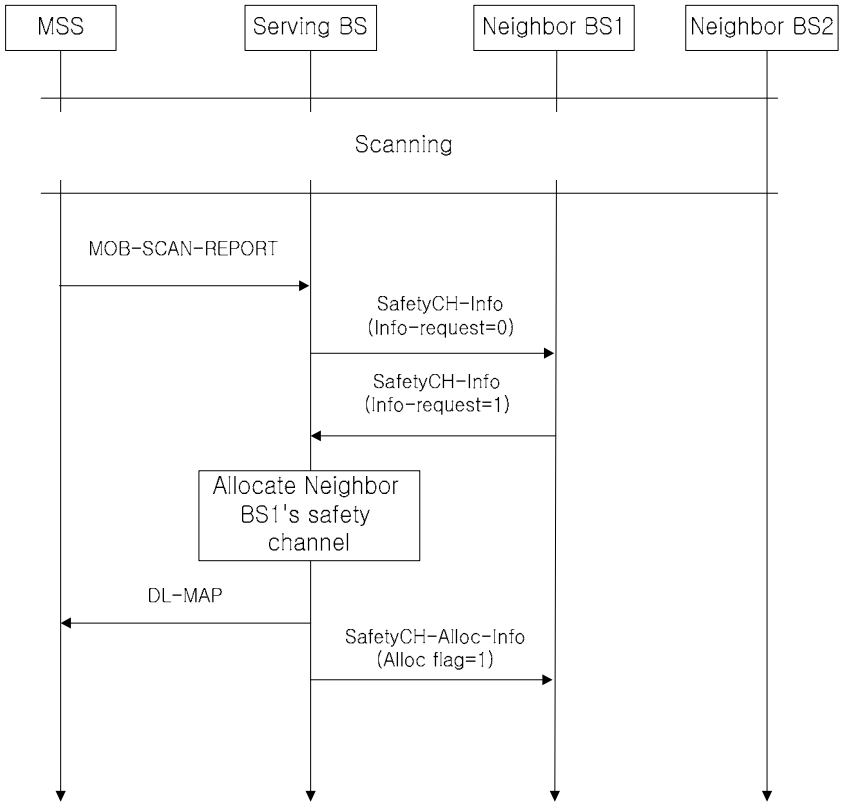

Figure 2.Safety channel operation in case 1

2) Case 2: Switching to Safety zone in target cell using BS-initiated handover

In case 1, the serving BS may fail to switch the MSS's current channel to the safety zone. This may arise when the safety zone is already occupied by other MSSs without leaving enough resource for the MSS. In this case, t he serving BS or MSS may initiate the normal handover procedure after waiting for some time when the CINR

of neighbor BS meets the criteria for normal handover hysteresis margin. However, the MSS should suffer fro m the harsh channel conditions, and even worse, the time may be quite long for slow-moving or stationary MS Ss. Thus, the normal handover may not be the good option. In order to solve this problem, the Serving BS may force the MSS to perform handover to the neighbor BS and use the Serving BS's safety channel. Through Safe tyCH-Alloc-Info with Alloc flag set to 1, the Serving BS informs the neighbor BS that the channel, correspondi ng to the neighbor BS's safety channel, is unavailable in the serving cell and the MSS will move to the neighbo r BS. The SafetyCH-Alloc-Info message also contains the safety channel information of the Serving BS. At this time, the Target BS may grant the non-contention based ranging opportunity to the MSS.

If the Target BS cannot allocate the channel corresponding to the safety channel of the Serving BS, it shall info rm the Serving BS of the unavailability through SafetyCH-Alloc-Info with Alloc flag set to 0. In this case, the Serving BS shall perform the normal handover operation with the MSS.

The example of safety channel handover operation is depicted in figure 3 and figure 4. Figure 5 shows the case where the safety channel allocation in Target BS fails and the Serving BS and the MSS perform the normal han dover operation.

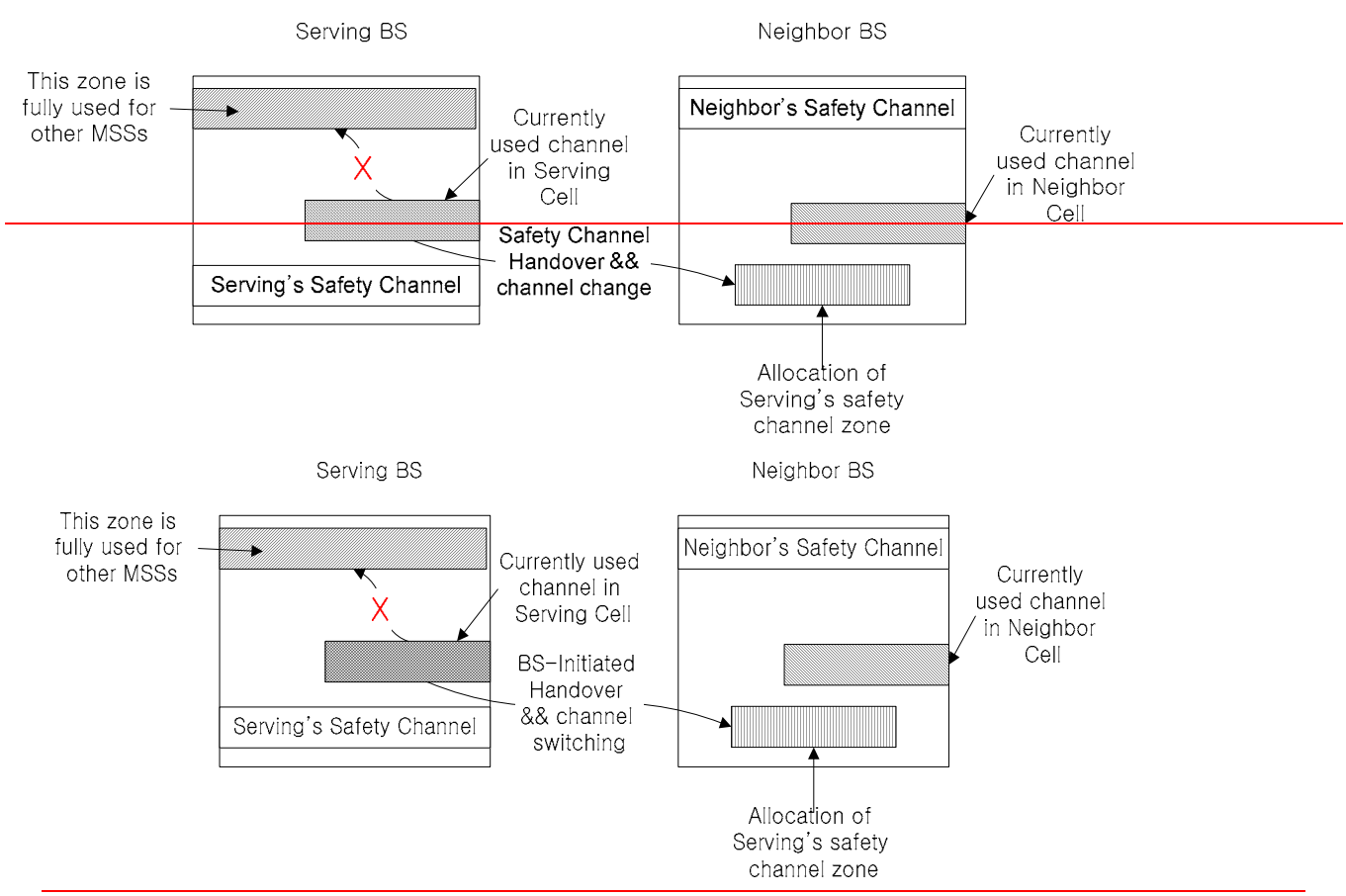

Figure 3.Example of Case 2 operation

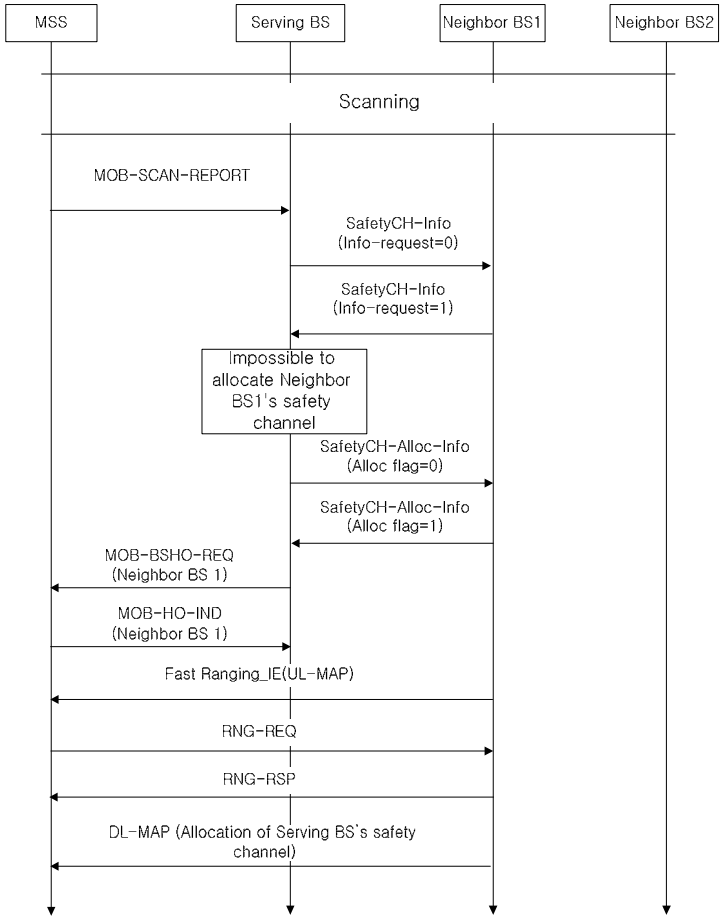

Figure 4.~~Safety channel operation in case 2~~Safety channel operation in case where the safety channel allocation succeeds in Target BS

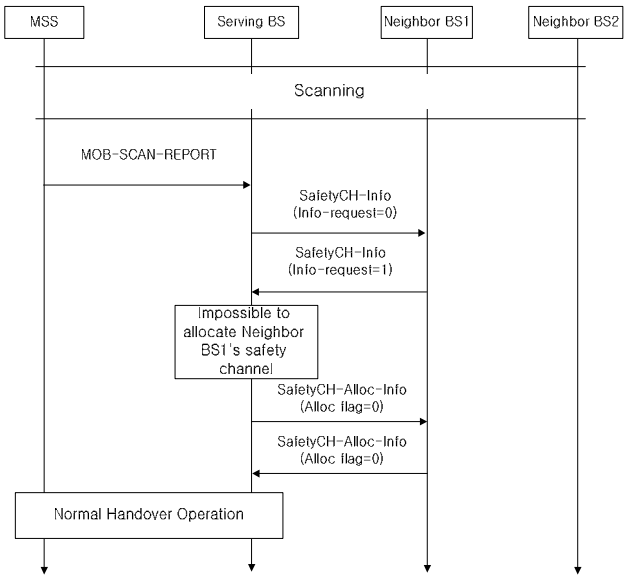

Figure 5.Safety channel operation in case where the safety channel allocation fails in Target BS

Therefore we propose the remedies as followings:

- Change the Neighbor BS-ID field description in line 41-42 page 25.
- Add the safety channel handover operation after line 8 in page 46 and line ~~45~~ 34 in page 50.
- ~~Add the following field to Table 92h MOB_BSHO_REQ message format in page 25.~~
- ~~Handover mode~~
- Add the following ~~SBC~~REG-RSP TLV encoding in page 108.
  - SafetyCH_~~Threshold~~Support
- Add a new section D.2.14 and D.2.15 after the section D.2.13 in page 125.
  - D.2.14 SafetyCH-Info message
  - D.2.15 SafetyCH-Alloc-Info message

Proposed Text Changes

We propose the following remedies in IEEE P802.16e/D3 to provide the efficient safety channel switching~~handover~~ operation.

Remedy 1:

[Replace line 41-42 page 25 section 6.3.2.3.53 with the followings]

Neighbor BS-ID
Same as the Base Station ID parameter in the DL-MAP message of neighbor BS. This may include the Serving BS.

Remedy 2:

~~[Add the followings after line 8 page 46 section 6.3.20.1.2 MSS Scanning of neighbor BS]~~

~~If the received CINRs of neighbor BSs exceed the predefined SafetyCH_Threshold, the MSS reports the scanning result to its Serving BS. Then the Serving BS may try to allocate the channel corresponding to the safety channel of the neighbor BS with the highest CINR. If the corresponding channel in the Serving BS is available, it is allocated to the MSS. Otherwise the Serving BS forces the MSS to perform handover to the neighbor BS and after handover new Serving BS allocates MSS safety channel of old Serving BS. These cases require that the Serving BS and the neighbor BS exchange the safety channel information over the backbone (see section Backbone network HO procedures).~~

[Add the followings after line 8 page 46 section 6.3.20.1.2 MSS Scanning of neighbor BS]

For systems using Safety Channels, Iif the received CINRs of a neighbor BS is s are within the predefined Safety Channel Allocation Threshold from that of the Serving BS, the MSS reports the scanning result to request its Serving BS. Based on the CINR values of the safety channel allocation. The Serving BS, receiving the MOB-SCAN-Report message for safety channel allocation request, the Serving BS may initiate switchinges the current channel to the safety zone channel which is designated for of the neighbor BS with the highest CINR. If the corresponding safety zone channel in the Serving BS is available, the switching operation ends successfully it is allocated to the MSS.. Otherwise the Serving BS checks to see if there is any available resource in its own safety zone, and if so, it tries to make forces the MSS to perform handover to the neighbor BS. During After handover, the new Serving BS allocates to the MSS the channel corresponding to the safety zone channel of the old Serving BS. In order to facilitate th

is operation, These cases require that the Serving BS and the neighbor BS shall exchange their safety channel information over the backbone (see section Backbone network HO procedures).

Remedy 3:

~~[Change the followings in line 36-40 page 50 section 6.3.20.2.2 HO decision & initiation]~~

~~If Handover mode is set to "01" in MOB-BSHO-REQ message, MSS may perform a hand-over to any BS among the recommended BSs in MOB-BSHO-REQ without notifying the Serving BS of a selected Target BS. As an acknowledgement to the MOB-BSHO-REQ message, the MSS may send a MOB-HO-IND message with its Target BS ID set to a pre-defined value other than any valid BS identifier.~~

~~[Add the followings after line 45 page 50]~~
~~If Handover mode is set to "10" in MOB-BSHO-REQ message, MSS shall perform a handover to the Target BS in recommended BS list after sending MOB-HO-IND message. Handover mode "10" means that the MSS may not use the safety channel in its serving cell and therefore it shall change its connection to the Target BS. The Serving BS notifies the Target BS that the MSS will move to the Target BS, which may provide non-contention based ranging opportunity to the MSS. The Serving BS also informs the Target BS of the Serving BS's safety channel information over the backbone. The Target BS shall allocate the channel to the MSS performing Safety channel handover to the target cell.~~

[Add the followings after line 34 page 50]
For systems using Safety Channels, the Serving BS may send MOB-BSHO-REQ when it decides switch the current channel for the MSS to the safety zone in a neighbor cell. In order to facilitate this handover operation, the Serving BS and the Target BS shall exchange their safety channel allocation information over the backbone.

~~[Change the table 92h in page 25]~~

~~Table 92h – MOB-BSHO-REQ Message Format~~

~~Syntax~~	~~Size~~	~~Notes~~
~~MOB-BSHO-REQ_Message_Format(){~~		
~~Management Message Type = 52~~	~~8bits~~	
~~Handover mode~~	~~2bits~~	~~00: Network Assisted HO is not supported~~ ~~01: Network Assisted HO is supported~~ ~~10: Safety Channel Handover~~ ~~11: reserved~~
~~For(j=0;j<N_Recommended;j++){~~		~~N_Recommended can be derived from the known length of the message~~
~~Neighbor BS-ID~~	~~48bits~~	
~~Service level prediction~~	~~8bits~~	
~~}~~		
~~Reserved~~	~~6bits~~	~~Reserved; shall be set to zero~~
~~HMAC Tuple~~	~~21bytes~~	~~See 11.4.11~~

}		

[Change the following in line 25-31 page 26]

Handover mode
This flag indicates that the Serving BS supports the Network Assisted HO features. This flag also indicates that the Serving BS forces the MSS to handover to the Target BS in N_Recommended list. The following applies:
00 = Network Assisted HO is not supported
01 = Network Assisted HO is supported
10 = Safety Channel Handover
11 = reserved

Remedy 4:
[Insert the following after the end of section 11.8.3 in page 108]

11.8.4 SafetyCH_Threshold

This field indicates the predefined CINR threshold to report MSS's scanning result for safety channel handover operation.

Type	Length	Value	Scope
1(TBD)	1	SafetyCH_Threshold	SBC-RSP (see 6.3.2.3.24)

11.7.10.5 Safety Channel_Support

11.87.510.5.1 SafetyCH_Support

This field indicates the BS supports safety channel operation. A bit value of 0 indicates "not supported" while 1 indicates "is supported".

Type	Length	Value	Scope
1(TBD)	1	Bit #0: Safety channel operation support Bit #1-7: reserved; shall be set to zero	SBCREG- RSP (see 6.3.2.3.24)

Remedy 5:
[Insert the following messages after the end of section D.2.13 in page 125]

D. 2.14 SafetyCH-Info message

This message is sent from the Serving BS to the neighbor BS to request the neighbor BS's safety channel information. This message is also sent from the neighbor BS to the Serving BS in order to inform the neighbor's safety channel information in case where the neighbor BS received SafetyCH-Info message with Info-request set to 0. The message contains the following information:

Field	Size	Notes

SafetyCH-Info_Message_Format(){		
Global Header	152bits	
Info-request	1bit	0: Request safety channel information 1: Inform safety channel information
TLV_Safety_channel_info	Variable	Safety channel information for case where info-request value is set to 1.
Security field	TBD	A means to authenticate this message
CRC field	32bits	IEEE CRC-32
}		

TLV_Safety_channel_info(){		
OFMDA symbol offset	8bit	
Subchannel offset	7bit	
No. OFDMA symbols	7bit	
No. subchannels	7bit	
}		

D. 2.15 SafetyCH-Alloc-Info message

This message is sent from the Serving BS to the neighbor BS, which provided its safety channel information, to inform whether the Serving BS successfully allocates the safety channel to the MSS. If the safety channel allocation fails, the Serving BS informs the neighbor BS of the MSS's handover and the Serving BS's safety channel information. This message is also sent from the neighbor BS to the Serving BS, in case where the neighbor BS inform whether the channel corresponding to the safety channel of the Serving BS is available for the MSS which will perform handover to the neighbor BS. The message contains the following information:

Field	Size	Notes
SafetyCH-Alloc-Info_Message_Format(){		
Global Header	152bits	
Alloc flag	1bit	Indicate whether the BS allocates the safety channel which provided from other BS. 0: Allocation fail and Safety Channel Handover for the MSS will happen. 1: Allocation success
MSS unique identifier	48bits	48bit unique identifier used by MSS. This field informs the ID of MSS to perform Safety Channel Handover and is activated for case where Alloc flag is set to 0
TLV_Safety_channel_info	Variable	This field informs the BS's safety channel information and is activated for case where Alloc flag is set to 0. (the same format with TLV_Safety_channel_info in SafetyCH-Info message)
Security field	TBD	A means to authenticate this message
CRC field	32bits	IEEE CRC-32
}		