

Project	IEEE 802.16 Broadband Wireless Access Working Group < http://ieee802.org/16 >	
Title	consolidation text in general	
Date Submitted	2006-04-30	
Source(s)	Jim Carlo, Wu Xuyong, Huawei Huawei Industrial Base, Bantian, Longgang, Shenzhen 518129 P.R.C	Voice: +86-755-28972324 Fax: +86-755-28975523 J.carlo@ieee.org ; wuxuyong@huawei.com
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.	
Notice	This document has been prepared to assist IEEE 802.16. It is offered as a basis for discussion and is not binding on the contributing individual(s) or organization(s). The material in this document is subject to change in form and content after further study. The contributor(s) reserve(s) the right to add, amend or withdraw material contained herein.	
Release	The contributor grants a free, irrevocable license to the IEEE to incorporate material contained in this contribution, and any modifications thereof, in the creation of an IEEE Standards publication; to copyright in the IEEE's name any IEEE Standards publication even though it may include portions of this contribution; and at the IEEE's sole discretion to permit others to reproduce in whole or in part the resulting IEEE Standards publication. The contributor also acknowledges and accepts that this contribution may be made public by IEEE 802.16.	
Patent Policy and Procedures	The contributor is familiar with the IEEE 802.16 Patent Policy and Procedures < http://ieee802.org/16/ipr/patents/policy.html >, including the statement "IEEE standards may include the known use of patent(s), including patent applications, provided the IEEE receives assurance from the patent holder or applicant with respect to patents essential for compliance with both mandatory and optional portions of the standard." Early disclosure to the Working Group of patent information that might be relevant to the standard is essential to reduce the possibility for delays in the development process and increase the likelihood that the draft publication will be approved for publication. Please notify the Chair < mailto:chair@wirelessman.org > as early as possible, in written or electronic form, if patented technology (or technology under patent application) might be incorporated into a draft standard being developed within the IEEE 802.16 Working Group. The Chair will disclose this notification via the IEEE 802.16 web site < http://ieee802.org/16/ipr/patents/notices >.	

consolidation text in general
Huawei Technologies Co., Ltd.

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 snetworks~~. 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 e~~ 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 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.]

~~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 controlling ~~of the~~ system powers. 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

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

* 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 least one of these two systems make interference higher than certain threshold to at least one SS in another system, or at least on of the SSs in at least 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.

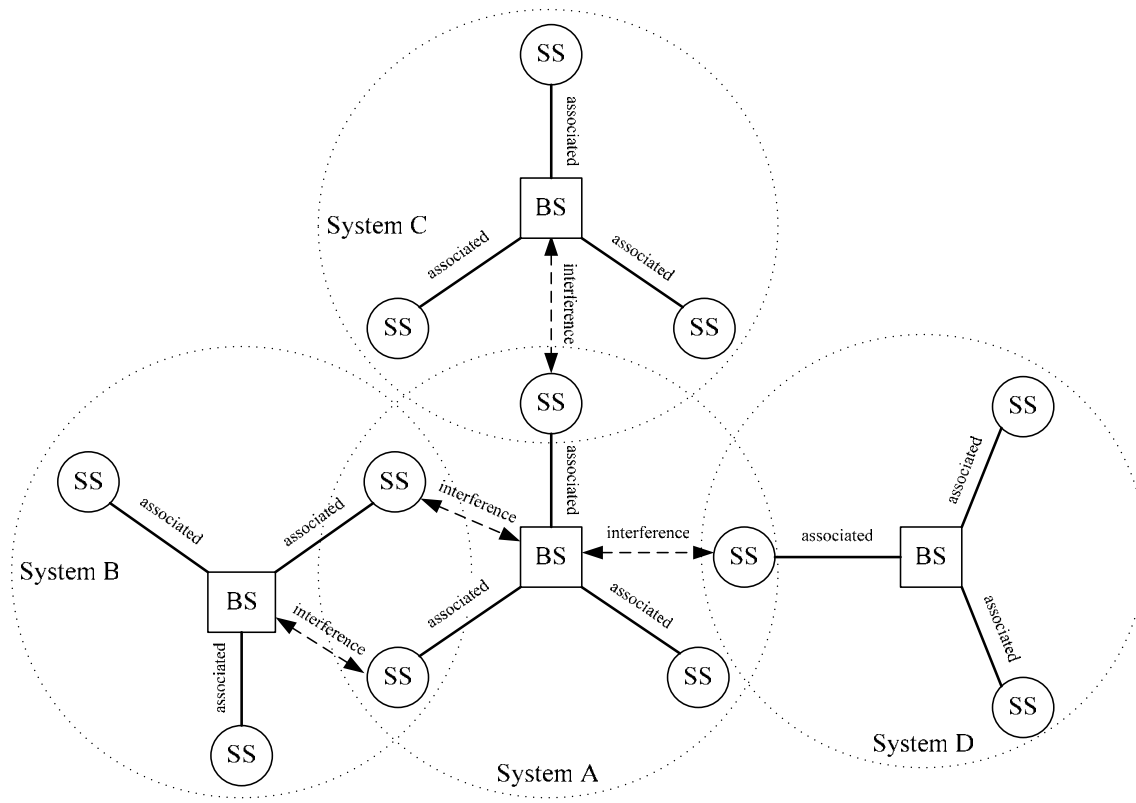


figure hxx. neighbor relationship formed by bidirectional interference

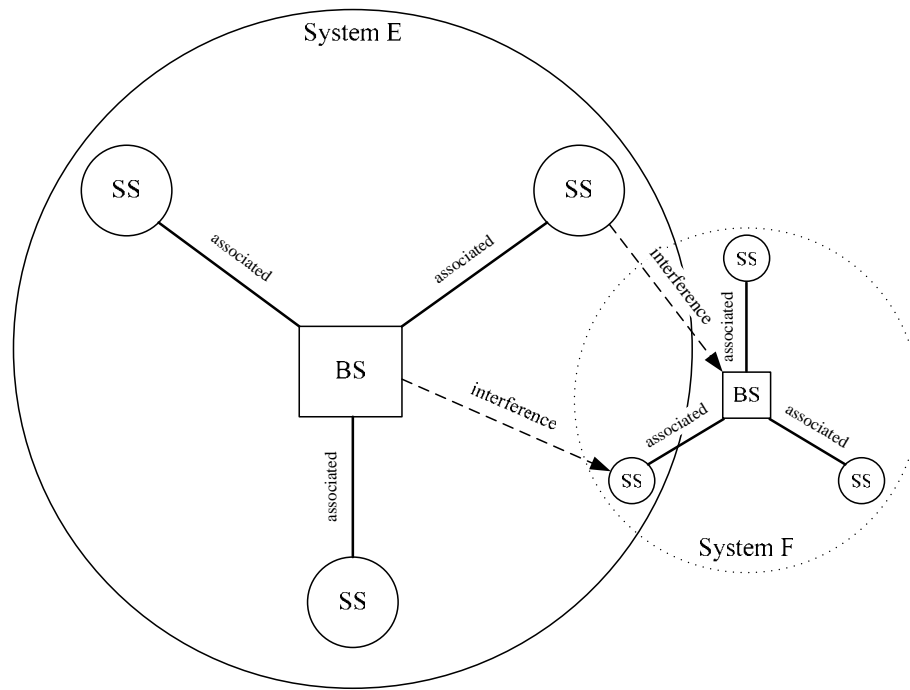


figure hxx. neighbor relationship formed by unidirectional interference

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.

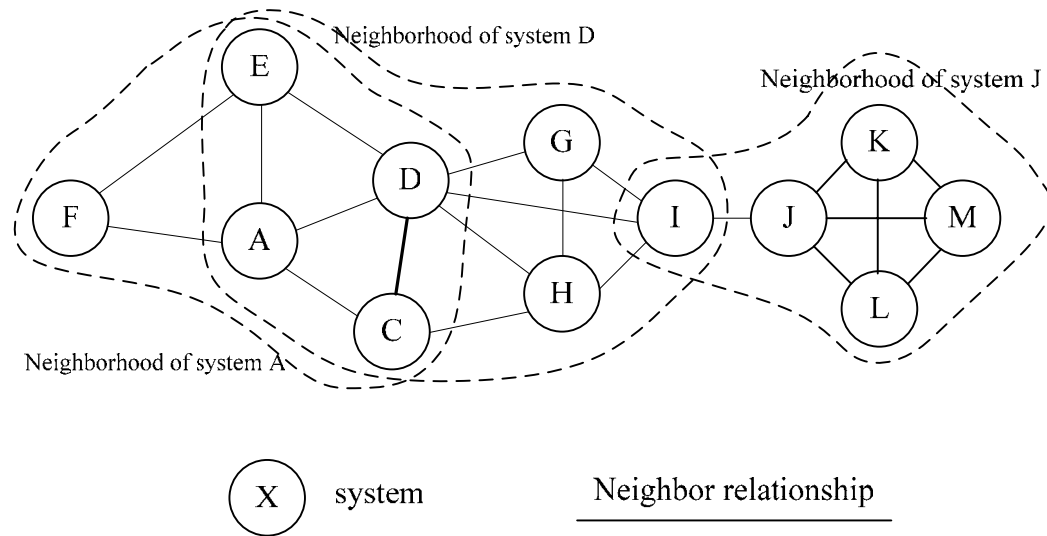


figure hxx. concept of neighborhood

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:

~~The~~ 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 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.~~

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~~ 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 systems to communicate their coexistence requests to the ~~IEEE 802.16h WirelessMAN-CX systems networks~~.

8) The IEEE 802.16h 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 guaranteed radio resource principle, using an 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 an example of BS to SS interference, the radio receivers in Zone A, have in the figure below, suffer from the interference (noted with \rightarrow) between system Network 1 and system Network 2. Interference Zone B includes also the Base Station of the Network B.

The operation of the 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 let's 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 \emptyset) situations, and split equally between the three networks systems the remaining resource, like shown below. 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 Network system 1, 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.