Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Neighbor Discovery using Interference Free Coexistence Time Slot**
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Re:	80216h-05_014：Call for Contributions IEEE 802.16's License-Exempt (LE) Task Group. 2005-06-09 Topic 3. Text for the IEEE P802.16h draft, according to the Table of Contents of the Working Document.
Abstract	Proposes a protocol for neighbor discovery
Purpose	
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Neighbor Discovery using Interference Free Coexistence Time Slot
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Considering Issues

In current working document [2], there are still some issues remain to be discussed:

a) No clear definition on the "neighbor" base station for coexistence;

b) No instruction on how the initializing base station could find neighbors without a centralized server;

c) Using detection on neighbor BSs' interference; there is still a big risk on hidden neighbor.

Please refer to the annex slide for the consideration reference.

Acronyms

CTS   − Coexistence Time Slot

IBS   − Initializing Base Station

OBS   − Operating Base Station

Reference:

[1]   *IEEE802.16-2004: IEEE standard for Local and metropolitan area networks Part16: Air Interface for Fixed Broadband Wireless Access Systems 2004-10-01*

[2]   *IEEE 802.16-05/013: working document Amendment for Improved Coexistence Mechanisms for License-Exempt Operation 2005-06-06*

Proposed definition on neighbor base station

"Neighbor" is a very important term in the 802.16h, and should differ from the definition for mesh in 802.16-2004[1]. It's said, "The stations that have direct links are called neighbors and shall form a neighborhood." This can not properly explain the neighborhood in coexistence protocol.

We propose to insert the text for definition of neighbor BSs & neighborhood:

[insert the following section into 2.1.1.1 Generic Principals]
"

Neighbor BSs: The base stations that have valid SSs in the common coverage area are called neighbor BSs, and shall form a neighborhood.

There are 2 basic conditions to form a neighborhood:

1) Common coverage area: base stations need to be close enough in geography;

2) Valid SSs exist in the common coverage area: When SS transfer data with one BS at a time, it shall consider other BSs as an interference source at the same time.

Neighbor Networks: Neighbor BSs & their SSs are called Neighbor Network, and shall form a network neighbor hood.

"

For example, as the figure 1 shown, BS1&BS2 have common coverage area , but no valid SSs exist in the common area, so BS1&BS2 are not neighbor, though BS1&BS2 could hear each other; BS2&BS3 have common radiation area, and there is valid SSs inside the common area, so BS2&BS3 form a neighborhood.
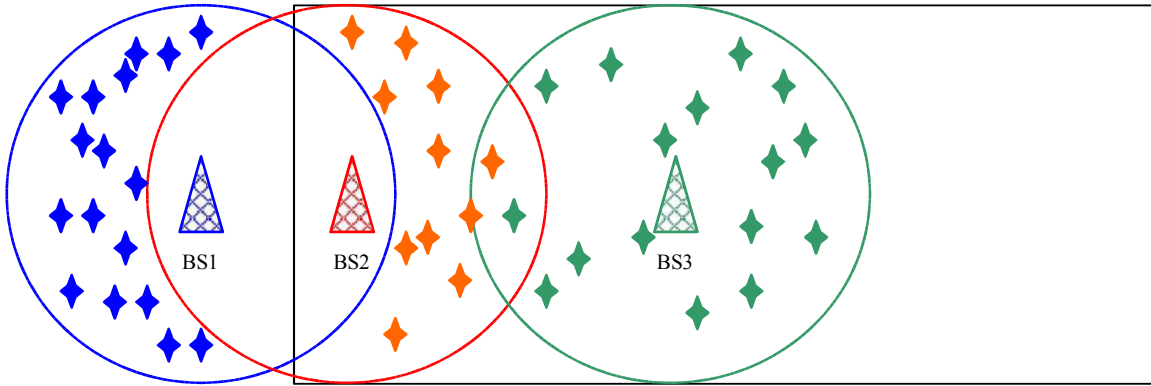
figure1. Concept of neighbor BSs in coexistence protocol

Description on the solution to neighbor discovery issues

Proposed text definition of CTS to be insert/append：

[insert the following section into 2.1.1.1 Generic Principal]
"
***CTS** (Coexistence Time Slot): a predefined time slot for the coexistence protocol signaling purpose, especially for the initializing BS to contact its neighbor operating BS through the SS in the common coverage area.*
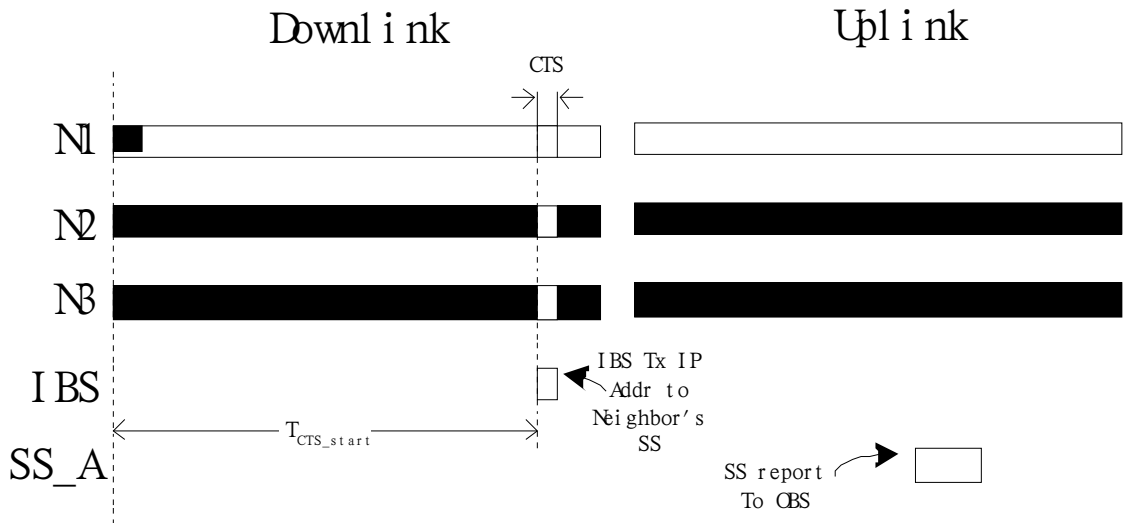
Figure2. Timing of Coexistence Time Slot

CTS must not be used for other purpose by all the BSs, so that it will be an interference free slot for the neighbor discovery purpose. Initializing BS (IBS) shall use this slot to broadcast its IP identifier, so that the neighbor operating BS (OBS) could find the new neighbor in IP network after the SS report the message. Then the IBS and OBS begin further negotiation for coexistence protocol.
The broadcasting procedure is unidirectional, only from the IBS to the SSs in IBS's coverage, and the SSs shall

report all the useful information to their OBSs they registered to. If the message be forward correctly to the OBSs, the OBSs will then find the IBS in the IP network, and go further signaling using IP network.
The CTS parameters need to be unified in particular region, and be well known by the BSs. So that each IBS could know the exact time to transmit the broadcasting message in its initialization. The parameters include:

$T_{CTSstart}$: *CTS starting time from the beginning of the frame (ms)*

$T_{CTSdurat}$: *CTS duration time (ms)*

$N_{CTSstart}$: *CTS starting frame number*（*frames*)

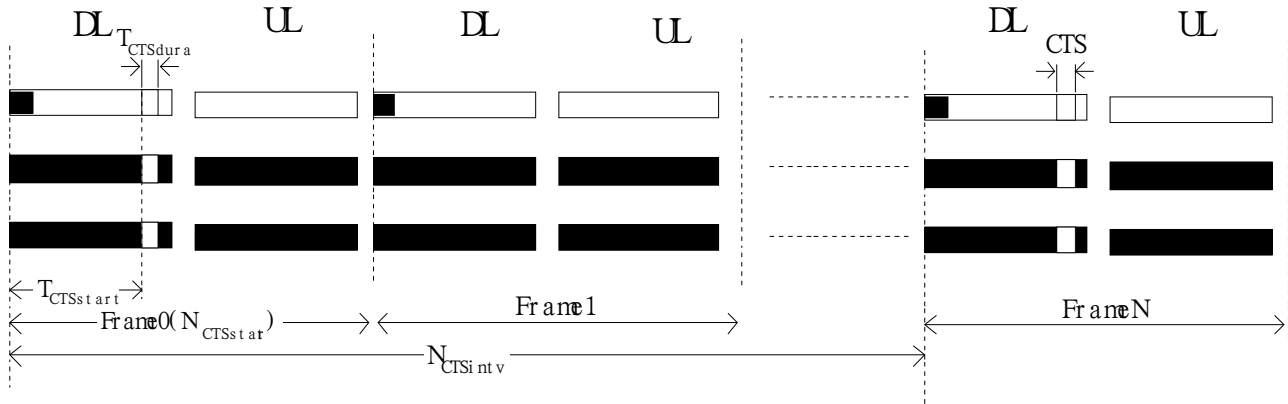$N_{CTSintv}$: *CTS interval frames*（*frames*)
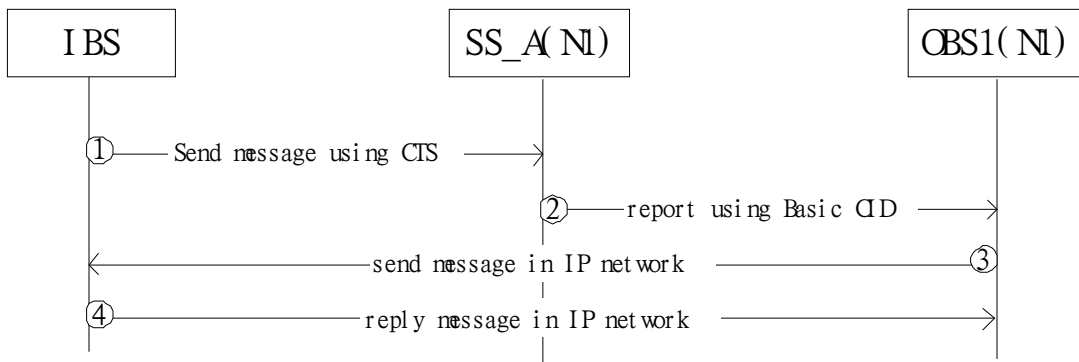

Figure3. CTS parameters

Figure4. CTS usage example- IBS broadcasting IP address to neighbor's SS

"
For robust purpose, we could define a randomize back off mechanism for the IBS contact request broadcasting, in case they may not receive the feedback in IP network in a certain duration.

In current working document [2], the neighbor discovery follows the procedures below:

2.1.1.3 Community Entry of new BS
•The first phase of the Community Entry process uses the country/region (FCC) data base:
        o Read the Regional/country (FCC) data base;
        o Identify which Base Stations might create interference, based on the location information;
        o Learn the IP identifier for those Base Stations;
•Build the local image of the relevant information in the community BS's, by copying the info in those BSs
•Listen on multiple frequencies

o Identify the level of interference on each frequency channel;

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

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

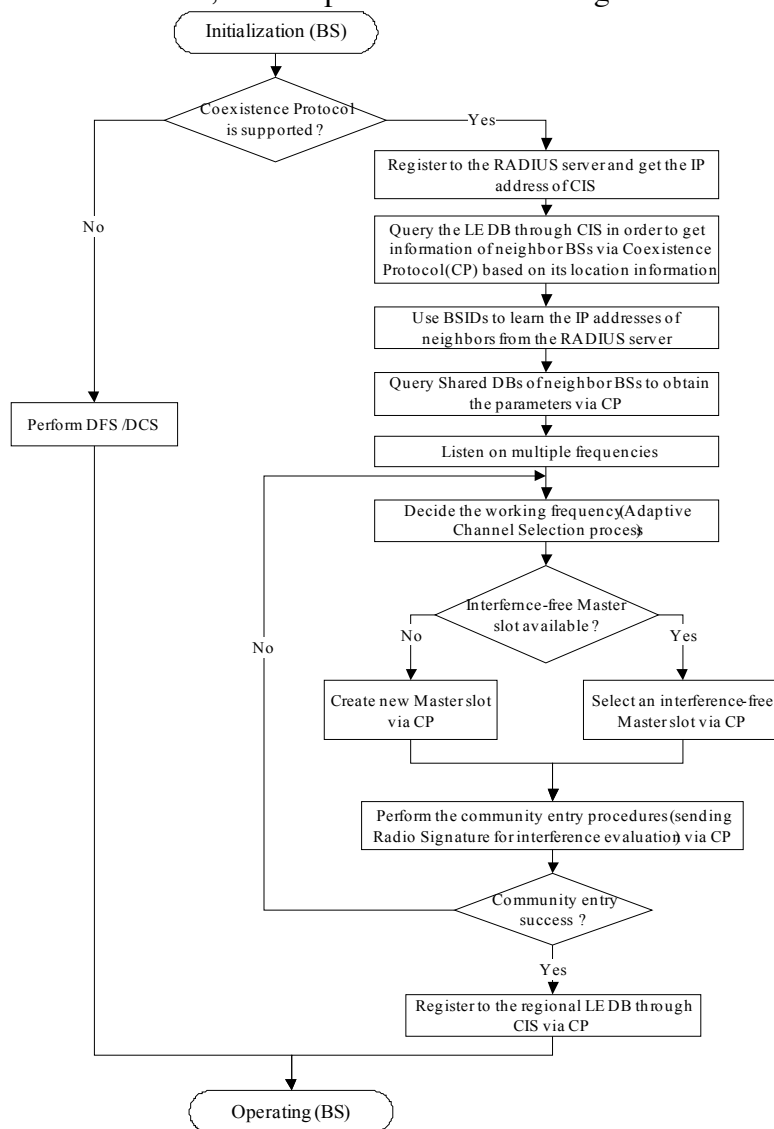•If no free Master slot sub-frame is found, use the procedure for creating new Master slots sub-frames.

Figure 11 Initialization procedures — BS

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Proposed modification on the procedure:

Add a verdict process in the BS initializing procedure:

Check if the CIS server is valid, if CIS is Valid, use the original process to get the neighbor's IP address, otherwise, use the CTS to broadcast the IP identifier and contact request, and waiting for the reply from neighbors.

[change the beginning part of 2.1.1.3 into the following text]
"

2.1.1.3 Community Entry of new BS
•The first phase of the Community Entry is to judge the validity of country/region data base. If the country/region database is valid, process uses the country/region (FCC) data base:
　　　o Read the Regional/country (FCC) data base;
　　　o Identify which Base Stations might create interference, based on the location information;
　　　o Learn the IP identifier for those Base Stations;
　Otherwise:
　　　o New BS uses the interference free slot to broadcast the contact request
　　　o The SS in the common coverage will forward the information to its operating base station.
　　　o The operating neighbor BS send feedback information using IP network
　　　o learn the IP identifier By the message from neighbor BS via IP network
•Build the local image of the relevant information in the community BS's, by copying the info in those BSs
•••••••
"

[change the figure 11 into the following chart]
　"

Figure x Initialization procedures — BS

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