Project	**IEEE 802.16 Broadband Wireless Access Working Group** <http://ieee802.org/16>
Title	**Ad hoc on CMI TX and RX**
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Re:	IEEE 802.16 Working Group Letter Ballot #29
Abstract	Ad hoc on SSURF message transmission.
Purpose	Discussion and accept.
Notice	
Release	
Patent Policy	

Ad hoc on CMI TX and RX

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Introduction

We have an ad hoc on CMI messages transmission [1]. This ad hoc is based on the discussion on the comment 27 of database 80216h-07_020r3 [2].

Comment 27 is proposed by Mariana:

Regarding:

The SSURF message is sent by a SS if a CMI is scheduled in its UL MAP.

How CMI is scheduled in the UL MAP?

Suggest Remedy:

probably the CX-DL MAP and CX-UL MAP may be adapted for the CMI scheduling

Two Reply Comments to this comment in 80216h-07_020r3[2].

Reply comments by Kenneth

Accepted-Clarified,

Page 12, line 44.

Reply comments by Xuyong

Disagree,

No need for special MAP.

Providing SSURF a special MAP, every individual UL message will need one.

All the 16h BS knows the CXCC allocation for each subframe and the interval timing, no need to tell every SS where is CXCC, SS need to know there own business, not all the system information.

Instead, the potential time where SS may receive BSD should be told to SS as a DL parameter.

We have set up an ad hoc offline and have discussed this issue by email. Contributors to ad hoc are Shulan Feng, Marina Goldhamer, John Sydor and Kenneth Stanwood.

We have discussed some technical issues on SSURF messages transmission.

- Is SSURF message necessary for 16h?
- How is SSURF message send in OFDMA mode?
- Do we need carrier location information in SSURF message?

1. Is SSURF message necessary for 16h?

Shulan think we can remove SSURF message first for two reasons. First, it is difficult to support SSURF message in OFDMA PHY mode. Second, we can find other simple way to achieve the same goal SSURF can do. We have use radio signature for CCD. And we can calculate the uplink interference based on downlink interference detection result. Here is the detailed algorithm.

The interference power one SS to its neighbor BS, P_{RX_SS}, can be calculated from

$P_{RX\_SS} = P_{MAX\_TX\_SS} + G_{RX\_NBS} - P_{EIRP\_NBS} + P_{RX\_NBS} + (G_{TX\_SS} - G_{RX\_SS})$

Where P_{RX_NBS} is the received signal strength at antenna output of SS from neighbor BS, $P_{MAX\_TX\_SS}$ is the maximum transmission power of SS, P_{EIRP_NBS} is the EIRP of neighbor BS, G_{RX_NBS} is the receive antenna gain of neighbor BS, G_{TX_SS} is the transmit antenna gain of SS, G_{RX_SS} is the receive antenna gain of SS.

So if P_{RX_SS} is greater than a threshold, BS may think SS can cause interference to neighbor BS.

Marina and John agree the uplink interference calculation proposed by Shulan is correct.

However, Marina and John think it is necessary to keep SSURF. Marina think SSURF message can take some important information, such as location information of SS as required by FCC.

John think that in many situations, especially where the SS has a higher EIRP than the BS, The SS will not receive a BSD and will not be affected by that BS in the downlink., but in the uplink the the BS is affected by the SS. Unless the BS receives a SSURF message, it has no way of knowing who the interfering SS is or what its EIRP is.

Conclusion

SSURF will be remained in the 16h.

Uplink interference can be calculated by reciprocal way.

2. How is SSURF message send in OFDMA PHY mode?

We all agree that it is needed to define in the standard how SSURF is transmitted in the OFDMA mode, including the permutation type and sub-chanelization.

To be decoded by foreign BS, all PHY transmission parameter should be specified and known to all systems in the coexistence community.

To set the PHY parameter, we should first calculate how many data carriers will be needed to carrier the SSURF message.

From the following figure, if no location information contained in SSURF message, the number of information bit from MAC layer to PHY layer is 280bits for IPV4 or 360bits for IPV6.

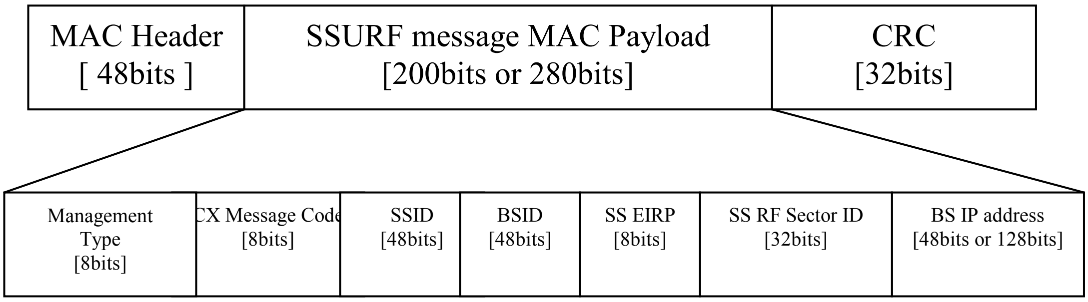

Figure 1

If SS GPS location information contained in SSURF message, additional 32 bits need to be carrier. So 312 data subcarriers or 392 data subcarriers are needed to carrier SSURF message.

There are 48 data subcarrier each uplink slot (section 8.4.6.2.1) and there are 17 subchannels every 3 OFDMA symbols.

For 5MHz bandwidth, the number of OFDMA symbol in one frame is 47. Following the 60%/40% rule, we can get that the number of OFDMA symbol of uplink is 18 or 19.

So if we set the number of OFDMA symbols for CMI_U is 12, we can get 17*4=68 uplink slots available for SSURF

If we use QPSK 1/2 CC for SSURF, one information bit will need one data subcarrier to carrier. So to transmit one SSURF message, 312 data subcarriers or 392 data subcarriers are needed. So we need 7 uplink slots for IPV4 and 9 uplink slots for IPV6.

Conclusion:

1. Following PHY parameters are used for SSURF message transmission. Channel Bandwidth: 5MHz; FFT Size: 512; CP: 1/8 [1/4 is not mandatory in WiMAX mobile profile]; PUSC: use PUSC in 8.4.6.2.1; Partitioning of subcarriers into subchannel: following the way specified in 8.4.6.2.2 with UL_PermBase= 0;
2. Defined the length of CMI_U is 12 OFDM symbols.
3. Every 7 slots for IPV4 or 9 slots for IPV6 are defined as a SSURF transmission opportunity.
4. The first SSUFR transmission opportunity in CMI_U is start at the lowest subchannel and lowest OFDMA slot in the CMI_U zone. The SSURF transmission opportunity continues mapping with OFDMA symbol index is increased. When the edge of the UL zone is reached, continue the mapping from the lowest numbered OFDMA symbol in the next available subchannel. The figure 2 shows the transmission opportunity allocation for IPV6.

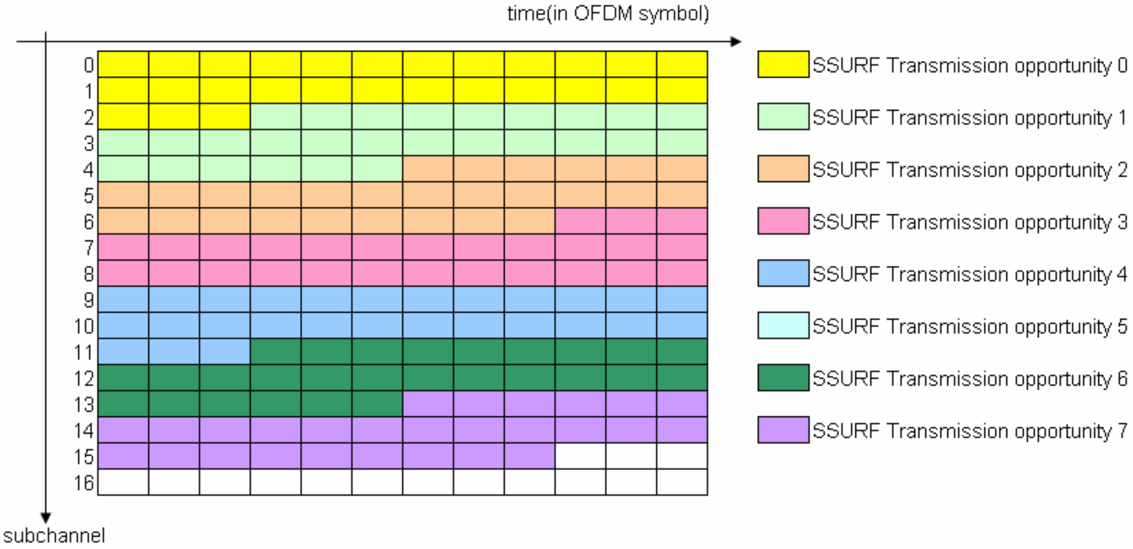

Figure 2

5. Following the syntax in table 1 or other way to define a special MAP to tell the SS during which SSURF transmission opportunity it will send SSURF message.

Table 1

Syntax	Size	Notes
SSURF_transmission_opportunity_IE_format {		
Extended UIUC	4bits	
Length	4bits	Length = 0x1
transmission opportunity	8 bits	Denote the SSURF message transmission opportunity in CX_CMI_U.
}		

3. Do we need carrier location information in SSURF message?

Marina think SSURF message can take some important information, such as location information of SS as required by FCC to provide the location information for fixed SS in 3.65GHz. But Kenneth think 3.65GHz rules don’t benefit from it. We may continue this issue in during Atlanta meeting.

Proposed Text

8.4.5.4 UL-MAP IE format

[*Insert the following row at the end of the table 290a*]

0B	SSURF_transmission_opportunity_IE

[Insert new subclause 8.4.5.4.29]

8.4.5.4.28 SSURF transmission opportunity IE

SSURF_transmission_opportunity_IE is used to tell the SS during which SSURF transmission opportunity it will send SSURF message.

Table 302w SSURF_transmission_opportunity_IE format

Syntax	Size	Notes
SSURF_transmission_opportunity_IE_format {		
Extended UIUC	4bits	
Length	4bits	Length = 0x1
transmission opportunity	8 bits	Denote the SSURF message transmission opportunity in CMI_U.
}		

15.3.3.5 Subscriber Station Uplink Radio Frequency (SSURF) Message

Subscriber Station Uplink RF (SSURF) messages are the primary means by which a system defines the extent of the interference caused by its subscriber stations to neighboring base stations and coexistence community members. It is demodulated and effectively sensed by the affected base stations. The message is sent on a periodic basis in the CX_CMI_U(1-3) when requested to by the Base Station and the transmissions can be maintained over a number of Tcxcc cycles, depending on the number of SS the BS controls. All of the SS should have an opportunity to transmit SSURF messages in order to facilitate their detection as interference by other systems. When received as interference at foreign base stations, the demodulated SSURF provides that station with its specific identity and the proxy IP address of the BS controlling it.
The monitoring process for foreign interfering SSURF messages is undertaken by the Base Station. A BS (system n) will monitor CX_CMI_U(n-1) and CX_CMI_U(n+1) in a system where n=3 (max). The BS also monitors its own CX_CMI_U(n), but only for foreign SSURF from co-channel systems that have claimed the same slot. Under most circumstances this should not occur since the IBS undergoes an extensive CMI claiming procedure (*15.3.3.3*), however, there is always the possibility of sporadic interference which must be identified. To facilitate such detection the scheduling of uplink SSURFs by the controlling BS should be such that the CX_CMI_U(n) slot is never fully occupied with its own SSURF messages in order to allow the opportunity for other foreign SSURFs to be detected without collision (see *15.3.3.1* and *Figure h 35*).

To send a SSURF message by a SS, the SS is granted an allocation in a UL subframe corresponding to subchannel 2 of the coexistence channel, where the allocation start time in UL-MAP will be the start of uplink sub-frame. These uplink grants for sending SSURF are unicast to SS. SS sends the SSURF by using this grant in a CXCC subchannel 2 frame. A long preamble needs to be added before the SSURF message for wirelessMAN-OFDM PHY. Here the preamble preceeding to the SSURF also uses a predefined CP.

For wirelessMAN-OFDM PHY, ~~A~~any interfered-with BS (n) while in listen mode on CX_CMI_U(n+/-1), if detecting any preamble (REF1 and REF2), by using a predefined CP (cyclic prefix), and by using a predefined modulation QPSK1/2, will detect the SSURF.

For wirelssMAN-OFDMA PHY, the following PHY parameters are used for SSURF message transmission: Channel Bandwidth: 5MHz; FFT Size: 512; CP: 1/8 [1/4 is not mandatory in WiMAX mobile profile]; PUSC: use PUSC in 8.4.6.2.1; Partitioning of subcarriers into subchannel: following the way specified in 8.4.6.2.2 with UL_PermBase= 0.

Every 9 slots are defined as a SSURF transmission opportunity. CX_CMI_U is the last 12 OFDMA symbols in a 5ms frame and contains 8 SSURF transmission opportunities. The first SSURF transmission opportunity in CX_CMI_U is start at the lowest subchannel and lowest OFDMA slot in the CMI_U zone. The SSURF transmission opportunity continues mapping with OFDMA symbol index is increased. When the edge of the UL zone is reached, continue the mapping from the lowest numbered OFDMA symbol in the next available subchannel. The following figure shows the SSURF transmission opportunity allocation.

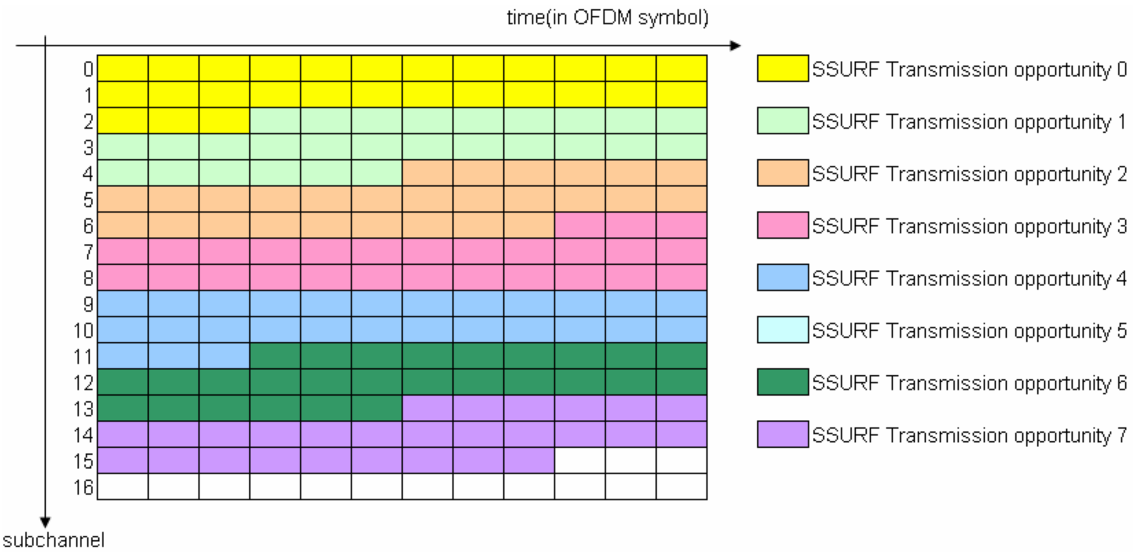

Figure hxx SSURF transmission opportunity allocation for WirelessMAN-OFDMA

SSURF_transmission_IE in UL-MAP is used to SS during which SSURF transmission opportunity it will send SSURF message.

[*Add a new section 15.3.7*]

15.3.7 Uplink Interference Estimation

The uplink interference can be identified by SSURF message or by uplink radio signature. However, if downlink interference is identified first, the following equation can be used by serving BS to estimate the interference power one SS to its neighbor BS, P_{RX_SS},

$$P_{RX\_SS} = P_{MAX\_TX\_SS} + G_{RX\_NBS} - P_{EIRP\_NBS} + P_{RX\_NBS} + (G_{TX\_SS} - G_{RX\_SS})$$

Where P_{RX_NBS} is the received signal strength at antenna output of SS from neighbor BS, $P_{MAX\_TX\_SS}$ is the maximum transmission power of SS, P_{EIRP_NBS} is the EIRP of neighbor BS, G_{RX_NBS} is the receive antenna gain of neighbor BS, G_{TX_SS} is the transmit antenna gain of SS, G_{RX_SS} is the receive antenna gain of SS.

So if P_{RX_SS} is greater than destructive interference threshold, BS may think SS causes destructive interference to the corresponding neighbor BS. If P_{RX_SS} is greater than acceptable interference threshold and less than destructive interference threshold, BS may think SS causes harmful interference to the corresponding neighbor BS. If P_{RX_SS} is greater than light interference threshold and less than harmful interference threshold, BS may think SS causes acceptable interference to the corresponding neighbor BS.

If G_{TX_SS} is equal to G_{RX_SS}, the interference power one SS to its neighbor BS, P_{RX_SS}, can be calculated from,

$$P_{RX\_SS} = P_{MAX\_TX\_SS} + G_{RX\_NBS} - P_{EIRP\_NBS} + P_{RX\_NBS}.$$

Reference

[1] C802.16h-07/094, Action Items and Ad-Hocs following Session #51

[2] 80216h-07/020r3, Comment database with group resolution for 16h draft D2c TG review