IEEE 802.19.1a  
Wireless Coexistence

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| --- | --- | --- | --- | --- |
| CID 162 resolution:  Text proposal on the algorithm and parameters for spectrum allocation based on graph | | | | |
| Date: 2016-09-11 | | | | |
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Abstract

This contribution provides text proposals for coexistence algorithm based on graph information.









6.3.4.5 ~~WSO~~GCO registration

Table below shows ***~~ListOfWSORegistrations~~ ListOfGCORegistrations*** information element.

|  |  |  |
| --- | --- | --- |
| *Parameter* | *Data type* | *Value* |
| ***~~wsoID~~ gcoID*** | ***OCTET STRING*** | ~~WSO~~GCO ID |
| ***~~networkTechnology~~*** | ***~~NetworkTechnology~~*** | ~~Network technology~~ |
| ***~~geolocation~~*** | ***~~Geolocation~~*** | ~~Geolocation~~ |
| ***gcoDescriptor*** | ***GCODescriptor*** | Shall be set to indicate a set of GCO parameters as specified in following table |
| ***networkID*** | ***OCTET STRING*** | Shall be set to indicate network ID |
| ***coverageArea*** | ***CoverageArea*** | Shall be set to indicate the coverage area of GCO as specified in following table ~~As specified in table below~~ |
| ***installationParameters*** | ***InstallationParameters*** | Shall be set to indicate the installation parameters of GCO as specified in following table ~~As specified in table below~~ |
| ***listOfAvailableFrequencies*** | ***ListOfAvailableFrequencies*** | Shall be set to indicate the list of available frequencies as specified in following table ~~As specified in table below~~ |
| ***operationRegion*** | ***Range*** | Shall be set to indicate range of activity in which the available frequencies are valid for. |
| ***listOfDesiredPerformances*** | ***ListOfDesiredPerformances*** | Shall be set to indicate the desired performance of GCO in each frequency band if available. |
| ***~~operatingFrequency~~*** | ***~~OperatingFrequency~~*** | ~~As specified in table below~~ |
| ***~~txPowerLimit~~*** | ***~~REAL~~*** | ~~Transmission power limit of the operating frequency if available~~ |
| ***listOfOperatingFrequencies*** | ***ListOfOperatingFrequencies*** | Shall be set to indicate the list of operating frequencies and related operational parameters as specified in following table |
| ***~~maximumNumberOf~~***  ***~~ControllableWSO~~ maximumNumberOf***  ***ControllableGCO*** | ***~~MaximumNumberOf~~***  ***~~ControlableWSO~~ INTEGER*** | ~~Optionally, present~~ Optionally present. If present, this parameter shall be set to indicate the maximum number of controllable GCO. |
| ***spectrumTransitionCapability*** | ***BOOLEAN*** | Spectrum transmission supported by the GCO or not |
| ***interferenceGraph*** | ***InterferenceRelationshipGraph*** | Optionally present. If present the parameter shall be set to indicate the relationship using graph representation. |

* + - 1. ~~WSO~~GCO registration update

Table below shows *~~ListOfWSORegistrations~~ListOfGCORegistrations* information element.

|  |  |  |
| --- | --- | --- |
| *Parameter* | *Data type* | *Value* |
| ***operationCode*** | ***OperationCode*** | Shall be set to indicate that information is update/to-be-deleted. |
| ***~~wsoID~~ gcoID*** | ***OCTET STRING*** | Shall be set to indicate GCO ID ~~WSO ID~~ |
| ***gcoDescriptor*** | ***GCODescriptor*** | Shall be set to indicate a set of GCO parameters as specified in 6.3.4.5~~As specified in 6.3.4.5~~ |
| ***~~networkTechnology~~*** | ***~~NetworkTechnology~~*** | ~~Network technology if any update~~ |
| ***~~geolocation~~*** | ***~~Geolocation~~*** | ~~Geolocation if any update~~ |
| ***coverageArea*** | ***CoverageArea*** | Shall be set to indicate the coverage area of GCO as ~~As~~ specified in 1.3 if any update is needed. |
| ***installationParameters*** | ***InstallationParameters*** | Shall be set to indicate the installation parameters of GCO as ~~As~~ specified in 1.3 if any update is needed. |
| ***listOfAvailableFrequencies*** | ***ListOfAvailableFrequencies*** | Shall be set to indicate the list of available frequency information at GCO’s geo-location as ~~As~~ specified in 1.3 if any update is needed. |
| ***listOfOperatingFrequencies*** | ***ListOfOperatingFrequencies*** | Shall be set to indicate the list of operating frequency and related operational parameters of GCO as ~~As~~ specified in 1.3 if any update is needed. |
| ***operationRegion*** | ***Range*** | Shall be set to indicate range of activity in which the available frequencies are valid for. |
| ***listOfDesiredPerformances*** | ***ListOfDesiredPerformances*** | Shall be set to indicate the desired performance of GCO in each frequency band if available. |
| ***~~operatingFrequency~~*** | ***~~OperatingFrequency~~*** | ~~Shall be set to indicate the operating frequency if any update~~ |
| ***~~txPowerLimit~~*** | ***~~REAL~~*** | ~~Transmission power limit of the operating frequency if any update~~ |
| ***spectrumTransitionCapability*** | ***BOOLEAN*** | Spectrum transmission supported by the GCO or not |
| ***interferenceGraph*** | ***InterferenceRelationshipGraph*** | Optionally present. If present the parameter shall be set to indicate the relationship using graph representation. |

7.2.2.x Algorithm for spectrum allocation based on graph information

7.2.2.x.1 Introduction

Different GCOs have different QoS requirements. Making spectrum allocation, the desired QoS shall be considered in order to satisfy as many GCOs as possible. Graph has been used commonly to describe the interference relationship among GCOs. The weight of the graph edge shall take into account the desired QoS of different GCOs.

7.2.2.x.2 Channel assignment using graph representation of interference relationship among GCOs and their expected QoS

In Figure xx, there are multiple GCOs with different QoS requirements, which are desired SINRs. The weight of the edge is defined using the transmit power of each GCO *Pmax* and the distance *dij* between different GCOs as well as their SINR threshold represented by *SINRth*. Here, *i* and *j* are the index of the GCOs.



The actual SINR observed at each GCO is represented by



where, *N*0 is the power of AWGN.



Figure XX Graph representation of interference relationship among GCOs.

The channel assignment procedure tries to allocate as many GCOs into one cluster that will be using the same channel as possible while considering the interference threshold of each individual GCO. The procedure can be illustrated in the following figure. After selecting the first GCO (GCO1), the next GCO (GCO3) is selected that the sum of the weight of edges among the selected GCOs is maximized.



Figure xx procedure of the clustering based on graph information

Once the channel is allocated, the desired SINR shall be checked among against the actual SINR observed at each GCO. If there is any margin between desired and actual SINRs, the transmit power of GCO shall be reduced in order to reduce the interference among GCOs as much as possible.

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 receives the receiver information of the GCO through the GCO registration procedure as specified in 5.2.3.1.
* P#2  
  In this process, the interference set is determined. If there are multiple CMs, the graph presentation of interference relationship shall be exchanged via Master/Slave Configuration procedure in 6.3.4.10 where the master CM obtains all the information of the GCOs and constructs graph information set..
* P#3  
  In this procedure the graph representation is established based on the location of GCOs.
* P#4  
  In this procedure, the weight of each edge is determined based on the pathloss, transmit power, location and desired SINR information.
* P#5  
  Allocate the spectrum of GCOs and also calculate the margin between the actual SINR and the desired SINR. According to the margin the power reduction value can be decided.
* P#6  
  The channel assignment and power reduction margin will be sent in 5.2.10.1.
* P#6  
  No configuration is made.

The branch conditions are as follows.

* BC#1  
  This branch condition shall be conducted based on the information of GCOs registered at the CDIS. If coexistence is needed, go to BC#2. If not go to P#6. No reconfiguration is needed.



Figure XX Algorithm of graph based resource allocation

**Annex A** (normative) **Data types**

## Data types for IEEE 802.19.1a

IEEE802191aDataType DEFINITIONS AUTOMATIC TAGS ::= BEGIN

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

**--Exported data types**

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

--Exported data types

EXPORTS

--Coexistence protocol entity ID

CxID,

--Status

Status,

--Cx Media status

CxMediaStatus,

--Coexistence service

CoexistenceService,

--Network technology

NetworkTechnology,

--Network type

NetworkType,

--Geolocation

Geolocation,

--Coverage area

CoverageArea,

--Installation parameters

InstallationParameters,

--Frequency range

FrequencyRange,

--List of available frequencies

ListOfAvailableFrequencies,

--List of operating frequencies

ListOfOperatingFrequencies,

--List of supported frequencies

ListOfSupportedFrequencies,

--Required resource

RequiredResource,

--Operation code for registration

OperationCode,

--Measurement capability

MeasurementCapability,

--CM registration

CMRegistration,

--CE registration

CERegistration,

--Coexistence report

CoexistenceReport,

--List of coexistence reports

ListOfCoexistenceReports,

--Mobility Information

MobilityInformation,

--Entity profile

EntityProfile,

--List of master CM candidates

ListOfMasterCMCandidates,

--List of neighbor CMs

ListOfNeighborCMs,

--List of GCOs

ListOfGCOs,

--Coordinates

Coordinates,

--Antenna Characteristics

AntennaCharacteristics,

--Type of frequency

TypeOfFrequency,

--GCO Descriptor

GCODescriptor,

--Receiver information

ReceiverInfo,

--Modulation type

ModulationType,

--Filter characteristics

FilterCharacteristics,

--Energy detection information

EnergyDetectionInfo,

SpecRequestModification,

GraphEdge,

InterferenceRelationshipGraph

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

**--GraphEdge**

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

--GraphEdge parameters

GraphEdge ::= SEQUENCE {

--Head vertex of edge

head OCTET STRING,

--tail vertex of edge

tail OCTET STRING,

--weight of the edge

weight REAL}

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

**--Graph of interference relationship**

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

--Graph representation of interference relationship among GCOs

InterferenceRelationshipGraph ::= SEQUENCE {

--GraphEdge

edge GraphEdge,

...

}

**Annex A** (normative) **Data types**

## A.2 Data types for IEEE 802.19.1a

--List of GCOs for registration

ListOfGCORegistrations ::= SEQUENCE OF SEQUENCE {

--New registration, registration update or deregistration

operationCode OperationCode OPTIONAL,

--GCO ID

gcoID OCTET STRING OPTIONAL,

--Network ID

networkID OCTET STRING OPTIONAL,

--GCO Descriptor

gcoDescriptor GCODescriptor 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,

-- operation region

operationRegion Range OPTIONAL,

--Maximum number of controllable GCO

maximumNumberOfControllableGCO INTEGER OPTIONAL,

--List of desired performance

listOfDesiredPerformances ListOfDesiredPerformances OPTIONAL,

interferenceGraph InterferenceRelationshipGraph OPTIONAL,

. . .

}