Wireless Network.
EP2950
26/11/2015

Planning Terrestrial Radio Networks

Report :
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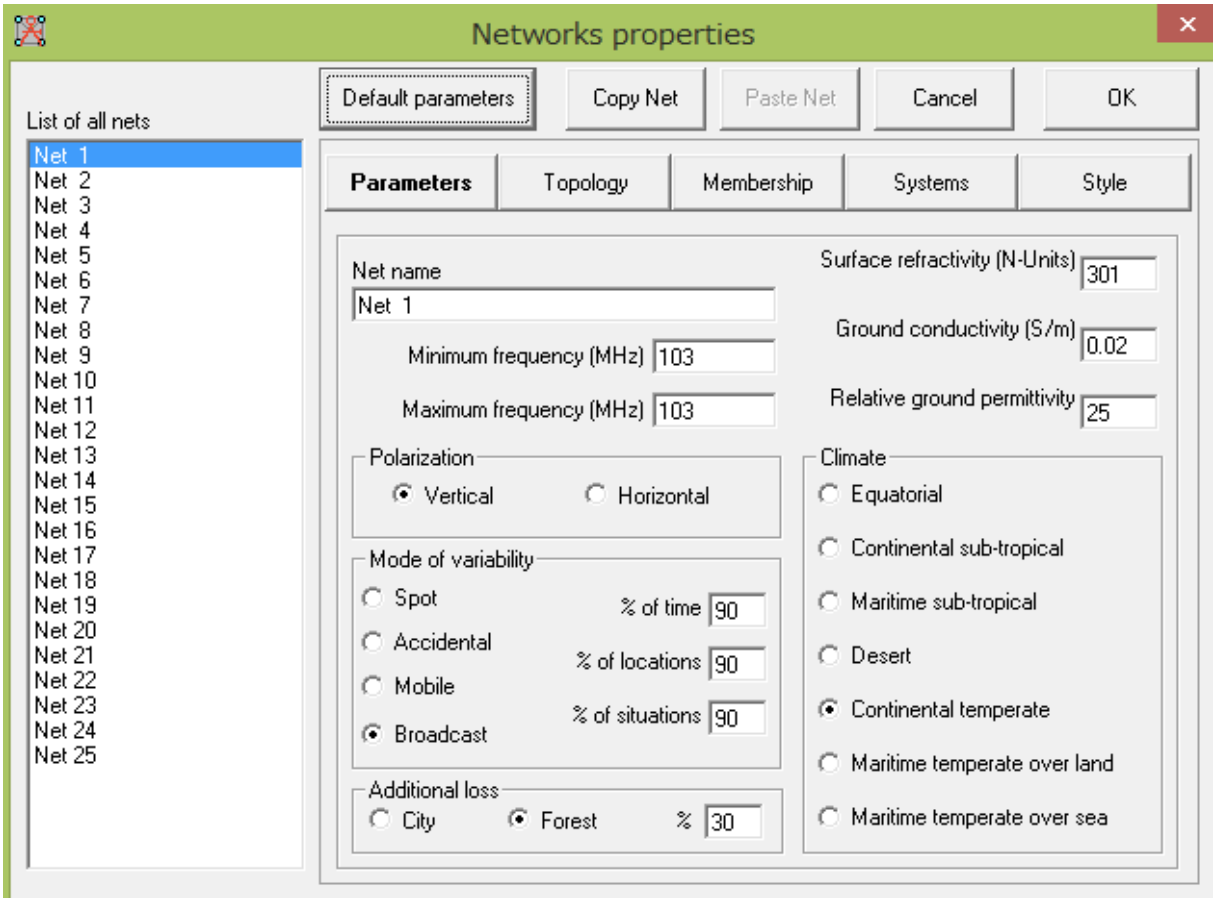
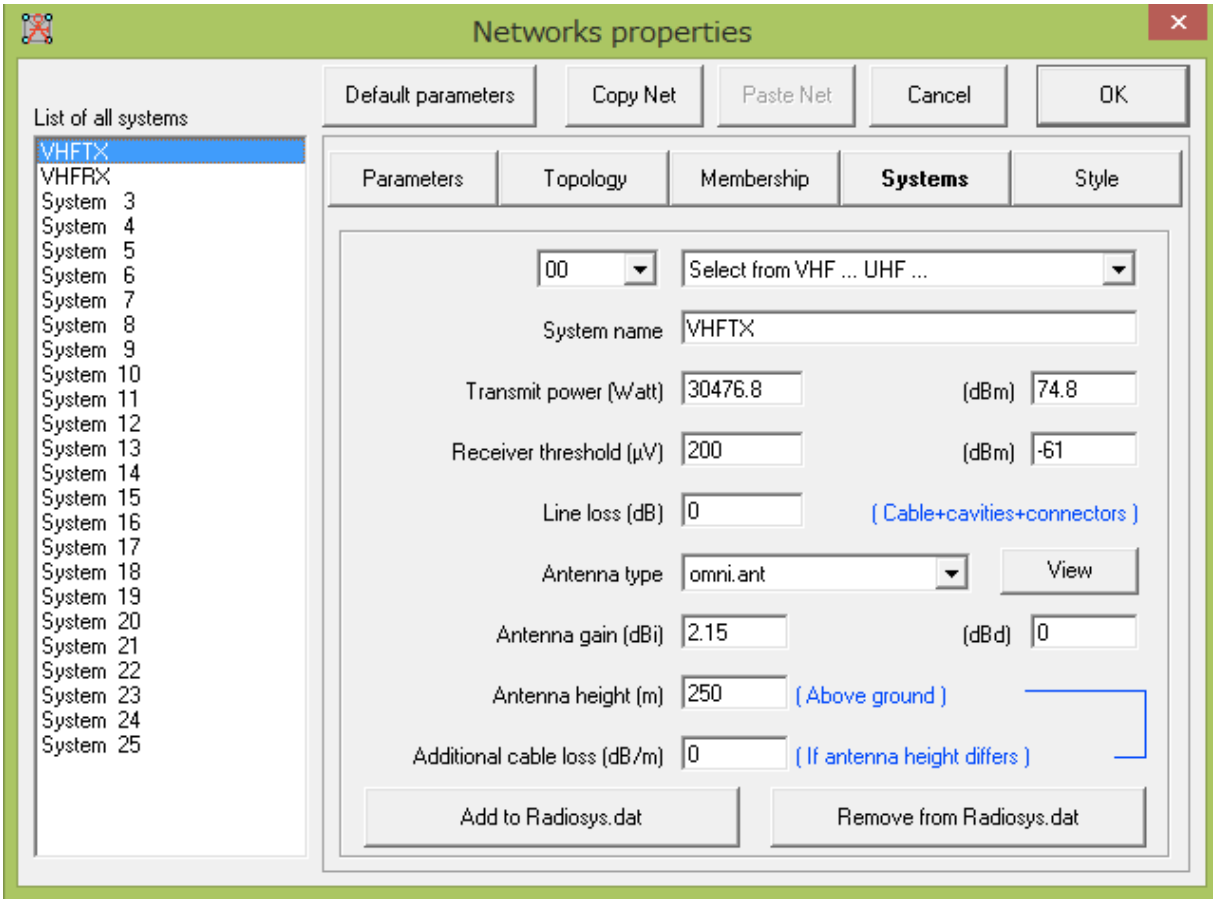
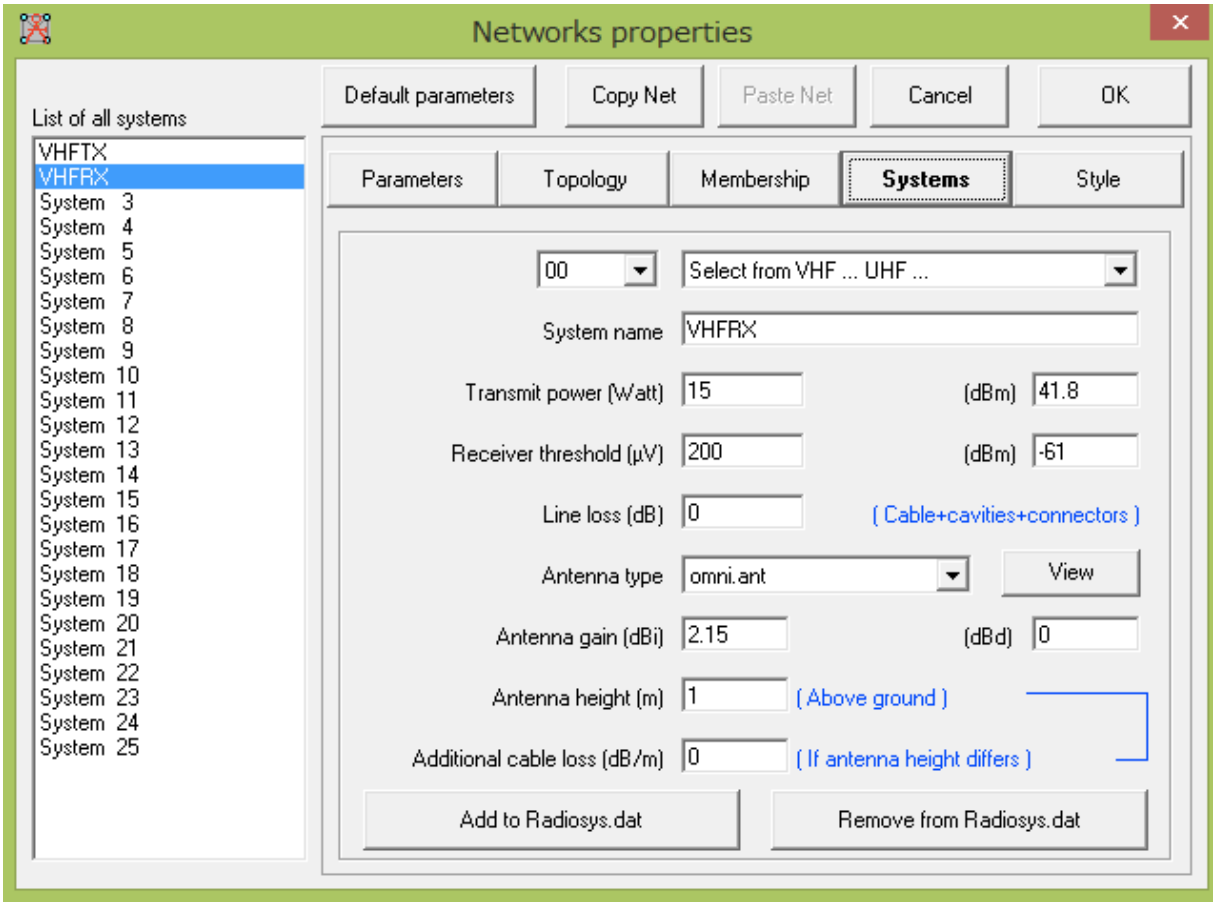
1. Service Area for Sveriges Radio P4 :

Setup of parameters :

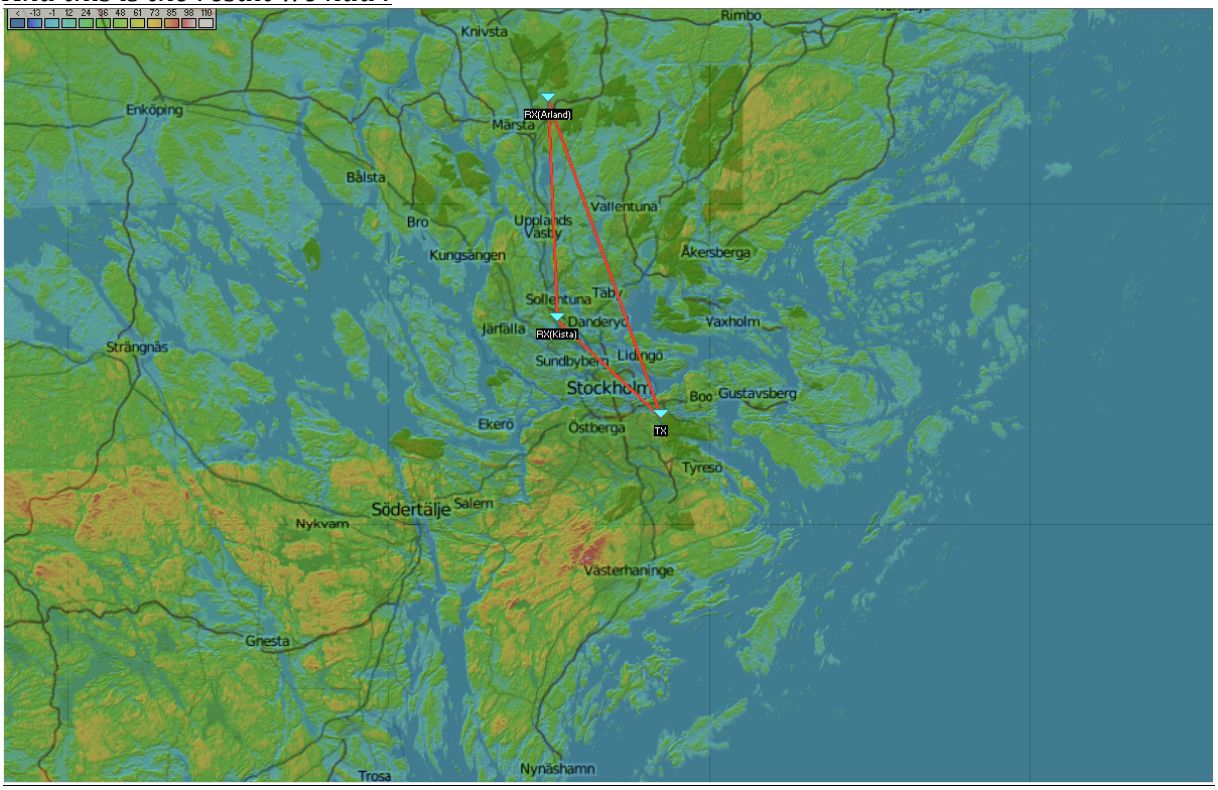
We know that we have EIRP = 50 kW and Omni = 2.15 dbi. We also know that :
EIRP = Pt * Gt (in linear scale). Therefore we have : Pt = EIRP / Gt
Gt = 10^(2.15/10) Watt.
Then : Pt = 50*10^3 / 10^(2.15/10) = 30476.8 W




Networks properties
List of all systems
VHFTX
VHFRX
System 3
System 4
System 5
System 6
System 7
System 8
System 9
System 10
System 11
System 12
System 13
System 14
System 15
System 16
System 17
System 18
System 19
System 20
System 21
System 22
System 23
System 24
System 25
Default parameters
Copy Net
Paste Net
Cancel
OK
Parameters
Topology
Membership
Systems
Style
00
Select from VHF ... UHF ...
System name
VHFTX
Transmit power (Watt)
30476.8
(dBm)
74.8
Receiver threshold (µV)
200
(dBm)
-61
Line loss (dB)
0
(Cable+cavities+connectors)
Antenna type
omni.ant
View
Antenna gain (dBi)
2.15
(dBd)
0
Antenna height (m)
250
(Above ground)
Additional cable loss (dB/m)
0
(If antenna height differs)
Add to Radiosys.dat
Remove from Radiosys.dat


Networks properties
List of all systems
VHFTX
VHFRX
System 3
System 4
System 5
System 6
System 7
System 8
System 9
System 10
System 11
System 12
System 13
System 14
System 15
System 16
System 17
System 18
System 19
System 20
System 21
System 22
System 23
System 24
System 25
Default parameters
Copy Net
Paste Net
Cancel
OK
Parameters
Topology
Membership
Systems
Style
00
Select from VHF ... UHF ...
System name
VHFRX
Transmit power (Watt)
15
(dBm)
41.8
Receiver threshold (µV)
200
(dBm)
-61
Line loss (dB)
0
(Cable+cavities+connectors)
Antenna type
omni.ant
View
Antenna gain (dBi)
2.15
(dBd)
0
Antenna height (m)
1
(Above ground)
Additional cable loss (dB/m)
0
(If antenna height differs)
Add to Radiosys.dat
Remove from Radiosys.dat

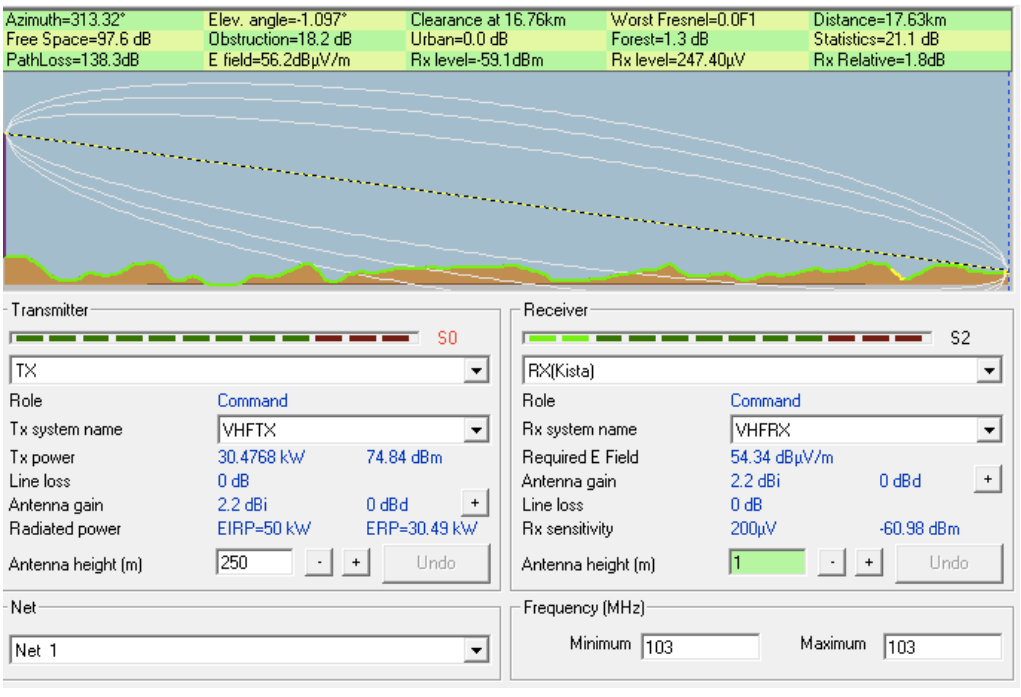
And this is the result we had :



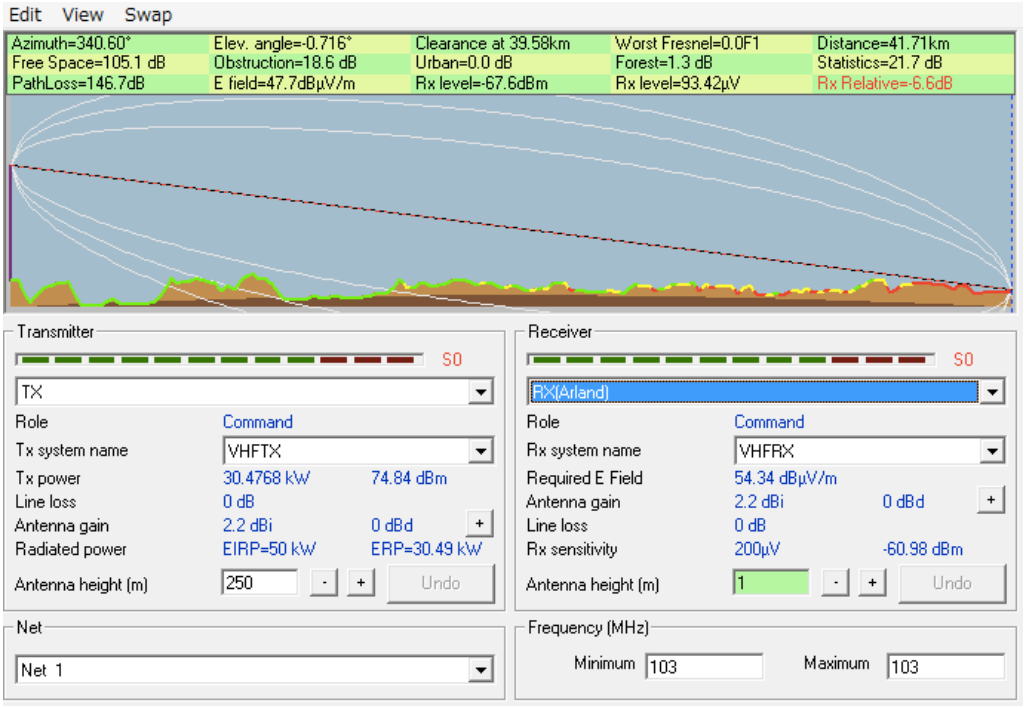
Solutions :

- According to our simulation results the coverage is quite good and the received signal level is **-59.1 dBm** in Kista area.
- The received signal level in Arland is **67.6 dBm**. It seems that we can't listen to the P4 Radio at Arlanda Airport.
- In order to have the limit in kilometers we used the method written in the assignement and the result is **5 km**.
- Below you will find screenshots of our differents results :

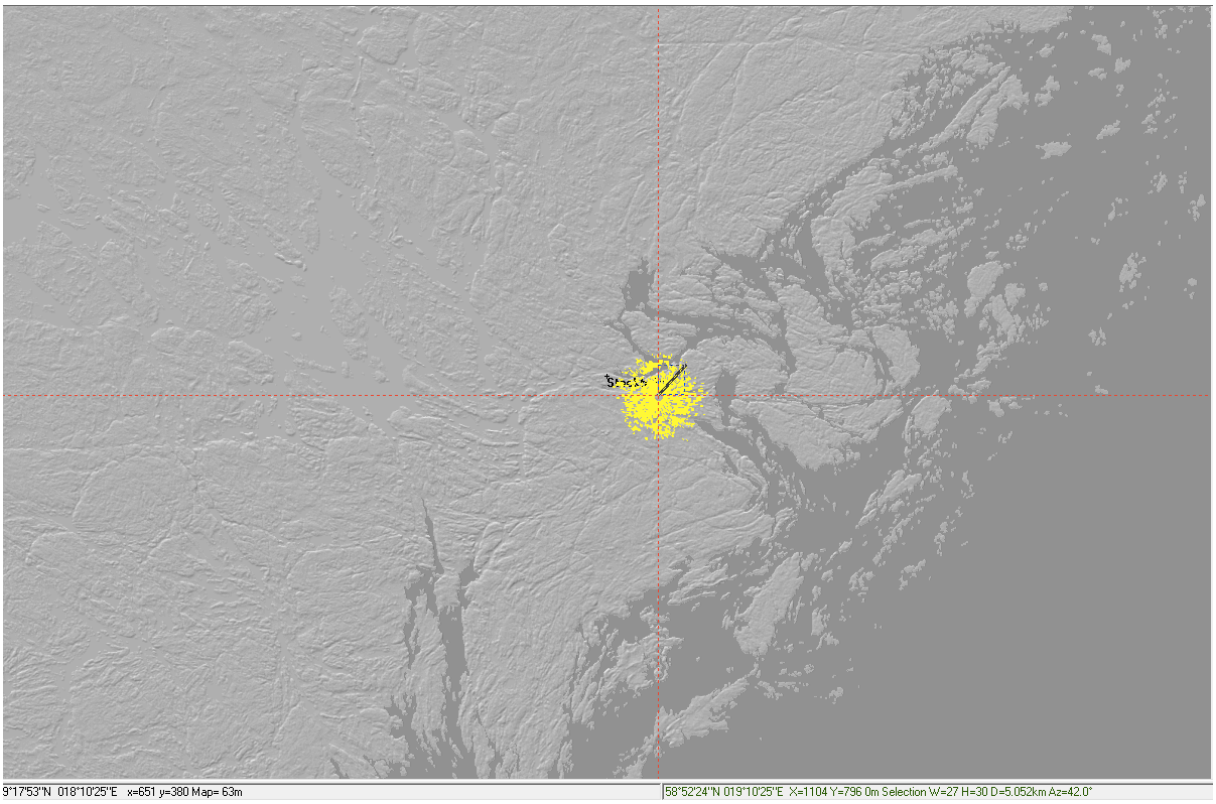
<u>Kista</u>



Arlanda

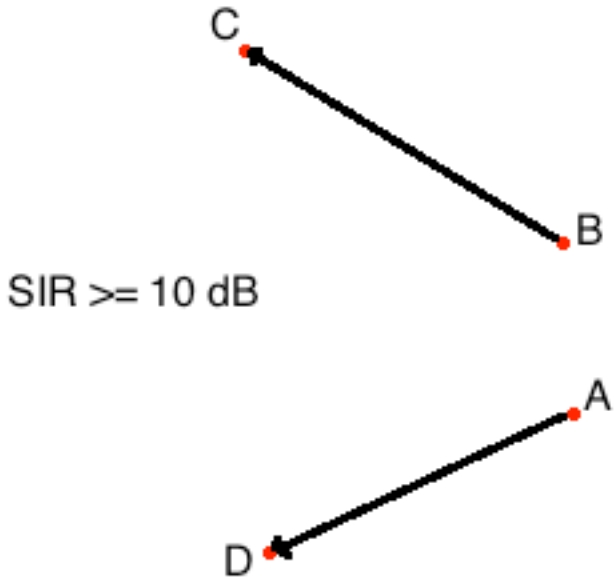


Coverage



2. Avoiding interference in a data network :

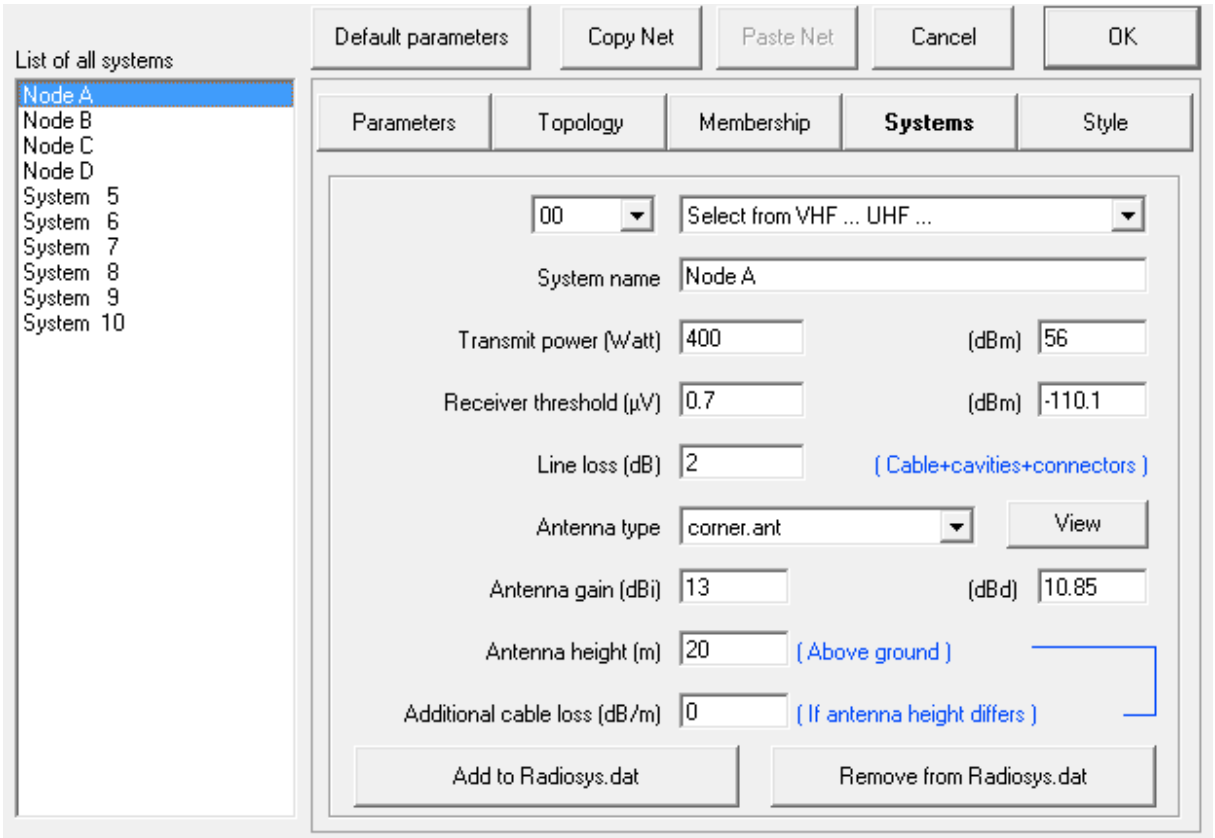
This is what the configuration system is supposed to look like :

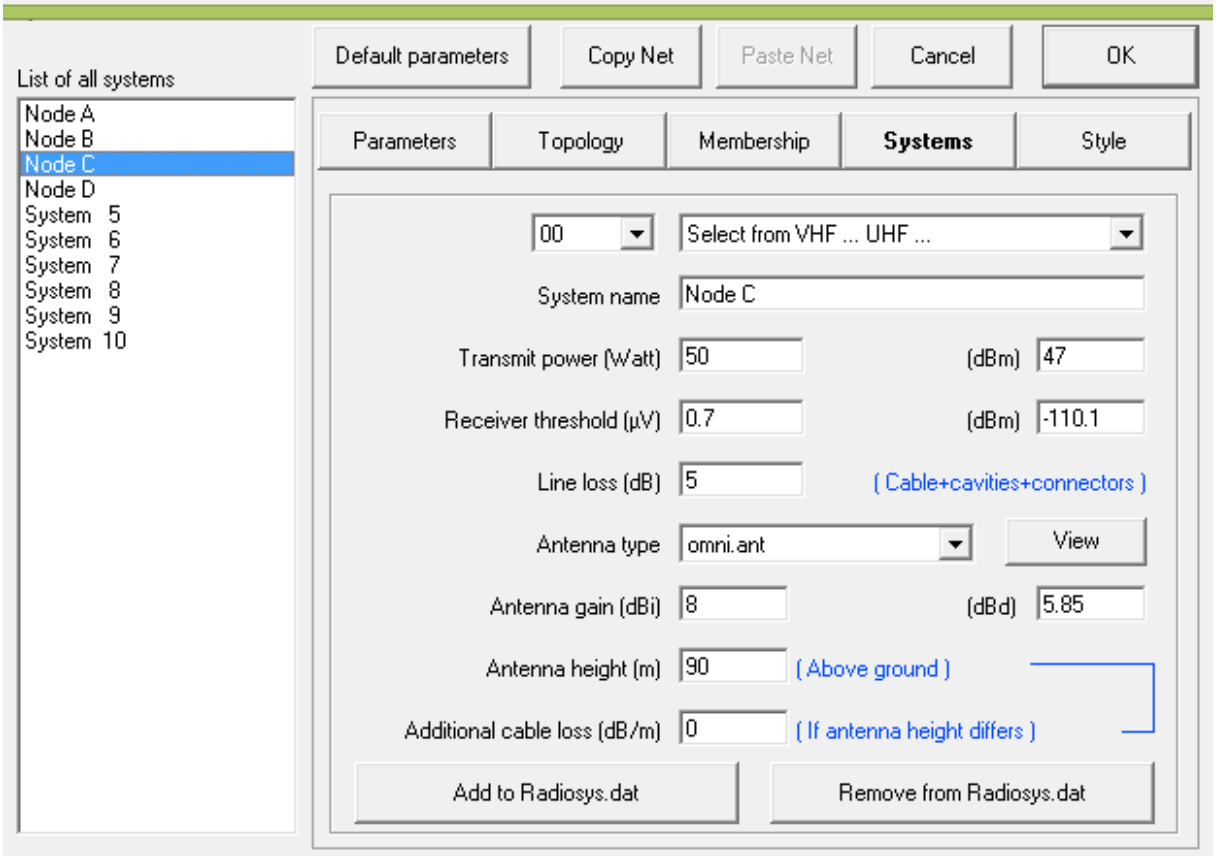


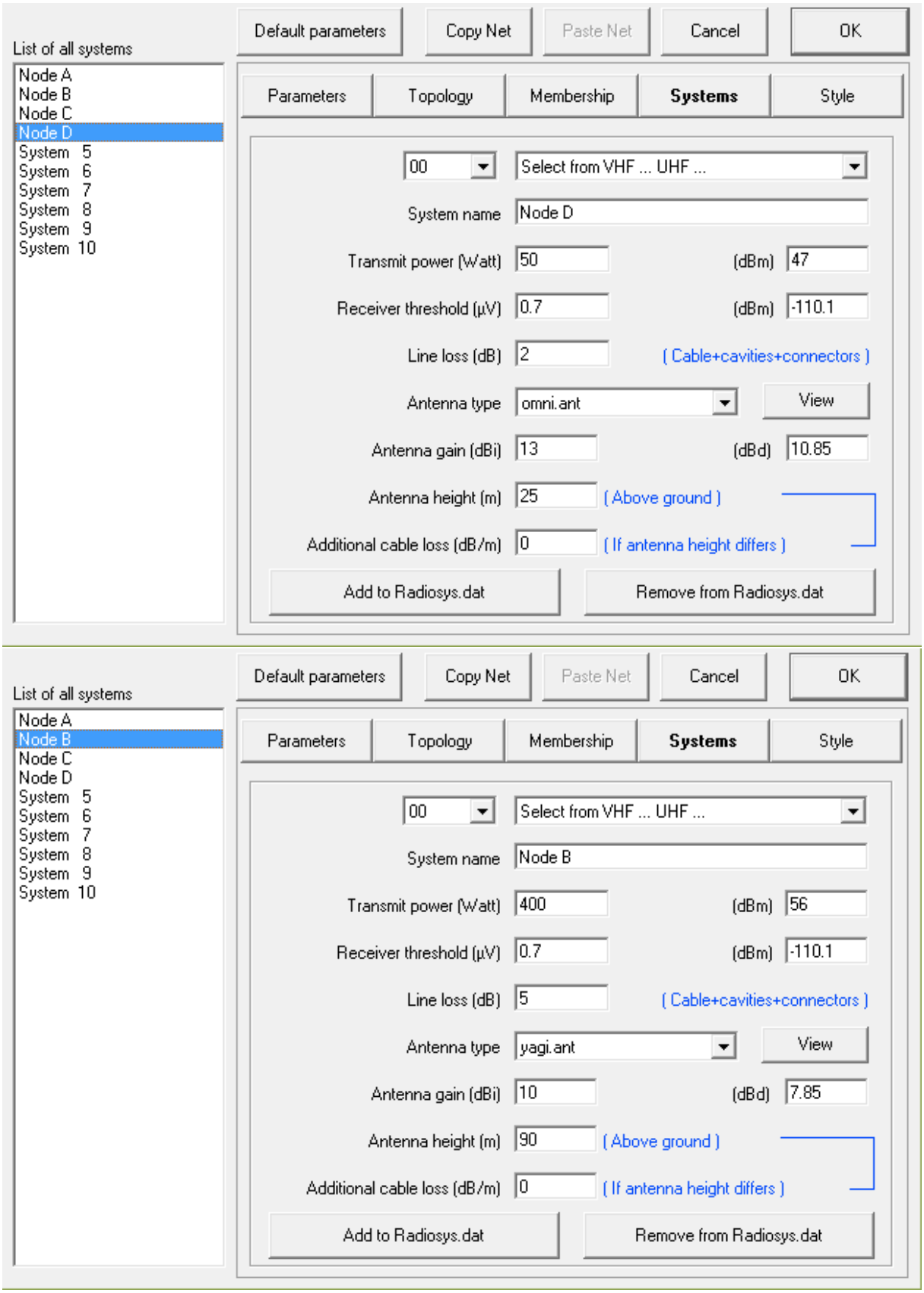
Solutions :

In order to find a solution we had to play with several parameters so we can have less interferences possible (less red on the map between our antennas).

- To solve the problem we used **corner antennas because they are directionnal so we can have less interference than we omni antennas** and then we played with parameters to find correct direction/power transmission for both B and A antennas.
- First we tried to align the power direction with the vectors between the two antennas by playing with the direction transmission of the antennas.
- Secondly we played with the height of the antennas so we can have the most acceptable configuration possible. *Note* that we played with the height of transmission antennas A and B but also with reception antennas C and D.
  And finally we played with the power of antennas.
- One of the problem we met was between B and C : whatever changes we were doing (in a realistic way) there was always interferences. Finally we found out that between both of them there was a hill. We corrected it by playing with the heights of our antennas.
- On the screenshots below we can see what we had after playing with those antennas parameters. We decided to put screenshots of our parameters settings also to show you what we did.

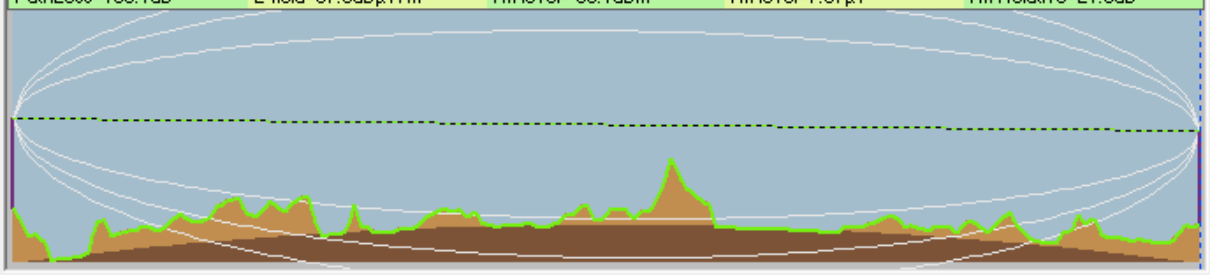

List of all systems
Node A
Node B
Node C
Node D
System 5
System 6
System 7
System 8
System 9
System 10
Default parameters
Copy Net
Paste Net
Cancel
OK
Parameters
Topology
Membership
Systems
Style
00
Select from VHF ... UHF ...
System name
Node A
Transmit power (Watt)
400
(dBm)
56
Receiver threshold (µV)
0.7
(dBm)
-110.1
Line loss (dB)
2
(Cable+cavities+connectors)
Antenna type
corner.ant
View
Antenna gain (dBi)
13
(dBd)
10.85
Antenna height (m)
20
(Above ground)
Additional cable loss (dB/m)
0
(If antenna height differs)
Add to Radiosys.dat
Remove from Radiosys.dat


List of all systems
Node A
Node B
Node C
Node D
System 5
System 6
System 7
System 8
System 9
System 10
Default parameters
Copy Net
Paste Net
Cancel
OK
Parameters
Topology
Membership
Systems
Style
00
Select from VHF ... UHF ...
System name
Node C
Transmit power (Watt)
50
(dBm)
47
Receiver threshold (µV)
0.7
(dBm)
-110.1
Line loss (dB)
5
(Cable+cavities+connectors)
Antenna type
omni.ant
View
Antenna gain (dBi)
8
(dBd)
5.85
Antenna height (m)
90
(Above ground)
Additional cable loss (dB/m)
0
(If antenna height differs)
Add to Radiosys.dat
Remove from Radiosys.dat


List of all systems
Node A
Node B
Node C
Node D
System 5
System 6
System 7
System 8
System 9
System 10
Default parameters
Copy Net
Paste Net
Cancel
OK
Parameters
Topology
Membership
Systems
Style
00
Select from VHF ... UHF ...
System name
Node D
Transmit power (Watt)
50
(dBm)
47
Receiver threshold (µV)
0.7
(dBm)
-110.1
Line loss (dB)
2
(Cable+cavities+connectors)
Antenna type
omni.ant
View
Antenna gain (dBi)
13
(dBd)
10.85
Antenna height (m)
25
(Above ground)
Additional cable loss (dB/m)
0
(If antenna height differs)
Add to Radiosys.dat
Remove from Radiosys.dat
List of all systems
Node A
Node B
Node C
Node D
System 5
System 6
System 7
System 8
System 9
System 10
Default parameters
Copy Net
Paste Net
Cancel
OK
Parameters
Topology
Membership
Systems
Style
00
Select from VHF ... UHF ...
System name
Node B
Transmit power (Watt)
400
(dBm)
56
Receiver threshold (µV)
0.7
(dBm)
-110.1
Line loss (dB)
5
(Cable+cavities+connectors)
Antenna type
yagi.ant
View
Antenna gain (dBi)
10
(dBd)
7.85
Antenna height (m)
90
(Above ground)
Additional cable loss (dB/m)
0
(If antenna height differs)
Add to Radiosys.dat
Remove from Radiosys.dat

Edit View Swap

Azimuth=291.53°	Elev. angle=-0.303°	Clearance at 28.17km	Worst Fresnel=0.3F1	Distance=50.83km
Free Space=119.2 dB	Obstruction=7.6 dB	Urban=0.0 dB	Forest=2.9 dB	Statistics=23.4 dB
PathLoss=153.1dB	E field=37.8dBµV/m	Rx level=-89.1dBm	Rx level=7.87µV	Rx Relative=21.0dB



Transmitter

S5

B

Role	Node	
Tx system name	Node B	
Tx power	400 W	56.02 dBm
Line loss	5 dB	
Antenna gain	10 dBi	7.8 dBd
Radiated power	EIRP=1.26 kW	ERP=0.77 kW
Antenna height (m)	90	Undo

Receiver

S8

C

Role	Node	
Rx system name	Node C	
Required E Field	16.78 dBµV/m	
Antenna gain	8 dBi	5.8 dBd
Line loss	5 dB	
Rx sensitivity	0.7µV	-110.1 dBm
Antenna height (m)	90	Undo

Net

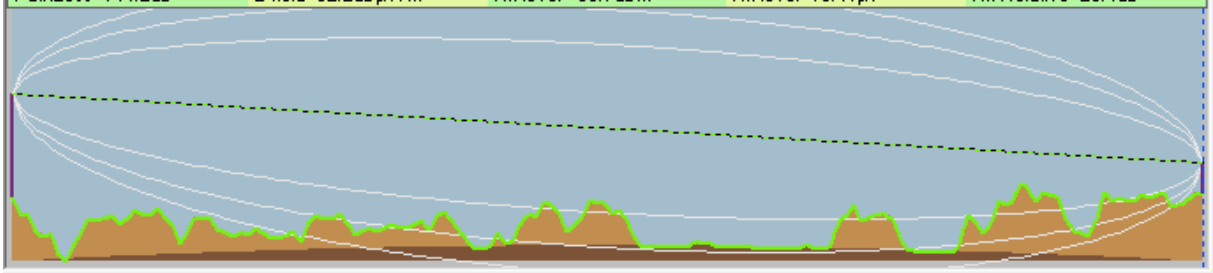
Data Net

Frequency (MHz)

Minimum 430 Maximum 430

Edit View Swap

Azimuth=225.82°	Elev. angle=-0.131°	Clearance at 25.94km	Worst Fresnel=0.5F1	Distance=30.62km
Free Space=114.8 dB	Obstruction=3.5 dB	Urban=0.0 dB	Forest=2.9 dB	Statistics=23.0 dB
PathLoss=144.2dB	E field=32.2dBµV/m	Rx level=-86.7dBm	Rx level=10.41µV	Rx Relative=23.4dB



Transmitter

S6

B

Role	Node	
Tx system name	Node B	
Tx power	400 W	56.02 dBm
Line loss	5 dB	
Antenna gain	-4.5 dBi	-6.6 dBd
Radiated power	EIRP=44.88 W	ERP=27.37 W
Antenna height (m)	90	Undo

Receiver

S9

D

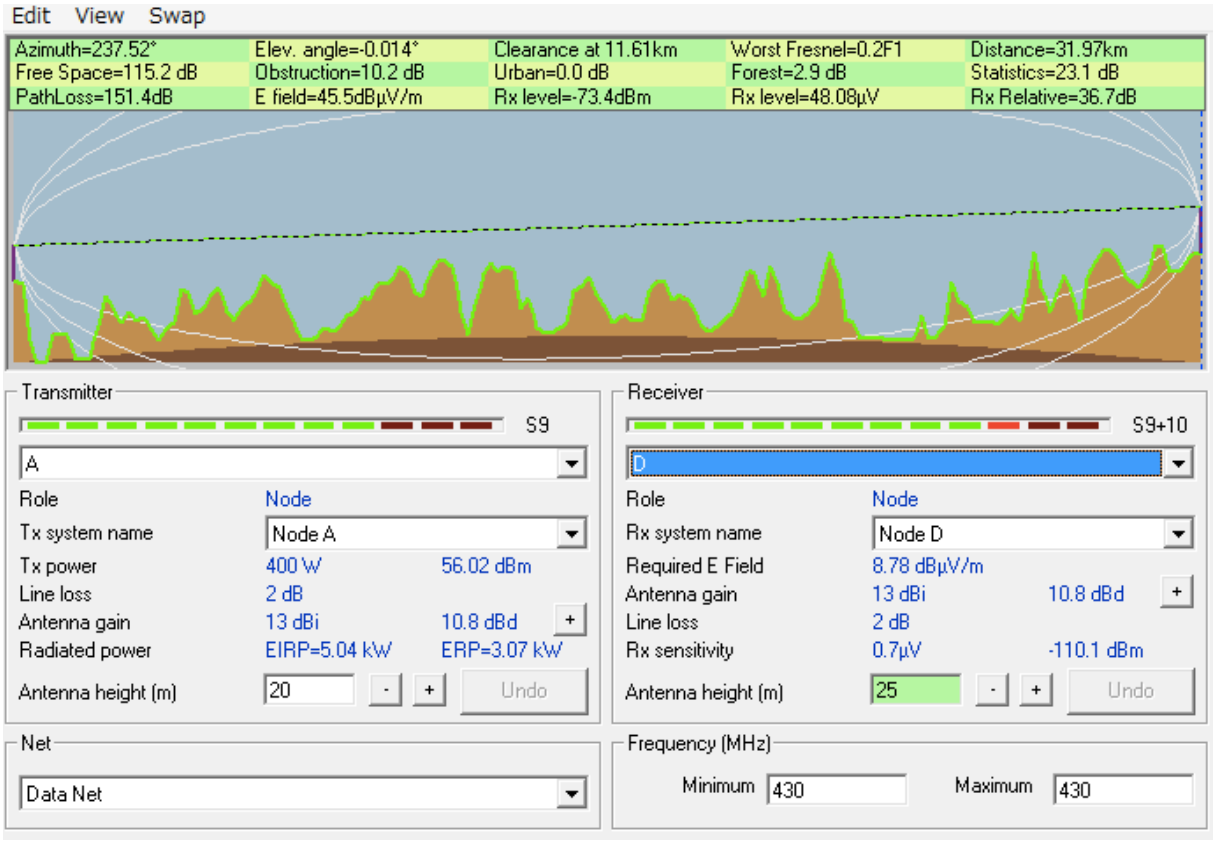
Role	Node	
Rx system name	Node D	
Required E Field	8.78 dBµV/m	
Antenna gain	13 dBi	10.8 dBd
Line loss	2 dB	
Rx sensitivity	0.7µV	-110.1 dBm
Antenna height (m)	25	Undo

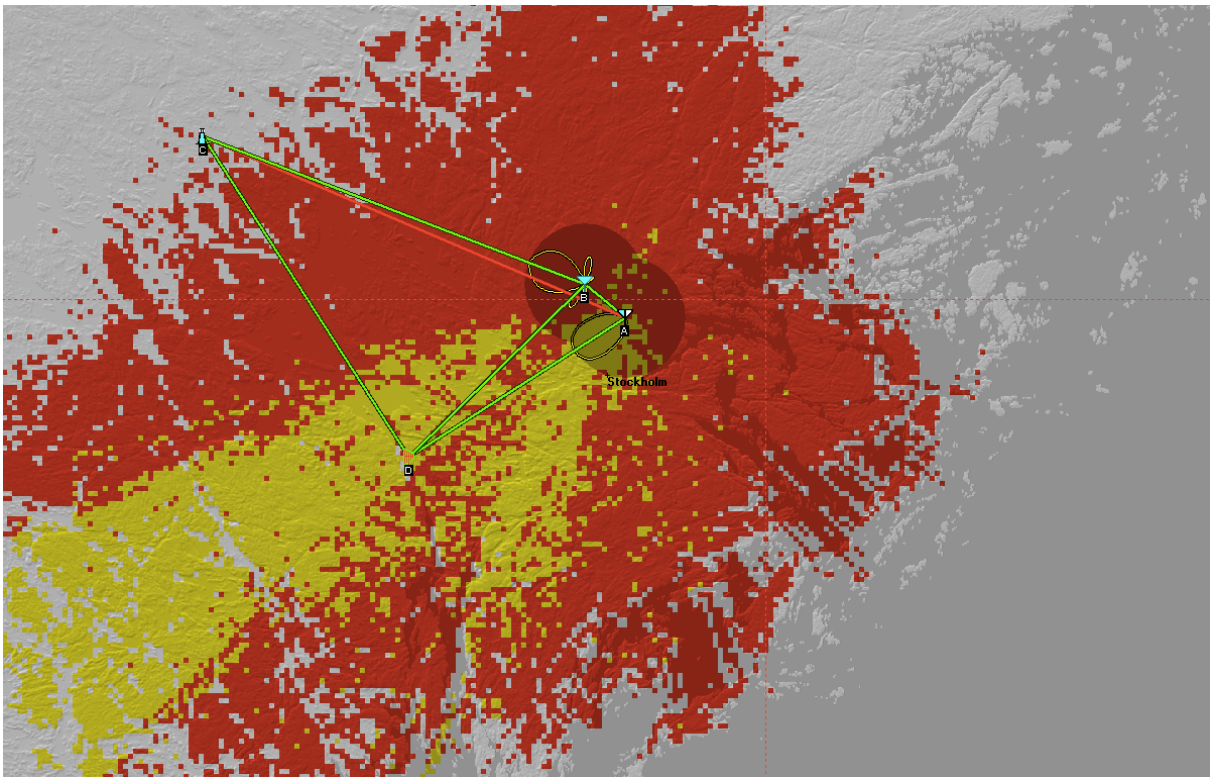
Net

Data Net

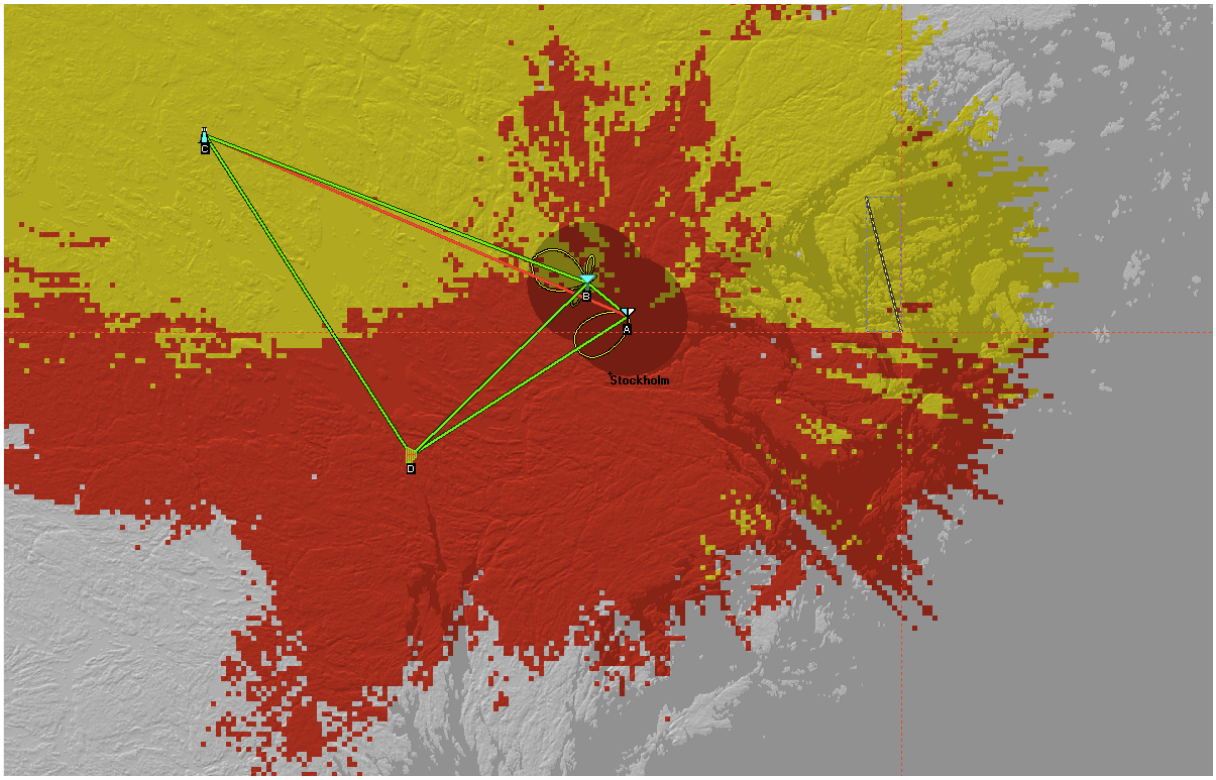
Frequency (MHz)

Minimum 430 Maximum 430


Edit View Swap
Azimuth=237.52° Elev. angle=-0.014° Clearance at 11.61km Worst Fresnel=0.2F1 Distance=31.97km
Free Space=115.2 dB Obstruction=10.2 dB Urban=0.0 dB Forest=2.9 dB Statistics=23.1 dB
PathLoss=151.4dB E field=45.5dBµV/m Rx level=-73.4dBm Rx level=48.08µV Rx Relative=36.7dB
Transmitter
S9
A
Role Node
Tx system name Node A
Tx power 400 W 56.02 dBm
Line loss 2 dB
Antenna gain 13 dBi 10.8 dBd
Radiated power EIRP=5.04 kW ERP=3.07 kW
Antenna height (m) 20 - + Undo
Receiver
S9+10
D
Role Node
Rx system name Node D
Required E Field 8.78 dBµV/m
Antenna gain 13 dBi 10.8 dBd
Line loss 2 dB
Rx sensitivity 0.7µV -110.1 dBm
Antenna height (m) 25 - + Undo
Net
Data Net
Frequency (MHz)
Minimum 430
Maximum 430


Stockholm

A to D



B to C