Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
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Re:	80216h-06_011：Working Group Review: P802.16h Working Document (2006-04-07)
Abstract	Some consolidation text in General description for the working document
Purpose	To introduce the basic component and basic relationship at the front of the WD.
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consolidation text in general

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Overview

1) The current WD haven't gather the important component of coexistence mechanism into a sub clause in the general description. This contribution try to gather most of the important component and the basic relationship between or among the components. As a reference of the terms used inside the rest part of the WD.

2) A mechanism list in a centralized table will be beneficial not only for the reader but also for the following consolidation of the amendment.

3) Some editorial correction have been indicated in clause 15.1 and 15.2 as the reference of commentary database.

Reference:

[1] *IEEE 802.16-06/010: Working Document for P802.16h (2006-03-29)*

[2] *IEEE 802.16-06/011: Working Group Review: P802.16h Working Document (2006-04-07)*

Proposed text changes

15.1 General

This ~~chapter~~ clause ~~introduces~~ describes high-level protocols and policies to be used for coordinating the system operation~~,~~ in order to ~~with the scope to~~ reduce the inter-system interference.

The basic mechanisms for achieving better coexistence are different for managed systems ~~networks~~ and for ad-hoc system s~~networks~~. It is recognized that the managed systems ~~networks~~, generally deployed by operators, should receive a higher priority than the ad-hoc systems ~~networks~~. *[JC: Is it clear what a managed network and ad-hoc network is?]*

Three basic mechanisms for achieving coexistence are ~~envisioned as being~~:

- 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 approaches.

For inter-system communication, at infrastructure and radio level, there are defined IP-level messages, MAC level messages and Cognitive Radio Signaling.

~~The c~~ Communication using IP-level messages ~~at IP level~~ is the most general ~~one,~~case and is ~~being~~ 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 and ~~. These may~~ convey special information between the BS and its subscribers, or may send messages between systems. In the last case, the communication takes place during the Coexistence Messaging Interval.

The Cognitive R~~r~~adio 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.]

~~The d~~ Different system parameters, including ~~their~~ 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~~ling~~ of ~~the~~ system power~~s~~. 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 ~~the~~ operation with reduced interference. The Coexistence Zone provides ~~gives the~~ support at the MAC level for scheduling the interference-free sub-frames.

The following table shows a list of the coexistence mechanisms for WirelessMAN-CX. The mechanisms are classified with collaborated and non-collaborated. Collaborated means information exchanges between the systems in the mechanism, while non-collaborated means the systems do not exchange information in the mechanism:

Table h_xx coexistence mechanism list for WirelessMAN-CX

Applicable condition	with ***wired IP*** communication available	Yes				No			
	same ***PHY*** profile	Yes		No		Yes		No	
	in signaling/messaging ***range****	Y	N	Y	N	Y	N	Y	N
non-collaborative mechanism	dynamic frequency selection(DFS)6.3.15	✓	✓	✓	✓	✓	✓	✓	✓
	GPS timing recovery(GPS/UTC)	✓	✓	✓	✓	✓	✓	✓	✓
collaborative mechanism	IP network message(CP message)15.2.2.3	✓	✓	✓	✓				
	coexistence proxy(CXPRX)15.2.1.1.6	✓	✓	✓	✓				
	coexistence signaling (CSI/ radio signature)15.2.1.1.3/4/5	✓		✓		✓		✓	
	coexistence messaging(CMI/CCD) 15.2.1.1.7	✓				✓			
	sub frame sharing(master sub frame)	✓	✓	✓	✓	✓		✓	
	channel reallocation(ACS)	✓	✓	✓	✓	✓		✓	
	credit token	✓	✓	✓	✓				

*** reachable range for signaling and messaging vary with different approach.**

15.1.1 Component and Relationship

System: *the BS and its associated SSs form a system*

Neighbor Relationship: *neighbor is a kind of relationship between two systems, when the BS in at lest one of these two systems make interference higher than certain threshold to at lest one SS in another system, or at lest on of the SSs in at lest one of these two systems make interference higher than certain threshold to the BS in another system.*

The figure_hxx shows some examples of neighbor relationship formed by bidirectional interference. In the figure hxx, system A have neighbor relationship with system B, system C and system D, vice versa, system B have neighbor relationship with system A, so do system C and system D.

The figure_hxx is an example of neighbor relationship formed by unidirectional interference., system E and system F have neighbor relationship with each other, although all the interference between the two systems is caused by system E. The interference from the SSs in one system to the SSs in another system, and from the BS in one system to the BS in another system is ignored, for the reason that they have been avoid by transmit/receive synchronization.

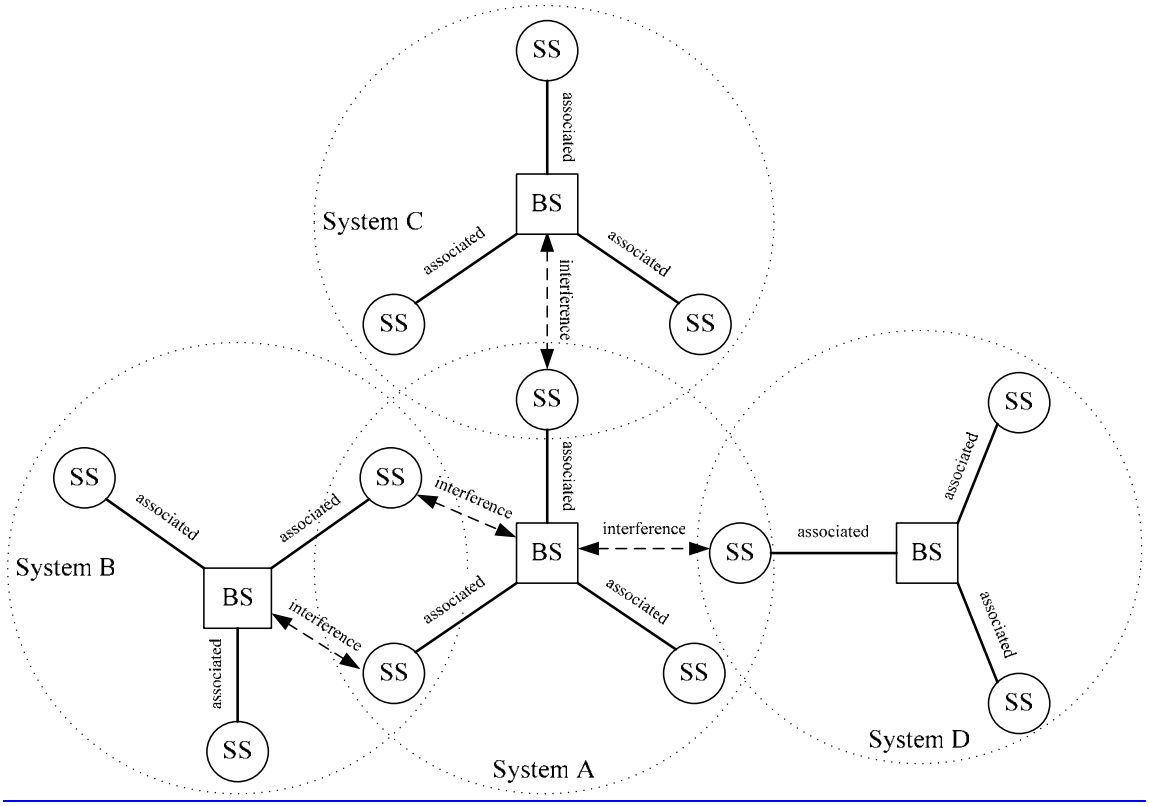

figure hxx. neighbor relationship formed by bidirectional interference

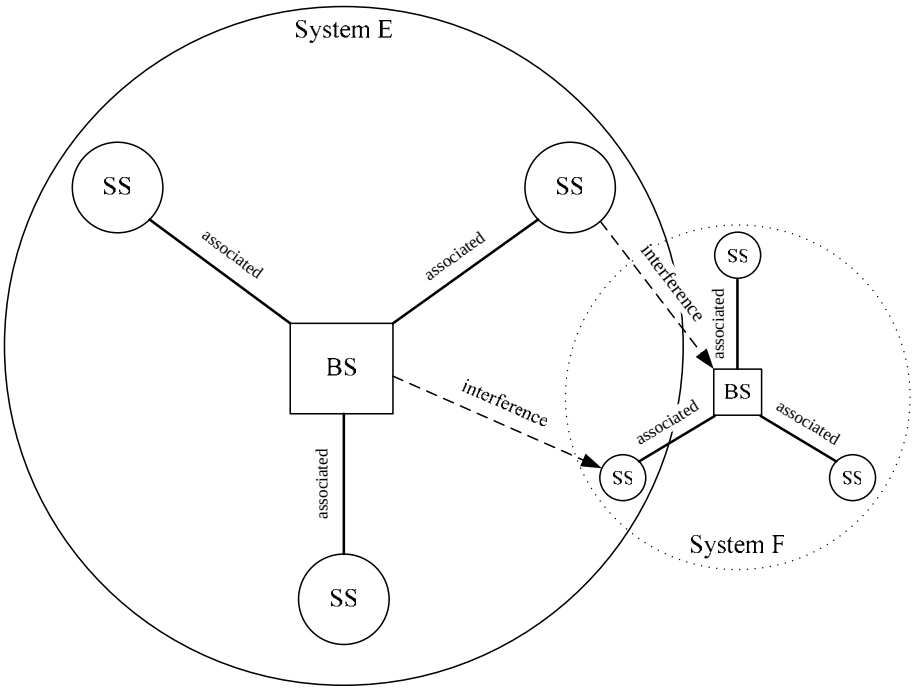

figure hxx. neighbor relationship formed by unidirectional interference

Neighbor: *another system should be called a neighbor system of the system, when it have the neighbor relationship with this system,*

Interference Victim System: *the system is an interference victim system, when there is BS or SS in this system which is interfered by the system's neighbor system, and the interference is higher than a certain threshold. The interference victim system could be an interference source system to its neighbor system at the same time(eg. system A/B/C/D in figure hxx), or only an interference victim system of its neighbor system(eg. system F in figure hxx).*

Interference Source System: *the system is an interference source system, when there is BS or SS in this system which make interference to the system's neighbor system, and the interference is higher than a certain threshold. The interference source system could be an interference victim system to its neighbor system at the same time(eg. system A/B/C/D in figure hxx), or only an interference source system of its neighbor system(eg. system E in figure hxx).*

Interference Victim BS/SS: *the BS/SS in an interference victim system is an interference victim BS/SS, when the BS/SS is interfered by the SS/BS in this system's neighbor system, and the interference is higher than a certain threshold. The interference victim system could be an interference source BS/SS to the SS/BS in its neighbor system at the same time(eg. BS in system A/B/C and the interference victim SSs in system A/B/C/D in figure hxx), or only an interference victim BS/SS of the interference source SS/BS in its neighbor system(eg. interference victim BS/SS in System F in figure hxx).*

Interference Source BS/SS: *the BS/SS in an interference source system is an interference source BS/SS, when the BS/SS make interference to the SS/BS in the system's neighbor system, and the interference is higher than a certain threshold. The interference source BS/SS could be an interference BS/SS to the SS/BS in its neighbor system at the same time(eg. BS in system A/B/C and the interference source SSs in system A/B/C/D in figure hxx), or only an interference source system of its neighbor system(eg. Interference source BS/SS in system E in figure hxx).*

Interference Neighborhood: *Interference neighborhood is relative to a system. A system will perceive as interference neighbors, all other systems which create/receive interference to/from it. The figure hxx shows some examples of neighborhood.*

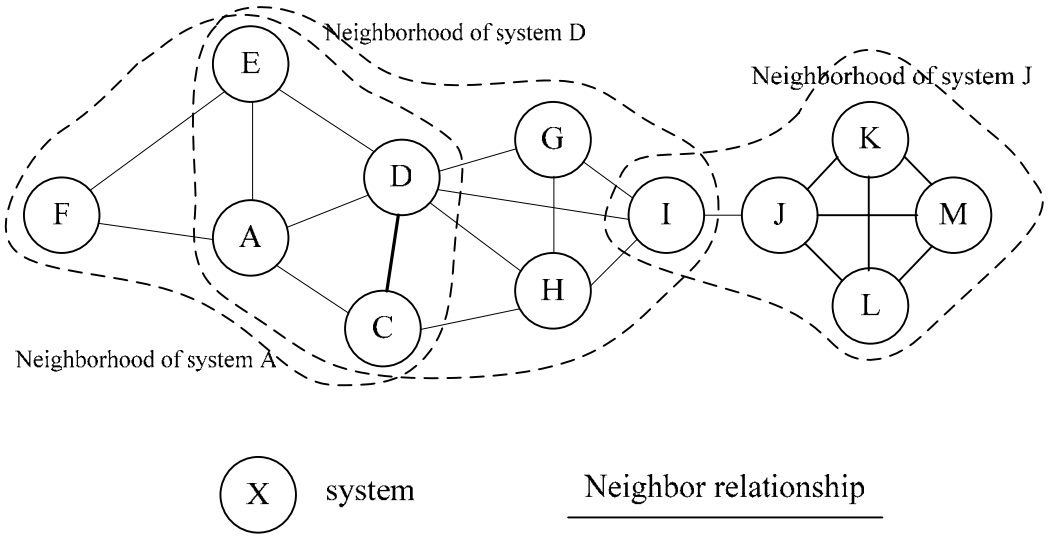

figure hxx. concept of neighborhood

Community: *is composed of those systems which coordinate to resolve their interference. Community could be formed by various aggregate systems in different phase and different approach, such as the systems in a neighborhood of a system or a picked subset of the systems with successive neighbor relationship of a system.*

Coexistence Community: *is a community composed of those systems which have resolved their interference and coexist.*

15.2 Interference detection and prevention – general architecture

15.2.1 Operational Principles and Policies

15.2.1.1 General Principles

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.

Tthe separation of remaining interference is resolved by separation of interferers in the time domain, by using procedures of the Coexistence Protocol. The Coexistence Protocol is defined at the IP level and it is mainly intended for BS-BS communication.

In order to obtain the IP address 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:

*1) In some circumstances,*there is country/region data base, which includes, for every Base Station:

- Operator ID
- Base Station ID
- Base Station GPS coordinates

~~o IP identifier~~

~~The local Radio Administration may use, for light licensing procedure, its own database, generally not including the Base Station ID and IP identifier information.~~

~~There is a server that manage the write/reading of this Data Base, using the 802.16h standardized procedures; the server and the country/region data base can be hostedby one of the operators or a trusted entity, like the local Radio Administration.~~

~~Otherwise, if the region/country database is not available, the base stations should try to find its neighbor and the community topology in a coordinatively distributed fashion.~~

~~2)~~ 1) Every Base Station includes a data base, ~~open for~~ base on which the Base Station standing for its system negotiate with other ~~Base Station~~ systems in the ~~same~~ community; the BS data-base contains information necessary for spectrum sharing, and includes the information related to the Base 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 **Error! Reference source not found.**).The base station shall represent its system in the cooperation with other systems when communicating over the backbone. It is ~~'s~~ possible to use the subscriber station to relay the control messages in some situations. The base station locations may be ~~registered~~ obtained by GPS or other positioning systems, however there is no need to register the subscriber locations;

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

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

The local Radio Administration may have, for light licensing procedure, 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 Data Base, using the 802.16h standardized procedures; the server and the country/region data base can be hosted by one of the operators or a trusted entity, like the local Radio Administration.

Otherwise, if the region/country database is not available, the base stations should try to find its neighbor and the community topology in a coordinatively distributed fashion.

3) All the Base Stations forming a community will have synchronized MAC frames and frame number.

4) A community will be limited to a reasonable size; the size limitations and interactions between different coexistence neighborhoods: t.b.d.

5) All Base Stations and their systems ~~networks~~ will as a first step be equipped with a spectrum detection and monitoring capability that prevents ~~seek the avoidance of~~ co-channel utilization of the same spectrum~~, and will be equipped with a spectrum detection and monitoring capability which will allow this.~~

6) All base stations are synchronized to a GPS clock. The start of all MAC frame and other transaction are referenced to the rising edge of this clock.

7) All base stations and their systems ~~networks~~, operating in the LE bands, will provide the opportunity to other ~~non IEEE 802.16h~~ non-WirelessMAN-CX systems to communicate their coexistence requests to the ~~IEEE 802.16h~~ WirelessMAN-CX systems~~networks~~.

8) The ~~IEEE 802.16h~~ WirelessMAN-CX systems will recognize the use of radar and other systems having higher priority to LE spectrum.

9) Every system~~network~~ 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

~~***Interference Neighborhood:*** Interference neighborhood is relative to a system (BS and its subscribers). A system (BS and its SSs) will perceive as interference neighbors, all other systems (BSs and their SSs) which create/receive interference to/from it.~~

~~***Community:*** is composed of those systems (BSs and their SSs) which coordinate to resolve their interference.~~

~~***Coexistence Community:*** is composed of those systems (BSs and their SSs) which have resolved their interference and coexist.~~

Figure h3 illustrates an example of three overlapping radio systems and illustrates a possible implementation of the ~~The figures below explain possible ways of implementing the~~ guaranteed radio resource principle~~.~~, ~~using a example of three overlapping radio networks.~~

The overlapping radio systems ~~networks~~ create different interference zones~~,~~ based on the spatial distance between transmitters and receivers. As example of BS to SS interference,, the radio receivers in Zone A~~,~~ have ~~in the figure below, suffer from the~~ interference ~~(noted with)~~ between system~~Network~~ 1 and system ~~Network~~ 2. ~~Interference Zone B includes also the Base Station of the Network B.~~

The operation of the ~~3~~ three ~~networks~~ systems in Figure h3 assume the following different situations:

Zones in which the systems ~~networks~~ 1,2~~,~~and 3 do not interfere;

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

Now lets suppose that we split ~~a~~ the time frame in 3 sub-frames (being 3 different systems~~networks~~), ~~and~~ so that every system ~~network~~ will receive an interference free interval for operation as shown in Figure h4.

Another possible approach shown in Figure h5 will be to set an operating time for not interfering (noted Ø) situations, and split equally between the ~~3~~three ~~networks~~systems the remaining resource, like shown below. It can be seen that non-interfering traffic may be scheduled in parallel, resulting a much better radio resource usage.

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

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