

IEEE 1900.5 Contribution

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Document Title: The Spectrum Consumption Model Builder and Analysis Tool

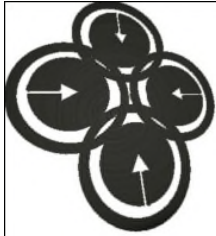
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The Spectrum Consumption Model Builder and Analysis Tool



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Spectrum Consumption Modeling

Objectives



- Provide means to capture all the relevant parameters and phenomena that affect spectrum consumption
- Provide means to compute compatibility between any two models without dependence on external databases of environmental or system data
- Support methods for computing compatibility that are tractable and definitive



SCM Constructs

- Total power
 - Spectrum mask
 - Underlay mask
 - Power map
 - Propagation map
 - Intermodulation masks
 - Platform
 - Location
 - Schedule
 - Minimum power spectral flux density
 - Protocol or policy
- Captures the spectral content of the signal and the unique characteristics of spread spectrum systems**
- Captures a definition of interference**
- Can capture antenna effects**
- Can capture environmental effects**
- Captures susceptibility to intermodulation**
- Enable greater resolution in spectrum management**
- Can capture behaviors that enable compatible reuse**

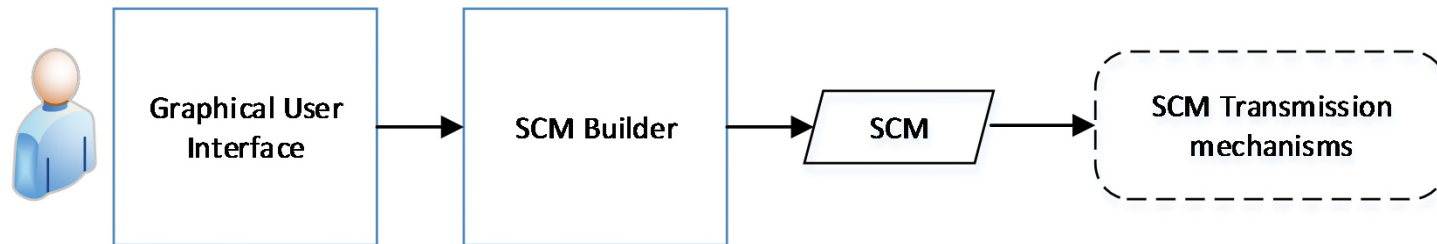
Most constructs have probability data elements to declare confidence in parts that are variable or are uncertain

SCM Builder and Analysis Tool (Objectives)

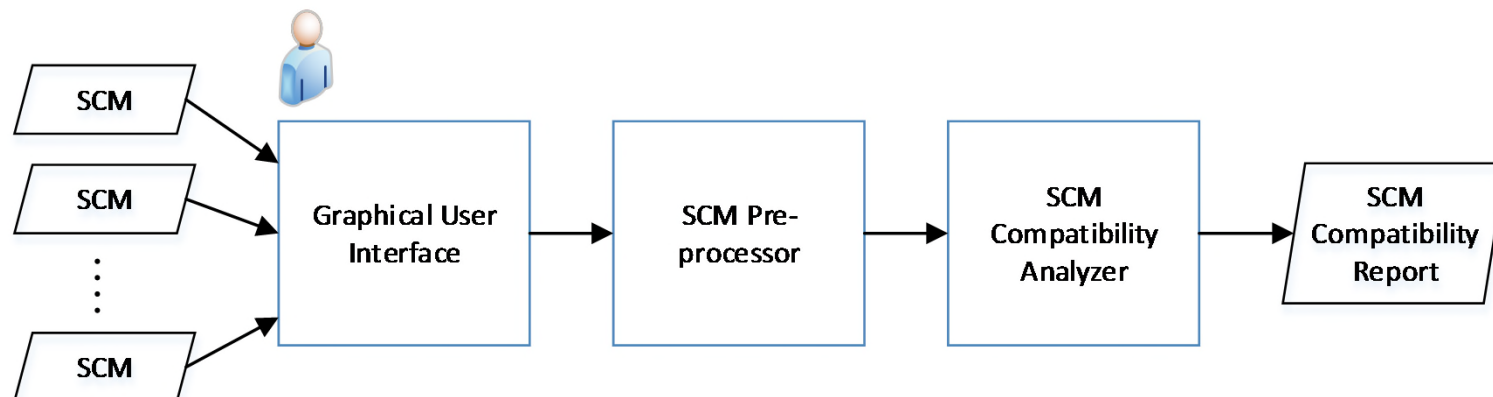


- Software tool for elaborating/defining SCM models in conformance with the 1900.5.2 standard.
- Incorporates algorithms to compute the compatibility between SCMs
 - Several single Tx to single Rx receiver cases covered
 - Evolve to more complex scenarios
- Identify limitations in the use of SCMs
- Provide feedback and suggest improvements to the IEEE 1900.5.2 standard elaboration efforts

SCM Builder and Analysis Tool (Use scenarios)

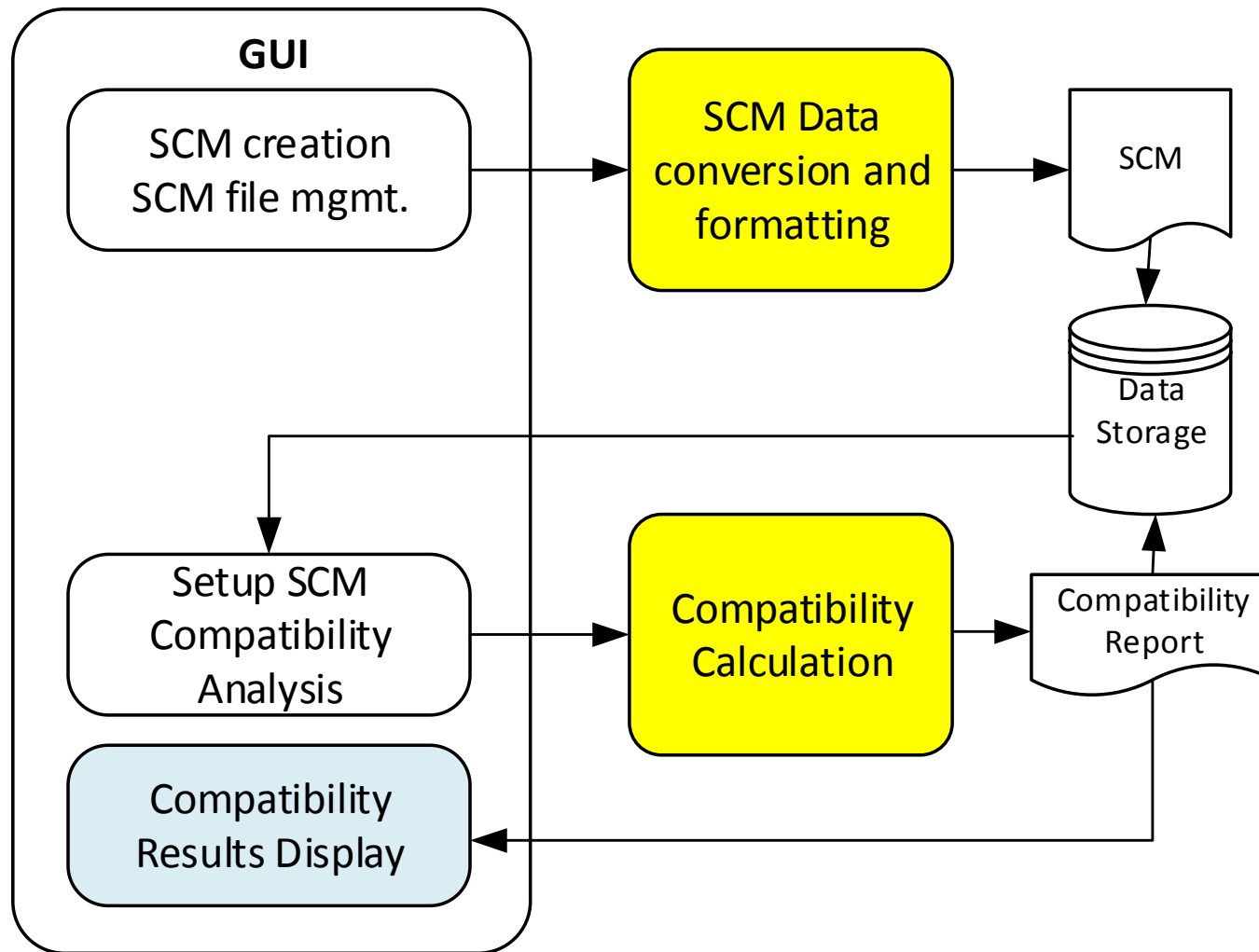


(a)



(b)

SCM Builder and Analysis Tool (Architecture)

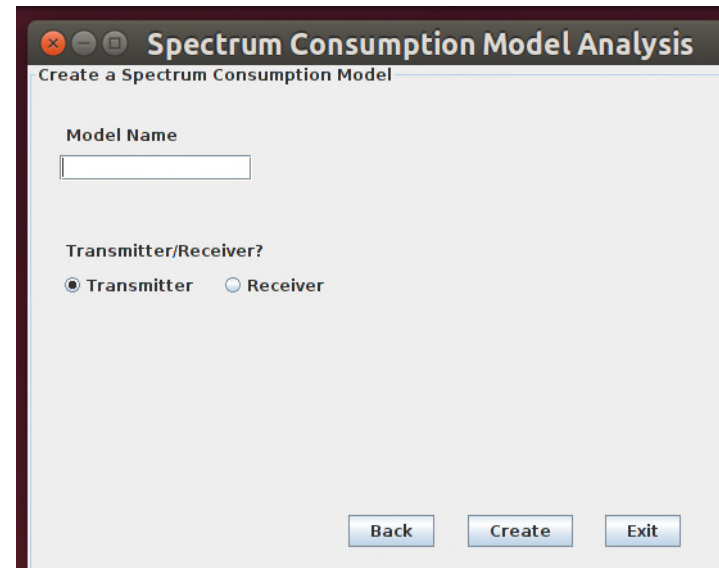
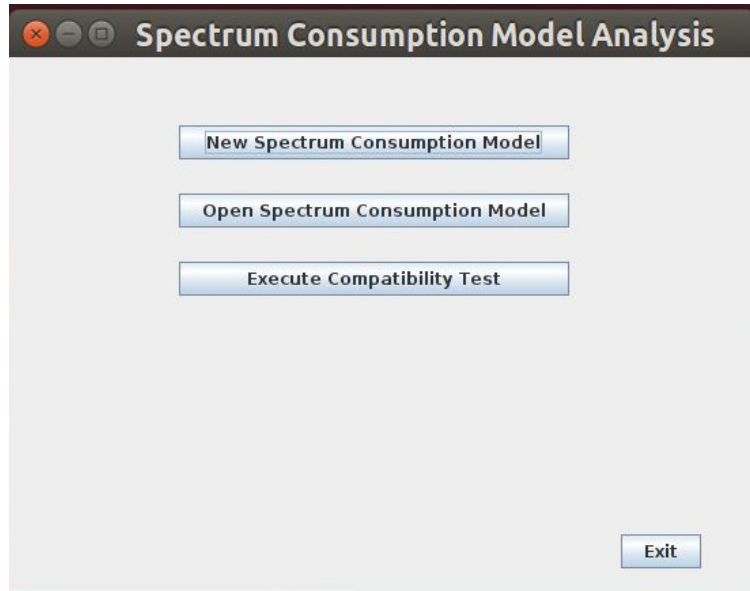


SCM Builder tool - Future perspectives



- Incorporate XML based SCM schema into tool
 - Has suffered delays
 - Its development was not part of the original scope of the project/tool
- Enhance compatibility calculations
- Release of version 1.0 in the First quarter of 2016
 - Open source
 - Create and manage a development group/community around the tool
 - Enhance and promote the use of SCMs in spectrum management (e.g. SAS interactions)

DEMO



Tabs to input information for a Tx Model



Spectrum Consumption Model Builder - TestTx01

Reference Power | Spectrum Mask | Power Map | Propagation Map | IMC Mask | IMA Mask | Platform | Location | Schedule

Define Confidence Values

Reference Power: dBW **Save Data**

Exit

Minimum PSFD

Minimum PSFD (dBW/Hz/m2)

Do you want to include 'Protocol or Policy': Yes No

Spectrum Consumption Model Builder - TestTx01

Reference Power | **Spectrum Mask** | Power Map | Propagation Map | IMC Mask | IMA Mask | Platform | Location | Schedule

Define Confidence Values

This is a frequency hopping system No Yes

Specify frequency hopping characteristics via a: Center frequency list Band list

Use relative frequency values Resolution Bandwidth (Mhz)

Center Frequency (MHz)

#	Frequency (MHz)	Power (dB)
1		

Add Row Exit

Remove Row Save Data

Spectrum Consumption Model Builder - TestTx01

Reference Power
Spectrum Mask
Power Map
Propagation Map
IMC Mask
IMA Mask
Platform
Location
Schedule

Define Confidence Values

This is a frequency hopping system No Yes

Specify frequency hopping characteristics via a: Center frequency list Band list

Use relative frequency values Resolution Bandwidth (Mhz)

Center Frequency (MHz)

#	Frequency (MHz)	Power (dB)
1		

Add Row
Exit

Remove Row
Save Data

Band list definition

#	Start Freq	End Freq
1		

Add Row
Dwell Time (ms)

Remove Row
Revisit Period (ms)

Spectrum Consumption Model Builder - TestTx01

Reference Power | Spectrum Mask | Power Map | **Propagation Map** | IMC Mask | IMA Mask | Platform | Location | Schedule

Define Confidence Values

Location Index (Optional)

Associate model with a specific distant height Yes No

Propagation Map

Add new map

Previous

Next

#	Elevation Angle	Azimuth Angle	n1	BreakPoint (m)	n2
1					

Add Row

Delete Row

Save Values

Save & Exit

Spectrum Consumption Model Builder - TestTx01

Reference Power | Spectrum Mask | Power Map | Propagation Map | IMC Mask | IMA Mask | Platform | **Location** | Schedule

Define Confidence Values

Add new location Previous Next

Location Index (Optional)

Location Type: Point

Location - Point

Longitude	Latitude	Altitude (m)

Save

Save & Exit

Exit

Spectrum Consumption Model Builder - TestTx01

Reference Power | Spectrum Mask | Power Map | Propagation Map | IMC Mask | IMA Mask | Platform | Location | **Schedule**

Define Confidence Values

Location Index (Optional) Add new schedule Previous Next

Schedule

Period (optional)

Start Time	End Time	Wait Until On	Duration On	Duration Off

Save

Save & Exit

Cancel

Tabs to input information for a Rx Model

Spectrum Consumption Model Builder - TestRx01

Reference Power Underlay Mask Power Map Platform Location Schedule

Define Confidence Values

Reference Power: dBW

Save Data

Exit

Do you want to include 'Protocol or Policy': Yes No

Spectrum Consumption Model Builder - TestRx01

Reference Power | **Underlay Mask** | Power Map | Platform | Location | Schedule

Define Confidence Values

This is a rated underlay mask No Yes

Power Margin method to use: Total Power Max. Power Density

Resolution Bandwidth (Mhz)

#	Frequency (MHz)	Power (dB)
1		
2		

Add Row
Save Data

Remove Row
Exit

Spectrum Consumption Model Builder - TestRx01

Reference Power | **Underlay Mask** | Power Map | Platform | Location | Schedule

Define Confidence Values

This is a rated underlay mask No Yes Rated Mask Type: Bandwidth Rated

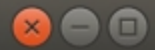
Power Margin method to use: Total Power Max. Power Density

Resolution Bandwidth (Mhz) Bandwidth rating for this mask (MHz)

#	Frequency (MHz)	Power (dB)
1		
2		

Add Row
Save Data

Remove Row
Exit



Spectrum Consumption Model Builder - TestRx01

Reference Power

Underlay Mask

Power Map

Platform

Location

Schedule

Define Confidence Values

Orientation

Surface

Relative to platform

Towards reference point

Location Index (optional)

Do you want to define a scanning region?

Yes

No

Gain Map

#	Elevation Angle	Azimuth Angle	Gain (dB)
1			

Add Row

Save Data

Remove Row

Exit

Spectrum Consumption Model Builder - TestRx01

Reference Power Underlay Mask Power Map Platform **Location** Schedule

Define Confidence Values

Add new location Previous Next

Location Index (Optional)

Location Type: **Point**

Location - Point

Longitude	Latitude	Altitude (m)

Save

Save & Exit

Exit

Spectrum Consumption Model Builder - TestRx01

Reference Power Underlay Mask Power Map Platform Location **Schedule**

Define Confidence Values

Location Index (Optional) Add new schedule Previous Next

Schedule

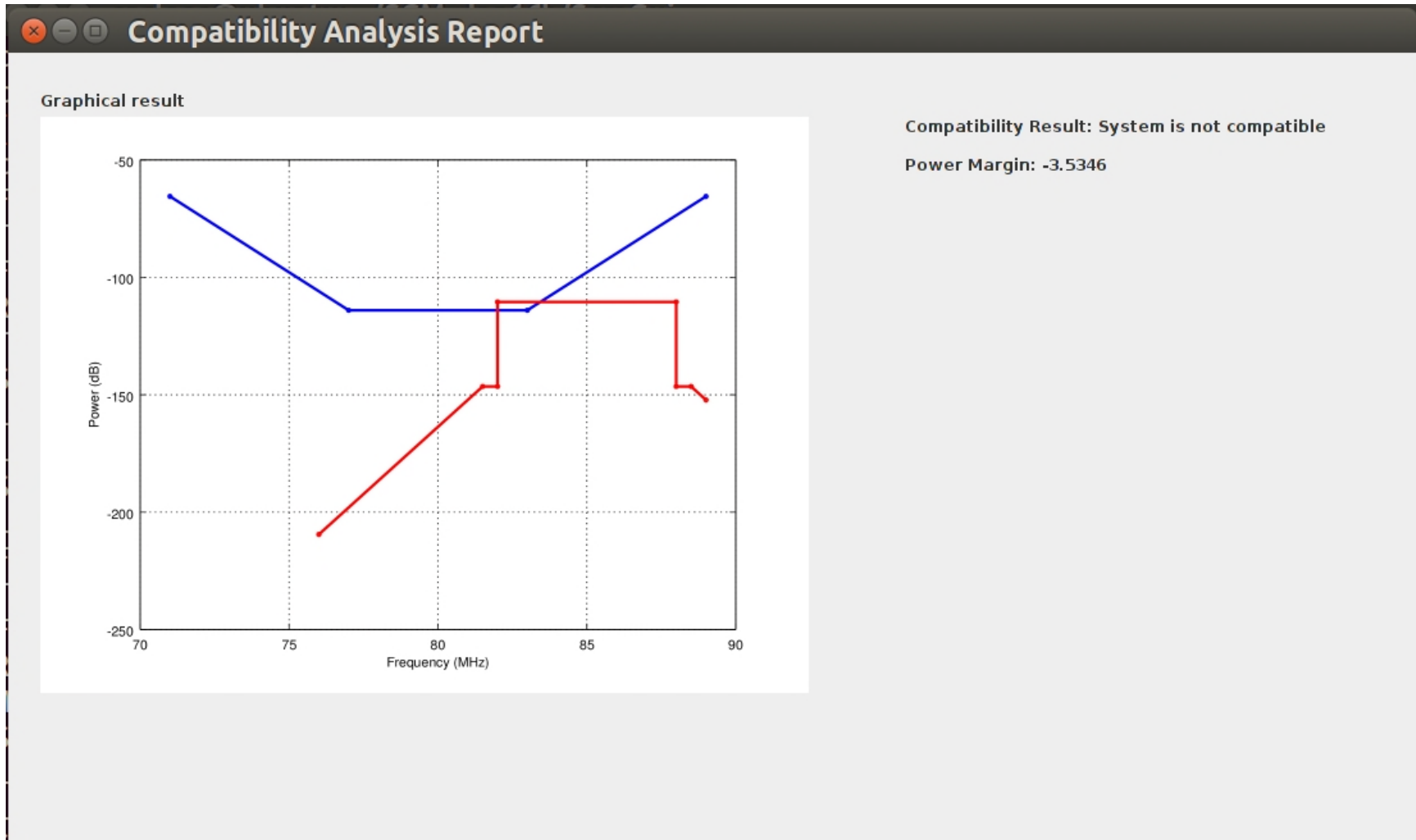
Period (optional)

Start Time	End Time	Wait Until On	Duration On	Duration Off

Save

Save & Exit

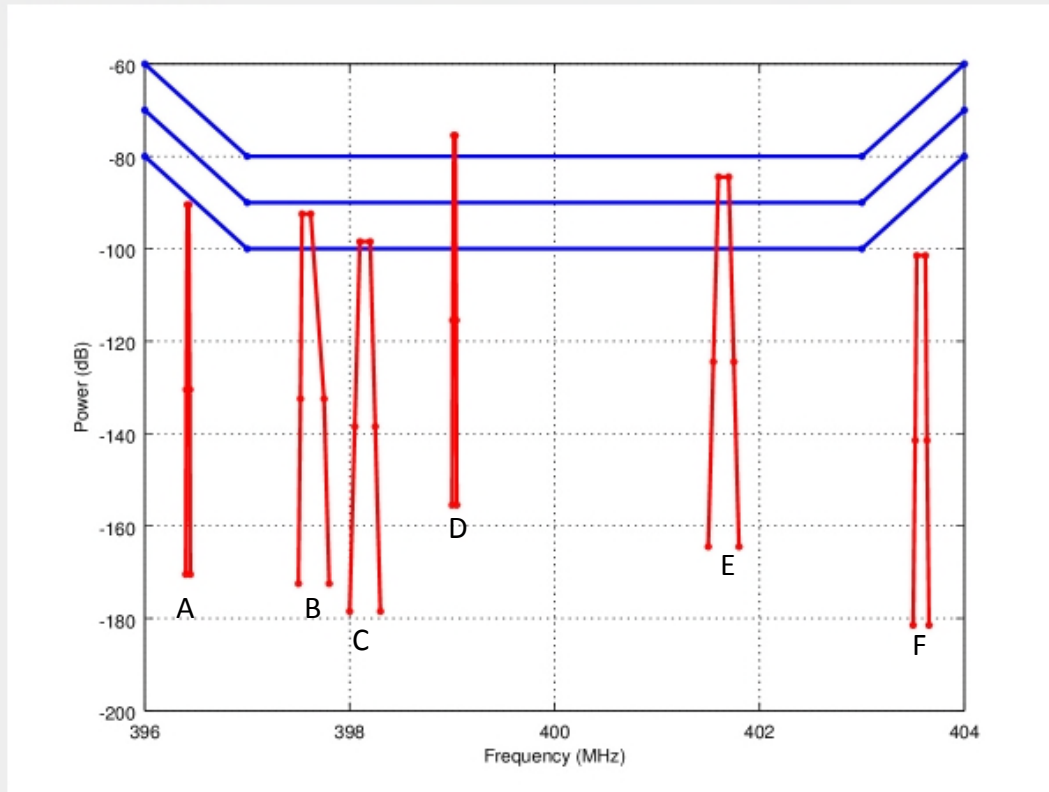
Cancel



Compatibility calculation example. Shown is a receiver's underlay mask (Blue) and a transmitter's adjusted spectrum mask (red)

Compatibility Analysis Report

Graphical result



Not Compatible

Tx_narrowD
Tx_narrowE

Compatible with all

Tx_narrowA

Compatible with specific masks

Tx_narrowB with [0.2, 20.0]
Tx_narrowC with [0.2, 20.0]
Tx_narrowF with [0.2, 20.0, 0.25, 10.0]

Compatibility calculation example. Multiple interferers vs. a bandwidth rated underlay mask