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**APT REPORT ON**

**Study on Geo-Location Database as an enable technology of CRS**

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# Background

Spectrum scarcity is becoming a major issue for wireless communication with soaring spectrum demand and limited resource. Traditional spectrum allocation allocates spectrum block to radio system statically for exclusive usage. Due to the imbalanced service/business distribution between various radio systems, the overall spectrum utilization is very low [1].Cognitive Radio (CR) is known as an innovative spectrum management technology [1,2] to improve spectrum efficiency.

Since the enormous role of CRS/SDR technology in addressing spectrum scarcity issues, at AWG #10 meeting, TG CRS&SDR started to develop the report of “CRS DEPLOYMENT SCENARIOS AND ASSOCIATED TECHNOLOGIES”. This document focuses on CRS Application scenarios, enabling technologies studies, and the influence which CRS brings on the existing system. After several meeting discussion, based on discussion process and scheduled work plan, this work was ended at AWG #18 meeting.

However, this report is just a preliminary study on CRS/SDR technology, some detailed technical issues need to be further addressed. In the current discussion of other external standards organizations related to CRS, Geo-location databases and sensing are two widely discussed CRS enabling technology. As for spectrum sensing, the performance is restricted by many factors, and several challenges still need to overcome [3]. Firstly, there is a conﬂict between data rate and sensing accuracy. Moreover sensing result may be inaccurate due to the hidden terminal phenomena. Last but not least, sensing puts high requirement regarding device sensitivity and raise power consumption. Considering the disadvantages of spectrum sensing, wireless industry tends to adopt Geo-Location Database as the method for spectrum management in CR system. Specially, GLDB has been regulated as a mandatory technology by CEPT, FCC[4] and Ofcom[5]. FCC has authorized third party database vendors to develop and operate the database.

This project on the basis of preliminary study of CRS of the previous AWG meeting, the Geo-location Database technology needs to be further researched.

This document is to study GLDB deployment scenarios, functional architecture in the APT region and associated key techniques and potential implementation scheme.

# Definitions, abbreviations and related Documents

## Definitions

***Cognitive Radio***: radio, which has the following capabilities:

to obtain the knowledge of radio operational environment and established policies and to monitor usage patterns and users' needs;

to dynamically and autonomously adjust its operational parameters and protocols according to this knowledge in order to achieve predefined objectives, e.g. more efficient utilization of spectrum; and

to learn from the results of its actions in order to further improve its performance.

***Cognitive radio system (CRS)***: A radio system employing technology that allows the system to obtain knowledge of its operational and geographical environment, established policies and its internal state; to dynamically and autonomously adjust its operational parameters and protocols according to its obtained knowledge in order to achieve predefined objectives; and to learn from the results obtained.

NOTE: This is the current definition in Report ITU-R SM.2152.

***White Space (WS)***: part of the spectrum, which is available for a radiocommunication application (service, system) at a given time in a given geographical area on a non-interfering/non-protected basis with regard to primary services and other services with a higher priority on a national basis.

## Abbreviations

APT Asia-Pacific Telecommunity

ARP Allocation and Retention Priority

AWG APT Wireless Group

COGEU COGnitive radio systems for efficient sharing of TVWS in EUropean Context

CR Cognitive Radio

CRS Cognitive Radio System

FCC Federal Communications Commission

LBT Listen Before Talk

SC Spectrum Coordinator

WLAN Wireless Local Area Network

WS White Spaces

# Deployment Scenarios of Geo-Location DataBase

Based on different external interfaces, the deployment scenarios of GLDB can be classified into three types: Direct-connection scenario, Non-direct-connection scenario and Hybrid scenario.

## Direct connection scenario

When the secondary system utilizes WS spectrum, the Cognitive Radio (CR) system is not only to consider the coexistence issues between incumbent and secondary system, but also to take into account the self-coexistence of WSDs. If the secondary system has the capability of self-coexistence, then the WSD shall connect to a GLDB directly to obtain its operational parameters limit in white spaces, and these parameters are calculated by GLDB according to the protection criteria of incumbent system and the device parameters of that WSD. Furthermore, under the limitation of operational parameters, WSD utilizes its own self-coexistence mechanisms (such as the LBT mechanism under WLAN system) to coexist with other WSDs to determine the specific operational parameters. Meanwhile, A GLDB needs to maintain a record of the practical usage of the white spaces, and the interference source could be readily identified according to the occupancy information of idle spectrum when the incumbent system was disturbed.



Figure 1．Direct connection scenario

## Non-direct connection scenario

When the secondary system utilizes WS spectrum and does not have the self-coexistence ability, the cognitive radio system needs additional consideration of the self-coexistence of WSDs. For this reason, the Spectrum Coordinator (SC) is introduced for coordinating spectrum usage among different WSDs. Based on the above, the SC sends device parameters of the WSD to a GLDB for operational parameters limit calculating, determines the specific operational parameters of the WSD. Besides, during the process, the SC maintains data about spectrum usage of the different WSDs. This data contains information that reflects the current state of spectrum usage, including spectrum measurement data from WSDs, and usage maps or areas of occupancy of the different WSDs. It also contains coexistence parameters of different WSDs. A GLDB receives information from SC about device parameters of WSD in order to generate operational parameters for that WSD according to the protection criterion of incumbent system. Moreover, a GLDB provides the operational parameters limit of WSD to SC, and the specific operational parameters determined by the SC shall not violate the protection criteria of the incumbent system, in order to further carry out the coexistence solution of WSDs. Different from the Direct-connection scenario, the Non-direct-connection scenario allows more flexible control due to the existence of SC, for example, as long as SC meets the overall requirements of operational parameters limit provided by GLDB, the configuration parameters (such as spectrum, transmit power) of each WSD can be flexibly allocated.



Figure 2．Non-direct connection scenario

## Hybrid scenario

In a certain area, the hybrid scenario of GLDB in WS is constituted when there are secondary systems with or without the capability of self-coexistence. In this scenario, the database not only needs to take the responsibility of the parameters of WSDs under two systems, but also provides the possible assistance for the coexistence of the two types of WSD.

# Functional Architecture

## Location of GLDB in network



Figure 3．Position of GLDB within CRN

Figure 3 shows the architecture diagram of GLDB within cognitive radio network, it demonstrates clearly the following relationships: in the whole system, GLDB is the center of this system; operations are managed by third parties of regulatory domain or incumbent system. Besides, the spectrum sharing between incumbent and secondary system have to be supervised by regulatory domain. Furthermore, database provides the access interface and accepts the registration of secondary system.

## Internal function framework of GLDB



Figure 4．Functional Architecture of GLDB

* Data collection and storage

Collection and storage of raw data are the fundamental function of GLDB. To achieve the target of incumbent protection, GLDB needs to collect the following information.

* Regulatory domain information:

In order to ensure the normal operation of radio system, the regulatory domain takes the role of supervision and management. First of all, the regulatory domain shall make transparent and fair policy to ensure the normal spectrum sharing order between incumbent and secondary system. Secondly, grant the WS to legitimate secondary system; furthermore, monitor and manage the interference between the incumbent and secondary system; and finally, develop a fair and reasonable charging policy. All these functions are implemented by the regulatory domain of GLDB.

* Radio environment information:

Radio environment information is mainly used to indicate the relationship among signal intensity, distance and environment. Radio environment information can determine the coverage of incumbent signal to generate radio environment map. The interference experienced by incumbent system can also be evaluated using radio environment information.

* Incumbent parameters:

Most incumbent parameters can reflected with three attributes: time, spectrum and location. Together with information about interference tolerance, all these parameters are provided to GLDB. GLDB could also acquire the spectrum utilization condition and interference tolerance of incumbent systems in different geographic areas to provide protection to them.

* Secondary system parameters:

Secondary systems parameters are collected during the phases of registration, applications and configuration, which would be used in processes such as authentication, available spectrum and emission parameter calculation.

* Information maintenance and process

Utilizing the latest information stored in GLDB, processing needs to be conducted to generate information for a variety of applications.

* Incumbent protection criteria:

Incumbent protection criteria could be generated according to incumbent characteristics, such as the interference tolerance threshold, the adjacent channel leakage limitation.

* WS resource map:

Combining the criteria generated above and the spectrum management policy adopted by the regulatory domain, an WS resource map indicating channel utilization status, signal coverage area can be calculated in GLDB. Using resource map, WSD could determine the available spectrum and emission parameter restrictions.

* Priority management policy:

Priority of multiple secondary systems is established based on network strategy. When there are a large number of secondary systems, spectrum is usually allocated according to priority. Alternative different proportions of interference margin can be assigned to secondary system according to priority.

* Interference solution:

Protecting incumbent system against interference from a single WSD. The two kinds of interference problems shown in Fig. 5 should also be taken into consideration.



Figure 5．Interference among different types of devices

In hybrid scenario, due to the presence of two types of WSD, GLDB should act as an anchor to provide necessary assistance on interference resolution between secondary systems.

Interference from multiple sources has cumulative effect, so when there are several WSDs under one GLDB, it is necessary to ensure aggregated interference does not exceed interference threshold. When conﬁguring transmission parameter for new WSDs, calculation should be done according to the remaining interference margin of current network.

* Information application

In correspondence with its external function, GLDB develops different interface and defines the following applications:

Several critical applications need to be defined over the interface between GLDB and external entities such as incumbent system to facilitate the normal operation of CR system.

* Registration and Authentication

Registration and authentication process determines whether spectrum utilization is allowed according to WSD type. The user device information provided by WSD in this process will also help to identify the interference source when strong interference is observed.

* Interference resolution

GLDB protects incumbent system from harmful interference through limiting the transmission parameters of WSD, . To distribute interference margin among multiple users, a reasonable solution should be made based on the established interference resolution rule and actual situation of WSDs. Another function GLDB also needs to address is interference coordination and resolution when interference happens.

* Spectrum allocation

When secondary system applies for spectrum resources, Spectrum Coordinator provides information of its subordinate devices to GLDB. Subordinate devices can also provide information directly to GLDB to facilitate the allocation process.

* Charging

Considering the interests of the incumbent systems, secondary systems may be required to provide compensation for using WS resources [6]. Therefore, NRA should provide the relation between reference price , available frequency, bandwidth, location characteristic , length of available time , the maximum allowed transmission power ,etc. Spectrum Price  can be written as the function of above parameters.

 （1）

Based on the charging policy, bill will be generated by the charging module in GLDB according to the actual usage of WS spectrum.

# Key technologies

## Registration and authentication

Registration has been mentioned in some organizations, for example in FCC, fixed devices needs to register in database; in Ofcom, master WSD also needs to register in database. In COGEU, the unlicensed fixed or portable devices need to register in database.

These registration progresses have the following effects:

* To authorize the registered devices;
* Be convenient for searching interference sources.

The organizations mentioned above are all about registrations of second system devices, but in our project, there is a manage node (SC module) based on each second system between second system devices and database. As the second system devices access the database through the SC module, so the registration of the SC module is only considered, rather than the specific device. Besides, in regulatory domain perspective, this is the authorization for a system, such as 2G (GSM) system can utilize CR technology to occupy TVWS resource through authorization.

Such a practice is consistent with the duty of SC module, when a network entry CR mode, first of all, the SC module of this system sends an application for registration to the database. Besides, the database authenticates this system by searching regulatory domain information, and then the second system which is authorized by regulatory domain can register in the database. After that, the resources application of second system devices initiated by the SC module is to be allowed.

For the search of interference source, the database does not need to find the specific equipment, only to find the corresponding SC module, and the SC module will eliminate interference by completing reconfiguration and control of interference source. Besides, in our project, SC module can be regarded as this second system. Furthermore, the wrong calculation of transmit power or any subordinate node interference will affect the priority of spectrum utilization in the whole SC module.

The specific parameters provided by SC module at registration including:

* SC module identification
* Capability (whether there is computing function based on coexistence )
* PLMN
* RAT
* Location range

## Spectrum application/Access management

When secondary system applies for spectrum resources, Spectrum Coordinator provides information of its subordinate devices to GLDB in order to get more accurate TVWS information from database, as follows:

* Device type (indicated by the exclusive device identification of regulatory domain )
* Frequency and bandwidth requirement
* Location information (location coordinates and location precision)
* Expected duration of occupation
* Priority information (network status, user attribute)
* Preemption property (whether or not to be preempted , whether preemption)

## Idle channel statistics module

When database receives the application of TVWS spectrum resources based on location, combining TVWS spectrum map, in order to feedback SC module the TVWS spectrum resources, and provides the protection rules and charging strategy of these resources, as follows:

1. Coverage of target TVWS resources: combining the location coordinates and location precision, also includes rough service distance of the devices. The coverage of target TVWS resources is a circle by taking location coordinates as the centre point, the sum of location precision and service distance as the radius.
2. Mapping this coverage and TVWS spectrum map, making a list which includes the idle channels on the coverage of target TVWS resources.
3. Adding protection rule information (covering edge, interference tolerance threshold, etc) and charging strategy on each channel of the list, and feedback these results to SC module.

## Priority management

When secondary systems need to coexist, the priority management should be considered for resource coordination allocation.

### Priority management method

Based on the concept of assigning priority ARP, the similar ideas to prioritize each secondary system can be used.

ARP parameter: it is a service -based parameter that only works when bearer is established or modified. When a bearer is set up for a service and the ARP attribute of the service is preemptive, then it can preempt the lower-priority spectrum resources of a service that can be preempted. Correspondingly, When the ARP attribute of a service is allowed to be preempted, it means its spectrum resources are allowed to be preempted by other higher-priority services.

Be similar to the process of allocating the bearer resources of the service, the priority issues also occurs when multi-level systems seize TVWS resources or secondary systems need coexistence management. Therefore, the above method can be used as reference to manage the priority issues between each secondary system.

Furthermore, there are many factors related to the priority of the secondary system when occupying TVWS resources, such as the attribute of the secondary systems (PLMN, RAT, etc.), previously used credit records of TVWS resource (if any harmful interference) and network status or attribute of the secondary systems (the level of users, number of users under each level, etc.). Therefore, the level of secondary system will not be allocated fixedly when it is registered to the database. The initial priority is set according to the inherent attribute of the secondary system during the registration process. With the user access subsequently, its priority and preemption characteristics may be adjusted when certain conditions are met.

### Priority basis

The attribute of secondary system (SC module):

* PLMD: different operators may correspond to different usage priorities.
* RAT: taking into account the different RAT access TVWS, the protection performance of the primary user will be different, may also be used as a basis for priority.

Credit record:

* Interference: the priority of secondary system will be reduced when its users generate harmful interference.
* Timeout: the TVWS spectrum resource has not been exited within the specified time, leading to a low priority.

Network status:

* Payload: the level of payload reflects the urgency of occupying TVWS resources.
* Communication quality: the status of communication quality responses to the urgency of occupying TVWS resources.

User attributes:

* User level and the number of users of each level: it comprehensively reflects the priority of the network.

## Channel allocation

This is mainly about database with the management function, the TVWS resource is assigned to the secondary system according to the priority principle. For example, if two secondary systems simultaneously apply TVWS spectrum resources, but there is only one channel to meet the requirements. Thus it is necessary to make a judgment about priority of two secondary systems, in order to assign TVWS to the higher priority secondary system.

# Potential implementation schemes

## Backhaul based on TV White Space (TVWS)

### Scenario

Currently, there are some different types of assess points supporting varying coverage range. They can be connected with each other via Backhaul link, taking 3GPP LTE for example, the backhaul between eNB and relay is wireless.

Characteristics of access points connected by wireless backhaul link:

* + Directional antenna can be deployed in the backhaul link；
  + Fixed Installation position with good wireless transmission environment；
  + Active equipment；
  + Scalability。

The advantages of backhaul on TVWS：

* + Reasonable complexity of interference environment cognition under fixed access higher capacity and better service can be expected；
  + Supporting flexible frequency utilization；

### Implementation scheme

In the Backhaul scenario based on TVWS, there are many base station in the Urban or Rural. In one macro cell, some APs, such as Relay, Femto NB, Pico NB, HNB, are deployed in the hotpot or blind pot, which is described in the Figure 6. These APs are installed on the rooftop; as well as they can connect with base station by wireless backhaul link. Therefore, in order to obtain TVWS maintaining information, Spectrum Coordinator (SC) should fixed connect with Geo-Location Database(GLDB); and based on wireless backhaul link operating time and location, spectrum resource can be effectively allocated into backhaul link between appreciated BS and its AP. The main benefit, SC effectively allocated spectrum, is avoiding interference between license users and secondary users using TVWS for backhaul link communication.

**Rural area**

**Marco/Micro cell**

**Base Station**

**Relay**

**Backhaul link**

**over white space**

**frequency bands**

**Hot Spot/Home/**

**Femto/Pico are**



**Fixed access**

**Wireless link,**

**e.g. GSM, UMTS, LTE**

**over licensed frequency bands**

**UE**

**Rural area**

**Marco/Micro cell**

**Base Station**

**Relay**

**Backhaul link**

**over white space**

**frequency bands**

**Spectrum Coodinator**

**Geo-location Database**

**Hot Spot/Home/**

**Femto/Pico are**



**Fixed access**

**Wireless link,**

**e.g. GSM, UMTS, LTE**

**over licensed frequency bands**

**UE**

Figure 6 wireless backhaul scenario by Utilization TVWS spectrum resource

In the backhaul scenario, each Network Element is described below：

Geo-Location Database (GLDB): it is recorded, managed and maintained by 3rd party operator. The Database information include spectrum utilization for TV operator. More specifically, the information includes:

1. Status of spectrum utilization, including but not limited to: channel number, bandwidth, duration time, value, covering range, spectrum emission mask and isolation area.
2. Status of unused Spectrum, including but not limited to: channel number, bandwidth, duration time and covering range.
3. Prohibition Spectrum information, including but not limited to: channel number and bandwidth.

In the processing of TVWS resource configuration of secondary system, based on sending request from SC, GLDB feedbacks a list of available TVWS spectrum; and provides restricting information about transmission parameters of each TVWS spectrum resource. Meanwhile, based on wireless backhaul link condition, SC confirms spectrum configuration parameters, including TVWS spectrum resource, transmission power, antenna parameter and so on. Then, GLDB receives these feedback information from SC; as well as, allocated spectrum resource.

Spectrum Coordinator (SC): fixed connection can be deployed between SC and GLDB. Its functions are:

1. Collecting spectrum utilization information from BS and GLDB;
2. Allocating TVWS spectrum resources for each BS, including:
   1. Initial resource allocation
   2. Coordination spectrum resource among different wireless backhaul links of each BS.
   3. Handover management in case of primary user reappearing

BS (Base Station), directly connects with SC, its functions include but not limited to:

1. Adjust transmission parameters, such as modulation mode, transmission power
2. Update carrier frequency and band
3. Communicate with SC
4. Spectrum sensing
5. Capacity of data processing of sensor network, based on both self-spectrum sensing and reported sensing result by APs

AP (Access Point), specifically, it could be used as Relay, Pico NB, Femto NB and home NB. AP can collect users’ information; and communicate with BS by wireless backhaul link; but the covering range of AP is obviously narrower than BS’s. Its main functions are:

1. Adjust transmission parameters, such as modulation mode, transmission power
2. Update carrier frequency and band
3. Spectrum sensing
4. Link between BS and users.

It is notable seen that TVWS information includes but not limited below:

1. Covering range, means geographic region of available spectrum
2. Available channel, including bandwidth and frequency
3. Adjacent frequency information, such as RD/U, transmission power and template for spectrum
4. Channel effective utilization time

Cognitive Radio System’s network elements include but not limited to SC, BS and AP.

## Hybrid scenario

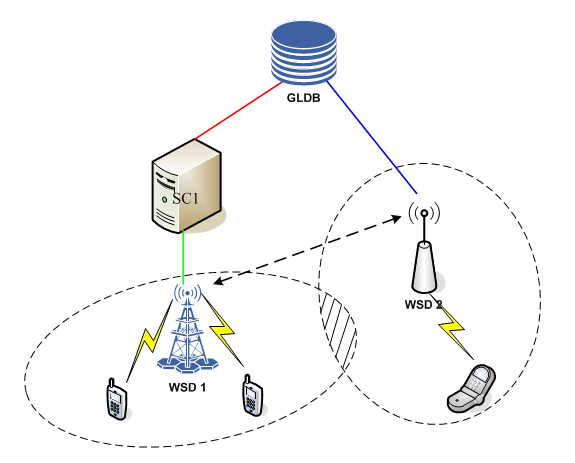


Figure 7 Interference issue in the hybrid scenario

Above Figure 7, varying kind of WSDs, for example both WSD1(indirect-connected) and WSD2(direct-connected), are coexistence in same frequency band; obviously, because of coverage overlap, the interference will not be avoided. Although, currently there is spectrum coexistence scheme with same type of WSD, one coexistence scheme with different type of WSD should be assisted by GLDB. The two possible solved schemes will be based on the priority of different WSD. On the one hand, if WSD2 has a higher priority, then when WSD1 applies idle spectrum resource form GLDB by SC1, GLDB will feedback interference protection criterion of WSD2 to SC1. Finally, SC1 will update transmission parameters of WSD1 based on the feedback. On the other hand, if WSD1 has a higher priority, then GLDB not only feedbacks transmission parameters of WSD2, but also sends interference protection criterion of WSD1 to WSD2, in order to avoid interference WSD1.

Take direct-connected secondary WSD with higher for example.



Figure 8 resource reconfiguration procedure of indirect-connected secondary WSD in the hybrid scenario

Spectrum resource reconfiguration procedure of indirect-connected secondary WSD (lower priority), BS1, can be found below:

Step1: Sending resource reconfiguration request from BS1 to SC, including location information of BS1, BS1 device parameters and indicator information for idle spectrum, which are used to apply idle spectrum of primary system, confirmed maximum transmission power for protected primary system, and indicated requested idle resource for BS1. Take specific request information for instance in the Table 1 below:

Table 1

|  |  |  |  |
| --- | --- | --- | --- |
| location information of BS1 | WSD device parameters | | indicator information for idle spectrum |
| East longitude: 46 degree | Omni-directional antenna | Horizontal Polarization | Frequency band: 470-790MHz |
| Northern latitude:64 degree | Antenna gain: 10dB | ACLR: 45dB | Bandwidth: 8MHz |
|  | Downtilt: 3 degree |  |  |

Step2: Sending resource reconfiguration request from SC to GLDB, including location information and device parameters in the Table 1 and spectrum resource utilization of direct-connected secondary WSD, which spectrum resource utilization of direct-connected secondary WSD shows adjust spectrum resource utilization and idle spectrum resource of direct-connected secondary WSD under certain range around BS1.

Step3: Processed request and produced response by GLDB. More specifically, firstly, based on location information of BS1, search spectrum resource utilization of primary system; and find idle spectrum resource of primary system in the location information of BS1, which can be found from Table 2, such as idle frequency band (f1、f2、f3). Furthermore, based on device parameters of BS1, protection criterion of f1、f2、f3 and propagation model, GLDB calculates maximum transmission power of f1、f2、f3; as well as obtains idle spectrum resource of direct-connected secondary WSD, BS2-BS5in Table 3, in a 500m radius of BS1. Finally, SC resource reconfiguration response can be generated by information both Table 6.2 and 6.3.

Table 2

|  |  |  |  |
| --- | --- | --- | --- |
| Location | Frequency  (MHz) | Bandwidth  (MHz) | Maximum transmission power  (dBm) |
| L1 | f1=530 | 8 | 40 |
| L1 | f2=560 | 8 | 30 |
| L1 | f3=480 | 8 | 40 |

Table 3

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| WSD | Location | Frequency  (MHz) | Bandwidth  (MHz) | transmission power  (dBm) | antenna height  (m) | Antenna type | Downtilt | Polarization |
| BS2 | L2 | f1=530 | 8 | 10 | 10 | omni-directional | 3degree | Horizontal |
| BS3 | L3 | f1=530 | 8 | 40 | 30 | omni-directional | 7 degree | Horizontal |
| BS4 | L4 | f2=560 | 8 | 40 | 10 | omni-directional | 3 degree | vertical |
| BS5 | L5 | f3=480 | 8 | 30 | 10 | omni-directional | 3 degree | vertical |

Step4: Sending SC resource reconfiguration response from GLDB to SC;

Step5: resource reconfiguration response is received by SC. More specifically, the resource reconfiguration response provides idle spectrum bands and maximum transmission power for protecting primary system, which is some spectrum utilization restricted information for BS1. Then, SC can calculate spectrum utilization of indirect-connected secondary WSD, both BS6 and BS7 in the Table 4, by processing information of Table 3, in the frequency band f1、f2、f3.Finally, based on information of Table 2, 3 and 4, SC produces resource reconfiguration response.

Table 4

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| WSD | Location | Frequency  (MHz) | Bandwidth  (MHz) | transmission power  (dBm) | antenna height  (m) | Antenna type | Downtilt | Polarization |
| BS6 | L6 | f1=530 | 8 | 10 | 10 | omni-directional | 3 degree | Horizontal |
| BS7 | L7 | f3=480 | 8 | 30 | 10 | omni-directional | 3 degree | vertical |

Step6: Sending resource reconfiguration response from SC to BS1;

Step7: judgment and decision of spectrum configuration of BS1 will be considered. Based on obtained both idle frequency band(s) information and spectrum utilization of secondary WSD in these band(s) from resource reconfiguration response, BS1 can pick available idle frequency band and finds configuration parameters in the Table 5, which should non-interference with other secondary WSDs, such as BS2、BS3、BS4、BS5、BS6、BS7. Finally, resource reconfiguration response information is generated, including both maximum transmission power (30dBm) and available BS1 working band (f2).

Table 5

|  |  |  |  |
| --- | --- | --- | --- |
| Location | Frequency  (MHz) | Bandwidth  (MHz) | Maximum transmission power  (dBm) |
| L1 | f1=530 | 8 | 10 |
| L1 | f2=560 | 8 | 30 |
| L1 | f3=480 | 8 | 0 |

Step8 and 9: After updated configuration parameters of BS1, it wills feedback to SC, and then to GLDB, which feedback information includes transmission power (30dBm) and idle frequency band (f2).

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