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Re:	**IEEE 802.16h-06/016 –Second Working Group Review (2006-06-05)**
Abstract	**A set of editorial changes in the current text**
Purpose	**To assemble all the proposed editorial changes in a concise way**
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Editorial Changes in the Working Document

Avi Freedman (Hexagon)

Introduction

This document describes some **editorial** changes suggested in the text of some sections of document IEEE 802.16h-06/15. *In Italics I give the reference to document C802.16h-06/48 with the new proposed structure*.

Proposed Changes

Section 15.1
Section 15.1

This clause describes high-level protocols and policies to be used for coordinating the system operation in order to reduce the inter-system interference.
The basic mechanisms for achieving better coexistence are different for managed systems and for ad-hoc systems. It is recognized that the managed systems, generally deployed by operators, should receive a higher priority than the ad-hoc systems.

Section 15.1.4

Three basic mechanisms for achieving coexistence are:

—MAC Frame Synchronization, including Tx and Rx intervals;

—Adaptive channel selection, for finding a less interfered or less used frequency;

—Separation of the remaining interference in the time domain, by using coordinated scheduling and a fairness approach.

for inter-system communication, IP-level messages, MAC level messages and Cognitive Radio Signaling are defined at infrastructure and radio level. ~~For inter-system communication, at infrastructure and radio level, there are defined IP-level messages, MAC level messages and Cognitive Radio Signaling.~~
Communication using IP-level messages is the most general case and is PHY independent. It allows distributed BS-BS communication as well as communication with a central database. The messages defined for such communication constitute the Coexistence Protocol.
The MAC-level messages are intended for systems using the same PHY profile. These messages may convey special information between the BS and its subscribers, or may send messages between systems. In the latter~~st~~ case, the communication takes place during the Coexistence Messaging Interval.

The Cognitive Radio signaling uses elements of the existing PHY modes and allows simple communication between different systems. The radio signaling may be used to communicate with ad-hoc systems, or to indirectly transmit contact information for the IP network during the Coexistence Signaling Interval.
[These simple signals are selected in such a way, to allow in the future the extension of these procedures for communication with other systems, not belonging to IEEE 802.16 family.]
Different system parameters, including GPS coordinates and timing, may be shared between systems, through distributed communication between Base Stations grouped in a Coexistence Community.
The level of interference and the interference source may be assessed using the Radio Signatures and the interferer identification procedures.
Interference-free sub-frames are initially created based on the selection of one of three possible rules and control of system power. The Coexistence Protocol includes procedures, which allow the interference- free radio resource re-allocation. Some of these procedures use credit tokens and negotiations, such that the interference-free resources may be dynamically apportioned to support the changing character of the traffic. The protocols and policies described in this chapter enable operation with reduced interference. The Coexistence Zone provides support at the MAC level for scheduling the interference-free sub-frames.

Section 15.2.1.1
Section 15.4

The approaches for interference resolution are based on separating the interference in the frequency and time domains.
The separation of interference in the frequency domain is undertaken first, followed by the separation of remaining interference in the time domain, using procedures of the Coexistence Protocol. The Coexistence Protocol is defined at the IP level and is mainly intended for BS-BS communication.
In order to obtain the IP addresses of the Base Stations within the Coexistence Neighborhood, a number of procedures are defined, based on operator coordination, or on indirectly transmitting the contact information for the IP network.
The operators can exchange information tables containing the deployment information, such as GPS coordinates, IP address of the CX entity in the Base Station, etc.
Operators may also maintain a common database, including both deployment information and an IP identifier for allowing the operation of a technology-independent coexistence approach. In this case, it is assumed that:

Every Base Station includes a data-base, based on which the Base Station ~~standing for its system~~ negotiates with other systems in the community; the BS data-base contains information necessary for spectrum sharing, and includes the information related to the Base ~~station~~ Station itself and the associated SSs. ~~; a Base Station and the associated SSs form a system.~~ Other Base Stations can send queries related to the information in the database to the DRRM entity, located in a Base Station (see). The base station shall represent its system in the cooperation with other systems when communicating over the backbone. It is possible to use the subscriber station to relay the control messages in some situations. The base station locations may be obtained by GPS or other positioning systems, however there is no need to register the subscriber locations;

In some cases there is country/region data base, which includes, for every Base Station, the following parameters:

- Operator ID
- Base Station ID
- Base Station GPS coordinates
- IP identifier

The local Radio Administration may ~~have~~maintain, for light licensing ~~procedure~~purpose, its own database, generally not including the Base Station ID and IP identifier information.
There is a server that manages ~~the write/reading of~~ this Datab~~ B~~ase, using the WirelessMAN-CX standardized procedures; the server and the country/region data-base can be hosted by one of the operators or a trusted entity, ~~like~~ such as the local Radio Administration.
Otherwise, if the region/country database is not available, the base stations should try to find ~~its~~ their neighbors and the community topology in a coordinatively distributed fashion.

All the Base Stations forming a community will have synchronized MAC frames and frame numbers.

A community will be limited to a reasonable size.

All the Base Stations and their systems will, as a first step, be equipped with a spectrum detection and monitoring capability that prevents co-channel utilization of the same spectrum.

All base stations are synchronized to a GPS clock. The start of all MAC frames and other ~~transaction~~ events are referenced to the rising edge of this clock.

All non-WirelessMAN-CX systems, operating in the LE bands, will be provided with the opportunity to signal their presence to WirelessMAN-CX systems within the dedicated CMI slot.

The WirelessMAN-CX systems will recognize the ~~use~~ operation of radars and other systems having higher priority in the~~to~~ LE spectrum.

Every system will have a guaranteed minimum access time for the interference free use of the radio resource, being able to receive with minimum interference and to transmit at the needed powers for allowing communication between its Base Station and the remote subscribers.

Section 15.1.5.2

Frame Structure for interference prevention & reso~~u~~lution

illustrates an example of three overlapping radio systems and illustrates a possible implementation of the guaranteed radio resource principle.

The overlapping radio systems create different interference zones based on the spatial distance between transmitters and receivers. As an example~~ of BS to SS interference,~~, ~~the~~ ~~radio~~system 1 SS's ~~receivers~~ in Zone A are interfered by ~~have interference between~~the BS of ~~system 1 and~~ system 2 and vice versa.

~~The operation~~Operationally, a component of any of the three systems in ~~assume~~ may be in one of the following ~~different~~ situations:

Zones S1, S2 and S3 in which the systems 1, 2 and 3 do not interfere each other;

- Zone A: systems 1 and 2 interfere;
- Zone B: systems 1 and 3 interfere;
- Zone C: systems 3 and 2 interfere;
- Zone D: systems 1 and 2 and 3 interfere.

Now let us suppose that we split the time frame in 3 sub-frames (being 3 different systems), so that every system ~~will~~ receives an interference free interval for its operation as shown in .

Another possible approach, shown in , will be to set an operating time for ~~not~~ non- interfering ~~(noted ?)~~ situations, and split ~~equally between the three systems~~ the remaining resource equally and fairly between the three systems, ~~like~~ as shown ~~below~~in . It can be seen that non-interfering traffic may be scheduled in parallel, resulting in a much better radio resource usage.

Taking as an example system1, it can be seen that this system operates in all the sub-frames, achieving~~ in the same time~~ interference-free operation and good spectral efficiency in the same time.

However, the systems working~~ in the same time~~ simultaneously with the system having the control of the radio resource~~,~~ shall use power control, sectorization or beam-forming in order ~~to~~ not to create interference to that system.

Systems working in parallel at the start of the frame may need to use reduced ~~transmitted~~ transmission power, to avoid creating interference to each other.

Section 15.2.1.1.2 Scheduling of interference free intervals in the context of IEEE 802.16 MAC
Section 15.4.2.1.2

A number of repetitive scheduling approaches are presented below, for Tx synchronized intervals. The ~~S~~same approach is valid for Rx intervals.

—*Type 1*: The MAC frame, for each Tx and Rx part, is split into N+1 sub-frames:

- One for non-interfering traffic

o All the other subframes are each used by another single system, which assumes the Master role for that sub frame, and traffic of other systems that do not interfere with it.~~Every other one to be used by a single BS or more non-interfering BSs which are assuming the Master role~~

—*Type 2*: The MAC frame, for each Tx and Rx part, is split into N sub-frames, each to be used by a single system which assumes the Master role for that sub frame and traffic of other systems that do not interfere with it.~~every one to be used by a single BS or more non-interfering BSs which are assuming the Master role during a sub-frame~~

—*Type 3*: The MAC frame is split into two sub-frames: one for non-interfering traffic and one in which a single system is assuming the master role and traffic of other systems that does not interfere with it. ~~a single BS or more non-interfering BSs are assuming the Master role~~; each Base Station will assume the Master role after M frames

The duration of each sub-frame, in a given community, is calculated as follows:
For type 1:

—$T_{Tx\_sub\text{-}frame} = T_{TxMAC} / (N+1)$ ~~/ (N+1)~~

or

—$T_{Tx\_sub\text{-}frame} = (T_{TxMAC} - T_{Txsh}) / N$

—$T_{Rx\_sub\text{-}frame} = T_{RxMAC} / (N+1)$

or

—$T_{Rx\_sub\text{-}frame} = (T_{RxMAC} - T_{Rxsh}) / N$

For type 2:

—$T_{Tx\_sub\text{-}frame} = T_{TxMAC}$ ~~/ N~~ $/N$

—$T_{Rx\_sub\text{-}frame} = T_{RxMAC}$ ~~/ N~~ $/N$

For type 3:

—$T_{Tx\_sub\text{-}frame} = T_{TxMAC} / 2$

or

—$T_{Tx\_sub\text{-}frame} = T_{TxMAC} - T_{Txsh}$

—$T_{Rx\_sub\text{-}frame} = T_{RxMAC} / 2$

or

—$T_{Rx\_sub\text{-}frame} = T_{RxMAC} - T_{Rxsh}$

and the repetition interval ~~is~~ equals ~~with~~ to N^*T_{MAC},
where:

—T_{MAC}, T_{TxMAC}, T_{RxMAC} are the durations of the respectively the MAC frame, Tx interval and Rx interval of the MAC frame;

—T_{Txsh}, T_{Rxsh} are the durations of the shared sub-frames. In the above relations, the meaning of Tx or Rx is relative to the usage of the MAC Frame by a Base Station.

During ~~the~~a ~~Master~~ sub-frame the Base Station~~s~~ which ~~have~~ has the Master role may use ~~their~~its maximum power;

During some of the~~every~~ ~~Master~~ sub-frames, the Master Base Station~~s~~ will create a slot, possibly not overlapping with another slot of a coexistence neighbor Base Station, during ~~each~~ which every transmitter (BS or associated SS) will send a predefined signal; this signal, called "radio signature", will be used to measure the interference created by that transmitter.

—The "radio signature slot" for a Base Station will be created during its Tx Master sub-frame, every B MAC-frames;

—The "radio signature slot" for a Subscriber Station will be created during the Rx Master sub-frame;

—UL MAP and suitable UIUC for scheduling the "radio signature" are t.b.d.

—During the "radio signature" intervals, all the other BSs and SSs shall use a GAP interval, during which no transmission is to be made.;

—The Base Station shall ~~take care to~~ provide enough transmit opportunities for the active SSs.

~~The figure below~~Figure h42 shows the possible allocation of the "radio signature" transmission opportunity for a given system, using for example the Type 1 repetitive pattern, with a focus on ~~Network~~ system 2. ~~The Network~~System 2 will transmit its Base Station radio signatures from time to time (every N MAC intervals); different radio signatures will be sent for every used power/sub-channelization/OFDMA sub-channel/ spatial direction combination. During these intervals the other Base Stations will schedule a GAP interval, in order to identify ~~solely~~ one Base Station solely. Base Stations using the same MAC sub-frame as the Master sub-frames shall schedule the transmission of their "radio-signatures" in such a way that they will not interfere ~~one~~ with each~~the~~ other.

The transmission of "radio-signatures" used by the active SSs will take place during the Master sub-frame, from time to time (a timer shall be defined). The repetition period and the duration of the signature transmission shall be a parameter in the BS Datab~~-B~~ase. The active SSs will provide a signature for every used power/OFDMA/sub-channelization/ direction ~~partition~~setting.

15.2.1.1.3 Coexistence Signaling Interval

Section 15.1.5.1.1

The CSI (Coexistence Signaling Interval) is a predefined time slot, in which the BS may contact its coexistence neighbor BSs through one or more coexistence neighbor SSs in the common coverage area. Every CSI has its number, called CSIN (Coexistence Signaling Interval Number). The sequence of CSINs is periodic with a period of $N_{CSIintv}$ (see below). For the Initializing BS (IBS), the ~~periodical~~ correspondent CSI is called the ICSI (Initialization Coexistence Signaling Interval) and is used by the IBS to contact its neighbor Operating BSs (OBSs). By coordination with the other BSs, the IBS will get its ~~periodical~~ OCSI (Operation Coexistence Signaling Interval), which is allocated only for this BS, and start the operating stage, hence ~~ceased from using~~releasing the ICSI for another IBS.
~~Every CSI have its number, called CSIN (Coexistence Signaling Interval Number), that's a periodical number according to the time order.~~

In order ~~to~~ not to ~~break the downlink PDU~~change the structure of the downlink PDUs ~~and,~~ and to ~~reduce~~avoid the overhead of more preamble and gaps, CSI slots shall be located before the RTG/TTG in the TTD frame structure or before the preamble of the downlink frame in FDD frame structure. To unify the location in these two kinds of ~~frame~~ duplexing methods, in an FDD frame CSI slots ~~in FDD frame~~ shall be ~~put into the downlink structure~~transmitted right before the preamble, and shall be located right before the RTG in a TDD frame.
The CSI/ICSI parameters need to be unified in a particular region, and to be well known by the BSs. So that each BS could know the exact time to transmit the broadcasting message in its initialization. The parameters include:

—$T_{CSIstart}$: CSI starting time from the beginning of the frame (ms)

—$T_{CSIdurat}$: CSI duration time (ms)

—$N_{CSIstart}$: CSI starting frame number frames

—$N_{CSIintv}$: number of frames in CSI interval

15.2.1.1.4 Energy Symbols Used in the CSI
Section 15.3.1.1.3

The symbols in the CSI slots are broadcast by the BS and received by the SSs in a coexistence neighbor ~~network~~system. The modulation technology ~~on~~ of the interference source and victim system ~~should~~ could be one of the following: SCa, OFDM or OFDMA, and could be different between the interference source system and interference victim system. The operation bandwidth of the ~~the~~ source and victim systems shall have overlapping~~ed~~ part, ~~and~~ but the bandwidth could be different.
The symbol in the CSI slot is defined only ~~in the power and time aspect~~by its power profile in time, and could use any one of the modulation technology and any band that are available in the equipment. The

~~length~~ duration of the energy symbol shall be 1/N of the CSI length, where N is a natural number ~~that is~~ specified by the region/country regulator.
There ~~is~~ are four kinds of symbols: <SOF>,0/null,1,<EOF>, to be used to form any frame in CSI and to carry the information.

—<SOF>: Start Of Frame, indicating the data portion will start at the following symbol.

—0/null: Binary code 0 used to compose the data portion, same ~~with~~ as a null symbol.

—1: Binary code 1 used to compose the data portion.

—<EOF> End Of Frame, indicating the data portion ended at the last symbol

Each symbol is divided into two equal length parts. For each part, there are two kinds of power keying level defined, H (high) and L (low). The BS uses the maximum power to transmit in the H (high) portion so that the SS can detect higher RSSI, and the BS is silent in the Low (L) portion and the SS can detect lower RSSI at that time.
The format of each of the four kinds of symbols is shown in the table below:

TCSI symbol Format

format		signification
Part1	Part2	
L	H	<SOF>
H	L	<EOF>
L	L	0
H	H	1

The receiving SS shall follow up the CSI timing and decode each symbol continuously in every symbol space. ~~S~~so that it can acquire the information transmitted by the source system. The SSs shall verify the symbol by this aspect of RSSI and time. ~~One CSI consists of one or multiple symbols with the same length, and the number of symbols in each CSI slot is standardized in region/country~~

Section 15.3.1.1.2

The CSI frame is broadcast~~ed~~ from the base station to the coexistence neighbor's subscriber station, ~~-~~within ~~serialized~~ a series of CSI slots fragmentally. The CSI frame ~~-~~consists of power keying energy symbols as the basic element and carry the information from BS to the coexistence neighbor's SS. The CSI frame has the <SOF> symbols and <EOF> symbols as the boundary of slots when there ~~is~~ are more than 4 symbols in each CSI slot. Two consecutive <SOF> and <EOF> indicate the signaling frame boundaries~~y~~. Each CSI frame shall have 8 bits cyclic redundancy check (CRC) (Polynomial "X^8+X^2+X+1") ~~appendant~~ appended to check the validity of the information carried within the CSI frame. In case ~~when~~ the last slot of the signaling frame ~~have~~ has not been fully used up with the CRC and <EOF>, a ~~Pad~~ pad ~~is~~ filled with "one" symbols ~~one~~ will be added between the CRC and the double <EOF>~~,~~. CSI frame should be continuously carried in the serialized CSI slots during the whole CSI frame structure. The basic structure is shown below:

The subscriber station of coexistence neighbor cannot get correct timing offset because ~~of~~ there is no ranging process between the SS and IBS, so RCG (Receive-CSI gap) and CTG (CSI-Transmission gap) should be ~~engaged~~ included in the CSI slot for reliable sampling in the SS.
The PLD (payload) part of the CSI frame should be ~~divided~~ structures as a ~~into~~ TLV, as described in figure h21 (*h28*) ~~aspect~~. TYPE indicates the type of the payload, LENGTH corresponds to the number of symbols/bits contained in the VALUE portion. (TYPE and LENGTH ~~is~~ are 1 octet each.)

The SS should keep monitoring the RSSI to detect <SOF> in the ~~I~~CSI interval. <SOF> flag can be detected according to the ~~energy~~ power value against ~~the~~ time~~ing~~, When the power ~~of symbol~~ in first half ~~part~~ of the symbol window is significantly lower than the second part, one <SOF> is expected to have been received, and the SS will pick a value in the middle of the two value as a threshold for the following symbols. ~~The following symbols in this frame should using this threshold as criterion.~~ If a following symbol shows lower power in the first part than the threshold and in the second part a higher power than the threshold ~~in the second than the threshold~~, it will consider as a successful~~eded~~ in detection of ~~ng~~ another <SOF>. A CSI frame considered to start here. When ~~all the symbols in the frame are received and verdict correctly, and received consecutive~~ two consecutive <EOF> are detected at the end using ~~the~~ a similar method as the <SOF> detection~~-~~, and all the symbols in the frame are received and verified correctly by the CRC, the whole signaling frame is received correctly and the information inside will be extracted and reported. . Symbols between the two consecutive <SOF> and the two consecutive <EOF> are reassembled into CSI frame while the pad is dropped, when~~ile~~ the check is passed. If the check ~~is failed~~fails, the signaling frame will be reported with an error indication and no value will be reported ~~part~~ for ~~of~~ the payload ~~will be reported~~. The whole CSI symbol sequence will be ignored if no consecutive two <SOF> ~~was~~ were detected. When there ~~is~~ are more than 4 symbols in each CSI slots, there will be a <SOF> and an <EOF> at the beginning and the end of the slots respectively. All the <SOF> and <EOF> will be dropped when reassembling the payload of the CSI frame.

15.2.1.1.6 Coexistence proxy

Section 15.2.5

Every BS shall use its coexistence proxy to exchange CP messages while ~~they~~ it sends/receives signaling containing the IP contact information over the air, so that ~~other BSs~~ malevolent interceptors will not know the real IP address of ~~this~~ the BSs from the signaling over the air. The coexistence proxy should have a stand alone physical port and an IP address to connect ~~in~~to the internet using either direct link or an internal interface. The coexistence proxy could be a module of the BS or a stand alone server~~-~~.
A coexistence proxy can also ~~optionally~~ be optionally used to forward the CP messages between BSs when the IP address of the BS is not transmitted over the air, so that the proxy will act as an agent between the BSs ~~with~~ and other BSs and terminals in the internet. ~~In the coexistence coordination process, b~~By using the coexistence proxy, all the BSs know other BSs' coexistence proxy's IP address instead of their actual IP

address~~ of the BS's~~, and contact them only via coexistence proxy and the BSID information. In order to prevent various attacks from the internet, the proxy could utilize various approaches to protect the BSs without affecting~~influence~~ the data services of the BSs. *[The ~~P~~proxy could limit the forwarding bandwidth from one IP address or to one BSID. The ~~P~~proxy could qualify or block the messages using various approaches.]*

15.2.1.2 Interference Control

Section 15.4.2.4

The i~~I~~nterference~~r~~ control procedures can use~~s~~ interferer identification obtained from the radio signature

—A receiver will listen to the media during the radio signature slot and will find out which are the strongest interferers; by then scanning the BS data~~-~~bases it will be possible to identify, ~~due to the knowledge of the~~by the frame number, sub-frame number and offset, which BS is the associated interferer~~ associated~~; based on time-shift information, the Base Station will be able to identify the Subscriber Station ID. During the allocated radio-signature transmit opportunity no other radio transmitters will operate.

Interference reduction

—A BS has the right to request any interferer to reduce its power by P dB, for transmissions during the time in which ~~a~~ this Base Station is the~~a~~ Master; if the requested transmitter cannot execute the request, it has to cease the operation during the Master sub-frame of the requesting Base Station; this applies also for systems using the sub-frame as a Master

Sharing the Master time

—A Base Station ~~will~~ shall indicate in the data-base *what portion of the sub-frame time, ~~separately for~~ Tx and Rx separately, is actually used*

—Other systems, which do not interfere ~~one~~ with each other, may use that time interval

Target acceptable interference levels during Master sub-frames:

For the Base Station and its SS, using the Master sub-frame: min. 14dB above the noise + interference level (16QAM 1/2) *[note: we should define the interference criteria; the existing one may be too stringent and not necessary for short links]*

15.2.1.3 Community Entry of new BS

Section 15.3.1.3

To enter the existing community at its neighborhood, a new BS (the Initializing BS, IBS) without any associated SS contacts its neighbors ~~and coordinates~~ using the IP network. The new BS should synchronize to the timing of the CSI and ICSI in the air before using ICSI to broadcast the BS_NURBC (see) signaling to make its neighbors know of its operation ~~arrival~~ and its contact information.
ICSI is used by the IBS to establish communication with its neighbor BSs. ~~Initializing BS (~~The IBS~~)~~ shall use the ICSI slot to broadcast its coexistence proxy's IP address and the BSID of its IBS, by sending a message and/or cognitive radio signaling. ~~The~~ A coexistence neighbor operating BS (OBS) finds the initializing coexistence neighbor in the IP network via its coexistence proxy after receiving the SS report for this signaling. In order to obstruct the coexistence request from an ~~unqualified~~ unauthorized internet terminal (such as a terminal far away or some terminal without any capability of WirelessMAN-CX air signaling which have known the static BSID and IP address information, the BS should use a RTK (Random Temporary Key) in the broadcast signaling. To ~~qualify~~ authenticate the request of a CP message, the RTK sender requires that the request CP message, sent back later via the IP network, ~~to~~ contains this random temporary key.
Then the IBS and OBS begin further negotiations via their coexistence proxy ~~for~~ using the coexistence protocol. After coordination with the neighbors in the community, the IBS will get periodical interference free OCSIs, and become OBS, after that, it will cease ~~from~~ using the ICSI.
The BS_NURBC (see) broadcasting procedure is unidirectional, only from the BS to the SSs in the common coverage area of the BS and its neighbors, and the SSs shall report all the useful information to the~~ir~~ OBSs they are associated with~~to~~. The SSs that succeed in ~~receiving~~ decoding the ~~signaling~~message should report the content of the ~~BS_NURBC~~ message, together with ~~and~~ the frame number of the starting frame of BS_NURBC to the BS.~~;~~ ~~t~~The SSs ~~which~~ that fail to ~~received the broadcasting signaling~~ decode the ~~but get~~ BS_NURBC, but sill identify it as interference in the CSI should report the error status and the starting frame number of receiving the interference in the CSI. The IBS uses ICSI to broadcast the BS_NURBC ~~signaling~~message, the content ~~in the signaling~~of the message will enable its neighboring systems to communicate with the IBS ~~in~~ over the IP network ~~to~~ and coordinate their operation by the coexistence protocol. ~~By~~Using the IP address of the IBS's coexistence proxy and the BSID reported ~~from~~ by the SSs which have successfully decoded the BS_NURBC message, together with the RTK, the OBSs ~~will then~~ communicates with the IBS ~~in~~ over the IP network via their coexistence proxy.~~, and go further coordinate using IP network. And b~~By checking the frame number in the report, the OBS determines if the SSs that report the error status in BS_NURBC rece~~ption~~~~iving~~ ~~have~~were interfered by ~~got~~ the same interference source identified in the BS-NURBC message, then the OBS will update the database and reply to the SSs which have ~~send~~ sent the error report.(see .)

A new entering BS knows the IP address of its coexistence proxy. By receiving the broadcast~~ed~~ IP address of ~~its~~ the IBS's coexistence proxy and the BSID of the IBS, all the neighbor OBSs which have ~~get~~ the contact information of the IBS should start to communicate with this IBS using CP messages through the internet via the coexistence proxy. After receiving the CP request message from the OBS, the OBS's coexistence proxy will ~~then~~ transform the source IP address into the IP address of the OBS's proxy, and forward the CP request message to the destination of the coexistence proxy which serves the IBS. The IBS's coexistence proxy should get the destination BSID by parsing the CP request message, and map it into IBS's IP address. If the BSID is in the coexistence proxy service list and the proxy can find~~s~~ the corresponding IP address, the coexistence proxy should forward the ~~qualified~~ authenticated CP request message to the IBS. By receiving the CP messages from its neighbor systems, the IBS can discover its neighbor systems and continue on further negotiation and communication using the IP network through the coexistence proxies. Vice versa, the IBS should send the CP reply message to the OBS via the coexistence proxy after receiving and processing the CP request message.

explains how one ~~new entry~~ IBS discovers its coexistence neighbor BSs. The new entry BS-5 uses its GPS coordinates (x5, y5) and its maximum coverage radius in LOS, Rm, at allowed maximum transmission power. A BS is a *potential* coexistence neighbor BS of another BS if:

—In co-channel operation the LOS maximum coverage areas of the two BSs, calculated ~~resulting~~ for the allowed maximum transmission power overlap~~s one with each other.~~ As depicted in , the regional LE DB will return BS-1, BS-2 and BS-3 as the *potential* coexistence neighbor BSs of the new entry BS.

—In first or alternate adjacent channels operation, the BS should consider the net filter discrimination ~~attenuation~~ of the ~~transmitted~~received power, corresponding to the actual operation channels of different Base Stations.

Once a LE BS has learnt its *potential* coexistence neighbor topology from the regional LE DB, it evaluates the coexisting LE BSs and identifies which BSs might create interference~~s~~. The Adaptive Channel ~~selection~~ Selection will select the actual operating frequency, such that the probability of interference will be minimized. Each LE BS tries to form its own community, ~~B~~by including the coexistence neighbor BSs that create interference~~s~~ to the associated SSs. The members of a community will change when the working frequency of any BS~~s~~ changes or a new interfering coexistence neighbor BS comes in.

Within a regional LE DB, a LE BS can construct its coexistence neighbor topology and acquire the IP addresses of its coexistence neighbors securely.

In any case that the new coming BS could not find the regional LE DB, it should start an ad-hoc method to find the neighborhood topology. The entering BS uses the coexistence time slot to broadcast its IP address to the reachable SSs in the neighbor ~~network~~systems. Once the SSs received this signaling, they will report to their serving BS one by one unsolicitedly, the information of the new BS and the interference status that they record during the reception~~iving~~ will be reported to there serving BS.

The serving BS will get all the information from the related SSs and will save~~d~~ the useful content ~~to~~ in its~~their~~ database. After that, the serving BS will contact new BSs using the IP address reported by the SS and transfer the parameter of its own database to the new coming one with authorization and negotiation, thereafter the serving BS will also get the parameters and other corresponding information from the new coming BS.

Section 15.1.3

In general, the coexistence detection, avoidance and resolution are performed in two stages, initialization stage and operating stage.

(1) *Initialization stage*

In the initialization stage the BSs may avoid the co-channel or adjacent channel interference by scanning the available frequencies (even those frequencies allocated for BS transmission only in FDD cases). But this method cannot avoid the hidden neighbor system problem, i.e. the BS that cannot be heard directly by the initializing BS but may have overlapping service coverage and interfere with the initializing system SSs.. Thus, with the knowledge of coexistence neighbor topology the IBS can ~~detect~~ take the potentially hidden neighbor systems into account and can, therefore, avoid the possible interferences from those neighbors.

Alternatively, if the country/region database is not ~~valid~~ available in this ~~phase~~stage, the initializing BS will use the initialization coexistence signaling interval (ICSI) to broadcast its contact information to its coverage area using its maximum power. In this way, ~~the~~ SSs ~~in the reachable zone~~ susceptible to the interference of the new BS~~'s interference~~ will receive the signaling and forward the contact information to ~~its~~ their serving BSs. A~~nd a~~fter the neighbor BSs get the address via the SSs' reports, they will contact ~~with~~ their new coming neighbor via the IP network and update~~ing~~ the database on both sides. Thus, in an ad-hoc fashion, the procedure~~it~~ will solve the hidden neighbor problem by the SSs in the neighbor systems. Therefore, using the information that the IBS has ~~got~~ from its neighbors, the IBS can get the information of the ~~relative~~ collaborative systems in a potential community.
If the IBS finds that there is no "free" channel ~~exist~~, the information in the distributed database can be used to figure out ~~with~~ which system~~om~~ it should negotiate with. The IBS may decide whether ~~a "free" frequency can be allocated for itself~~ a free channel can be made available by channel reallocation within the community, If the IBS can figure out an optimized channel distribution in the community, which ~~made~~ enables every member in the community ~~could~~ to occupy ~~a~~ exclusive channels, the IBS can contact the BSs in the community, which need to reallocate the channels (the candidate BS's) and negotiate with them the reallocation. ~~;~~ ~~a~~After receiving the confirmation~~ed~~ by all of the~~every~~ candidate BSs, the IBS ~~will vacate a exclusive channel for its system. After that it~~ should send a CP message to the candidate BSs to indicate the success~~eding~~, all the candidate BS should then continue operation on the new set of channels. Otherwise, if the IBS can't get a "free" frequency after the effort of reallocation, the IBS should try to share a frequency with some of its neighbors.
Similarly to the channel allocation, the IBS will then first try to find a vacant sub-frame in the potential channels using the information of~~inside~~ the distributed ~~database,~~database; ~~when~~ if it ~~failed~~ fails the IBS will then try to vacate an exclusive existing sub-channel by sub-frame distribution optimization, if supported. If an exclusive existing sub-channel is not available, theIBS will then try to negotiate with the systems inside the community to create a new sub frame. ~~While~~ If all these attempts fail~~ed~~, the IBS will not be able to get any interference free resource ~~in its interference situation~~for operation. These procedures are described in .

(2) *Operating stage*

In the operating stage, the BS has SSs associated with ~~it,~~it; however, until the operating system parameters are determined~~.~~, the co-channel or adjacent channel interference from LE BSs of different networks may still occur due to the detection of interference from primary users (which may cause the meighbor 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 ~~is~~ are not enough channels. If the LE BS finds that there is no "free" channel at that moment, synchronous channel switching may be executed, or the coexistence neighbor topology provides the guidelines of with whom it should negotiate to share the channel. *[detailed procedures are to be defined]*

shows the initialization procedures for the 802.16 LE BSs. Note, that the procedures that the BS uses ~~tries~~ to create a Master slot or channel switching are also applicable for the operating stage. The detailed negotiation and update procedures are described in section and .

[Note: the following text needs further consideration]

—The first phase of the Community Entry is to ~~judge the validity~~determine the availability of the country/region database. If the country/region Root RADIUS server is available and the database is valid (t.b.c: what means valid?)~~,~~, the process~~further~~ queries the Root RADIUS server:

- oGet the BSISs from the country/region Root RADIUS server;
- oRead the database maintained by BSIS via the Coexistence Protocol;
- oIdentify which Base Stations might create interference, based on the location information;
- oThe IBS learns the IP identifiers ~~for~~ of those Base Stations;

Otherwise (the database is not available):

- oA New BS uses the interference free slot to broadcast the message containing the contact request and/or the cognitive radio signal transmitting the IP address
- o~~The~~ An SS in the common coverage area, identifying the new BS signals, will forward the information to its operating base station. using REP_RSP message
- oThe operating BS updates its database and sends feedback information to the IBS, using the IP network
- oThe new BS learns the IP identifier of the coexistence neighbor BS from the message sent by the coexistence neighbor BS via the IP network

—Build the local image of the relevant information in the community BS's, by copying the info in those BSs

—Listen on multiple frequencies

- oIdentify the level of interference on each frequency channel;

—Decide the working frequency (ACS – Adaptive Channel Selection process);

- oIf no interference detected on some channels, select one randomly as a working channel;

o If interference detected by the IBS or the OBS ~~network~~ system on all the channels, then the IBS should decide whether an optimized channel distribution can allocate an exclusive channel for each BS, ~~s~~ including the IBS, in the community.

o If every BS in the community can be allocated an exclusive channel without interfering with the others, that means default interference-free Master slot is available for this initializing BS.

—If available, select an interference-free Master sub-frame; if not, use the procedure for creating new Master sub-frames;

—Search the Base Station data base for finding the BSs using the selected Master sub-frame;

—Request those Base Stations, by sending IP unicast messages, to listen during the BS_entry slot in order to evaluate the interference from the new Base Station;

—Use the allocated slots for transmitting the "radio signature" at maximum power, maximum power density and in all the used directions;

—Ask for permission of the Base Stations, using the sub-frame as Masters, to operate in parallel and use the same sub-frames;

—If all of them acknowledge, the Base Station acquires a "temporary community entry" status; the final status will be achieved after admission of the SSs;

~~—If no free Master slot sub-frame is found, use the procedure for creating new Master slotssub-frames.~~

15.2.1.7 Creation of a new sub-frame

Section 15.4.2.3

If none of the existing sub-frames can be used, a *new Base Station may request the addition of another sub-frame.* The effect of such a request will be the reduction of operating time for those Base Stations that interfere with the new ~~Base Station~~system. However, all the others, ~~that~~ which do not interfere ~~one with each other and~~ with it~~the new one~~, may work in parallel and use the same operating time as before the introduction of the new BS.

A Base Station will request the creation of a new sub-frame by:

—Sending IP messages to all the ~~BS~~ member BSs of the community, ~~and~~ indicating:

o The interfering operator ID and BS ID

o The MAC frame-number in which the addition of a new sub-frame will take place.

—All the requested *BSs will acknowledge the request*, by

—Sending back a message having as parameters:

o Frame-number for the change (must be the same as the requested one

o Master sub-frame number for the new BS (SF = old_SF~~fold~~+1).

—If ~~are missing~~a neighbor BS fails to~~—~~acknowledges, ~~those BS~~it will be asked again, for additional~~another~~ M attempts, after that it will be considered that they are not working;

- At the above specified MAC frame number, a new sub-frame partition will take place, by inserting in the sub-frame calculation relation N=N+1
- The BSs will up~~-~~date their own SSs about the change

—Start to use the created Master sub-frame.

Section 15.2.1.11 Coexistence with non-WirelessMAN wireless access systems
Section 15.7.2

The principles in section are also applicable to non-WirelessMAN systems, like IEEE 802.11, ~~-~~as the Coexistence Protocol, working at IP level, allows the communication between systems independent of their PHY/MAC standards. During every WirelessMAN MAC frame, ~~a IEEE 802.11~~the other system, e.g. a 802.11 access point may find that a sub-frame may be used, due to the low created interference levels. In the case that no operation in parallel is possible, the new system will ask for the creation of a new Master sub-frame. ~~The Coexistence Protocol, working at IP level, will allow the communication between systems using different PHY/MAC standards.~~
The scheduled use of the MAC frame is possible by using the IEEE 802.11 PCF mode.

15.2.2.1 Architecture
Section 15.1.2
The architecture for Radio Resource Management in the context of this clause it is a distributed one and allows communication and exchange of parameters between different systems. A system consists from a base station and its associated subscriber stations and its coexistence proxy.
Every base station includes a distributed radio resource management (DRRM) entity, to apply the spectrum sharing policies, and a data base (DB) to store the shared information regarding the actual usage and the intended usage of the radio resource.
A subscriber station may include an instance of DRRM, adapted to SS functionality. ~~in~~ The two figures, and , illustrate ~~the~~ two System Architecture alternatives.

15.2.2.2 Inter-network communication
Section 15.6.5
The inter-network communication consists ~~in~~ of:

—Inter-network *messages*

o Base Station to/from Base Station

- oBase Station to/from Subscriber Station to/from a foreign Base Station; the subscriber Station is used as a relay of the signaling, if the two Base Stations are hidden ~~one~~ from ~~the~~ each other

—Open access to the DRRM Data Base (*optionally via a coexistence proxy ~~when between systems~~*):

- oTo read the parameters of the hosting Base Station
- o*To request* changes of the hosting Base Station operating parameters.

1Interference identification

In order to coordinate with the neighbor systems, ~~the~~ a system should be aware of its interference situation and identify the victims and sources around it. Based on this, the systems can proceed with further Interference ~~prevention~~ Prevention (section) procedures.
When able to exchange information between them, the WirelessMAN-CX system and the neighbor systems, may use collaborative mechanisms ~~and~~ to become aware of the identity of the interferer, otherwise ~~it can not know the identity of the interference victims or sources. In the latter case~~ it will only be possible to use non-collaborative mechanisms () and procedures to coexist, such as interference power detection, DFS and so on. This section defines the identification procedures based on information exchange using signaling and messages.

15.3.1 Identification of the interference situations

The BS in the system takes responsibility for gathering and maintaining all the interference information of the system and determines the resources allocated for its own system use. The interference identification is determined by the power detection, CSI signaling decoding, CMI messaging receiving~~,~~ and CP messages received.

All the corresponding interference information should be stored in the distributed database *[as SS and BS interference tables]* for each system (see) and maintained regularly. The distributed database ~~have~~ has the information related~~ive~~ to all the systems in the neighborhood or in other communit~~y~~ies.

The Interference information gathering approaches include:

1) ~~using~~ Using interference power detection to measure the basic interference situation in the candidate channels

2) ~~signaling~~Signaling decoding in candidate channels ()

3) ~~receiving~~Receiving messages in candidate channels

4) ~~exchanging~~Exchanging system information using CP message in the IP network

IP address information may be acquired by the following methods:

1) ~~the~~The initializing BS uses a configured IP contact list, the list is either read from a regional centralized server or from an off-line address list;

2) ~~by~~By decoding the contact information from the signaling/messaging sent by the neighbor systems.

The details of the CP message exchanged in the initializing procedure are shown in section .

15.3.1.1.1 Interference Identification & Resolution via CSI Detection

Downlink CSI is used by the BSs to broadcast signaling to the neighbor systems. These signals are used for ~~Interference~~ interference identification and resolution. In order not to collide with the other neighboring interferers, the coordinated community should prevent neighboring BSs from using the same CSI.
There is one ICSI for IBS in an ICSI cycle, in the example figure below, each ICSI cycle ~~have~~ has 4 CSIs and CSIN 0/4/8/12 indicate the CSI numbers of the ICSI. The other CSI is ~~leave~~ left to the OBS as OCSI, as shown in . Every OBS needs to obtain an OCSI allocation in one OCSI cycle, which is formed by multiple ICSI cycle so that an IBS can get more opportunities~~y~~ ~~then~~ than the OBS. There are 4 ICSI cycles inside one OCSI cycle and 4 CSIs in each ICSI cycle in the example, so that there ~~is~~ are 4 ICSI intervals for the IBS and 12 intervals for up to 12 OBSs.
Notice that the CSI allocation MAP should indicate all the CSI allocation in the uncoordinated channel as unusable. The uncoordinated channel information can be gathered in the DFS procedure or by the failure of coordination procedure in the interfered channel.
In the initialization phase of a BS, before the BS has an OCSI allocation, the BS should use ICSI to advertise itself ~~arrival in the air~~ at every candidate channels sequentially one by one. The neighbor OBS will then send their current OCSI allocation and current sub frame allocation to the IBS using CP message. After the IBS chooses the working channel for its radio link, the IBS shall choose a vacant CSIN for OCSI in this channel and inform other neighbors about this choice. Then, this BS will start using this OCSI allocation as its exclusive CSI allocation.
illustrates an example of the CSI allocation MAP of one BS during his initialization phase by collecting the CP message information from ~~his~~ its neighbors. Assume this BS chooses channel 0 as its working channel, it can then choose any one of the CSIN 2,5,7,9,10,11,13,14 as its OCSI allocation number. Every BS will have its own CSI allocation map indicating the current situation of CSI occupancy by the neighbors in the working channel and potential neighbors in the potential working channel. The CSI allocation MAP table of potential working channel will be used when the BS moves to another channel. ~~in cases~~. The CSI allocation MAP of the BS should be updated in time when any changes ~~have been~~are informed by its neighbors in the working channel and potential neighbors in the potential working channel.
In the OCSI mapping table, every neighbor in the working channel or potential neighbor in potential channels is mapped to one OCSI allocation, every OCSI allocation will indicate its status as occupied~~ant~~ or vacant~~cy~~. By inquiring the mapping table of the OCSI allocations to the BSs, one BS can recognize the source of the interference or signaling in each OCSI allocation.
The initializing BS uses the OCSI allocation table to find out its neighbors in the working channel. By the contact information it acquired from the CP messages, the IBS will then use CP messages to negotiate for interference resolution with its neighbors.

15.3.1.1.3 Interference from Non-IEEE 802.16 systems.
Section 15.7.1

Non-IEEE802.16 systems can make use of the coexistence procedures by using the collaborative mechanisms or the non-collaborative mechanisms. When sharing information and coordinating with WirelessMAN-CX systems using CP messaging or signaling, non-IEEE802.16 systems, such as IEEE802.11 systems, can share the same spectrum band ~~of spectrum~~ or do~~ing~~ radio resource distribution optimization using the collaborative mechanisms (summarized in) with WirelessMAN-CX systems. Otherwise, only non-collaborative mechanisms can be used for~~on~~ coexistence between IEEE802.16 and non-IEEE802.16 systems.

15.3.1.1.3.1 Non-IEEE 802.16 Systems (BSs and their SSs) capable of GPS/UTC Timing Recovery

Section 15.7.1.1

Other wireless systems, not specified in this standard, using uncoordinated bands ~~using the LE bands~~ that ~~that~~ are capable of GPS/UTC timing recovery can monitor the CMI intervals to determine the existence of co-channel IEEE 802.16 users. Monitoring the intervals and undertaking CCI measurements over CMI cycles will allow ~~these~~ those other systems to determine the occupancy o~~n~~f a channel and avoid settling on it. *[NOTE THAT BS AND SS MAY NOT BE DEFINED IN OTHER SYSTEMS.]*

Additionally, [CMI_ID54] [tbd.] will be left unoccupied by IEEE 802.16 systems. Non -IEEE 802.16 systems occupying the same ~~LE~~ uncoordinated spectrum can insert downlink and uplink power bursts [tbd.] into this interval. Such energy should be detected by the IEEE 802.16 WirelessMAN-CX systems, which will consequently avoid the use of the given channel.

Additionally, [CMI_ID54] [tbd.] will be left unoccupied by IEEE 802.16 systems. Non -IEEE 802.16 systems occupying the same ~~LE~~ uncoordinated spectrum can insert downlink and uplink power bursts [tbd.] into this interval. Such energy should be detected by the IEEE 802.16 systems, which will consequently avoid the use of the given channel.

15.3.1.2 Grouping of interfering/not-interfering units

Section 15.6.2

The system needs to~~he~~ group~~ing~~ of interfering/not interfering units of all the systems in the community and all the SSs in the native system for various purposes.
For all the neighbor systems (which ~~shows the aspect of~~can be either an interference victim or a source in any one of the candidate channels), the initializing BS will group them all as its potential interfering systems before choosing the operation channel. When the initializing BS have allocated the operation channel, only the neighbor systems, which are interfering in the current channel are grouped as interfering neighbor systems. ~~The~~ An interfering neighbor system should share the same band of spectrum by coordinating into different master sub frame or controlling the power spectrum density etc. The other neighbor systems are to be maintained in the database, for ~~the~~ cases ~~of~~ such as channel reallocation coordination.
As ~~F~~for all the SSs ~~inside the~~associated with the native systems, the BS needs to group them into interfering or not-interfering ones, so that the BS can schedule their data traffic into different sub frame to prevent interference. The not interfering SS can use either the interference free sub frame or the master sub frame for their data traffic, while the data traffic of interfering SS can only be ~~tied up into~~scheduled within the master sub frame of the native systems.

Section 15.3.2.4
Section 15.3.4.1
The following tables specify the fields (TLVs) to be included in the BS data base, ~~and~~ contain~~n~~ing information relat~~ive~~ed to its own operation (see) and to the operation of the base stations in the community (see). specifies the information (TLV) to be included in the SS data~~-~~base.

15.4.4.1.3 Selection of suitable reception sub-frames
Section 15.6.1

An ad-hoc unit will identify suitable reception sub-frames, by using the ACS and Registration processes repetitively~~in a repetitive way~~, searching for a suitable operation frequency. The practical interference situations, with synchronized MAC ~~Frames~~ frames are BS-SS and SS-BS interference. Assuming similar transmit powers, the above mentioned processes will find, ~~have~~ as result ~~finding~~, Master sub-frames in which the path attenuations between interfering units ~~is~~ are maximized.

15.4.4.1.5 Using the coexistence slot for transmitting the BS IP identifier
Section ***15.3.1.2.2***

The radio signaling described in section may be also used for the transmission of the BS_NURBC message (see), when there is no active Base Station Identification Server.
The transmission is done in consecutive coexistence time slots, spaced apart by Tiptx seconds. The first CSI in the series starts with CSI_~~-~~start signal, while the CSI in the series contains the Tx_end signal, the continuation in sequential CSI slots starts with the CSI_Continuation, as defined . ~~Between these signals is transmitted t~~The IP identifier of the BS and a 8bit CRC, ~~the L.S.B (least significant bit) for each field being transmitted first.~~ are transmitted between these signals, the L.S.B (least significant bit) for each field being transmitted first The transmission of the above information uses only the preambles for the sub-channels 6,8,10,12,14,18,20,22,24,26 (10bits / symbol), the L.S.B. corresponding to the lowest sub-channel number. The transmission of an IPV4 address will require 1+ (32+8)/10 + 1 = 6 symbols and the transmission of an IPv6 address will require 1+ceil((128+8)/10) +1 = 16 symbols.

15.4.4.1.6 Coexistence with non-IEEE 802.16 systems

Section 15.7

~~In continuation~~Subsequently we provide a review of the main mechanisms that can be used for providing better spectrum sharing with non-IEEE802.16 systems, other than those considered as "preferred spectrum users".
The Candidate Channel Selection, which is , as previously presented, ~~as~~ useful for the detection of ~~the~~ co-channel interference, can be used in a much larger scale for interference determination. A slot is reserved for non-IEEE802.16 systems, which may, in the future, to signal their presence in a controlled mode to IEEE802.16 systems.
The Signaling to Ad-hoc Systems, by using a simple, well-known PHY transmission, with increased power on the used sub-carriers, provides a better level of penetration. These transmissions may be detected in the future by non-IEEE802.16 systems, and used by them for choosing an optimal operation channel and to further isolate the interference in time domain.
For non-IEEE802.16 systems, these mechanisms are complementary: the first will allow ~~to~~ non-IEEE802.16 systems to signal their presence to IEEE802.16 systems, while the second will permit to non-IEEE802.16 systems to:

- Detect the potential interference ~~to be~~ caused by IEEE802.16 systems in both frequency and time domains
- Select the operating channels and time intervals, such that ~~will avoid to~~ interference to ~~with~~ IEEE802.16 systems is avoided.

Table h8

Syntax	Size	Notes
CP _Message_Format() {		
Version of protocol in use	4 bits	1 for current version

Code	8 bits	See
Management Message Type	16 bits	0-CP-REQ 1-CP-RSP
Length of Payload	16 bits	
Confirmation Code	8 bits	0-OK/success 1-Reject-other 2-Reject-unrecognized-configuration-setting 3-Reject-unknown-action 4-Reject-authentication-failure 5-255 Reserved
Alignment	4 bits	
AssociationID	?? bits	
CP Message Seq_ID	8 bits	
TLV Encoded Attributes	variable	TLV specific
}		

15.5.2.35 Channel Switch Negotiation Request message
Section 15.5.2.23

This message is ~~send~~ sent by a BS to another coexistence BS in the community to negotiate to switch to a ~~certain~~ different target channel.

Code: 35

Parameters: tbc.

15.5.2.36 Channel Switch Negotiation Reply message

A message sent by a BS in~~,~~ reply to a Channel Switch Negotiation Request message ~~about~~ whether it agrees or refuses to switch.

Code: 36

Parameters: tbc.

1Channel Switch Request message

This message is ~~send~~ sent by a BS to another coexistence BS in the community to request to switch to an alternative channel.

Code:37

15.6.1 How to select a "free" channel (for ACS and DFS)

Section 15.2.2

The IBS should ~~listen for~~monitor candidate frequencies during the selection of a working frequency. If the interference level is greater than the detection threshold, which is the required strength level of a received signal within the channel bandwidth, the channel is considered as an interfered channel.

Section 15.4.1.1

After Scanning before interference identification, the IBS should try to figure out whether it interferes with other systems in each of these candidate channels. By the feedback messages received after the signaling broadcasting, the IBS will collect the information of its interference victims on each channel.
If there is neither interference detected nor interference victims found in some channel by the IBS, the channel is marked as a "free" channel of the IBS. Otherwise, the IBS should figure out whether a~~n~~ "free" channel can be vacated by optimized channel distribution, as described in .
The ~~P~~process of ACS is shown in . The ACS process concludes with either on of two possible results: ~~in two kinds of conclusion,~~a) a "free" channel is validated with or without channel distribution optimization, or b) no "free" channel.
If a "free" channel is validated, it means default interference-free master slot is to be ~~used,~~used; otherwise, the IBS needs to share the channel with coexistence neighbors, as described in .

15.6.1.4 Optimization of Channel Distribution

Section 15.4.1.2

In the initialization phase of an IBS, ~~IBS's~~ its neighbors will send it their current working channel ID, OCSI allocation and subframe allocation ~~to the IBS~~ using CP messages, as well as a flag of having alternative channels. The IBS maintains the channel information of all neighbors in the BS information table.
When the IBS cannot find any free channel~~s~~ at the initialization phase, ~~IBS~~ it should try to optimize the channel distribution and to vacate a free channel for the IBS by switching some of its neighbors' working channels to others.
First, the IBS picks ~~up~~ all the channels that all the neighbors operating on it have ~~got~~ alternative channels, and sorts them according to the number of neighbor systems working on ~~it~~ each.
Second, the IBS selects one of the channels used by the fewest BS, and considers this channel as its potential working channel. The IBS should now negotiate with all ~~T~~the neighbors working on the selected channel ~~are then negociated~~.
Third, to negotiate with every neighbor BS working on this channel, the IBS should send a channel switch request message to each. A ~~N~~neighbor OBS, which ~~have~~ has received this message should select one of its alternative channels as the their target working channel, and try to move its working channel to that channel as long as the request is valid. After the working channel was switched to its alternative ~~channel~~, the neighbor OBS should acknowledge ~~to~~ the switch to the IBS by sending back a channel switch reply message with success indication, otherwise it should ~~show rejection to IBS by~~ send~~ing~~ back ~~channel switch reply message with~~a fail indication. If the IBS received any rejection from the neighbors, to which the IBS ~~have~~ had sent the request, the IBS should cancel the request by sending another message with the indication for the neighbors to switch back to the channel they used before the IBS's channel switching request.
Finally, when the IBS receives ~~from the neighbor OBS all~~ a positive acknowledge~~d~~ messages from all of its neighbor OBSs, it means the channel re-distribution optimization procedure has succeeded to vacate a channel for the IBS, ~~.~~ ~~A~~and the IBS should use it as a working channel afterwards. Otherwise, the IBS should try to vacate the next potential channel.
If the channel re-distribution procedure failed and all the potential channels can not be vacated to become the IBS's working channel, ~~channel distribution optimization procedure is failed, and~~ the IBS shall try to share one channel with some of its neighbors.
~~With succeeding of the~~If the channel redistribution ~~optimization~~ procedure succeeds, a list of alternative channels of ~~relative~~ related BSs should be updated if their neighbors have changed their working channels. ~~For~~ The IBS~~, it~~ should broadcast to all its neighbors that it will be working on the selected channel, ~~and~~ all its neighbors should add it~~IBS~~ as their~~its~~ new neighbor in the BS information table, and exclude ~~IBS's~~ its target working channel ~~in~~ from the list of potential alternative channels. ~~For t~~The neighbor OBSs that moved away from this channel~~, they also~~ should also notify the~~ir~~ change to all of their neighbors ~~for the channel switching,~~ so their neighbors can update the database according to the change.
The above process of channel selection optimization is shown in .

15.6.2.1.1 Synchronization of the WirelessMAN-CX Networks
Section 15.2.1

All the base stations forming a community of users sharing a common radio spectrum will use a common clock to synchronize their MAC frames. The common clock will be available to all outdoor WirelessMAN-

CX networks. Such a clock can be provided by global navigational systems such as GPS (Annex 2) or can be distributed by other means~~.~~. Every BS~~ upon activation,~~ will as a first step upon activation, ensure the derivation of the common system clock.

15.6.2.2.6 Credit token based coexistence protocol

Section 15.4.2.5

Spectrum sharing between several networks (NW) can be achieved ~~through the~~by sharing ~~of~~ a common MAC frame ~~between~~ among the different NWs as exampled by . In such a MAC frame structure, dedicated portions (denoted as “master NW sub-frames”) of the frame are periodically and exclusively allocated to a NW (denoted as the “master NW”) respectively in the forward and reverse link. The terminology used hereafter defines a slave NW as a NW that may operate during the other master NWs sub-frames. With respect to this definition, the slave NW sub-frames are the time intervals operating in parallel of the master NWs sub-frames.

Additional flexibility can be provided by such a frame structure if ~~The~~ the length of each master sub-frame (interference free sub-frame) can be dynamically adjusted as a function of the spatial and temporal traffic load variations of each NW as stated in section 15.2.1.1.1.
To achieve this, this section proposes the dynamic coordination of the frame structure sharing between BSs when several master NWs compete to share this common shared MAC frame.

15.6.2.2.6.1 General principle

Section 15.4.2.5.1

In order to resolve contention in accessing the channel and resources scheduling issues between NWs, the first step consists~~ in~~ of defining credit tokens and designing appropriate reserve price auctioning and bidding mechanisms. Then, on the basis of the usage of the credit tokens based mechanisms~~ usage~~, the second step consists ~~in~~ of managing dynamically (temporally) the bandwidth requests and grants mechanisms for the sharing of the master sub frames within the common MAC frame.

Based on the credit tokens transactions (selling, purchase and awarding), these two steps provide the mechanisms to enable spectrum efficiency and a fair spectrum usage in a real time fashion, while ensuring both the master and slave NWs QoS. These two steps enable to manage spectrum sharing between master NWs themselves. The result is the dynamic shaping of the MAC frame structure sharing as a function of the ~~space time~~ traffic intensity variations, and the dynamic credit tokens portfolio account of the master NWs. The transaction mechanisms are detailed in the following sections.