Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	Description of the negotiation for sub-frame distribution
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Re:	80216h-06_021： Third Working Group Review: P802.16h Working Document (2006-08-10)
Abstract	Complement for the negotiation for sub-frame distribution, according to the AI in meeting 44#
Purpose	Give description of the process negotiation for sub-frame distribution
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Proposed text about sub-frame distribution optimization

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Overview

The basic idea of sub-frame distribution optimization is quite similar with channel distribution optimization. This mechanism is used when the system fail to allocate a free channel and fail to find a free sub-frame with current sub-frame allocation in the neighborhood.

Before creating a new subframe for itself, the system will try to vacate a subframe by subframe distribution optimization in the neighborhood or other community. If this step succeed, it is obviously better than creating a new subframe counting on the over all efficiency in the community. We talk about optimization inside neighborhood only the existing working document 802.16h-06_015r1.

A action item was called in last meeting to give some detail illustration of the negotiation process during the sub-frame distribution optimization. And some proposed text is give below according to this scope.

Reference:

[1] *IEEE 802.16h-06/019: 802.16h License-Exempt Task Group Meeting Minutes (2006-08-08)*

[2] *IEEE 802.16h-06/015r1: Working Document for P802.16h (2006-08-01)*

[3] *IEEE 802.16h-06/021: Third Working Group Review: P802.16h Working Document (2006-08-10)*

[4] *C802.16h-06/053:* Proposed text about sub-frame distribution optimization *(2006-07-10)*

Proposed Text

15.4.2.2 Sub frame distribution optimization

When WirelessMAN-CX system have to share one channel with its neighbor system, it shall allocated a subframe as its master subframe. By checking the information table (see 15.3.3), if it can find some subframes free in any channel it can take up in its neighborhood, it can randomly choose one of them as it's master subframe and start operation.

When not able to find a free subframe currently, the system shall check in any of it capable channel if there is some subframe on which all the neighbor systems using it as the master subframe have alternative subframe (ALTSF). The system can negotiate with the systems occupying one of these subframe to move to there ALTSF and vacate a subframe for itself without change the current structure of WirelessMAN-CX frame.

The system shall check with these kind of subframe one by one and negotiate with its neighbors taking it as its master subframe to move to it's ALTSF before it succeed. If the system succeeded on one of this subframe, it can take this subframe as it's master subframe, otherwise, it means that the system fails in vacating a current subframe as its master subframe by subframe distribution optimization. The figure of procedure to find a current subframe as its master subframe for a system is shown below:

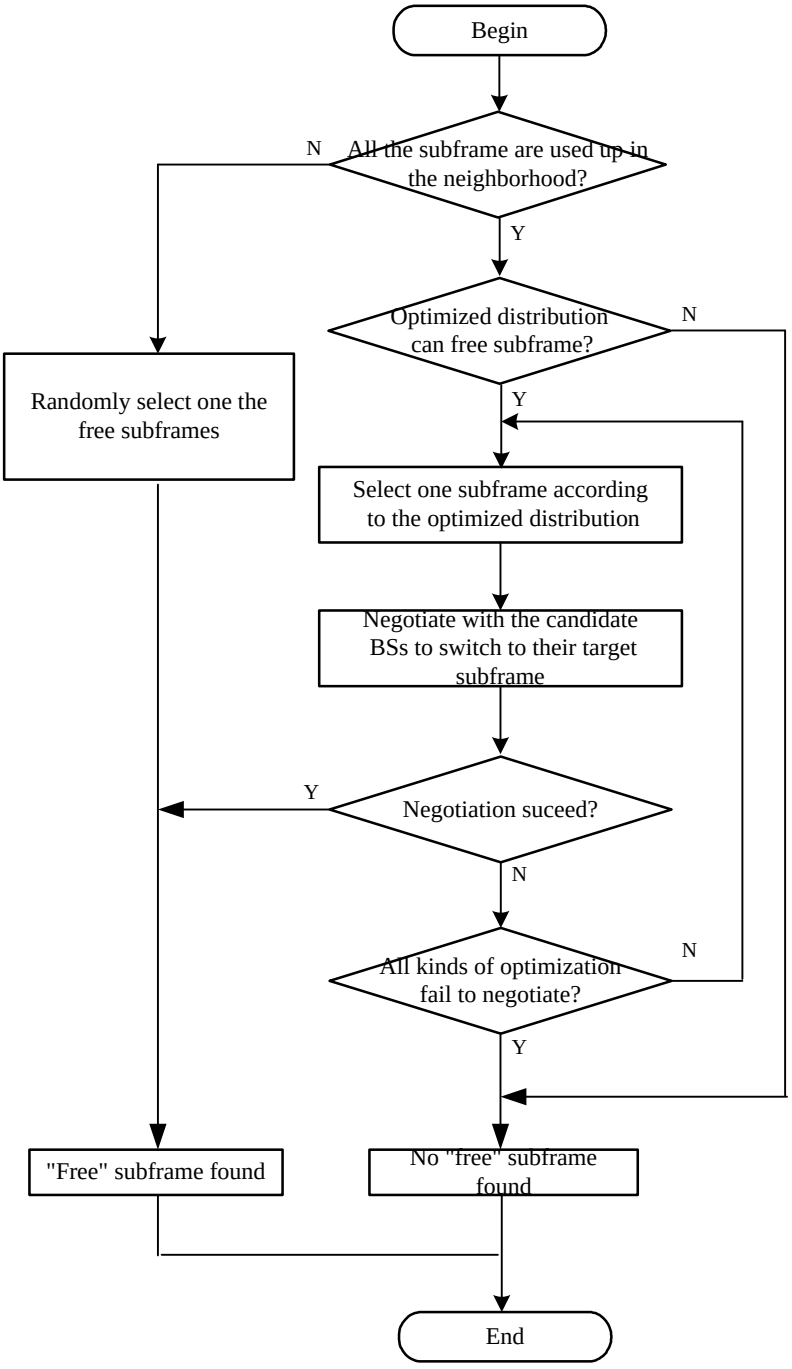

Figure h42—the procedure to find a current subframe as its master subframe

Similar to the channel distribution optimization (see 15.4.1.2), the order of the subframe to be checked maybe counted on the user using it as master subframe.

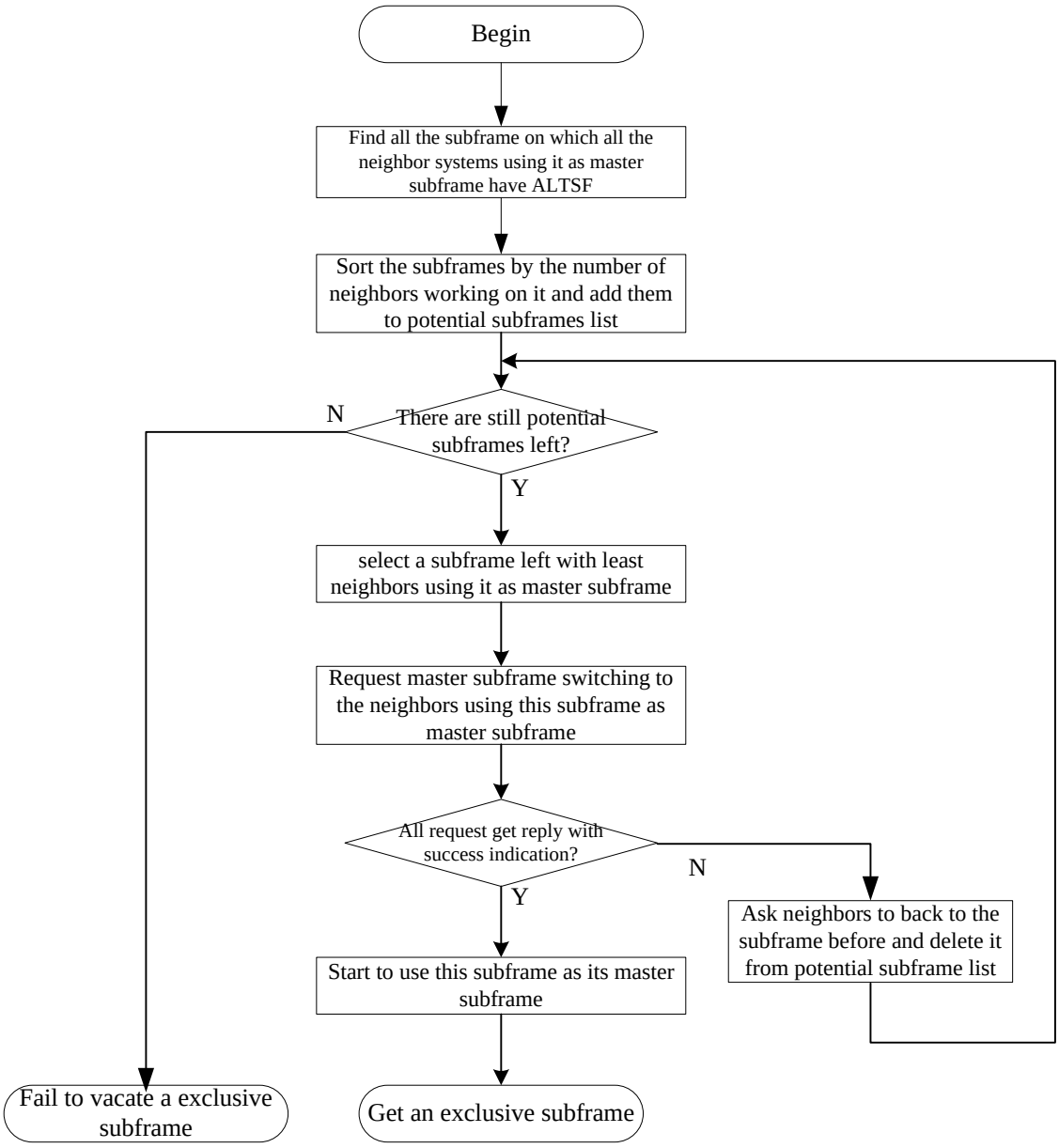

Figure h43 — Process of subframe distribution optimization

Every BSs maintain the status of their ALTSFs for their own. They count up all the vacant subframes which are able to be used as master frame and have the same or larger occupation ratio of the frame. For example, if the working master subframe is one out of 4 subframes in current working channel, and there is vacant subframe out of 3 subframes in another channel in surrounding, the second subframe will counted as one ALTSF. If the second subframe is one out of 4 subframes, it will be counted as ALTSF as well. But if the second subframe is one out of 5 subframes, it will not be counted as ALTSF, since it's worse than the current master subframe. The BSs will count up the number of its ALTSFs by scanning and contacting with all its coexistence neighbor, resource IDs for every ALTSFs are also stored in the database. All the channels which are not usable shall be ignored. These information shall be maintained in the information table in shared database (see table h4).

Using CP message with the systems inside the neighborhood, the BS can learn whether its neighbor have ALTSF and notes down an flag for each neighbor. These information will help the BS to find negotiable neighbor system.

Finding all the subframe on which all the neighbor systems using it as master subframe have ALTSF, the system can sort the subframes by the number of neighbors working on it and add them to potential subframe list. ~~Everytime~~Every time the system should choose a subframe with least neighbors using it as master subframe and negotiate to ~~the~~ these neighbors, requesting the neighbor systems currently using this subframe as its master subframe to switch to one of its ALTSF. If all the request succeed, the system can switch to this channel and start to use this subframe as its master subframe, otherwise the system need to ask all the neighbors to keep using their original subframe. ~~and~~ It shall delete~~d~~ the subframe from the potential subframe list and continue to negotiate on another potential subframe. If all the potential subframes in the list have been checked and no one can be vacated as master subframe of the system, the process of subframe distribution optimization is failed to get a exclusive current subframe as the master subframe for the system.

Table h4/h5/h6 are proposed to be modified as indication:

Proposed modification (table h4 page 65 line 56):

Syntax	Size	Notes
This BS information table(){		
BSID	48bits	
Operator ID	~~?~~24bits	
IP version	1bits	0-IPv4 1-IPv6
if (IP version = 0){		
IPv4 address	32bits	IPv4 address of this BS
CXPRX IPv4 address	32bits	CXPRX IPv4 address
}		
Else{		
IPv6 address	128bits	IPv6 address of this BS
CXPRX IPv6 address	128bits	CXPRX IPv6 address
}		
RTK	16bits	Random Temporary Key
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)
~~Master resource ID~~	~~8bits~~	~~Sub-frame number:~~

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 neighboring) Bit4-7: tbc.
CSI parameter(){		Regulated by region/country
Tcsi_start	16bits	In microseconds
Tcsi_duration	8bits	In microseconds
Period of frames	8bits	frames
Starting frames offset	16bits	frame serial number of the first frame that CSI presented
Length of Symbols	8bits	In microseconds, need to be 1/n of Tcsi_duration
ICSI cycle	8bits	ICSI cycle counted in CSI cycles
OCSI cycle	8bits	OCSI cycle counted in ICSI cycles
}		
Number of CoNBRs	8bits	m:The number of coexistence neighbors of this BS
for (i= 1; i <= m; i++) {		
Index	16bits	Each Index here is referring to a BS in the neighborhood, and points to a set of information described in table h5
BSID	48bits	
~~(Tbc.)~~	~~(Tbc.)~~	~~(Tbc.)~~
}		
Profile(){		
Band		
PHY mode(){		
Modulation		
Working Channel ID	8bits	Identifier of the working channel of this BS.

Master Subframe ID	8bits	Sub-frame number: Sub-frame number Bit7: sub-frame structure supported 0- not supported 1- supported Bit6: master subframe allocated 0- do not have a master subframe 1- have a master subframe Bit5-3: number of subframes in frame structure Bit2-1: the master subframe index this BS are is using.
Number of ~~alternative Channels~~ ALTCH	8bits	p: The number of alternative channels to which this BS can switch without interference.
For(i = 1; i <= p; i++){		
~~Alternative~~ Channel ID for ALTCH	~~16bits~~ 8bits	Identifier of the alternative channel.
}		
Number of ALTSF ~~(Tbc.)~~	8bits	q: The number of ALTSF to which this BS can switch to without interference.
for(i = 1; i <= q; i++){		
Resource ID for the ALTSF	16bits	Bits15-8: Channel ID Bits7-0: Subframe ID
}		
}		
Maximum power	8 bits	dbm
Number of registered SS	12bits	n
for (i = 1; i <= n; i++) {		
Index	16bits	Each Index here is referring to a SS in this system, and points to a set of information described in table h6
SSID	48bits	
~~(tbc.)~~	~~(tbc.)~~	~~(tbc.)~~

}		
~~(tbc.)~~	~~(tbc.)~~	~~(tbc.)~~
}		
}		

Proposed modification(table h5 page 67 line 8):

Syntax	Size	Notes
BS information table(){		
Index	16bits	
BSID	48bits	
Operator ID	?bits	
RTK	16bits	Random Temporary Key
IP version	1bits	0-IPv4 1-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)
~~Master resource ID~~	~~8bits~~	~~Sub-frame number~~
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= 1; i <= m; i++) {		
BSID	48 bits	
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.)	(Tbc.)	(Tbc.)
}		
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 0- not supported 1- supported Bit6: master subframe allocated 0- do not have a master subframe 1- have a master subframe Bit5-3: number of subframes in frame structure Bit2-1: the master subframe index this BS are is using.
Alternative Subframe Flag	1bit	Flag indicates this neighbor has one or more ALTSF.
~~(Tbc.)~~		
}		
Maximum power	8 bits	dbm
Number of registered SS	12 bits	
~~(tbc.)~~	~~(tbc.)~~	~~(tbc.)~~
}		
if (CMI Interval used) {		
Number of coexistence neighbors		
For (i=0; i<=n; i++) {	TBD	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	BS_ID 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 interference 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	1 bit	Has the interference caused by this SS been resolved by use of the CP between this BS and the foreign system?
}		
}		
}		
~~(tbc.)~~	~~(tbc.)~~	~~(tbc.)~~
}		

Proposed modification(table h6 page 68 line 58):

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 process 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 neighbor
for (i = 1; i<= n; i++) {		
BSID	48bits	
BS_NURBC detected	1bit~~s~~	1-yes 0-no
If (BS_NURBC detected){		
IP version	1bit~~s~~	0-IPv4 1-IPv6
(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	~~2~~8bits	Reported by SS
Frame number	24bits	Reported by SS
Error Status	~~2~~8bits	0 -no error 1 - not capable to decode the energe 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
~~(tbc.)~~	~~(tbc.)~~	~~(tbc.)~~
}		
RSSI	16bits	1byte RSSI mean (see also 8.2.2, 8.3.9, 8.4.11 for details) 1byte standard deviation
~~(tbc.)~~	~~(tbc.)~~	~~(tbc.)~~
}		
~~(tbc.)~~	~~(tbc.)~~	~~(tbc.)~~
}		
If (CMI frame used) {		
Associated BS ID	TBD	BS_ID 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	BS_ID 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 CP.
CMI-ID	TBD	CMI_ID of this foreign BS
}		
}		
~~(tbc.)~~	~~(tbc.)~~	~~(tbc.)~~
}		

The following 2 CP messages are proposed to be inserted into 15.5.2 right after 15.5.2.34:

15.5.2.xx Master Subframe Switch Request message

This message is sent by a BS to another coexistence BS in the community to request to switch the master subframe to an ALTSF.

Code:xx

Parameters:

Table hxx – Master Subframe Switch Request message attributes

Attribute	Contents
Operator ID	The Operator identifier of requesting BS.
BSID	The requesting BS identifier
Requested BSID	BS identifier of the requested BS
Channel ID	The current working channel ID of the requested BS
Subframe ID	The current master subframe ID of the requested BS
Rolling back indication	0: to switch master subframe to one of the ALTSF 1: to switch back to the subframe before the last master subframe switching request
FSN	Frame sequence number to switch master subframe

15.5.2.xx Master Subframe Switch reply message

A message sent by BS, reply to Master Subframe Switch Request message indicating the result of the Master Subframe switching.

Code: XX

Parameters:

Table hxx – Master Subframe Switch Reply message attributes

Attribute	Contents

Operator ID	The Operator identifier of requesting BS.
BSID	The requesting BS identifier
Requested BSID	BS identifier of the requested BS
Acknowledge	0: rejection for fail in switching 1: succeeded in switching
Target Channel ID (for new master subframe)	The channel ID of the requested BS will switch to
Target Subframe ID (for new master subframe)	The subframe ID of the requested BS will switch its master subframe to
FSN	Frame sequence number of the master subframe switching