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Re:	IEEE 802.16 Working Group Letter Ballot #24, on P802.16h/D1
Abstract	In this contribution, interference management procedure in the operating stage is introduced and the information table which contains interference status data is modified.
Purpose	Specify the interference management procedure in the operating stage.
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Interference Management Procedure in the Operating Stage

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Introduction

As the action item of meeting #46 in Mont Tremblant, an ad-hoc group discussing the interference management in network entry and operating stage is created.

The interference management procedure can be divided into two parts,

- Channel measurement, interference identity and information table update
- Interference prevention

In current 16h working draft, interference management procedure in initial stage has been specified. In this contribution, we'll give the interference management procedure in the operating stage.

Another purpose of this contribution is modifying the information table (table h7). The information table in current 16h working draft is not suitable for interference management and contains some overlapped IE.

Reference

[1] IEEE 802.16h-D1: Air Interface for Fixed Broadband Wireless Access Systems: Amendment for Improved Coexistence Mechanisms for License-Exempt Operation
[2] C80216h-06_094, Dynamic Interference Maintenance in Coexistence Community

Proposed Text

15.1.3 Procedure flow in WirelessMAN-CX

15.1.3.1 Procedure flow for BS

(2) Operating stage

In the operating stage, the BS has SSs associated with it; however, until the operating system parameters are determined, the co-channel or adjacent channel interference from LE BSs of different systems may still occur due to the detection of interference from primary users (which may cause the neighbor BS to switch to an interfering channel). Channel switching of coexistence neighbor systems or the entry of new coexistence neighbor BS might make the community so crowded that there are not enough channels. If the LE BS finds that there is no "free" channel at that moment, synchronous channel switching maybe executed, or the coexistence neighbor topology provides the guidelines of with whom it should negotiate to share the channel.

In the operating stage, system should monitor the channel status of its own working channel and other channels. System may use quiet period, such as slave sub-frame, extended quiet period and quiet period in CX CCH slot for sensing and identification. System will perform corresponding operation according to the result of channel

measurement and interference identity.

BS in the operating stage should accumulate the channel measurement and interference situation detected by itself or by associated SS and update its interference status in the information table (15.3.3.1). BS should allocate resource according to the interference status so that every SS associated it can get interference free slot for transmission and receiving.

If a new free channel is detected and the working channel of system is too crowded, system may switch to the new free channel. System may request its coexistence neighbors to delete it from their coexistence neighbor list using CP message. And the co-existence neighbor may update their frame structure after system switching to another free channel.

If a system has no interference neighbor and finds a new free channel, it just records the new free channel as its alternative channel in the information table.

If a primary user is detected on current working channel and system may not share same channel with this user, system must switch to another channel as quickly as possible. System may follow procedure same as the initialization of BS to get interference free resource.

If a new interference victim SS is reported and the neighbor BS interfering it is a new un-coordinated neighbor, system should negotiate with this neighbor to get interference free for the victim SS. If a new interference victim SS is reported and the neighbor interfering it has already been in the community, then system just records it in the information table and allocates this interference victim SS an interference free sub-frame.

If a new interfering SS associated an un-coordinated BS is detected by BS, BS should negotiate with this neighbor BS to get interference free. If a new interfering SS associated with the neighbor already in the community, BS may request neighbor system to allocate a sub-frame which couldn't cause interference to this SS.

If the interference to a victim SS is released, e.g. if victim SS powers off or leaves interference area, BS will check if all interference with one neighbor is released, that is, the number of victim SS interfered by the neighbor is zero and the number of interfering SS which causes interference to the system is zero. If not, system just updates the resource allocation to this SS. If all interference with one neighbor is released, system may delete this neighbor in its coexistence neighbor list and update frame structure according to new neighborhood.

If the interference from a interfering SS is released, e.g. if interfering SS powers off or leaves interference area, BS will check if all interference with one neighbor is released, that is, the number of victim SS interfered by the neighbor is zero and the number of interfering SS which causes interference to the system is zero. If not, system may request its neighbor updates the resource allocation to this SS. If all interference with one neighbor is released, system may delete this neighbor in its coexistence neighbor list and update frame structure according to new neighborhood.

Figure hxx shows the procedure for the WirelessMAN-CX BS in operating stage.

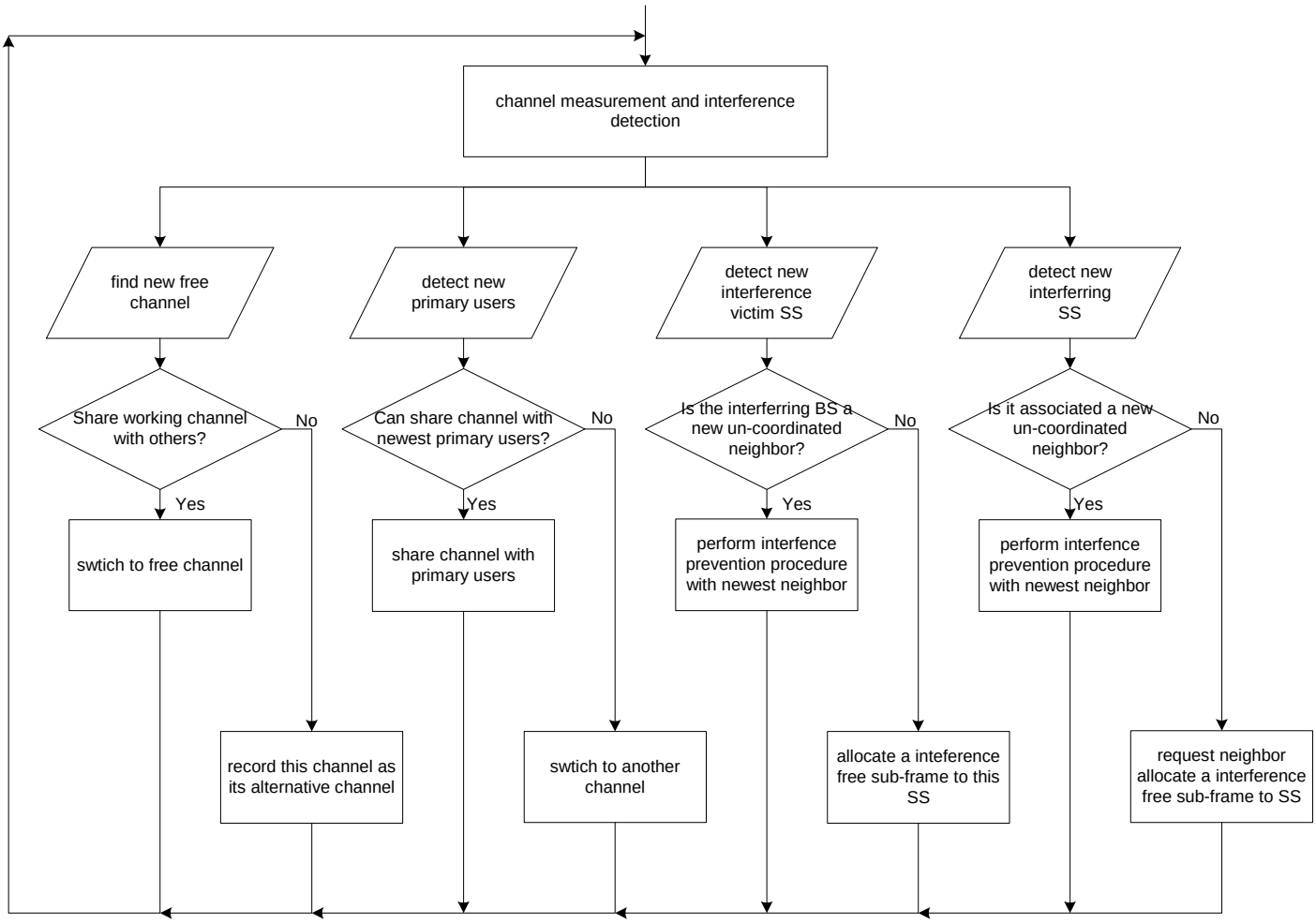

Figure hxx-a procedure in the operating stage

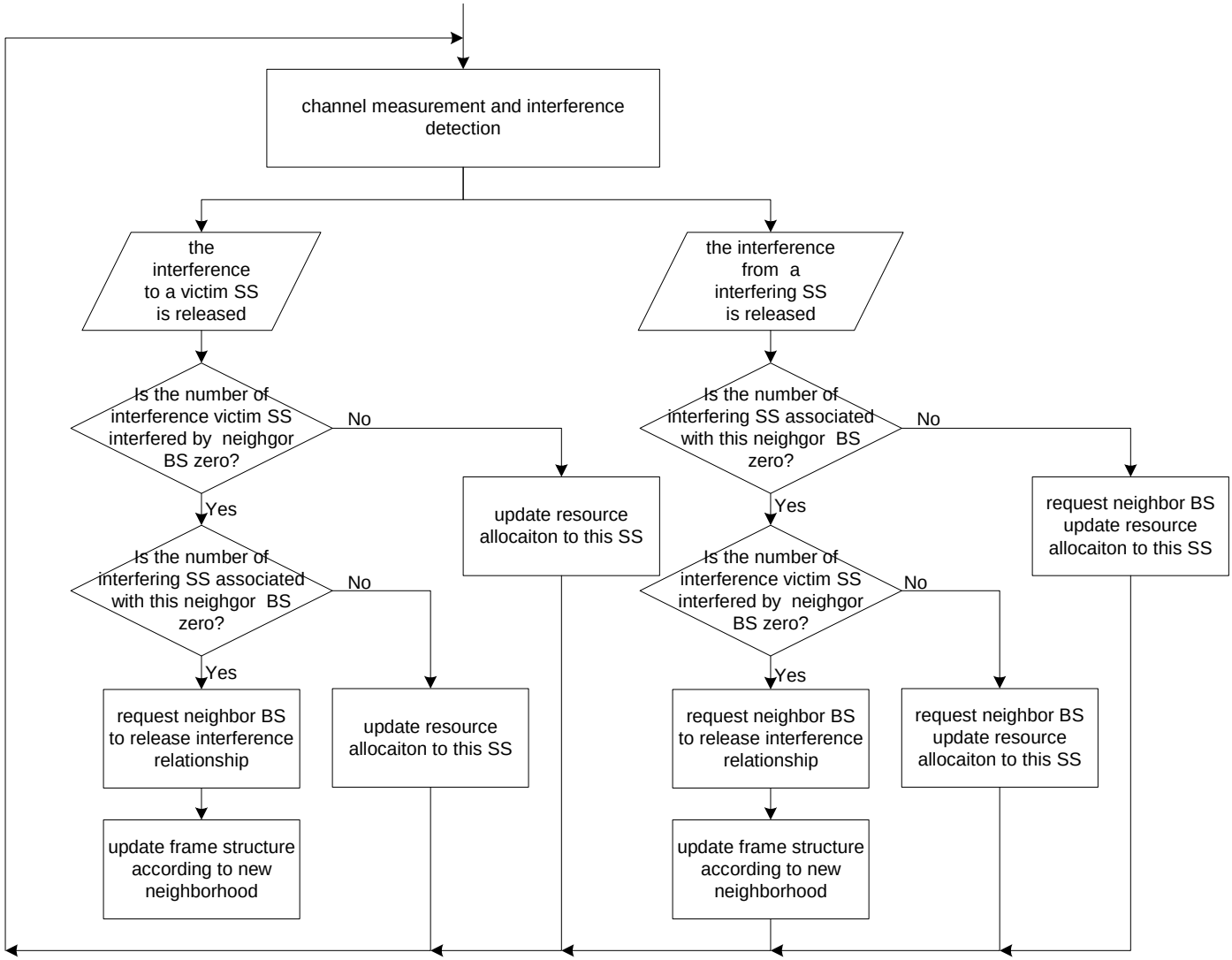

Figure hxx-b procedure in the operating stage

15.3.3 Information table

15.3.3.1 Information table in distributed database

Table h7 – Information table for the system inside the neighborhood or community

Syntax	Size	Notes
BS information table(){		
Index	16bits	
BSID	48bits	
Operator ID	?bits	
RTK	16bits	Random Temporary Key
IP version	1bit	IPv4 IPv6
if (IP version = 0){		
CXPRX IPv4 address	32bits	CXPRX IPv4 address
}		
Else{		
CXPRX IPv6 address	128bits	CXPRX IPv6 address
}		
Sector ID	8bits	
Extended Channel Number (ExChNr)	16bits	2 byte base reference to frequency range or deployment band. This reference maps to an absolute frequency value.
Base Channel Reference (BaseChRef)	8bits	1 byte specific channel number reference
Channel spacing (ChSp)	16bits	2 bytes channel spacing value (10kHz increments)
OCSI ID	8bits	CSIN of OCSI allocation
Negotiation status	8bits	Bit0: get communication in the IP network Bit1: be registered in Bit2: registered to Bit3: done for resource sharing (if coexistence neighboring) Bit4-7: tbc.
~~Coexistence neighboring~~	~~1bit~~	~~Coexistence neighbor with this BS?~~ ~~1 yes~~ ~~0 no~~
BS GPS coordinates	TBD	GPS coordinates of this Base Station
BS RF antenna sector ID	8bits	Identifier of antenna creating this sector
BS nominal EIRP	TBD	Nominal EIRP of this Base Station
BS PSD Vector	TBD	PSD as determined by this BS of all available channels using RSSI scanning process
BS antenna azimuth	TBD	Azimuth orientation of this Base Station's antenna
BS antenna beamwidth	TBD	Azimuth Beam width of this Base Station's antenna
~~If (Coexistence neighbor){~~		
~~Number of victim SSs~~	~~16bits~~	~~n: The number of victim SSs of this coexistence neighbor, in this system~~
~~For (i = i; i <= n; i++) {~~		
~~SSID~~	~~48bits~~	
~~RSSI~~	~~16bits~~	~~1byte RSSI mean (see also 8.2.2, 8.3.9, 8.4.11) for details) 1byte standard deviation~~
~~}~~		
~~(Tbc.)~~	~~(Tbc.)~~	~~(Tbc.)~~
~~}~~		
Number of Coexistence neighbors	8 bits	m: The number of coexistence neighbors of this BS
for (i= 0~~1~~; i <~~=~~ m; i++) {		
Neighbor BSID	48 bits	BSID of this coexistence neighbor BS
Neighbor BS IP address	32 bits or	IP address of this neighbor BS

	128bits	
Neighbor BS OCSI ID	8bits	The CSIN of this neighbor BS
Neighbor BS CMI ID	4bits	CMI_ID of this neighbor BS
~~Working Channel ID~~	~~16 bits~~	~~Identifier of the working channel of this neighbor.~~
~~Alternative Channel Flag~~	~~1 bit~~	~~Flag indicates this neighbor has one or more alternative channels.~~
~~(Tbc)~~		
~~}~~		
Number of victim SSs	16bits	n: The number of victim SSs in this system which interfered by this coexistence neighbor
For (i = 0; i < n; i++) {		
SSID	48bits	
RSSI	16bits	1byte RSSI mean (see also 8.2.2, 8.3.9, 8.4.11) for details) 1byte standard deviation
Interference resolved	1bits	Has this BS and this neighbor BS resolved DL interference to this SS?
}		
Number of interfering SSs	16bits	q: The number of interfering SSs in this system which cause interference to this coexistence neighbor
for (i = 0; i < q; i++) {		
SSID	48bits	
RSSI	16bits	1byte RSSI mean (see also 8.2.2, 8.3.9, 8.4.11) for details) 1byte standard deviation
Interference resolved	1bits	Has the interference caused by this SS been resolved?
}		
Profile(){		
Band		
PHY mode(){		
Modulation		
Working Channel ID	16 bits	Identifier of the working channel of this neighbor.
Alternative Channel Flag	1 bit	Flag indicates this neighbor has one or more alternative channels.
Master Subframe ID	8bits	Sub-frame number: Bit7: sub-frame structure supported not supported supported Bit6: master subframe allocated do not have a master subframe have a master subframe Bit5-3: number of subframes in frame structure Bit2-1: the master subframe index this BS is using.
Alternative Subframe Flag	1bit	Flag indicates this neighbor has one or more ALTSF.
}		
Maximum power	8 bits	dBm
Number of registered SS	12 bits	
}		
}		
~~if (CMI Interval used) {~~		
~~Number of coexistence neighbors~~		
~~For (i=0; i<=n; i++) {~~		~~All Co-existing neighbor BS information. This is the list of foreign BS, which may be causing interference to this BS and its SS~~
~~Foreign BSID~~	~~TBD~~	~~BSID of this foreign BS~~
~~Foreign BS IP address~~	~~TBD~~	~~IP address of this foreign BS~~
~~Foreign BS CMI ID~~	~~TBD~~	~~CMI_ID of this foreign BS~~
~~Number of foreign SSs causing Co-channel interfering~~	~~TBD~~	~~Number of SS associated with this foreign BS causing inter-ference to this BS~~
~~For (j=0; j<=m; j++) {~~	~~TBD~~	~~All SSs associated with this foreign BS, which cause co-channel interference~~
~~Interfering SSID~~	~~TBD~~	~~SS_ID of this SS causing interference to this BS~~
~~CMI Interfering occurrence~~	~~TBD~~	~~Number of instances where interference recorded.~~
~~RSSI of interfering SS~~	~~TBD~~	~~RSSI of this interfering SS~~
~~SS interference resolved~~	~~1bits~~	~~Has the interference caused by this SS been resolved by use of the CXP~~

		~~between this BS and the foreign system?~~
~~}~~		
~~}~~		
}		

Table h8 – Information table for the SSs inside the system containing this database

Syntax	Size	Notes
SS information table(){		
Index	16bits	
SSID	48bits	
SS location	TBD	Optional
SS GPS location	TBD	Optional
SS antenna beam width	TBD	Beam width of this SS antenna
SS nominal uplink EIRP	TBD	Nominal EIRP of this SS
SS PSD vector	TBD	Power Spectral Density determined by the SS by RSSI pro-cess scanning all available channels
Interference status	1bit	Interfered by coexistence neighbor? 1-yes 0-no
If (Interfered){		
Number of source BSs	8bits	n: The number of interference source of coexistence neigh-bor
for (i = 1; i<= n; i++) {		
~~BSID~~	~~48bits~~	
BS_NURBC detected	1bit	1-yes 0-no
If (BS_NURBC detected) {		
IP version	1bit	0- IPv4 1- IPv6
If(IP version = 0){		
CXPRX IPv4 address	32bits	the v4 IP address of the CXPRX reported by the SS
}		
Else{		
CXPRX IPv6 address	128bits	the v6 IP address of the CXPRX reported by the SS
}		
~~IBS~~ BSID	48bits	The BSID reported by SS
RTK	16bits	RTK in the BS_NURBC reported by SS
Sector ID	8bits	Reported by SS
BS EIRP	TBD	EIRP of this neighbor BS as determined from its BSD
BSD occurrence ratio	TBD	Defined as the ratio of demodulated foreign BSD messages to CMI cycles. A metric indicating severity of interference caused by this foreign co-channel BS.
Interference resolution	1 bit	An indication that interference from this foreign BS has been resolved by the CXP.
CMI-ID	TBD	CMI_ID of this foreign BS
Frame number	24bits	Reported by SS
Error Status	8bits	0 -no error 1 - not capable to decode the energy pulse symbol.; 2 - not able to find the eligible <SOF>; 3 - not able to find the eligible <EOF>; 4 - not able to pass the CRC check for message; 5 to 255 - reserved
}		
RSSI	16bits	1byte RSSI mean (see also 8.2.2, 8.3.9, 8.4.11 for details) 1byte standard deviation
}		

}		
~~If (CMI frame used) {~~		
Associated BS ID	TBD	BSID to which this SS is associated
Associated BS RSSI	TBD	Mean RSSI of BS downlink to which this SS is associated
Associated BS RSSI Var	TBD	Variance of RSSI of downlink
Associated BS BER	TBD	BER of downlink
~~Number of foreign BSs~~	~~TBD~~	~~Number of foreign BS this SS has detected via BSD~~
~~For (I=0; I <=n; I++) {~~		
~~Foreign BS ID~~	~~TBD~~	~~BSID of this foreign BS as determined from its BSD~~
~~Foreign BS EIRP~~	~~TBD~~	~~EIRP of this foreign BS as determined from its BSD~~
~~Foreign BS antenna sector ID~~	~~TBD~~	~~Antenna sector ID of this foreign BS as per BSD~~
~~Foreign BS Proxy IP address~~	~~TBD~~	~~Proxy IP address of this foreign BS as per BSD~~
~~Foreign BSD occurrence ratio~~	~~TBD~~	~~Defined as the ratio of demodulated foreign BSD messages to CMI cycles. A metric indicating severity of interference caused by this foreign co-channel BS.~~
~~Interference resolution~~	~~1 bit~~	~~An indication that interference from this foreign BS has been resolved by the CXP.~~
~~CMI ID~~	~~TBD~~	~~CMI_ID of this foreign BS~~
~~}~~		
~~}~~		
}		