IEEE P802.19  
Wireless Coexistence

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| Coexistence Decision Making Algorithm for Profile N | | | | |
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Abstract

This document is a submission to IEEE 802.19 TG1 proposing a coexistence decision making algorithm for profile N.

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# Proposed update

*It is proposed to add clause 8.4.2.7 using the text below.*

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# Coexistence decision making algorithm based on per-coordinate optimization

# Algorithms 1a, 1b, and 2

Three types of algorithms are distinguished:

* Coexistence decision making algorithm 1a
  + This algorithm is run at the beginning of state C before sending ***CoexistenceSetElementReconfigurationRequest*** messages to neighbor CMs
  + The goal of this algorithm is to select operating frequencies to the subject WSOs and to the neighbor WSOs
* Coexistence decision making algorithm 1b
  + This algorithm is run at the end of state C after receiving all ***CoexistenceSetElementReconfigurationResponse*** messages from neighbor CMs
  + The goal of this algorithm is to select operating frequencies to the subject WSOs based on the responses from the neighbor CMs
* Coexistence decision making algorithm 2
  + This algorithm is run when a ***CoexistenceSetElementReconfigurationRequest*** message is received from a neighbor CM
  + The goal of this algorithm is to decide whether to proposed reconfiguration of the subject WSOs is acceptable or not.

Four types of WSOs are distinguished in the coexistence decision making algorithm:

* Subject WSO  with flexible operating frequency
  + Any subject WSO subscribed to management service
* Subject WSO  with fixed operating frequency
  + Any subject WSO subscribed to information service
* Neighbor WSO  with flexible operating frequency
  + Any neighbor WSO subscribed to management service before sending ***CoexistenceSetElementReconfigurationRequest*** message to the neighbor CM
* Neighbor WSO  with fixed operating frequency
  + Any neighbor WSO after receiving ***CoexistenceSetElementReconfigurationResponse*** message from the neighbor CM.

Optimization of the target function is done only over subject WSOs  with flexible operating frequency and neighbor WSO  with flexible operating frequency.

In general form, target function is:



# Coexistence decision making algorithm 1a

For the coexistence decision making algorithm 1a, four types of WSOs are as follows:

* Subject WSO  with flexible operating frequency
  + Any subject WSO subscribed to management service
* Subject WSO  with fixed operating frequency
  + Any subject WSO subscribed to information service
* Neighbor WSO  with flexible operating frequency
  + Any neighbor WSO subscribed to management service
* Neighbor WSO  with fixed operating frequency
  + Any neighbor WSO subscribed to information service.

**Initialization**

For all WSOs  and , previous operating frequencies  and  are selected randomly from their available frequencies.

Previous target function value is calculated .

This is initial point of optimization for the first iteration.

**Iterations 1-N**

First WSO  is selected.

Among all its available frequencies one operating frequency is selected that optimizes the target function given that all other WSOs have previous operating frequencies:

.

Previous operating frequency for WSO  is updated .

Then proceed to next WSO and so on.

Once all WSOs  and  are considered, proceed to the next iteration with updated initial point of optimization  and .

Number of iterations can be set to some reasonable value.

Once all iterations are finalized, the CM shall check whether any of the neighbor WSOs has potential operating frequencies  different from their current operating frequencies. If there are such neighbor WSOs, the CM shall send ***CoexistenceSetElementReconfigurationRequest*** messages to the neighbor CMs serving these WSOs.

# Coexistence decision making algorithm 1b

For the coexistence decision making algorithm 1a, four types of WSOs are as follows:

* Subject WSO  with flexible operating frequency
  + Any subject WSO subscribed to management service
* Subject WSO  with fixed operating frequency
  + Any subject WSO subscribed to information service
* Neighbor WSO  with flexible operating frequency
  + These set is empty
* Neighbor WSO  with fixed operating frequency
  + Any neighbor WSO.

**Initialization**

For all WSOs , previous operating frequencies  are selected randomly from their available frequencies.

Previous target function value is calculated .

This is initial point of optimization for the first iteration.

**Iterations 1-N**

First WSO  is selected.

Among all its available frequencies one operating frequency is selected that optimizes the target function given that all other WSOs have previous operating frequencies:

.

Previous operating frequency for WSO  is updated .

Then proceed to next WSO and so on.

Once all WSOs  are considered, proceed to the next iteration with updated initial point of optimization .

Number of iterations can be set to some reasonable value.

Once all iterations are finalized, the CM shall check whether any of the subject WSOs has potential operating frequencies  different from their current operating frequencies. If there are such subject WSOs, the CM shall send ***ReconfigurationRequest*** messages to the subject CEs serving these WSOs.

# Coexistence decision making algorithm 2

When a new ***CoexistenceSetElementReconfigurationRequest*** message is received, the CM has the following information:

* Last operating frequencies  and 
* New potential operating frequencies for the neighbor WSOs of a CM that have sent the ***CoexistenceSetElementReconfigurationRequest*** message , where 
* New proposed operating frequencies for some subject WSOs of the CM , where .

The CM shall calculate potential value of the target function for the case when subject WSOs does not change operating frequencies and neighbor WSOs have new operating frequencies:

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The CM shall calculate proposed value of the target function for the case when subject WSOs change operating frequencies and neighbor WSOs have new operating frequencies:

.

If  is better than 

* Then the CM shall accept the proposal and change operating frequencies of the corresponding subject WSOs to the proposed values 
* Else the CM shall reject the proposal.

# Target functions

Two types of the target function are proposed:

* Total interference target function
* Total throughput target function.

All WSOs known to CM are .

**Total interference target function** is equal to

.

Here:

* , if  and WSO  is not operating, otherwise 
*  if WSO  is neighbor to WSO  on frequency  with interference direction equal to ***victim*** or ***mutual*** (WSO  creates interference to WSO ) and frequency  overlaps with frequency , otherwise 
*  is transmission power of WSO 
*  is distance between WSO  and WSO  on frequency .

Total interference target function shall be minimized.

**Total throughput target function** is equal to

.

Here:

*  is maximum throughput of WSO 
*  is loss in throughput of WSO  if WSO  is neighbor on frequency .
* Total interference throughput function shall be maximized.