Project	IEEE 802.16 Broadband Wireless Access Working Group <**http://ieee802.org/16**>
Title	Action Item from Session #47: Credit token based coexistence protocol text update
Date Submitted	2007-03-15
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Re:	Working Group Letter Ballot #24a for IEEE P80216h/D2
Abstract	During session # 47, several comments (438, 439, 1053, 1054, 1055, 1056) were made to update and clean up text related to the credit token based coexistence protocol. This contribution addresses these comments by presenting some first proposal of text changes.
Purpose	Action Item from Session #47: Credit token based coexistence protocol text update related to the credit token
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Action Item from Session #47: Credit token based coexistence protocol text update

David Grandblaise
Motorola

Overview

During session # 47, several comments (438, 439, 1053, 1054, 1055, 1056) were made to update and clean up text related to the credit token based coexistence protocol. This contribution addresses these comments by presenting some first proposal of text changes.

Following modifications are proposed as first remedies to the comments, and to make the mechanism simpler while providing more flexibility:

- scalable offering/renting modes:
  - non negotiated
  - negotiated (complexity of procedures has been decreased)

=> let vendor differentiating implementation

- non negotiated: over the air or backhaul based
- negotiated: backhaul based
- put specific algo in Annex
- SATI and SADD removed
- no need MATI/MADD => use existing BSD
- Two pricing methods for negotiated mode (context adaptive)
- Acronym for credit token based coexistence protocol: CT-CXP

Need to be further consolidated in the following areas:

- include ADV-REQ with BSD
- provide new text description for section “CXP Offering Procedure” and section “CT-CXP Requesting Procedure”
- over the air inter BS communications establishement for the CT-CXP non-negotiated mode
- match more precisely with the frame structure onvce frame structure is fixed

Specific editorial changes

This section provides a list of changes to the draft document.

Blue text represents specific editorial additions.

~~Red strikethrough~~ text is to be deleted.

Black text is text already in the draft.

Bold italic text is editorial instructions to the editor.

Proposed text changes

[Update title and text of section 15.4.2.4. as indicate:]

15.4.2.4 Credit token based coexistence protocol (CT-CXP)

In some traffic conditions circumstances, some master subframes are temporally under-used by some BS (offering BS, namely offeror) due to some low traffic activity while some of its neighboring BSs (requesting BS, namely requester) require temporally some additional master sub frame capacity to face some traffic increase. With respect to this, master sub frame sharing between neigbhouring systems contributes for better spectrum efficiency. This master sub frame sharing is supported by the credit token based coexistence protocol (CT-CXP). CT-CXP provides the means for an offeror to rent out temporally some of its master sub frame capacity to some requester(s). CT-CXP guarantees exclusive access of the offeror' unused master subframe resource to the requester(s) for an agreed period between the offeror and the requester. Also, CT-CXP ensures over time a fair access of the offeror's master subframe available resource between competing requesters.

CT-CXP can be instantiated either in a non-negotiated mode or in a negotiated mode. This allows CT-CXP to be flexibly executed as a function of the context (e.g. regulatory spectrum sharing policies, time constraints for negotiation and so forth). The followed approach is flexible in that it allows the implementation of non-negotiated or negotiated (of any types) based CT-CXP, vendor differentiated.

15.4.2.4.1 CT-CXP Procedures

15.4.2.4.1.1 Whole CT-CXP Procedure

A resource unit is defined as the minimum time*frequency unit (e.g., in OFDMA a minimum number of symbol time slots and subcarriers) that can be rented in/out between the offeror and a requester. A master sub-frame is composed of a fixed amount of resource units. The part of the offeror's available master sub-frame to be rented out is named resource. An offeror's resource is defined as an amount of resource units. Let a credit token (CT) be the pseudo monetary unit used by the requester to rent in a resource unit to the offeror. A resource unit is charged as a number of CTs. Each BS is inially assigned with a CT budget, i.e. a max number of CTs.

CT-CXP has two modes:

- Non-negotiated mode: this mode requires the minimum messages exchange to support resource renting/offering between the offeror and requester(s). This mode requires no iteration between the offeror and requester. This mode can be applied when time availability is very limited to handle several iterations for the negotiations and/or when the negotiated mode is executed over the air through over the air inter-BSs communications.
- Negotiated mode: this mode is used when time availability is enough to handle several iterations for the negotiation. This mode is operated through IP network based inter-BSs communications.

CT-CXP is composed of several consecutive procedures (offering advertisement, renting request, iterative negotiation, and resource allocation) as shown in Figure hx. For the sake of simplicity, this figure is only depicted for one (among multiple) requesters. The corresponding messages exchange between the offeror and the requester for each of the procedures is described in Figure hx. MAC

messages related to the over the air based inter-BSs communications implementation of the negotiated mode are specified in section 6.3.2.3. CXP messages related to IP network based inter-BSs communications implementation of the non-negotiated and negotiated modes are specified in section 15.5.1. This offering advertisement message specifies which mode (non-negotiated or negotiated) is used by the CT-CXP in each specific context. The iterative negogiation procedure is executed only with the negotiated mode and not with the non-negotiated mode.

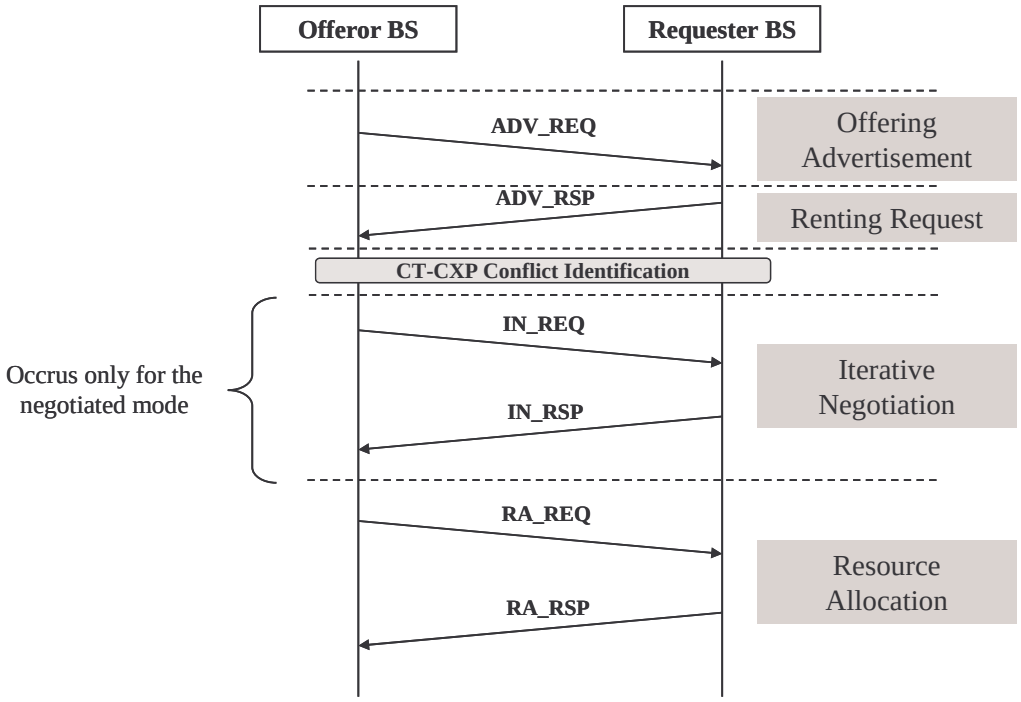


Figure hx: Whole CT-CXP Procedure

The details of these procedures are specified in subsections hereafter.

15.4.2.4.1.2 CT-CXP Offering Procedure

[updated text to be added here]

15.4.2.4.1.3 CT-CXP Requesting Procedure

[updated text to be added here]

15.4.2.4.2 CT-CXP conflict identification

Process of Figure hy aims at identifying the possible coexistence conflicts that could appear if the renting between an offeror and a (or several) requester(s) occur. This process is done prior the offeror actually grants its offered resource to the requester(s). If the coexistence conflicts can be resolved, the iterative negotiation, resource allocation and resource granting acknowledgement (Figure hx) are executed. Otherwise, the whole CT-CXP procedure is stopped and the renting will not occur.

Figure hy takes into account of the coexistence conflicts between the master sub-frames operated by a same operator, or by different operators.

After the offeror has advertised about an offering period to rent out resource, and after some requesters have expressed their interest to rent the resource in this period, the identification of the interference in

the proposed renting period starts. Each of these requesters follows the interference detection process described in the flowchart. Based on the interference detection and identification mechanisms of sections 15.3 and 15.4, each requester is able to know if it is interfering some other master sub-frames (not the one under consideration for renting). With respect to this, it can know if there are some coexistence conflicts. In case the conflict is with a master sub-frame operated by the same operator, this operator can check if the interfered master sub-frame can have the same time duration and starting time as the one proposed for renting. In that case, coexistence conflicts disappear. In case the conflict is with a (or several) master sub-frames operated by a (or several operators), it is checked if the interference level in these master sub-frames is acceptable. If not, coexistence conflicts cannot be resolved, and the renting process is stopped. In case this interference level is also acceptable for these other operators, the process goes on. The next step consists in checking if the requester system can support any interference originated from these master sub-frames. If the requestor system can support this interference, coexistence conflicts can be hndled and remaining procedures of CT-CXP can be pursued.

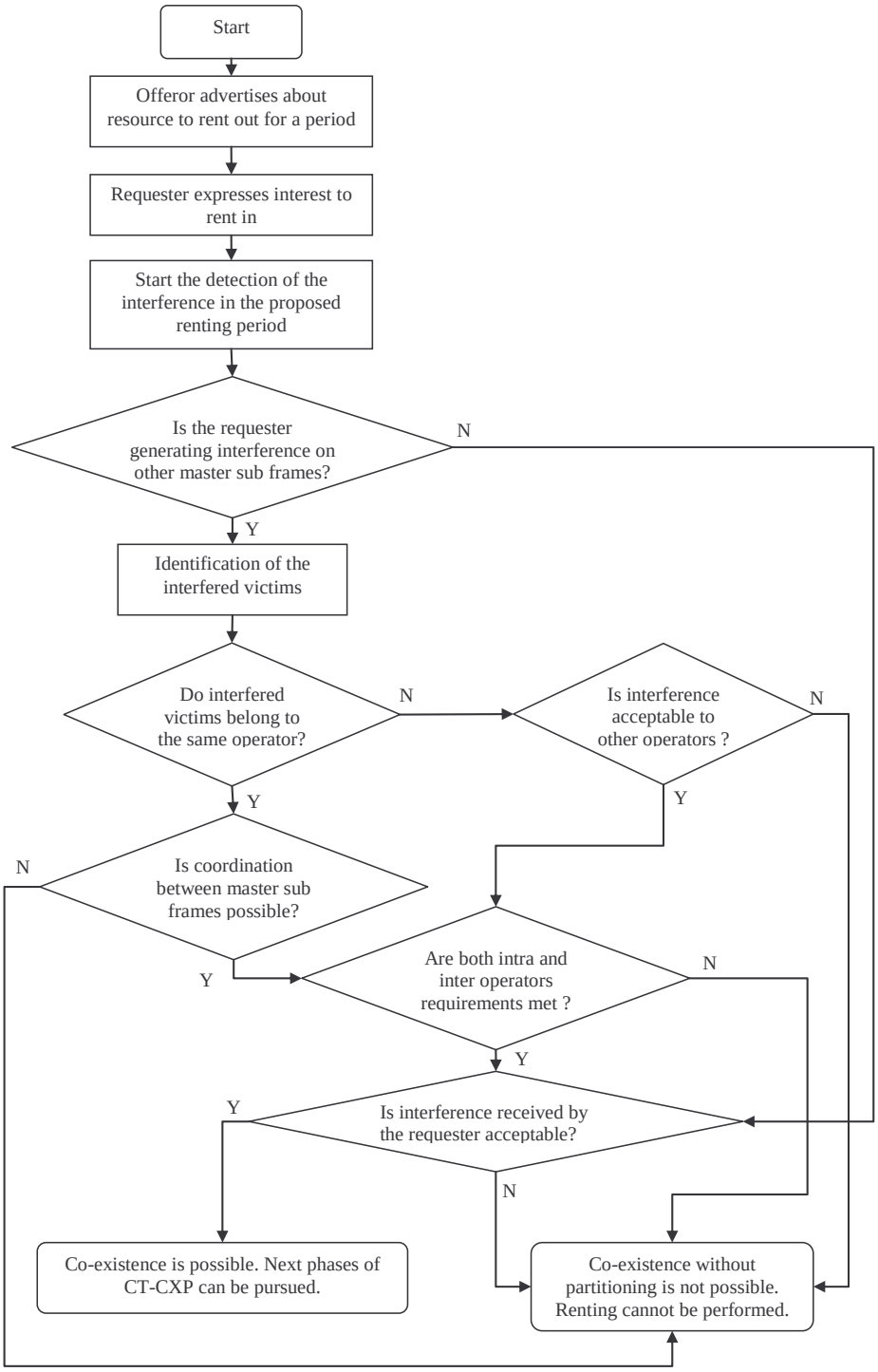


Figure hy: CT-CXP renting conflicts identification

15.4.2.4.3 Inter BSs communications for CT-CXP

~~The credit token based mechanisms~~CT-CXP (~~section *15.4.2.4.3*~~section *15.4.2.4*) requires inter BSs communication between different systems. This inter BS communications is necessary to exchange the parameters (Table h12) related to the CT-CXP procedures.~~credit token based negotiation cycle~~.

~~The primitive parameters include: T_{Start}, T_{end}, $T_{End\_Renting}$, $T_{Start\_Renting}$, $T_{Start\_Negotiation}$, $T_{End\_Negotiation}$, T_{Msf}, MRCTN, id_k, $BS\_CT^{(n)}{}_k$, $frac_k$, T_{Start_k}, T_{End_k} and LC.~~

~~The derived parameters include: TS_m, $\{id^{(n)}{}_{k,m}\}_{selected}$, $Pmin^{(n)}{}_m$, $Pmax^{(n)}{}_m$.~~

The ~~se~~ parameters related to CT-CXP (Table h12) are stored into the BSIS and into the local database of each WirelessMAN-CX BS of the shared distributed system architecture (section 15.1.6).

The exchange of these parameters between BSs is supported through IP network inter-BS communications for the negotiated and non-negotiated modes. The related CXP messages are defined in section 15.5.1.

The exchange of these parameters between BSs is also supported with over the air communications (section 15.4.2.4.6) for the non-negotiated mode. The related MAC messages are defined in section 6.3.2.3.

~~The information exchange about these parameters between these databases and the RADIUS/BSIS servers is performed by IP based wired using the coexistence protocol (CXP). This inter BS communication is supported by the inter system messages defined in the shared distributed system architecture (section *15.1.6*).~~

~~The inter BS communications to support the messages related to the awareness/advertisement sequence of the credit tokens based coexistence protocol can also be implemented by secured over the air mechanisms described in section *15.4.2.4.6*.~~

15.4.2.4.4 ~~Sharing opportunities Advertisement Discovery~~Over the air CT-CXP for non-negotiation mode

The over the air inter-BSs communications for the non-negotiated mode are established when IP network based inter-BSs connections cannot be established between the offer or and the requester(s).~~In case no backhaul exits, or in case backhaul is not operational, or in case BSIS is not valid or in to facilitate inter BSs communications, over the air signaling for the first phase (advertisement) of the negotiation cycle would be also of great support to facilitate radio resources sharing opportunities discovery between WirelessMAN-CX systems themselves, but also between WirelessMAN-CX systems and non-WirelessMAN-CX systems. This section describes discovery messages and procedures so that:~~ The non-negotiated mode procedures supported over the air include the offering advertisement, renting request and resource allocation procedures of Figure hx.

Offering advertisement, renting request and resource allocation procedures

During the offering advertisement procedure, the MAC ADV-REQ message is broadcast by the offeror in interval x within CXCC. Slave SSs in the overlapped (master/slave) systems area listen to the interval x within CXCC.

~~- Master BSs can advertise periodically to the neighboring slave BSs about their offers of radio resources for renting. This enables the slave BSs to be aware of master BSs' offers.~~

~~- Slave BSs can inform periodically the surrounding systems about their search of radio resources sharing opportunities for renting. This enables slave BSs to inform the master BSs that they are looking for temporally some additional radio resources.~~

~~Specific master BS and slave BS downlink time intervals are used to support the over the air advertisement discovery messages in support of the credit token based negotiation. These time intervals are respectively named MATI (Master Advertisement Time Interval) and SATI (Slave Advertisement Time Interval).~~

~~**Usage of MATI and SATI within CXCC**~~

~~The usage of MATI is~~

- ~~The MATIs are dedicated to master BS transmissions in downlink.~~
- ~~Each MATI is used by a master BS in downlink for broadcasting. At a given time, each MATI can only be used by a single BS within the coexistence neighborhood.~~
- ~~Each master BS can use any MATI provided it is not already used by any other BS of the coexistence neighborhood.~~
- ~~MADD (Master Advertisement Discovery Descriptor) message is sent in MATI (Section 6.3.2.3.64).~~
- ~~Each master system releases the MATI it is using when its negotiation starting time has elapsed. This enables new arriving master systems to use this MATI to advertise incoming radio resource reuse opportunities.~~

~~The usage of SATI is:~~

- ~~The SATIs are dedicated to slave BS transmissions in downlink.~~
- ~~Each SATI is used by a slave BS in downlink for broadcasting. Each SATI can only be used by a single BS among the coexistence neighborhood.~~
- ~~Each slave BS can use any SATI provided it is not already used by any other slave BS of the coexistence neighborhood.~~
- ~~SADD (Slave Advertisement Discovery Descriptor) message is sent in SATI (Section 6.3.2.3.65).~~

The over the air inter BSs communications establishment between the offeror and requester for the renting request and resource allocation procedures are established follow up the mechanisms based on relays as described in section y. Once the offeror-requester communication is established between the offeror and requester, the ADV-RSP, RA-REQ, RA-RSP MAC messages are transmitted.

A "master" SS is a SS belonging to ~~a~~ the master system acting as the offeror. A "slave" SS is a SS belonging to the~~a~~ slave system acting as the requester.~~.~~

~~The MATI and SATI time positions are known by the "master" and "slave" SSs within CXCC.~~

~~There are no direct RF communications between the master and slave BSs.~~ Follow up the mechanisms described in section y, the~~The master~~offeror-requester~~slave~~ BS communications are performed via master and slave SSs which act as ~~RF bridges~~relays ~~-~~to convey the information as follows:

— A "slave" SS performs the ~~RF bridge~~relay between its home BS and the foreign master BS (~~provided the coverage of the master system overlaps with the slave system area, and~~ this slave SS is located in the offeror/requester overlapping area). Once the communication is established, the requester sends the ADV-RSP and RA-RSP messages.

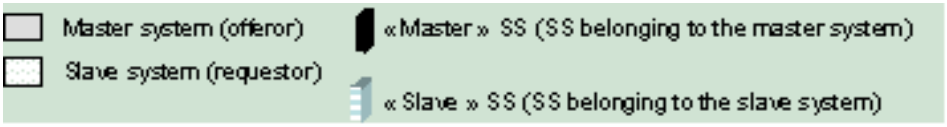
— A "master" SS performs the RF ~~bridge~~relay between its home BS and the foreign slave BS (~~provided the coverage of the slave system overlaps with the master system area, and~~ this master SS is located in the offeror/requester overlapping area). During this communication establishement, the offeror sends the RA-REQ message.

~~Slave SSs in the overlapped (master/slave) systems area listen *to the MATIs. Master SSs in the overlapped (master/slave) systems area listen to the SATIs.*~~

~~15.4.2.4.6.1 **Mechanisms enabling the discovery and the exploitation of the master systems originated advertisement discovery messages by the slave systems**~~

Discovery and exploitation of the offeror's originated ADV-REQ by slave systems

This paragraph describes the mechanisms enabling the discovery and the exploitation of ~~the master systems originated advertisement discovery messages by~~ADV-REQ message by the slave systems. The terminology used in the following is:



These mechanisms are described by the different steps as illustrated in the following:

~~1~~ *Policy instructions to the slave SSs by their home BS*

Figure h59—Policy instructions to the slave SSs by their home BSs

- During this step, prior to any ADV-REQ message has been sent, the slave BS initially instructs (by broadcasting) its SSs about the behaviors they have to adopt when some of these SSs receive~~get~~ ~~the~~ ADV_REQ messages. ~~from the different MATIs.~~

- The behavior is instructed by the ADPD (Advertisement Discovery Policy Descriptor) message (section *Advertisement* Discovery Policy Descriptor (ADPD) message) that specifies whether~~when~~ some

slave SSs (located in the overlapped area of this slave system and surrounding master systems and receiving ~~MADD~~ ADV-REQ message from master BS) associated to this slave BS have to forward ADV-REQ message toward this slave BS. ~~the MADD message received within MATI.~~

- The slave SSs that can hear ADV-REQ~~the MATIs~~ and meeting the requirements sent in ADPD are the only SSs that are allowed to act as relays~~make the RF bridge~~ between the master and slave systems. This means, the policy rules the transmissions from any slave SS towards the slave BS when these SSs are mandated to minotor ADV-REQ.~~get feedback about the MATIs proposals.~~ This mechanism avoids having incessant transmissions from the slave SSs towards the slave BS when ADV-REQ proposal does not meet the requester's need.~~the MATIs are not aligned with the slave BSs strategy. This saves bandwidth.~~ Any policy can be established. Moreover, the policy can be adapted dynamically in time by the requester~~slave BS~~.

~~2~~ *Detection and identification of ADV-REQ~~the MATIs~~ content by the slave SSs*

Figure h60—Detection and identification of ADV-REQ~~the MATIs~~ content by the slave SSs

- During this step, the slave SSs in the overlapping area between the master system and their home system monitor any ADV-REQ message sent within interval x within CXCC. ~~listen to the different MATIs sequentially. For each master system, these slave SSs can get the information sent out in the MADD message (Section *6.3.2.3.64*).~~

- Provided the received ADV-REQ~~MADD~~ and ADAP (section *Advertisement* Discovery Policy Descriptor (ADPD) message) messages information, the slave SS is able to decide whether it has to transmit this information to its home BS or not.

~~3~~ *Relaying of the ADV-REQ message~~MATIs~~ content by the slave SSs to their slave system*

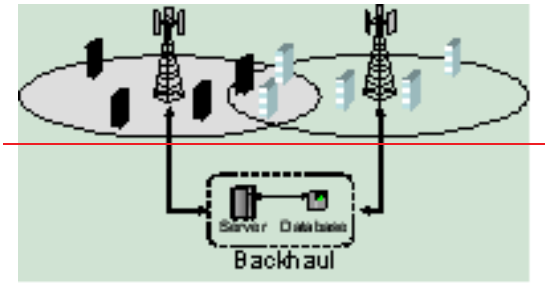
Figure h61—Relaying of the ADV-REQ message~~MATIs~~ content by the slave SSs to their home system

- In case the policy requirements are met, the information collected by the slave SS is conveyed to their home BS. The information the slave SS sends to its home BS is the content of the ~~MADD~~ ADV-REQ message.

- In order to ensure this information is appropriately received by the slave BS, the information could be sent out by several slave SSs (e.g. 2 slave SSs circulate this information to the slave BS in ~~R~~relaying of the ADV-REQ message~~MATIs~~ content by the slave SSs to their slave system~~-~~). ~~This ensures both reliability and security check.~~

~~Note:~~ In case the ~~policies requirements~~renting conditions sent in ADAP message ~~-~~are not met, the slave SSs do not transmit the information. However, it would be possible for the slave SS to convey the information about the list LC (~~message~~ parameter included in ADV-REQ~~MADD~~) to its home BS since it will provide it some further information about other radio resources renting opportunities on other channel (frequency domain). This decision to send the LC information can be ruled by the policy also.

~~4- Master BS - Slave BS communication through the backhaul~~



~~Figure h62—Master-Slave BS communication through the backhaul~~

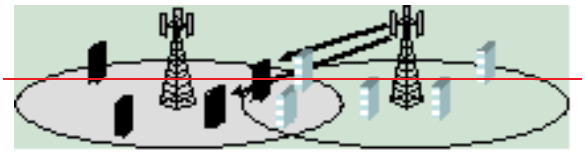
~~After step 3, the slave BS knows the IP_Proxy_address_M (Section *6.3.2.3.64*) associated to the master system. Accordingly, the communications between master and slave systems (BSs) is performed through the backhaul to make the negotiation (*Figure h 62*) with the coexistence protocol (CXP). The remaining phases of the credit token based negotiation cycle is performed via this backhaul with IP based communications using server(s) and database(s).~~

~~15.4.2.4.6.2~~ Mechanisms enabling the discovery and the exploitation of the slave systems originated requests discovery messages by the master systems

~~This paragraph describes the mechanisms enabling the discovery and the exploitation of the slave systems originated request discovery messages by the master systems. The terminology used in the following is the same as in the previous paragraph.~~

~~These mechanisms are described by the different steps illustrated as follows:~~

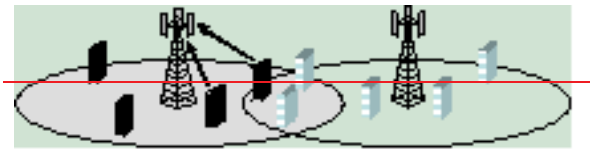
~~1- Detection and identification of the SATIs content by the master SSs~~



~~Figure h63—Detection and identification of the SATIs content by the master SSs~~

~~During this step (*Figure h 63*), the master SSs in the overlapping area of the master system and their slave system listen to the different SATIs sequentially. For each slave system, these master SSs can get the information contained in the SADD message.~~

~~2- Relaying of the SATIs content to the master system by the master SSs~~

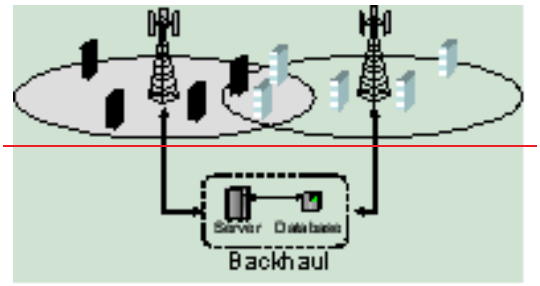


~~**Figure h64—Relaying of the SATIs content to the master system by the master SSs**~~

~~- The SADD message information is reported by the master SS to its master system (*Figure h 64*).~~

~~- In order to ensure this information is appropriately received by the master BS, the information is sent out by several masters (e.g. 2 master SSs convey this information to the master BS in *Figure h 64*). This ensures both reliability and security check.~~

~~3- Master BS - Slave BS communication through the backhaul~~



~~**Figure h65—Master BS - Slave BS communication through the backhaul**~~

~~After step 2, the master BS knows the IP_Proxy_address_S (Section *6.3.2.3.65*) of the slave system. Accordingly, the communications between master and slave systems (BSs) is performed through the backhaul to make the negotiation (*Figure h 65*) with the coexistence protocol (CXP). The remaining phases of the credit token based negotiation cycle is performed via this backhaul with IP based communications using a server and database.~~

4. Abrevations and acronmys

[Add following acronym to the list as indicate:]

CT-CXP Credit Token based Coexistence protocol

6.3.2.3 MAC management messages

[Update Table page 8 as indicate:]

Type	Message Name	Message Description	Connection
67	BSD	Base Station Descriptor	Broadcast
68	SSURF	SS Uplink RF Descriptor	Basic
69	ADPD	Advertisement Discovery Policy Descriptor	Broadcast
70~~69~~	ADV-REQ~~MADD~~	~~Master Advertisement Discovery Descriptor~~Advertisement Request	Broadcast

71	ADV-RSP	Advertisement Response	Basic
72	RA-REQ	Resource Allocation Request	Basic
73	RA-RSP	Resource Allocation Response	Basic
~~70~~	~~SADD~~	~~Slave Advertisement Discovery Descriptor~~	~~Broadcast~~
~~71~~	~~ADPD~~	~~Advertisement Discovery Policy Descriptor~~	~~Broadcast~~
74~~2~~	BS_CCID_REQ	Base Station Co-Channel Interference Detection Indication	Basic
75~~3~~	BS_CCID_RSP	Base Station Co-Channel Interference Detection Response	Basic
76~~4~~	CXP-REQ-MAC	Coexistence Protocol Request MAC message	Broadcast
77~~5~~	CXP-RSP-MAC	Coexistence Protocol Response MAC message	Broadcast
78~~6~~	OCSI_MNTR_REQ	CSI monitoring request message	Broadcast
79~~7~~	OCSI_MNTR_RSP	CSI monitoring response message	Basic
80~~78~~-255		reserved	

[Update section 6.3.2.3.64 as indicate:]

6.3.2.3.64~~Master Advertisement Discovery Descriptor (MADD)~~Advertisement Request (ADV-REQ) message

The ~~Master~~ Advertisement ~~Discovery Descriptor (MADD)~~Request (ADV-REQ) message specifies the advertisement discovery information sent out by the master BS (offeror) towards the ~~slave~~ requester's SSs located in the overlapped area of this master system and the surrounding slave systems (requesters). This information is sent out periodically by the offeror ~~master BS in MATI~~ in downlink within the coexistence control channel CXCC. MADD provides the necessary information to these ~~slave~~ requester's SSs to enable then these ~~slave~~ requester's SSs to inform their home BS about radio resources sharing opportunities offered by this ~~master BS~~offeror.

A ~~MADD~~ ADV-REQ message shall include the following parameters:

BSID~~_M~~: ID of the ~~master BS~~offeror.

BS_IP_Proxy_address~~:_M:~~ The Coexistence Proxy IP address of the ~~master BS~~offeror.

~~T~~**Renting_Out_Start**~~TART_TimeM~~: The Starting time of the period opened for renting by the ~~master system~~offeror on that channel. This starting time is identified by a UTC time stamp following the format HH:MM:SS after the transmission of the message.

Renting_Out~~T~~**_End_Time**~~M~~: The Ending time of the period opened for renting by this ~~master system~~offeror on that channel. This ending time is identified by a UTC time stamp following the format HH:MM:SS after the transmission of the message.

~~MR~~MNCT~~N~~: Minimum number of credit tokens per resource~~time~~ unit required by the ~~master BS~~odfferor from each ~~slave BS~~requester so that the ~~master BS~~requester's radio resources can be rented in.

LC: List of alternative channels (in frequency domain) opened for renting by the ~~master~~ offeror system in addition to the channel under consideration..

Table 108ac—~~MADD~~ ADV-REQ message format

Syntax	Size	Notes
ADV-REQ~~MADD~~_Message_Format( ) {		
Management Message Type = 70~~69~~	8 bits	
BSID~~_M~~	48 bits	BSID of the offeror
IP_Proxy_address~~_M~~	variable	TLV specific
~~T_START_M~~Renting_Out_Start_Time	16 bits	Absolute time based on UTC time stamp following the format HH:MM:SS
~~T_End_M~~Renting_Out_End_Time	16 bits	Absolute time based on UTC time stamp following the format HH:MM:SS
~~MRCTN~~MNCT	~~TBD~~16 b its	Minimum number of credit tokens required by the ~~master BS~~offeror
LC	~~TBD~~16 bits	List of other channels (frequency domain) of master system opened for renting
}		

[Delete section 6.3.2.3.65]

[Update section 6.3.2.3.66 as indicate and put it before the above section 6.3.2.3.64 :]

6.3.2.3.66 Advertisement Discovery Policy Descriptor (ADPD) message

The Advertisement Discovery Policy Descriptor (ADPD) message is sent out by the slave BS (requester)~~in SATI~~ in downlink within the coexistence control channel CXCC. ADPD specifies when some ~~slave~~ =SSs associated to the requester (located in the overlapped area of this ~~slave system~~requester and surrounding offerors~~master systems~~, and receiving MADD message from ~~master BS~~the offeror) associated to this ~~slave BS~~requester have to relay toward this ~~slave BS~~requester the MADD messages received within CXCC~~MATI~~. ADPD message shall include the following parameters:

~~T_START_S~~Rent_In_Start_Time: Starting time from which the ~~slave BS~~ requester would be interested to rent in a period opened for renting. For values received below this specified time in ~~MATI~~CXCC, the SSs associated to that ~~slave BS~~requester are not allowed to report MADD content to this BS. This starting time is identified by a UTC time stamp following the format HH:MM:SS after the transmission of the message.

~~T_End_S~~Rent_In_End_Time: Ending time of the period the ~~slave BS~~requester would be interested to rent in. This ending time is identified by a UTC time stamp following the format

HH:MM:SS after the transmission of the message. After this time, the SSs associated to that ~~slave BS~~requester are not allowed to report MADD content to this BS.

MNCT~~RCTN~~_MAX: Maximum admissible number of credit tokens per radio resource unit the ~~slave BS~~offeror will ~~provide~~ engage to get the radio resources offered for renting by the ~~master BSs~~requester. Above this number of tokens, the SSs associated to that ~~slave BS~~requester are not allowed to report MADD content to this BS.

Table 108ae—ADPD message format

Syntax	Size	Notes
ADPD_Message_Format( ) {		
Management Message Type = ~~71~~72	8 bits	
~~T_START_S~~Renting_In_Start_Time	16 bits	Absolute time based on UTC time stamp following the format HH:MM:SS
~~T_End_S~~ Renting_In_End_Time	16 bits	Absolute time based on UTC time stamp following the format HH:MM:SS
~~RCTN~~MNCT_MAX	16 bits	
}		

[Add new section 6.3.2.3.x as indicate below:]

6.3.2.3.x Advertisement Response (ADV-RSP) message

In response to ADV-REQ, each requester responds to the offeror with the Advertisement Response (ADV-RSP) message to mention its interest to rent totally or a fraction of the resource offered by the offerorfor the total or a portion of the proposed renting period.

A ADV-RSP message shall include the following parameters:

Requester's bid: number of credit tokens per resource unit bided by the requester in response to the offeror.

Rented Resource Amount: amount of the offeror's resource the requester is interested to rent in.

Renting_Out_Start_Time: start time from which the requester is interested to rent in, and for which the requester's bid applies for.

Renting_in End_Time: end time from which the requester is interested to rent in, and for which the requester's bid applies for.

Table 108ac—ADV-RSP message format

Syntax	Size	Notes
ADV_RSP_Message_Format( ) {		
Management Message Type = 71	8 bits	
Requester's bid	48 bits	number of credit tokens per resource unit bided by the requester in response to the offeror.

Rented Resource Amount	variable	amount of the offeror's resource the requester is interested to rent in.
Rent in Start Time	16 bits	Absolute time based on UTC time stamp following the format HH:MM:SS
Rent in End Time	16 bits	Absolute time based on UTC time stamp following the format HH:MM:SS
}		

[Add new section 6.3.2.3.x as indicat below:]

6.3.2.3.x Resource Allocation Request (RA-REQ) message

In response to ADV-REQ, the Resource Allocation Request message informs each requester whether he is granted with the resource he bidded for. Each granted requester is informed about the credit token price.

A RA-REQ message shall include the following parameters:

Requester's bid: number of credit tokens per resource unit bided by the requester in response to the offeror.

Rented Resource Amount: amount of the offeror's resource the requester is interested to rent in.

Renting_Out_Start_Time: start time from which the requester is interested to rent in, and for which the requester's bid applies for.

Renting_in End_Time: end time from which the requester is interested to rent in, and for which the requester's bid applies for.

Table 108ac—RA-REQ message format

Syntax	Size	Notes
RA_REQ_Message_Format( ) {		
Management Message Type = 72	8 bits	
Resource Granting	2 bits	number of credit tokens per resource unit bided by the requester in response to the offeror.
Credit Token Price	16 bits	amount of the offeror's resource the requester is interested to rent in.
}		

[Add new section 6.3.2.3.x as indicat below:]

6.3.2.3.x Resource Allocation Response (RA-RSP) message

In response to RA-RSP, the Resource Allocation Response message is sent out by each granted. In this message, the granted requester accepts or rejects to use the resource at the proposed credit token price.

A RA-REP message shall include the following parameters:

BSID: BSID of the requester

Acceptation bit flag: flag ==0 if requester accepts the resource at the proposed price, otherwise flag ==1 (reject).

Table 108ac—RA-RSP message format

Syntax	Size	Notes
RA_RSP Message_Format( ) {		
Management Message Type = 73	8 bits	
Resource Granting	2 bits	number of credit tokens per resource unit bided by the requester in response to the offeror.
Credit Token Price	16 bits	amount of the offeror's resource the requester is interested to rent in.
}		

15.5 Messages for WirelessMAN-CX

15.5.1 Coexistence Protocol (CXP) messages (CXP-REQ/CXP-RSP)

[Update messages in Table h11 as indicate:]

Table h11—CXP message codes

Code	CXP Message Name	CXP Message Type	Protocol type	Direction
35	Advertisement Request	CXP-REQ	TCP	BS->BS
36	Advertisement Reply	CXP-RSP	TCP	BS->BS
37	Iterative Negotiation ~~Process~~ Request	CXP-REQ	TCP	BS->BS
38	Iterative Negotiation ~~Process~~ Reply	CXP-RSP	TCP	BS->BS
39	~~Credit Token Proposal~~Resource Allocation Request	CXP-REQ	TCP	BS->BS
40	~~Credit Token Proposal~~Resource Allocation Reply	CXP-RSP	TCP	BS->BS

~~41~~	~~Negotiation Results Request~~	~~CXP-REQ~~	~~TCP~~	~~BS ->BS~~
~~42~~	~~Negotiation Results Reply~~	~~CXP-RSP~~	~~TCP~~	~~BS ->BS~~
~~43~~	~~Granting Request~~	~~CXP-REQ~~	~~TCP~~	~~BS ->BS~~
~~44~~	~~Granting Reply~~	~~CXP-RSP~~	~~TCP~~	~~BS ->BS~~
~~45~~41	Coexistence Conflict Identification Request	CXP-REQ	TCP	BS->BS
~~46~~42	Coexistence Conflict Identification Reply	CXP-RSP	TCP	BS->BS
~~47~~43	Intra Operator Coexistence Coordination Request	CXP-REQ	TCP	BS->BS
~~48~~44	Intra Operator Coexistence Coordination Reply	CXP-RSP	TCP	BS->BS
~~49~~45	Inter Operator Coexistence Coordination Request	CXP-REQ	TCP	BS->BS
~~50~~46	Inter Operator Coexistence Coordination Reply	CXP-RSP	TCP	BS->BS
~~51~~47	Final Coexistence Decision Request	CXP-REQ	TCP	BS->BS
~~52~~48	Final Coexistence Decision Reply	CXP-RSP	TCP	BS->BS

[Update Table h12 as indicate:]

Table h12—TLV types for CXP payload

Type	Parameter Description	Length (bytes)	Comment
34	~~T_{Start} *[Notes: For Credit Token till 48]*~~Renting out Start Time	2	In microsecond
35	~~T_{End}~~Renting out End Time	2	In microsecond
x	CT-CXP mode flag	1	
x	Credit Token Pricing Method	1	
36	~~$T_{Start\ Renting}$~~	~~2~~	~~In microsecond~~
37	~~$T_{End\ Renting}$~~	~~2~~	~~In microsecond~~
38	~~MRCTN~~MNCT	2	In number of credit token
39	~~$T_{Start\ Negotiation}$~~Start Negotiation Time	2	In microsecond
40	~~$T_{End\ Negotiation}$~~ End Negotiation Time	2	In microsecond
41	~~BS_CT~~Requester's bid	2	In number of credit token
42	~~frac~~Rented Resource Amount	2	Scalar
43	~~$T_{Start\ proposal}$~~Rent in Start Time	2	In microsecond
44	~~$T_{End\ proposal}$~~Rent in End Time	2	In microsecond
45	~~Pmin~~Minimal Payoff	2	In number of credit token
46	~~Pmax~~Maximal Payoff	2	In number of credit token
47	~~Pr~~	~~2~~	~~In number of credit token~~

48	~~Credit token transaction confirmation~~Resource Grannting	1	
49	~~Resource usage confirmation~~Credit Token Price	1	
50	~~Resource usage confirmation notification~~Acceptation bit flag	1	
51	BSID Interfered	1	
52	Intra Operator Coexistence Coordination Status	1	1 - Acceptance 2 - Rejection
53	Inter Operator Coexistence Coordination Status	1	1 - Acceptance 2 - Rejection
54	Coexistence Decision Status	1	1 - Acceptance 2 - Rejection

[Replace section 15.5.1.35 text by the text below:]

15.5.1.35 Advertisement Request

The offerer sends this broadcast message to advertise to the surrounding future potential requester candidates that it offers temporally resource for renting.

Code: 35

Attributes as shown in Table h35.

Table h35— Advertisement Request message attributes

Attributes	Contents
BSID	BSID of the offeror.
Renting out Start Time	Starting time of the renting period. It is the time from which the offered resource is opened for renting.
Renting out End Time	Ending time of the renting period. It is the time till which the offered resource is opened for renting.
CT-CXP mode flag	This flag specifies whether CT-CXP non-negotiation mode is active or not. 0 - non-negotiation mode is inactive (negotiation mode is active) 1 - non-negotiation mode is active (negotiation mode is not active)
Start Negotiation Time	If CT-CXP mode flag == 0, this field specifies the time from which the negotiation will start.
End Negotiation Time	If CT-CXP mode flag == 0, this field specifies the time from which the negotiation will end.
Credit Token Pricing Method	If CT-CXP mode flag == 0, this field specifies the CT-CXP pricing method applicable to the negotiation mode. Pricing methods are specified by the following: 00 – CT are transferred from the requester's

	CT budget to the offeror's one. 01 – CT are not transferred from the requester's budget to the offeror's one., but CT are not usable by this requester for a given time period (the freezing time period). 10-11: reserved
MNCT	Minimum number of credit tokens required per resource unit by the offeror for the renting.

[Replace section 15.5.1.36 text by the text below:]

15.5.1.36 Advertisement Reply

Each requester responds to the offeror with an Advertisement Reply message mentioning its interest to rent totally or a fraction of the resource offered by the offerorfor the total or a portion of the proposed renting period.

Code: 36

Attributes as shown in Table h36.

Table h36— Advertisement Reply message attributes

Attributes	Contents
BSID	BSID of the requester
Requester's bid	Number of credit tokens per resource unit bided by the requester.
Rented Resource Amount	Amount of the offeror's resource the requester is interested to rent in.
Rent in Start Time	Start time from which the requester is interested to rent in, and for which the requester's bid applies for.
Rent in End Time	End time from which the requester is interested to rent in, and for which the requester's bid applies for.

[Rename section 15.5.1.37 by the title "Iterative Negotiation Request' and replace section 15.5.1.37 text by the text below:]

15.5.1.37 Iterative Negotiation Request

Code: 37

Attributes as shown in Table h37.

The Iterative Negotiation Request message is sent out by the offerer only when the CT-CXP mode flag is set to 0 in the Advertisement Request message, i.e. when the CT-CXP negotiation mode is active. At each iteration of the negotiation, the decision making algorithm applied by the offeror derives a minimum and maximal payoff based on the requesters' bids. At each of these iterations, updated values of these payoffs are provided by the offeror to the requesters still bidding for the renting.

Table h37— Iterative Negotiation Request message attributes

Attributes	Contents
BSID	BSID of the offeror
Minimal payoff	Minimal derived payoff corresponding to the lower selected bid
Maximal payoff	Maximal derived payoff corresponding to the higher selected bid

[Rename section 15.5.1.38 by the title "Iterative Negotiation Reply' and replace section 15.5.1.38 text by the text below:]

15.1.5.38 Iterative Negotiation Reply

Code: 38

Attributes as shown in Table h38.

Based on the minimal and maximal payoff information, the Iterative Negotiation Reply message is sent out by the requester in response to Iterative Negotiation Request message in case the requester is willing to make a new bid proposal to be part of the selected requesters.

Table h38— Iterative Negotiation Reply message attributes

Attributes	Contents
BSID	BSID of the requester
Requester's bid	Updated bid proposal

[Rename section 15.5.1.39 by the title "Resource Allocation Request' and replace section 15.5.1.39 text by the text below:]

15.1.5.39 Resource Allocation Request

Code: 39

Attributes as shown in Table h39.

After the iterative negotiation is complete, the Allocation Request message informs each requester whether he is granted with the resource he bidded for. Each granted requester is informed about the credit token price. Pricing is executed followed up the method specified in the Advertisement Request message.

Table h39— Resource Allocation Request message attributes

Attributes	Notes
BSID	BSID of the offer or
Resource Granting	00….SUCCESS (requester is granted) 01….REJECT (requester is not granted)
Credit Token Price	This field can only be used when the Resource Granting field == 00 (SUCCESS). Credit token price is the number of CT (output of the negotiation process) to be used by the granted requester to acquire the

	resource.

[Rename section 15.5.1.40 by the title "Resource Allocation Reply' and replace section 15.5.1.40 text by the text below:]

15.1.5.40 Resource Allocation Reply

Code: 40

Attributes as shown in Table h40.

The Resource Allocation Reply message is sent out by each granted requester in response to the Resource Allocation Request message. In this message, the granted requester accepts or rejects to use the resource at the proposed credit token price.

Table h40— Resource Allocation Reply message attributes

Syntax	Notes
BSID	BSID of the requester
Acceptation bit flag	0….ACCEPT 1….REJECT

[Renumber section 15.5.1.45 and replace section 15.5.1.45 text by the text below:

15.5.1.45 Coexistence Conflict Identification Request message

The offeror asks to each requester to detect and identify the systems this requester could interfere during the renting period in its neighborhood.

Code: 45

Attributes are shown in *Coexistence Conflict* Identification Request message attributes.

Table h45—Coexistence Conflict Identification Request message attributes

Attribute	Contents
BSID	BSID of the offeror
Latitude	Latitude information of the offeror
Longitude	Longitude information of the offeror

[Renumber section 15.5.1.46 and replace section 15.5.1.46 text by the text below:]

15.5.1.46 Coexistence Conflict Identification Reply message

The requester responds to the master BS's Coexistence Identification Request message with a Coexistence Conflict Identification Reply message

Code: 46

Attributes are shown in *Coexistence Conflict* Identification Reply message attributes.

Table h46—Coexistence Conflict Identification Reply message attributes

Attribute	Contents
BSID	BSID of the requester
BSID Interfered	BSID of each identified master system which could interfere during the master sub-frame operating in parallel of the rented resource
Contact IP address	IP address of each identified master system (or coexistence proxy) which could interfere during the master sub-frame operating in parallel of the rented resource

[Renumber section 15.5.1.47 and replace section 15.5.1.47 text by the text below:]

15.5.1.47 Intra Operator Coexistence Coordination Request message

The offeror requests to each identified master system (which could interfere during the master sub-frame operating in parallel of the rented resource - these identified master systems belong to the same operator as the one renting out) to coordinate with itself to clarify whether the interfered master sub-frame can have the same time duration and starting time as the one proposed for renting.

Code: 47

Attributes are shown in *Intra Operator* Coexistence Coordination Request message attributes.

Table h47—Intra Operator Coexistence Coordination Request message attributes

Attribute	Contents
BSID	BSID of the offeror
Contact IP address	IP address of the offeror

[Renumber section 15.5.1.48 and replace section 15.5.1.48 text by the text below:]

15.5.1.48 Intra Operator Coexistence Coordination Reply message

Each requested master system responds to the Intra Operator Coexistence Coordination Request message with an Intra Operator Coexistence Coordination Reply message. Either, there is a possibility of coexistence coordination (acceptance) or there is none (rejection).

Code: 48

Attributes are shown in *Intra Operator* Coexistence Coordination Reply message attributes.

Table h48—Intra Operator Coexistence Coordination Reply message attributes

Attribute	Contents
BSID	BSID of the requested master system
Contact IP address	IP address of the required master system
Intra Operator Coexistence Coordination Status	1 - Acceptance 2 - Rejection

[Renumber section 15.5.1.49 and replace section 15.5.1.49 text by the text below:]

15.5.1.49 nter Operator Coexistence Coordination Request message

The requester asks to each identified master system (which could interfere during the master sub-frame operating in parallel of the rented master sub-frame - these identified master BSs do not belong to the same operator as the offering master BS) to check if the interference level in the master sub-frame of this other operator is acceptable.

Code: 49

Attributes are shown in *Inter Operator* Coexistence Coordination Request message attributes.

Table h49—Inter Operator Coexistence Coordination Request message attributes

Attribute	Contents
BSID	BSID of the master system
Contact IP address	IP address of the master system

[Renumber section 15.5.1.50 and replace section 15.5.1.50 text by the text below:]

15.5.1.50 Inter Operator Coexistence Coordination Reply message

Each requested master system responds to the Inter Operator Coexistence Coordination Request message with an Inter Operator Coexistence Coordination Reply message. (1) Either the system accepts the interference level (acceptance) or (2) rejects it (rejection).

Code: 50

Attributes are shown in *Inter Operator* Coexistence Coordination Reply message attributes.

Table h50—Inter Operator Coexistence Coordination Reply message attributes

Attribute	Contents

BSID	BSID of the requested master system
Contact IP address	IP address of the required master system
Inter Operator Coexistence Coordination Status	1 - Acceptance 2 - Rejection

[Renumber section 15.5.1.51 and replace section 15.5.1.51 text by the text below:]

15.5.1.51 Final Coexistence Decision Request message

The offeror asks to the requester if the coexistence for renting is feasible.

Code: 51

Attributes are shown in *Final Coexistence* Decision Request message attributes.

Table h51—Final Coexistence Decision Request message attributes

Attribute	Contents
BSID	BSID of the ~~master system~~requester
Contact IP address	IP address of the master system
~~BSID~~	~~BSID of the master BS~~

[Renumber section 15.5.1.52 and replace section 15.5.1.52 text by the text below:]

15.5.1.52 Final Coexistence Decision Reply message

Each asked requester responds to the master BS's Final Coexistence Decision Request message with a Co-Final Coexistence Decision Reply message: (1) Either the overall coexistence conflict can be resolved and in this case the renting process can be pursued (acceptance), or (2) the coexistence conflict cannot be resolved and this case the renting process cannot be pursued (rejection).

Code: 52

Attributes are shown in *Final Coexistence* Decision Reply message attributes.

Table h52—Final Coexistence Decision Reply message attributes

Attribute	Contents
BSID	BSID of the requested master system
Contact IP address	IP address of the required master system
Coexistence Decision Status	1 - Acceptance 2 - Rejection

References

[1] IEEE 802.16h/D2: Part 16: Air Interface for Fixed Broadband Wireless Access Systems Amendment for Improved Coexistence Mechanisms for License-Exempt Operation; 2007-01-30
[2] IEEE 80216h-06_068r5: *Letter Ballot #24 Commentary file with resolutions from Session #47.*