



# Function highlight : New features in HTZ (v.22.9.9)



November 11, 2020

[www.atdi-group.com](http://www.atdi-group.com)

# INTRODUCTION

This presentation highlights the main new features and other changes introduced in **HTZ Communications and HTZ Warfare, v.22.9.9.**

For more information, refer to the online “HTZ News and modification” document available in the ATDI doc center or contact [support@atdi-group.com](mailto:support@atdi-group.com)

For sales enquiry for maintenance support contract renewal, please contact: [contact@atdi-group.com](mailto:contact@atdi-group.com)



## **HTZ communications**

SPECTRUM ENGINEERING & RADIO PLANNING NEW GENERATION SOFTWARE.



## **HTZ warfare**

THE MOST POWERFUL SOFTWARE FOR TELECOM DEFENCE.

# AGENDA

- ▶ **User Interface:**
  - New drag and drop on map of vector files
- ▶ **Satellite: a new function to process massive constellation**
  - EPDF ( Equivalent Power Flux-Density ) calculation and examination
- ▶ **Broadcast (RRC06): direct connection to RRC06 from HTZ, without ICS manager**
  - RN (Reference Network) and RPC (Radio Planning Configuration) capabilities
  - Polygon Threshold Limit calculation
- ▶ **Mobile (4G/5G): a new algorithm to enhance calculation efficiency and visualization of the conflict check**
  - Root sequence index allocation
  - Physical layer cell identities

# INTERFACE: Drag and drop of vector files on map

It is now possible to drag and drop vector files

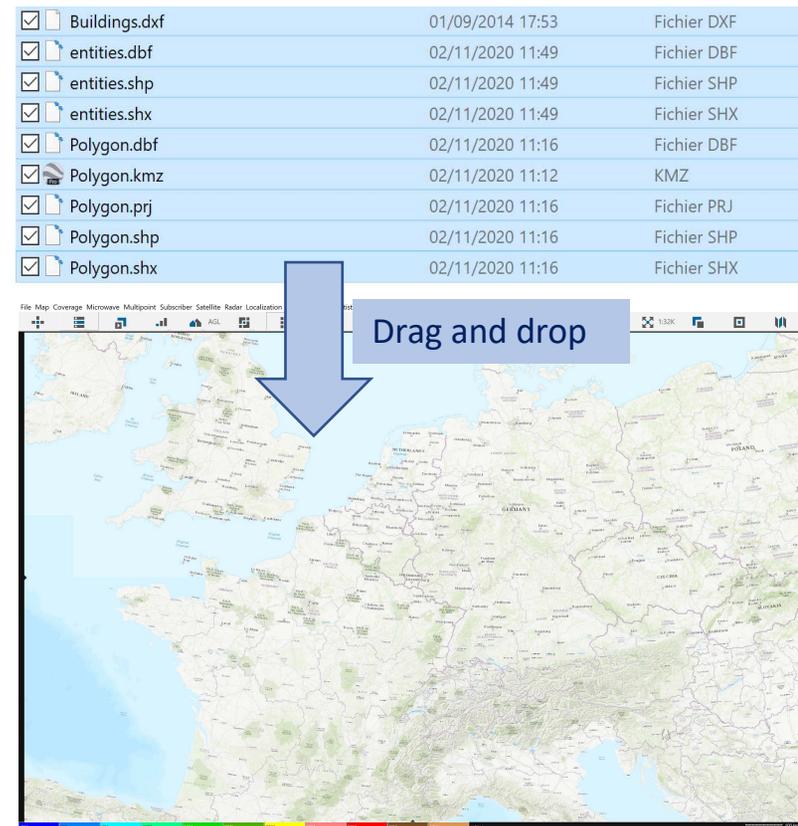
► Formats:

KML/.KMZ/.MIF/.GEOJSON/.SHP/.DGN/  
.OSM/.PBF/.DWG./.DXF

► Notes:

- DXF format: only coordinates in 4DEC (EPSG:4326) are supported
- DWG (Autocad): some versions of DWG format are not compatible

<input checked="" type="checkbox"/>	Buildings.dxf	01/09/2014 17:53	Fichier DXF
<input checked="" type="checkbox"/>	entities.dbf	02/11/2020 11:49	Fichier DBF
<input checked="" type="checkbox"/>	entities.shp	02/11/2020 11:49	Fichier SHP
<input checked="" type="checkbox"/>	entities.shx	02/11/2020 11:49	Fichier SHX
<input checked="" type="checkbox"/>	Polygon.dbf	02/11/2020 11:16	Fichier DBF
<input checked="" type="checkbox"/>	Polygon.kmz	02/11/2020 11:12	KMZ
<input checked="" type="checkbox"/>	Polygon.prj	02/11/2020 11:16	Fichier PRJ
<input checked="" type="checkbox"/>	Polygon.shp	02/11/2020 11:16	Fichier SHP
<input checked="" type="checkbox"/>	Polygon.shx	02/11/2020 11:16	Fichier SHX



The screenshot shows a GIS application window. At the top, there is a file list with columns for file name, date, and type. Below the list is a map of Europe. A blue arrow labeled "Drag and drop" points from the file list to the map area. The map interface includes a toolbar with various icons for navigation and map manipulation.

# EPFD EXAMINATION : Concept and criterions

- ▶ ITU Resolution: Article 22 (RR), appendix 5
- ▶ EPFD ( Equivalent Power Flux-Density ) limits enable non-GSO FSS systems to share frequencies with and protect GSO systems without requiring individual coordination with all the systems worldwide
- ▶ EPFD limits contained in Tables 22-1A, 22-1B, 22-1C, 22-1D, 22-1E, 22-2 and 22-3 (Article 22)
- ▶ EPFD takes into account the aggregate of the emissions from all non-GSO satellites in the direction of any GSO earth station, taking into account the GSO antenna directivity

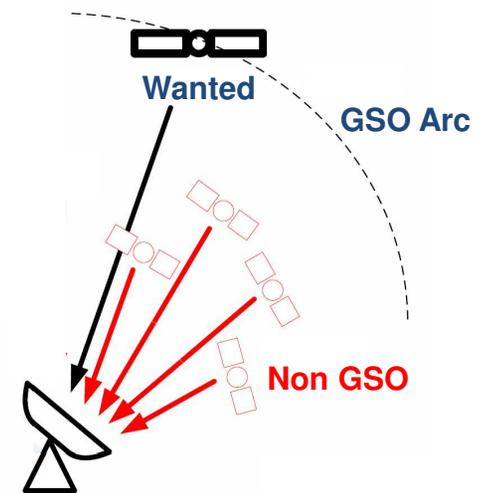


Fig 1: Effect of interferences from several sources

# EPFD Limits Regulatory Frameworks

## Article 9 – Coordination trigger limit (EPFD):

- ▶ Specific large Earth Station requires coordination under RR No. 9.7A with respect to any existing non-GSO satellite systems using the coordination triggers in RR Appendix 5; or
- ▶ FSS non-GSO satellite systems requires coordination under RR No. 9.7B with respect to any large earth station (under certain conditions) using the coordination triggers in RR Appendix 5.
- ▶ Coordination EPFD trigger limits enable protection of very large specific GSO earth stations.

# EPFD Equation

EPFD equation looks daunting, but at its core it is relatively straight-forward and builds on the concept of the PFD (Power Flux Density).

As the EIRP could vary depending upon the direction (for example if the transmitter didn't use an isotropic antenna), the term depends upon angle, here identified using theta. The idea of the EPFD is that in many cases the victim receiver has a directional antenna and so the impact of PFD on its performance will depend upon the relative gain towards the interfering station. Hence:  $EPFD = EIRP(\theta) / 4\pi d^2 * Gr_{rel}(\phi)$

- with  $Gr_{rel}(\phi) = Gr(\phi) / Gr_{max}$
- with  $Gr$  = Receiver antenna gain

# EPFD EXAMINATION - INTERFACE OPTIONS

Menu: "Satellite/Satellite PFD/EPFD map..."

C. Earth station parameters

D. Points selection on the map

A. Clutter and DEM selection

B. Selecting source GSO & NGSO satellite database

E. PFD limit for sharing of frequency bands in the 1-3 GHz range (FSS and NGSO MSS)  
F. User defined EPFD limit. If checked, calculations will stop as soon as the PDF value achieved for a given country exceeds the predefined limit value.  
G. PDF calculation limited to administrations codes available in .COD file  
H. PFD calculation limited to neighbor countries (without activated stations)

I. If option checked orbital planes will be computed and take into account during PDF calculation

J. Selection of the .COD country file

The screenshot shows the 'Satellite downlink - Max PFD / EPFD' dialog box. It is divided into several sections:

- Clutter selection:** A grid of 20 checkboxes for different clutter types: 0 open, 1 village, 2 suburban, 3 urban, 4 dense urban, 5 forest, 6 hydrology, 7 high urban, 8 park/wood, 9 building, 10 rail, 11 road, 12 airport, 13 water, 14 open water, 15 water, 16 b-glass, 17 b-glass, 18 b-wood, 19 border. Below this is a 'DEM selection (m):' section with 'min' set to -1000 and 'max' set to 9000.
- Receiver:** Includes a 'Parameters...' button, a 'Threshold (dBu)' field set to 1, and four checkboxes: 'Stop if PFD limit is exceeded (ITU R.1141/1142) per country', 'Stop if EPFD per country exceeds (dBW/m<sup>2</sup>/1MHz):' (set to -117.9), 'Do not compute if no country', and 'Do not compute in countries where activated stations are located'.
- Satellite:** Includes a 'DB satellite...' button, a checkbox for 'NGSO orbit calculation', a checkbox for 'Station / Satellite visibility area...', and a checkbox for 'Transmits only if at least one activated station is seen'.
- Test points:** Includes radio buttons for 'Map grid', 'Random points', and 'From vector points'. The 'Map grid' option is selected, with a 'Grid' field set to 100 and a 'Max points' field set to 100.
- Buttons:** At the bottom, there are buttons for 'Station list...', 'Countries...', 'OK', and 'Annuler'.

At the bottom left of the dialog, it states: 'EPFD / PFD: reference bandwidth = 1 MHz - Mode: Emission PFD: set receiver to omni'.

# Earth station configuration

**ANTENNA PATTERN**  
(ITU-R S.465) selection  
and azimuth orientation  
toward wanted satellite

**SATELLITE SELECTION**  
from internal satellite  
database

**Tx/Rx parameters: 2 E5004656**

General Patterns Channels Site Advanced

MSI/RPE 2D reverse tilt  Antenna file must be reloaded

ITU-R S.465 (K=27) parabol  
R 465-27 View

Horizontal pattern -90 Vertical pattern +90

Tx pol  V  H  C  M  
Rx pol  V  H  C  M  
X polar. disc. (dB) 0

Tx ant gain (dBd) 51.30  
Rx ant gain (dBd) 51.30

Antenna database none

Diameter or size (m) 0.10 Beamwidth (°) 0.75  
Crossover distance between near and far fields (m) 0.42

Two-line element set - Satellite catalog number 0

Save .TRX Load .TRX 3D creation... Modify cover

**Satellites**

Rec S/D	Callsign	Description	Notice ID	Beam
1 S	SAT1	SAT1	0	
2 D	SAT2	SAT2	0	
3 D	SAT2	SAT2	0	
4 D	SAT2	SAT2	0	
5 D	SAT2	SAT2	0	
6 D	SAT2	SAT2	0	
7 D	SAT2	SAT2	0	
8 D	SAT2	SAT2	0	
9 D	SAT2	SAT2	0	
10 D	SAT2	SAT2	0	
11 S	INTELSAT6	INTELSAT6 60E	91910988	EH
12 D	SAT2	SAT2	0	
13 D	SAT2	SAT2	0	
14 D	SAT2	SAT2	0	
15 D	SAT2	SAT2	0	
16 D	SAT2	SAT2	0	
17 D	SAT2	SAT2	0	
18 D	SAT2	SAT2	0	
19 D	SAT2	SAT2	0	
20 D	SAT2	SAT2	0	
21 D	SAT2	SAT2	0	
22 D	SAT2	SAT2	0	
23 D	SAT2	SAT2	0	
24 D	SAT2	SAT2	0	
25 D	SAT2	SAT2	0	
26 D	SAT2	SAT2	0	
27 D	SAT2	SAT2	0	

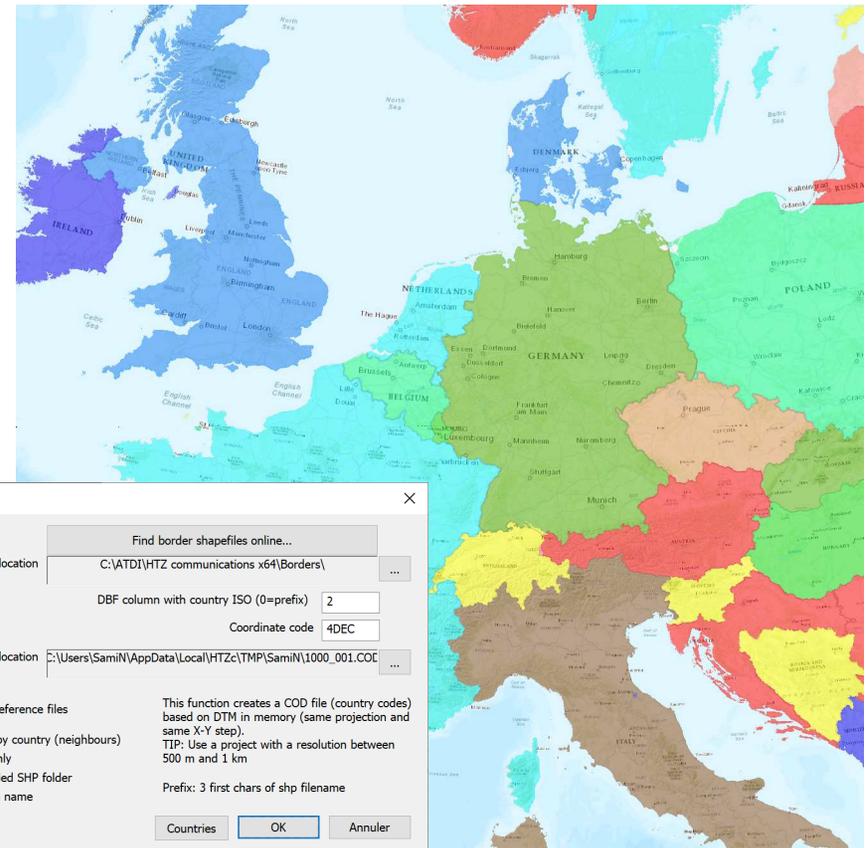
6.02569  
49.78666  
290 m  
0 - open  
0.0 m  
1  
0.00 km 0.0 us  
0.0 0.0 3.1 °  
0.0000 dBuV/m  
cx 0

Tx/Rx  
 0001 - S: E5004655  
 0002 - S: E5004656

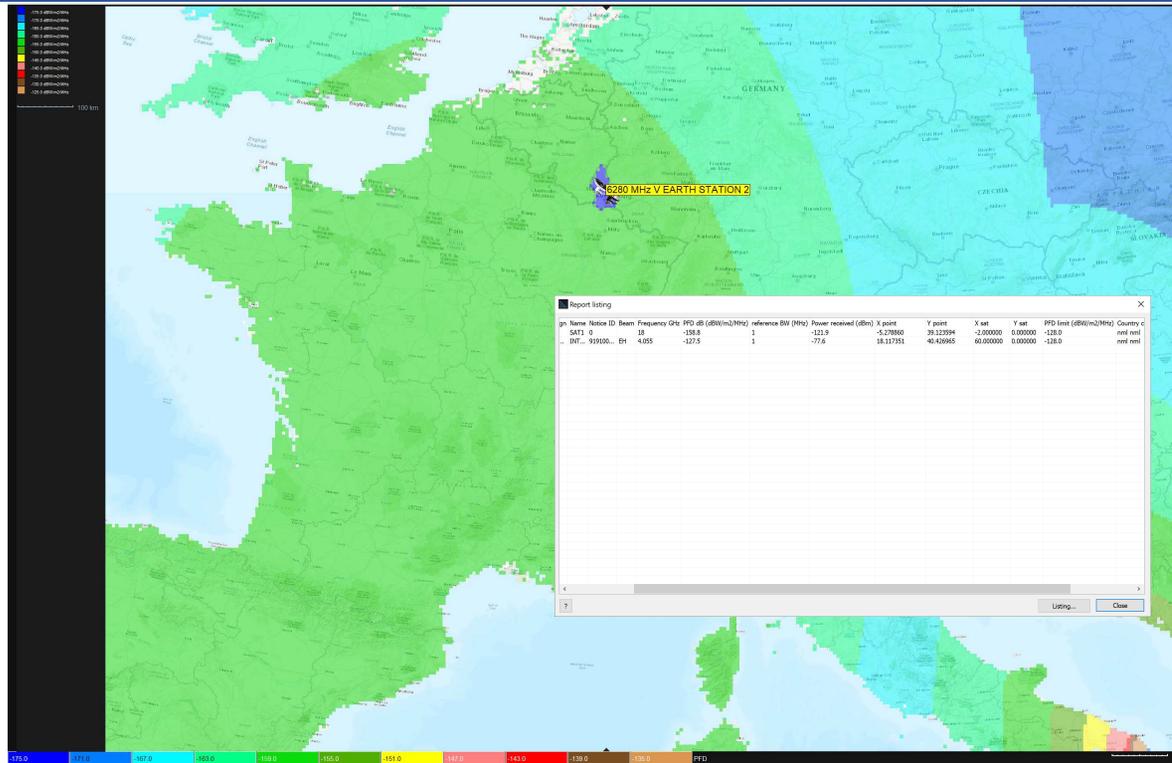
EW NS Coverage preview Gain map  
STOP / Reset map  
Coverage on map Coverage analysis  Diffraction loss applied (P2P calculation)

# .COD (Country Code) File

- ▶ ".COD" ( Country Code file): raster file describing the administration code and border countries.
- ▶ Mainly used for international coordination purposes.
- ▶ Can be built from the menu: "*Map/Border/Border Builder...*"



# Example of EPFD result : EPFD $\geq -117.9$ dB(w/m<sup>2</sup>)



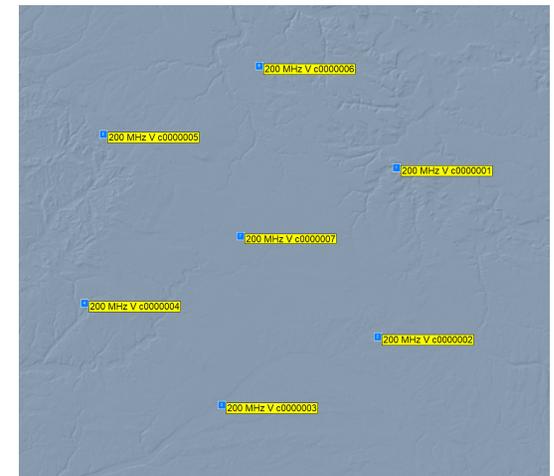
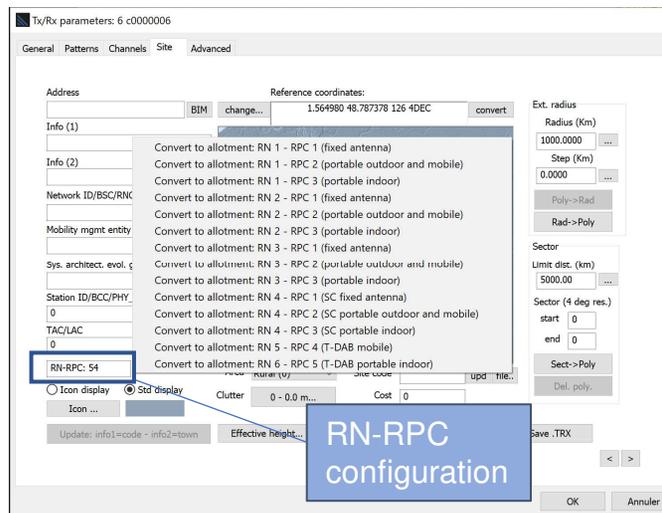
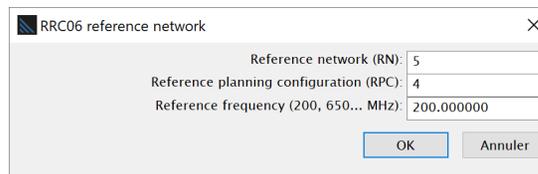
Callsign	Name	Notice ID	Beam	Frequency GHz	PFD dB (dBW/m2/MHz)	reference BW (MHz)	Power received (dBm)	X point	Y point	X sat	Y sat	PFD limit (dBW/m2/MHz)	Country codes	Delta PFD dB	Country...
INTELSAT6	INTELSAT6	91910088	EH	4.055	-127.5	1	-77.6	18.11735	40.42697	60	0	-128	nml nml	1	

# RN (Reference Network) creation

Menu: "Right-click on map/Add station /RR06 reference network..."

This feature creates a Reference Network(for allotment) according to RCC06 agreement and RN, RPC and reference frequency parameters

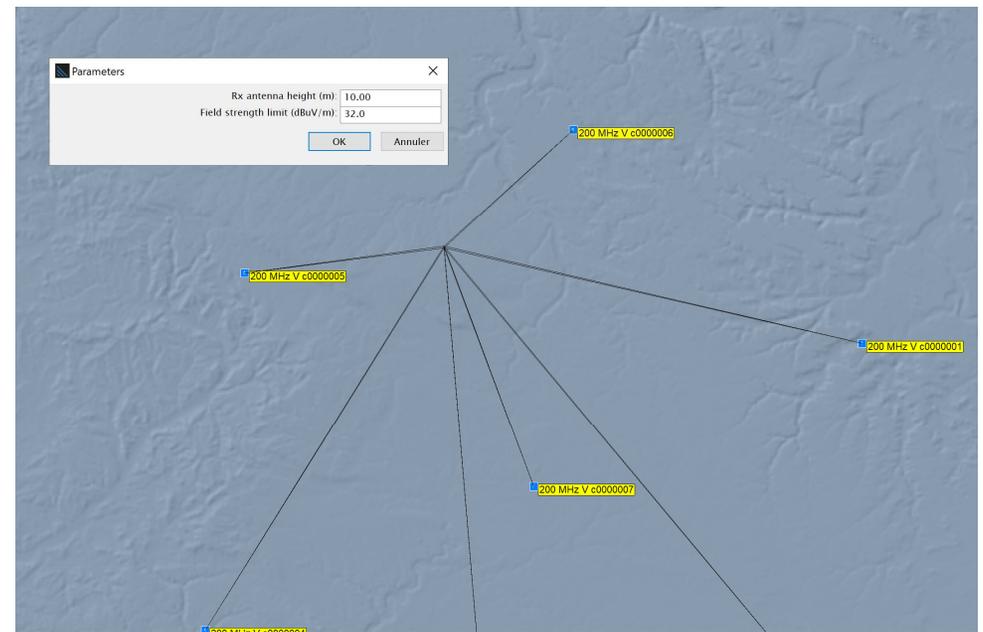
Note: RNRPC field added (integer) in StationX64 table (and EWX).



# RN (Reference Network) creation

Menu: "Right-click on map/Point to Point/received (fixed elevation)"

If station = Allotment and RN/RPC value is valid, the FS will be calculated according to RRC06 reference network.



Report

## TRANSMITTER RECEIVED - Rx: 10.00 m

BST	Callsign	Address	FSR dBuV/m	PR dBm	RS dBm	Freq (MHz)	Dist (km)	Az (°)	ToA (usec)	From	Path
5	c0000005		42.0	-79.12	-79.12	200.000000 V	33.56	75.87	111.96	p2p	NLOS
6	c0000006		49.6	-71.50	-71.50	200.000000 V	29.30	221.06	97.74	p2p	NLOS

# Types of Reference Network (RN1, RN2, RN3, RN4)

## Appendix 3.6 (RCC06 agreement) :

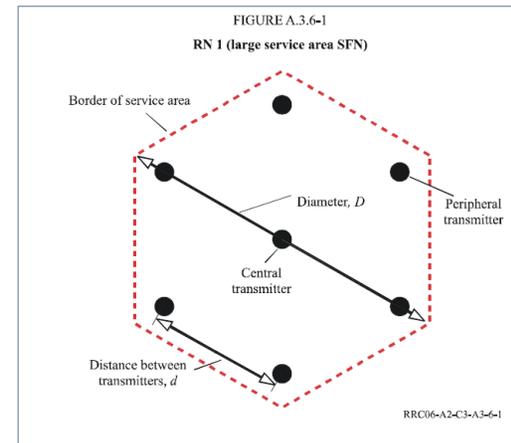
### ► RN1 (intended for large service area SFN coverage):

The network consists of seven transmitters situated at the center and at the vertices of a hexagonal lattice, as indicated in Fig. A.3.6-1. This reference network (RN 1) is applied to different cases: fixed (RPC 1), outdoor/mobile (RPC 2) and indoor (RPC 3) reception, for both Band III and Bands IV/V.

Parameters of RN 1 (large service area SFN)				
RPC and reception type	RPC 1 Fixed antenna	RPC 2 Portable outdoor and mobile	RPC 3 Portable indoor	
Type of network	Open	Open	Open	
Geometry of service area	Hexagon	Hexagon	Hexagon	
Number of transmitters	7	7	7	
Geometry of transmitter lattice	Hexagon	Hexagon	Hexagon	
Distance between transmitters $d$ (km)	70	50	40	
Service area diameter $D$ (km)	161	115	92	
Tx effective antenna height (m)	150	150	150	
Tx antenna pattern	Non-directional	Non-directional	Non-directional	
e.r.p.* (dBW)	Band III	34.1	36.2	40.0
	Bands IV/V	42.8	49.7	52.4

The e.r.p. is given for 200 MHz in Band III and 650 MHz in Bands IV/V; for other frequencies ( $f$  in MHz) the frequency correction factor to be added is:  $20 \log_{10}(f/200 \text{ or } f/650)$  for RPC 1 and  $30 \log_{10}(f/200 \text{ or } f/650)$  for RPC 2 and RPC 3.

\* The e.r.p. values indicated in this table incorporate an additional power margin of 3 dB.



# Types of Reference Network (RN1, RN2, RN3, RN4)

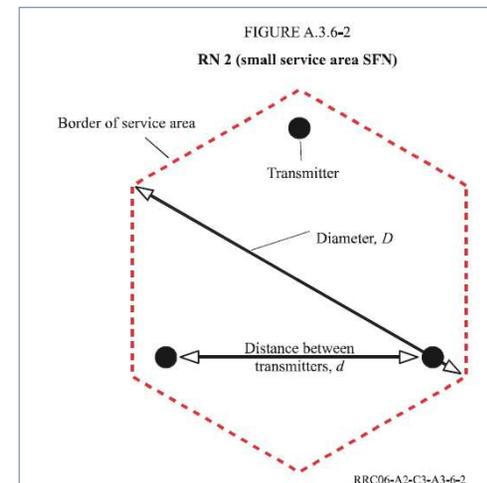
## ► RN2 (small service area SFN, dense SFN):

The network consists of three transmitters situated at the vertices of an equilateral triangle. The service area is assumed to be hexagonal, as indicated in Fig. A.3.6-2. This reference network (RN 2) is applied to different cases: fixed (RPC 1), outdoor/mobile (RPC 2) and indoor (RPC 3) reception, for both Band III and Bands IV/V.

Parameters of RN 2 (small service area SFN)				
RPC and reception type	RPC 1 Fixed antenna	RPC 2 Portable outdoor and mobile	RPC 3 Portable indoor	
Type of network	Open	Open	Open	
Geometry of service area	Hexagon	Hexagon	Hexagon	
Number of transmitters	3	3	3	
Geometry of transmitter lattice	Triangle	Triangle	Triangle	
Distance between transmitters $d$ (km)	40	25	25	
Service area diameter $D$ (km)	53	33	33	
Tx effective antenna height (m)	150	150	150	
Tx antenna pattern	Non-directional	Non-directional	Non-directional	
e.r.p.* (dBW)	Band III	24.1	26.6	34.1
	Bands IV/V	31.8	39.0	46.3

The e.r.p. is given for 200 MHz in Band III and 650 MHz in Bands IV/V; for other frequencies ( $f$  in MHz) the frequency correction factor to be added is:  $20 \log_{10}(f/200 \text{ or } f/650)$  for RPC 1 and  $30 \log_{10}(f/200 \text{ or } f/650)$  for RPC 2 and RPC 3.

\* The e.r.p. values indicated in this table incorporate an additional power margin of 3 dB.



# Types of Reference Network (RN1, RN2, RN3, RN4)

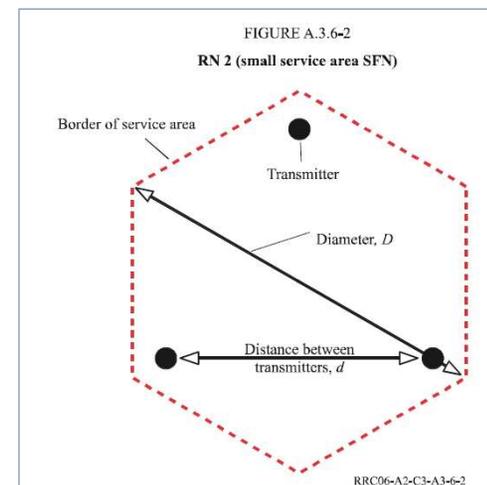
## ► RN3 (small service area SFN for urban environment):

The geometry of the transmitter lattice of reference network 3 (RN 3) and the service area are identical to those of RN 2. (See Fig. A.3.6-2.). RN 3 is applied to different cases: fixed (RPC 1), outdoor/mobile (RPC 2) and indoor (RPC 3) reception, for both Band III and Bands IV/V.

Parameters of RN 3 (small service area SFN for urban environment)				
RPC and reception type	RPC 1 Fixed antenna	RPC 2 Portable outdoor and mobile	RPC 3 Portable indoor	
Type of network	Open	Open	Open	
Geometry of service area	Hexagon	Hexagon	hexagon	
Number of transmitters	3	3	3	
Geometry of transmitter lattice	Triangle	Triangle	Triangle	
Distance $d$ (km)	40	25	25	
Service area diameter $D$ (km)	53	33	33	
Tx effective antenna height (m)	150	150	150	
Tx antenna pattern	Non-directional	Non-directional	Non-directional	
e.r.p.* (dBW)	Band III	24.1	32.5	40.1
	Bands IV/V	31.8	44.9	52.2

The e.r.p. is given for 200 MHz in Band III and 650 MHz in Bands IV/V; for other frequencies ( $f$  in MHz) the frequency correction factor to be added is:  $20 \log_{10}(f/200 \text{ or } f/650)$  for RPC 1 and  $30 \log_{10}(f/200 \text{ or } f/650)$  for RPC 2 and RPC 3.

\* The e.r.p. values indicated in this table incorporate an additional power margin of 3 dB.



# Types of Reference Network (RN1, RN2, RN3, RN4)

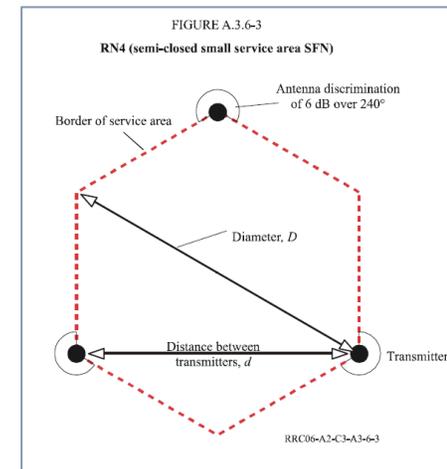
## ► RN4 (semi-closed small service area SFN):

The geometry for RN 4 is identical to that for RN 2, except for the antenna patterns of the transmitters, which have a reduction of the outgoing field strength of 6 dB over 240°. The service area of this RN is shown in Fig. A.3.6-3. RN 4 is applied to different cases: fixed (RPC 1), outdoor/mobile (RPC 2) and indoor (RPC 3) reception, for both Band III and Bands IV/V.

Parameters of RN 4 (semi-closed small service area SFN)			
RPC	RPC 1	RPC 2	RPC 3
Type of network and reception type	Semi-closed Fixed antenna	Semi-closed Portable outdoor and mobile	Semi-closed Portable indoor
Geometry of service area	Hexagon	Hexagon	Hexagon
Number of transmitters	3	3	3
Geometry of transmitter lattice	Triangle	Triangle	Triangle
Distance between transmitters $d$ (km)	40	25	25
Service area diameter $D$ (km)	46	29	29
Tx effective antenna height (m)	150	150	150
Tx antenna pattern	Directional 6 dB reduction over 240°	Directional 6 dB reduction over 240°	Directional 6 dB reduction over 240°
e.r.p.* (dBW)	Band III	22.0	24.0
	Bands IV/V	29.4	37.2

The e.r.p. is given for 200 MHz in Band III and 650 MHz in Bands IV/V; for other frequencies ( $f$  in MHz) the frequency correction factor to be added is:  $20 \log_{10}(f/200)$  or  $f/650$  for RPC 1 and  $30 \log_{10}(f/200)$  or  $f/650$  for RPC 2 and RPC 3.

\* The e.r.p. values indicated in this table incorporate an additional power margin of 3 dB.



# Threshold Polygon limited (RRC06)

Menu: "Spectrum/Threshold Polygon calculation..."

Check this option to report crossed country

The report will say if an existing vector polygon is crossed or not by the coordination contour (inside or outside that polygon).

If checked and if the station has a coverage attached (previously performed), the field strength received values will be extracted from that coverage. Otherwise, point to point calculations will be made.

Set the True North correction (offset between projected map North and True North).

The dialog box 'Threshold limited polygon' contains the following sections and controls:

- Countries and Vector polygons:**
  - Report crossed countries
  - Country code file: C:\Users\Sami\Documents\Formation IRL\Luxembourg + 1000Km\WORLD4SEC.RCO
  - Check crossing outside a vector polygon
  - Check crossing into a vector polygon
- Field strength calculation:**
  - Limit value >= 23
  - Model: GE06 (Digital broadcast)
  - From attached Tx coverage
  - Single frequency network or multiple allotments (Center of gravity)
  - Rx antenna height (m): 10.00
- Polygon calculation (1 deg resolution) / Station polygon (4 degrees resolution):**
  - Angle step (1-90 deg): 1
  - Max distance (m): 1000000.00
  - Tolerance distance (m): 1000.00
  - Add to vector layer (1 deg resolution)
  - Add to result layer
- Footer:**
  - North variation... Stations... OK Annuler
  - Small text: If allotment: compute max FS from GE06 Reference networks; If SFN stations: compute power sum; If SFN stations or multiple allotments = ON, all activated stations are taken into account and If SFN stations and allotments are activated: max FS is assumed

Coordination trigger limit selection

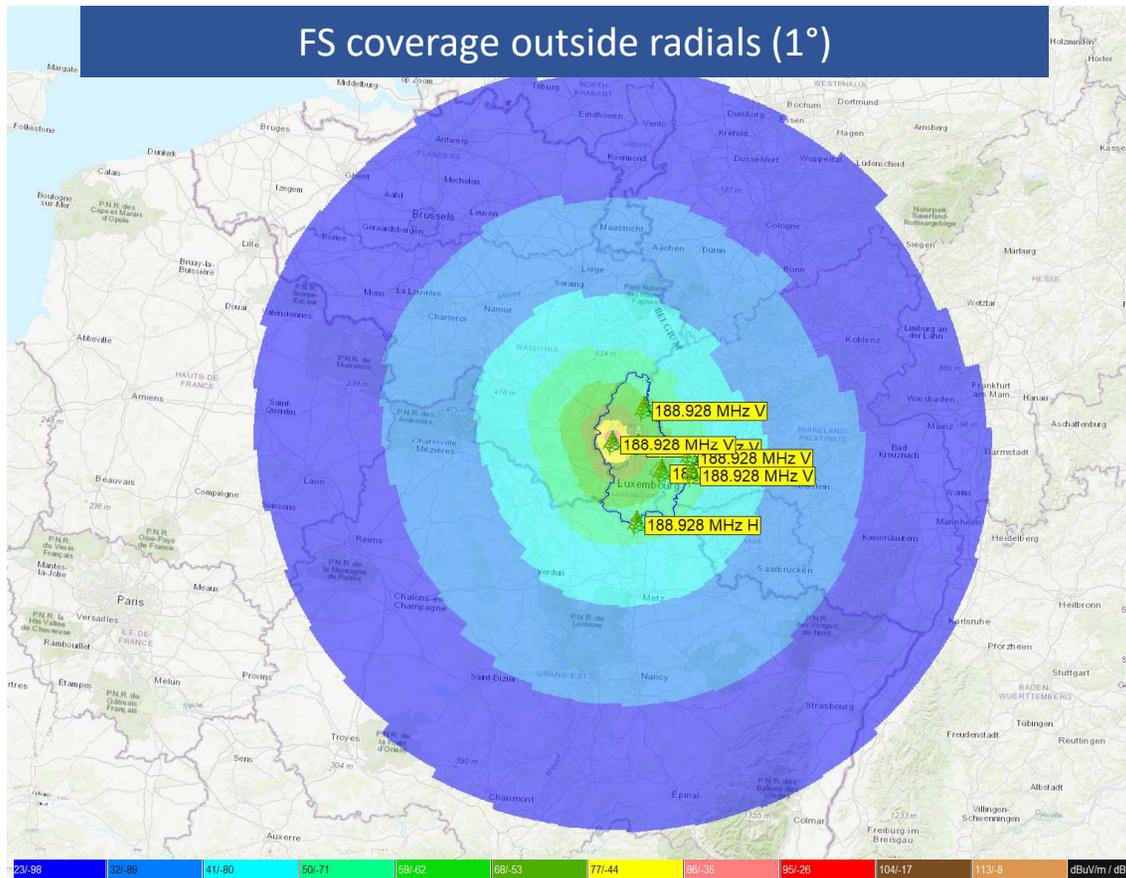
Check this option to set ITU-R P.1546-6 settings compatible with RR06 coordination method

Not used in case of a single station on the map

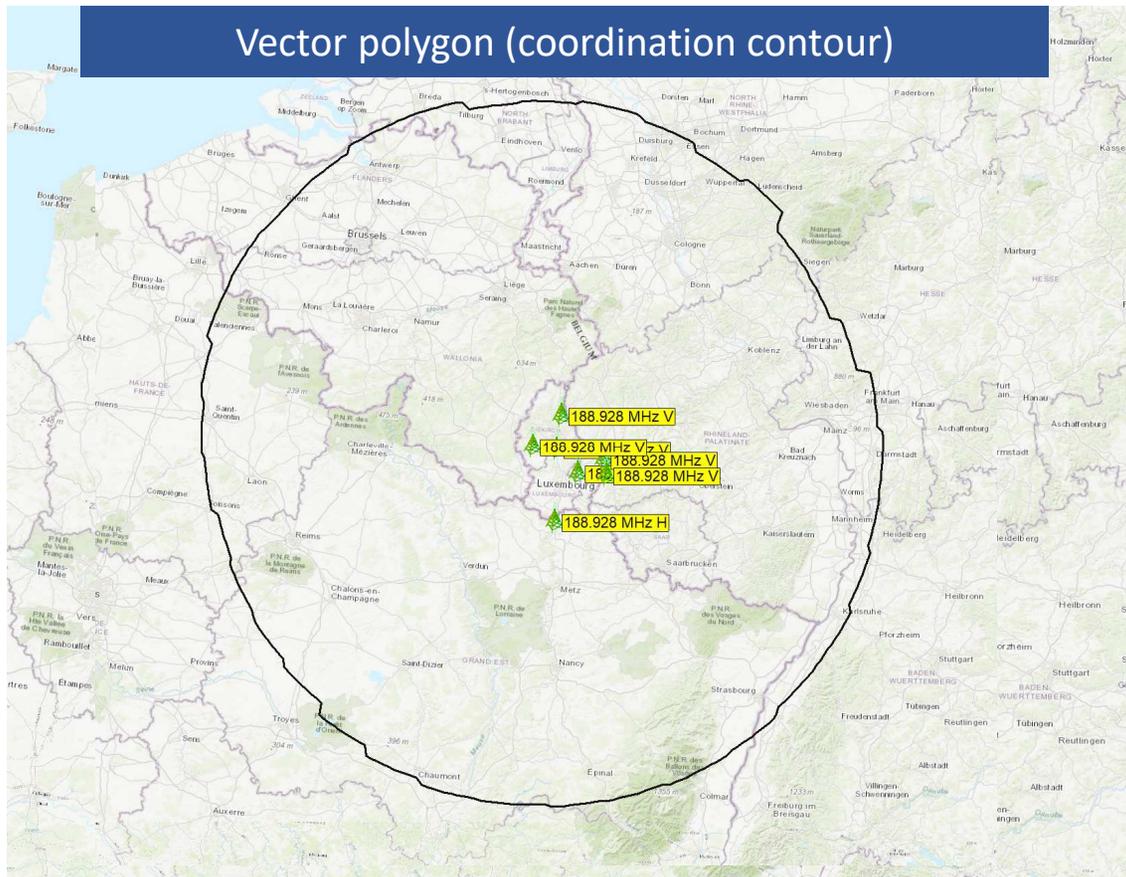
Each point of the contour will be added to a vector polygon with 1° step. Note: This function also computes a polygon attached to the station with a resolution of 4°.

**New:** computes FS outside radials (1°)

# Threshold Polygon limited (RRC06)



# Threshold Polygon limited (RRC06)



# Root Sequence Index (RSI) Allocation

Menu: "Coverage/Planning/Root sequence index allocation..."

4G and 5G options have been added. They are connected to the "From PRACH table (0-15)" option. PRACH optimized based on cell range profile (Long LRA = 839 / Short LRA = 139)

Table 6.3.3.1-7:  $N_{CS}$  for preamble formats with  $\Delta f^{RA} = 15 \cdot 2^\mu$  kHz where  $\mu \in \{0,1,2,3\}$ .

zeroCorrelationZoneConfig	Ncs value	max cell radius (meter)	Preamble quantity per root sequence
0	0	5000	1
1	2	71	69
2	4	143	34
3	6	215	23
4	8	287	17
5	10	359	13
6	12	431	11
7	13	467	10
8	15	539	9
9	17	611	8
10	19	683	7
11	23	827	6
12	27	971	5
13	34	1223	4
14	46	1654	3
15	69	2482	2

RSI allocation (from neighbours)

Max number of root sequence indexes: 838

Number of root sequences per sector: 4

User defined

From max coverage range

From extended radius

From PRACH table (0-15)

PRACH configuration index: 8

From user defined radius (km)

Random access radius (km): 5.4000

Maximize RSI usage

Randomize RSI usage

Optimize RSI usage

4G  5G

OK Annuler

# Physical Layer Cell Identities (PCI)

Menu: "Coverage/Planning/Physical layer cell identities... .."

Potential conflicts analysis between the "PCI MODn" values improved:

## ▶ Intracell case:

- MODn conflicts are checked "Max number of sector(s)".
- For 5G stations and if Max number of sector(s)"=4, MOD-3 and MOD-4 cases are checked;

## ▶ Intercell case:

- MODn conflicts are checked with  $n = 30$  (for 5G stations only).

# Physical Layer Cell Identities (PCI)

Menu: *“Coverage/Planning/Physical layer cell identities... ..”*

## Notes about conflicts analysis between the "PCI MODn :

- ▶ Intracell : only if stations belong to the same Group
- ▶ The idea is to avoid or minimize interference on Reference Signals. Cells for which either of PCI mod 3/4/30 is equal will have increased probability of interference among each other. As such, good PCI assignment should ensure, when possible, that the PCI mod 3 and the PCI mod 4 are dissimilar among cells of a same site and that the PCI mod 30 is dissimilar among any two potentially interfering cells. Ensuring dissimilarity of PCI mod 3 and PCI mod 4 among cells on two neighboring cells is hard to achieve in practice.

# Physical Layer Cell Identities (PCI)

Menu: "Object/Object properties <F5>..."

- ▶ "Station ID / PCI.PCIMODn" label is now displays the concatenation of the 2 following fields as set in the station parameters (Mobile):PHY\_CELL\_ID and PCIMODn.
- ▶ The "PCI MODn" label has been added. "n" is expected to be either be 3, 4 or 30.

Object properties

Site color

User defined color

Default color

Labels

<input checked="" type="checkbox"/> Station	Link / MW <input type="checkbox"/>
<input type="checkbox"/> Freq/Polar	Freq/Polar <input type="checkbox"/>
<input checked="" type="checkbox"/> Callsign	Bandwidth <input type="checkbox"/>
<input type="checkbox"/> Address	Ident <input type="checkbox"/>
<input type="checkbox"/> Site code	Bit rate <input type="checkbox"/>
<input type="checkbox"/> Network ID	Distance <input type="checkbox"/>
<input type="checkbox"/> Channel	Coordinates <input type="checkbox"/>
<input type="checkbox"/> Coordinates	
<input type="checkbox"/> Group	
<input type="checkbox"/> Delay	
<input type="checkbox"/> NomPower W	
<input type="checkbox"/> NomPower dBW	
<input type="checkbox"/> RSI	<input checked="" type="radio"/> Root <input type="radio"/> Sequence
<input type="checkbox"/> Neighbours (#)	
<input type="checkbox"/> TAC/LAC	
<input type="checkbox"/> SWT PI/LSN	
<input type="checkbox"/> PI-SID	
<input type="checkbox"/> TII main	<input type="checkbox"/> TII sub
<input type="checkbox"/> PN code	
<input type="checkbox"/> Tx BW	<input type="checkbox"/> Rx BW
<input type="checkbox"/> Info 1	<input type="checkbox"/> Info 2
<input checked="" type="checkbox"/> Station ID / PCI.PCIMODn	
<input checked="" type="checkbox"/> PCI MODn = <input type="text" value="30"/>	
<input type="checkbox"/> User (Station and MW)	





# Thank You

ATDI GROUP  
11 BOULEVARD MALESHERBES  
75008 PARIS, France

[support@atdi-group.com](mailto:support@atdi-group.com)  
[contact@atdi-group.com](mailto:contact@atdi-group.com)

