IEEE 802.19.1a
Wireless Coexistence

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| Text proposal on the algorithm for centralized control of energy detection  |
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Abstract

This contribution provides text proposals for coexistence algorithm of centralized control of energy detection.

7.2.2.x Algorithm for centralized control of energy detection

7.2.2.x.1 Introduction

There are WSOs that employ energy detection to check the availability of spectrum before utilizing the spectrum for transmission. Through such listen-before-talk procedure, the interference among WSOs can be avoided to a certain extent. A Higher detection threshold leads to less protection to other coexisting WSOs but gives a higher probability of obtaining the spectrum. Therefore, the energy detection threshold of different WSOs can be adjusted to control the spectrum utilization and interference condition of coexisting WSOs.

7.2.2.x.2 Status of energy detection based spectrum utilization

In Figure xx, there are two operators deploying WSOs at overlapping regions. Each WSO consists of one WSO master and one WSO slave. Each master is like a small cell base station. We consider the situation that the master is transmitting to the slave. Before transmission, each WSO master shall execute energy detection before transmission. If energy detection is successful the spectrum is considered available even if there could be cochannel WSOs in operator 2 deployment area. The status of the spectrum utilization can be described by, but not limited to, the following parameters

* Energy detetection successful rate
Energy detection successful rate can be calculated by the number of times that the spectrum is deemed available by energy detection by the total times of energy detection execution. It represents the percentage of time that a WSO can utilize the spectrum.
* Percentage of activated cells of one operator
As shown in Figure xx, in each operator’s deployment area, there are multiple WSO masters. These WSO masters employ energy detection before transmission. If energy detection is successful, the WSO master is activated. The percentage of activated cells is the number of such activated over the total number of cells that employ energy detection over a given region.



Figure XX Example of deployment for centralized control energy detection

7.2.2.x.3 Algorithm description

The processes are as follows.

* P#1
P#1 is the procedure operated at the CDIS where the CDIS obtains the receiver information of the WSO through the WSO registration procedure as specified in 5.2.3.1 WSO registration procedure.
* P#2
In this process, the CM obtains the actual operation status of the WSOs based energy detection such as their energy detection successful rate and their sell activation rate.
* P#3
In the process, the CM compare the actual operation status obtained in P#2 against the desired energy detection successful rate and cell activation rate as obtain through the Providing registration information procedure as specified in 5.2.2.1.
* P#4
In this procedure, CM can use the Reconfiguration procedure as specified in 5.2.10 to adjust the energy detection threshold of the WSO.
* P#5
In this procedure, CM can use the Requesting and obtaining measurements procedures as specified in 5.2.10 to adjust the energy detection threshold of the WSO.
* P#6
In this procedure no reconfiguration is made due to either the desired the operation status is satisfied or any reconfiguration will deteriorate the performance of the coexisting WSOs to an unacceptable level.

The branch conditions are as follows.

* BC#1
This branch condition shall be conducted based on the discover procedure based on the information of WSOs registered at the CDIS. If coexistence is needed, go to BC#2. If not the algorithm ends until coexistence is needed.
* BC#2
This branch condition shall be conducted based on receiver information from the WSO. If the WSOs that requirement coexistence management is capable of using SIC, go to P#3. If not go to P#2 where other coexistence method can be utilized.
* BC#3
This branch condition shall be conducted based on the measurement results after the energy detection adjustment to check if such adjustment will deteriorate the performance of the existing WSOs.



Figure XX

**Annex A (normative) Data types**

***Revise the text as follows***

MeasurementType ::= ENUMERATED {

 interferenceLevel,

 throughput,

 energyDetectionSuccessfulRate,

 activationRate,

 }

MeasurementReport ::= CHOICE {

 --Interference level value [dBm]

 interferenceLevelValue REAL,

 --Throughput value [Mb/s]

 throughputValue REAL,

--Energy detection successful rate in percentage [0 ~ 100] over the management region

 energyDetectionSuccessfulRate REAL,

--Percentage of activated cells of one operator [0 ~ 100] over the management region

 activationRate REAL,

 …

}

**Annex C (normative) Messages**

***Revise the text as follows***

**-----------------------------------------------------------**

**--CM registration**

**-----------------------------------------------------------**

--CM registration

CMRegistration ::= SEQUENCE {

 --CM IP address

 ipAddress OCTET STRING OPTIONAL,

 --CM port number

 portNumber INTEGER OPTIONAL}

--List of WSO for registration

ListOfWSORegistrations ::= SEQUENCE OF SEQUENCE {

 --New registration, registration update or deregistration

 operationCode OperationCode OPTIONAL,

 --WSO ID

 wsoID OCTET STRING OPTIONAL,

 --Network technology

 networkTechnology NetworkTechnology OPTIONAL,

 --Location

 geolocation Geolocation OPTIONAL,

 --Coverage area

 coverageArea CoverageArea OPTIONAL,

 -- Mobility information

 mobilityInformation MobilityInformation OPTIONAL,

 --Installation parameters

 installationParameters InstallationParameters OPTIONAL,

 --List of available frequencies

 listOfAvailableFrequencies ListOfAvailableFrequencies OPTIONAL,

 -- Operating frequency if available

 operatingFrequency FrequencyRange OPTIONAL,

 -- Upper limit of transmission power level of its operating frequency [dBm]

 txPowerLimit REAL OPTIONAL,

 --Maximum number of controllable WSO

 maximumNumberOfControllableWSO INTEGER OPTIONAL,

 --Range of operation

 Range RANGE,

 energyDetectionSuccessfulRate,

 activationRate,

 --Management region information

 range CHOICE {

--Information of the bounded area defined by the multiple geolocations

multipointRegion Region,

--Rectangular area defined by the upper-left and lower right points of the rectangular

rectangularRegion RectangularRegion},

--Desired energy detection successful rate in percentage [0 ~ 100]

desiredEnergyDectionSuccessRate REAL,

--Percentage of activated cells of one operator [0 ~ 100]

desiredActivationRate REAL

 }

**-----------------------------------------------------------**

**--WSO registration**

**-----------------------------------------------------------**

--Request for registration information

CxMediaRegistrationRequest ::= SEQUENCE {}

--Registration information

CxMediaRegistrationResponse ::= SEQUENCE OF SEQUENCE {

 --WSO ID

 wsoID OCTET STRING OPTIONAL,

 --Network ID

 networkID OCTET STRING OPTIONAL,

 --Network technology

 networkTechnology NetworkTechnology OPTIONAL,

 --Network type

 networkType NetworkType OPTIONAL,

 --Geolocation

 geolocation Geolocation OPTIONAL,

 --Discovery information

 discoveryInformation DiscoveryInformation OPTIONAL,

 --Coverage area

 coverageArea CoverageArea OPTIONAL,

 --Installation parameters

 installationParameters InstallationParameters OPTIONAL,

 --List of available frequencies

 listOfAvailableFrequencies ListOfAvailableFrequencies OPTIONAL,

 --List of operating frequencies

 listOfOperatingFrequencies ListOfOperatingFrequencies OPTIONAL,

 --List of available channel number

 listOfAvailableChNumbers ListOfAvailableChNumbers OPTIONAL,

 --List of supported channel number

 listOfSupportedChNumbers SEQUENCE OF INTEGER OPTIONAL,

 -- List of supported frequencies

 listOfSuppFrequencies ListOfSupportedFrequencies OPTIONAL,

 --List of operating channel number

 listOfOperatingChNumbers ListOfOperatingChNumbers OPTIONAL,

 --Transmission schedule is supported or not

 txScheduleSupported BOOLEAN OPTIONAL,

 --Measurement capability

 measurementCapability MeasurementCapability OPTIONAL,

 --Required resource

 requiredResource RequiredResource,

 --Mobility Information

 mobilityInformation MobilityInformation OPTIONAL,

 --Management region information

 range CHOICE {

--Information of the bounded area defined by the multiple geolocations

multipointRegion Region,

--Rectangular area defined by the upper-left and lower right points of the rectangular

rectangularRegion RectangularRegion},

--Desired energy detection successful rate in percentage [0 ~ 100]

desiredEnergyDectionSuccessRate REAL,

--Percentage of activated cells of one operator [0 ~ 100]

desiredActivationRate REAL

}

--Updated registration information

CxMediaRegistrationIndication ::= SEQUENCE OF SEQUENCE {

 --WSO ID

 wsoID OCTET STRING OPTIONAL,

 --Network ID

 networkID OCTET STRING OPTIONAL,

 --Network technology

 networkTechnology NetworkTechnology OPTIONAL,

 --Network type

 networkType NetworkType OPTIONAL,

 --Indication of WSO stop operation

 wsoStopOperation BOOLEAN OPTIONAL,

 --List of available frequencies

 listOfAvailableFrequencies ListOfAvailableFrequencies OPTIONAL,

 --List of operating frequencies

 listOfOperatingFrequencies ListOfOperatingFrequencies OPTIONAL,

 --Required resource

 requiredResource RequiredResource OPTIONAL,

 --Discovery information

 discoveryInformation DiscoveryInformation OPTIONAL,

 --Transmission schedule is supported or not

 txScheduleSupported BOOLEAN OPTIONAL,

 --List of available channel number

 listOfAvailableChNumbers ListOfAvailableChNumbers OPTIONAL,

 --List of supported channel number

 listOfSupportedChNumbers SEQUENCE OF INTEGER OPTIONAL,

 -- List of supported frequencies

 listOfSuppFrequencies ListOfSupportedFrequencies OPTIONAL,

 --List of operating channel number

 listOfOperatingChNumbers ListOfOperatingChNumbers OPTIONAL,

 --Measurement capability

 measurementCapability MeasurementCapability OPTIONAL,

 --Mobility information

 mobilityInformation MobilityInformation OPTIONAL,

 --Management region information

 range CHOICE {

--Information of the bounded area defined by the multiple geolocations

multipointRegion Region,

--Rectangular area defined by the upper-left and lower right points of the rectangular

rectangularRegion RectangularRegion},

--Desired energy detection successful rate in percentage [0 ~ 100]

desiredEnergyDectionSuccessRate REAL,

--Percentage of activated cells of one operator [0 ~ 100]

desiredActivationRate REAL

 }