



East West University

Department of CSE

Lab Report 02

CSE 453

Wireless Networking

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Planning Terrestrial Radio Networks

Part 2

Providing my solutions:

1. Antenna height, type and orientation for each transmitter and receiver.

Ans: Here, A, B = transmitter & C, D = receiver
Antenna gain: 13dBi for all.

For A, antenna type: yagi.ant
Antenna height: 100 meters
Orientation: A to D

For B, antenna type: yagi.ant
Antenna height: 100 meters
Orientation: B to C

For C, antenna type: yagi.ant
Antenna height: 25 meters
Orientation: C to B

For D, antenna type: yagi.ant
Antenna height: 25 meters
Orientation: D to A

2. EIRP for each transmitter.

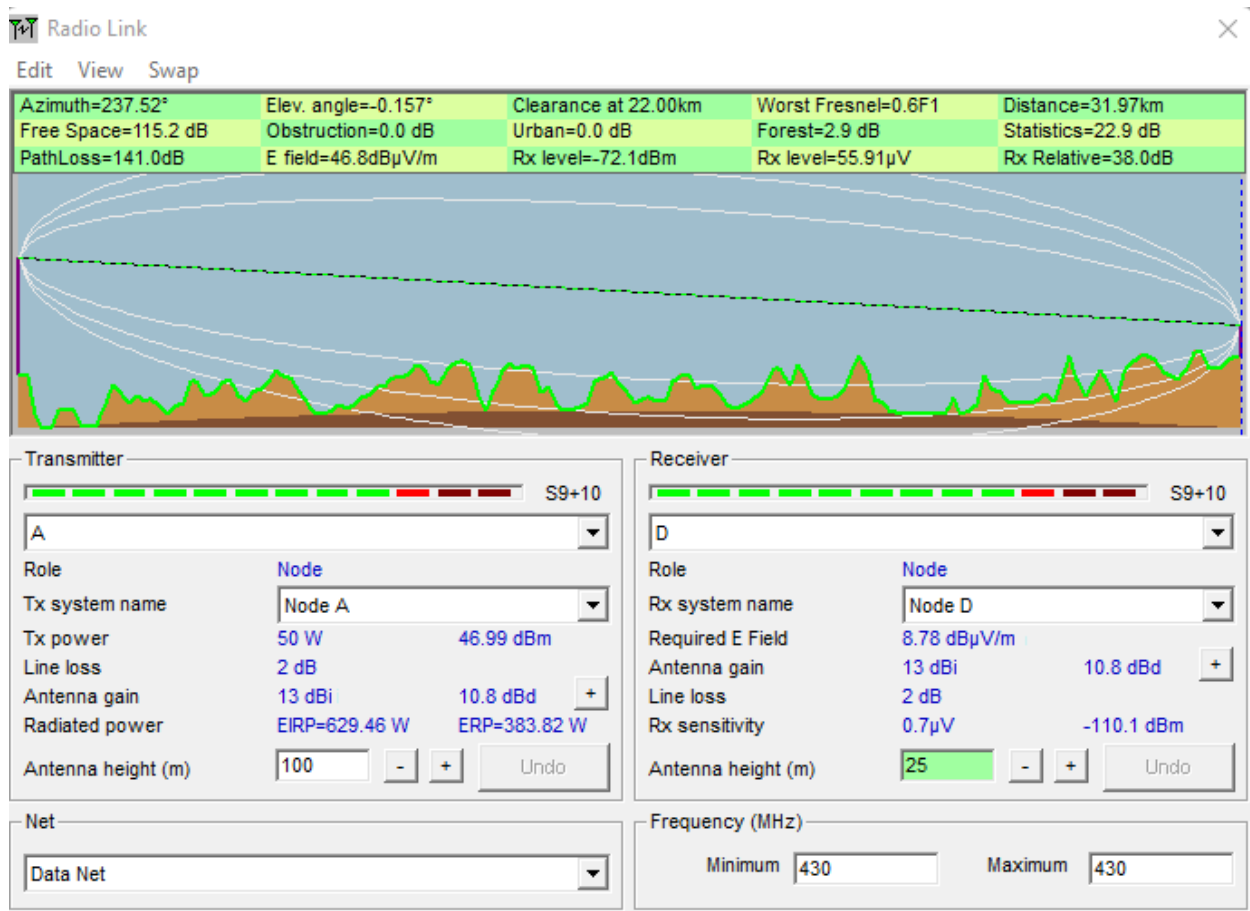
Ans: A & B is transmitter.

We know, $EIRP = P_t - L_c + G_A$
 P_t = transmitted power
 L_c = Line loss
 G_a = Antenna gain

For A,
 $EIRP_A \text{ (dBm)} = P_t - L_c + G_A$
 $= 46.99 - 2 + 13$
 $= 57.99 \text{ dBm} = 58 \text{ dBm}$

$EIRP_A \text{ (KW)} = (10^{(58/10)})/1000 \text{ W} = 630.957 \text{ W}$
 $= 0.630 \text{ KW}$

Which is same as the result we saw from the output EIRP screenshot below.

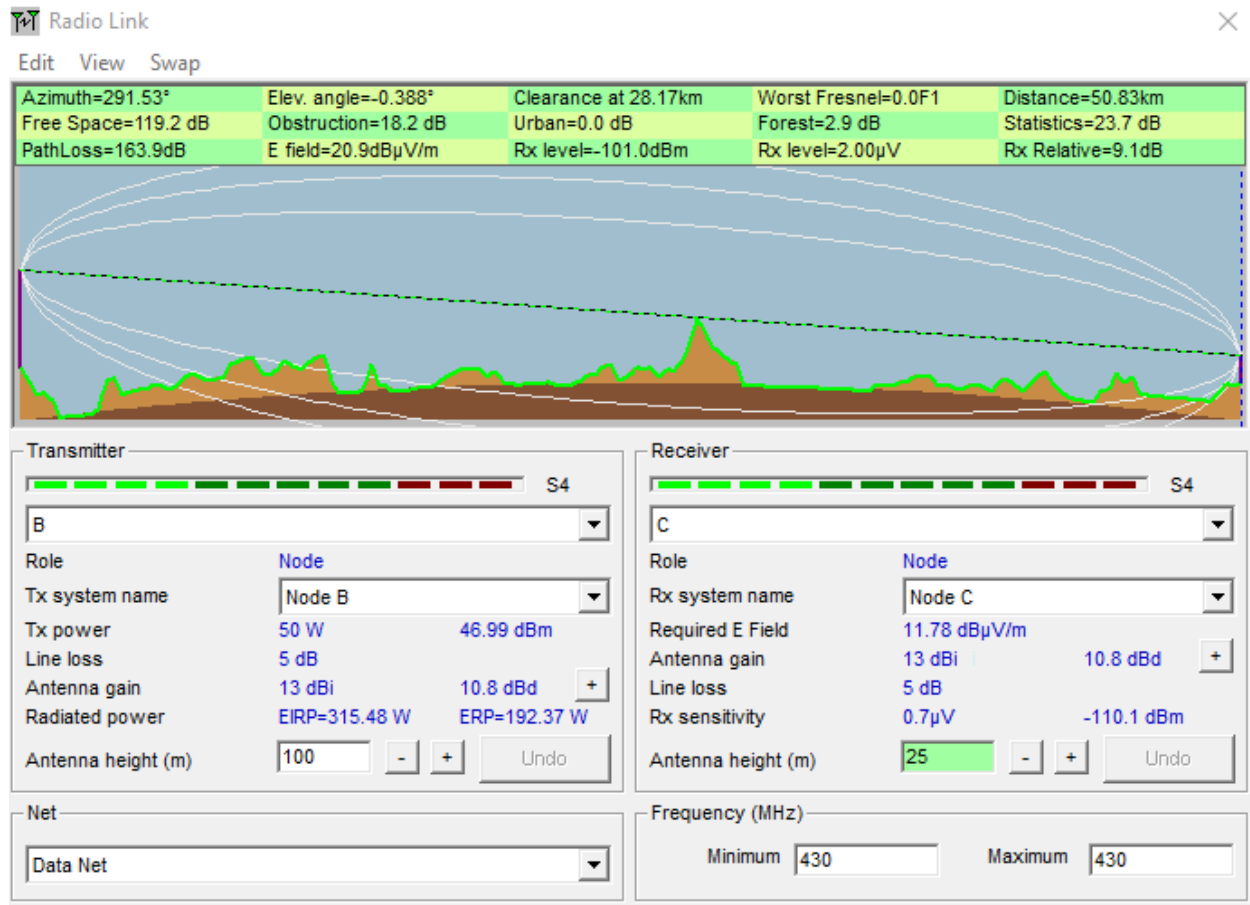


For B,

$$\begin{aligned} \text{EIRP}_B (\text{dBm}) &= P_t - L_C + G_A \\ &= 46.99 - 5 + 13 \\ &= 54.99 \text{ dBm} = 55 \text{ dBm} \end{aligned}$$

$$\begin{aligned} \text{EIRP}_B (\text{KW}) &= (10^{(55/10)}) / 1000 \text{ W} = 316.227 \text{ W} \\ &= 0.316 \text{ KW} \end{aligned}$$

Which is same as the result we saw from the output EIRP screenshot below.



3. Numerically show that SIR is greater than 10dB at both receivers. Note that you do not need to calculate the received powers analytically in order to do this task. Simply use the signal and interference levels that you obtained in your simulation results. Also, be careful about the units when you calculate the signal-to-interference ratio.

Ans:

From our results of radio link we saw,

From A to D Rx level is: -72 dBm

And B to D Rx level is: -93 dBm

B is interference on AD.

$$AD = AD - BD = -72.1 - (-93.7) = 21.6 > 10$$

Again,

From B to C Rx level is: -101 dBm

And A to C Rx level is: -112.3 dBm

A is interference on BC.

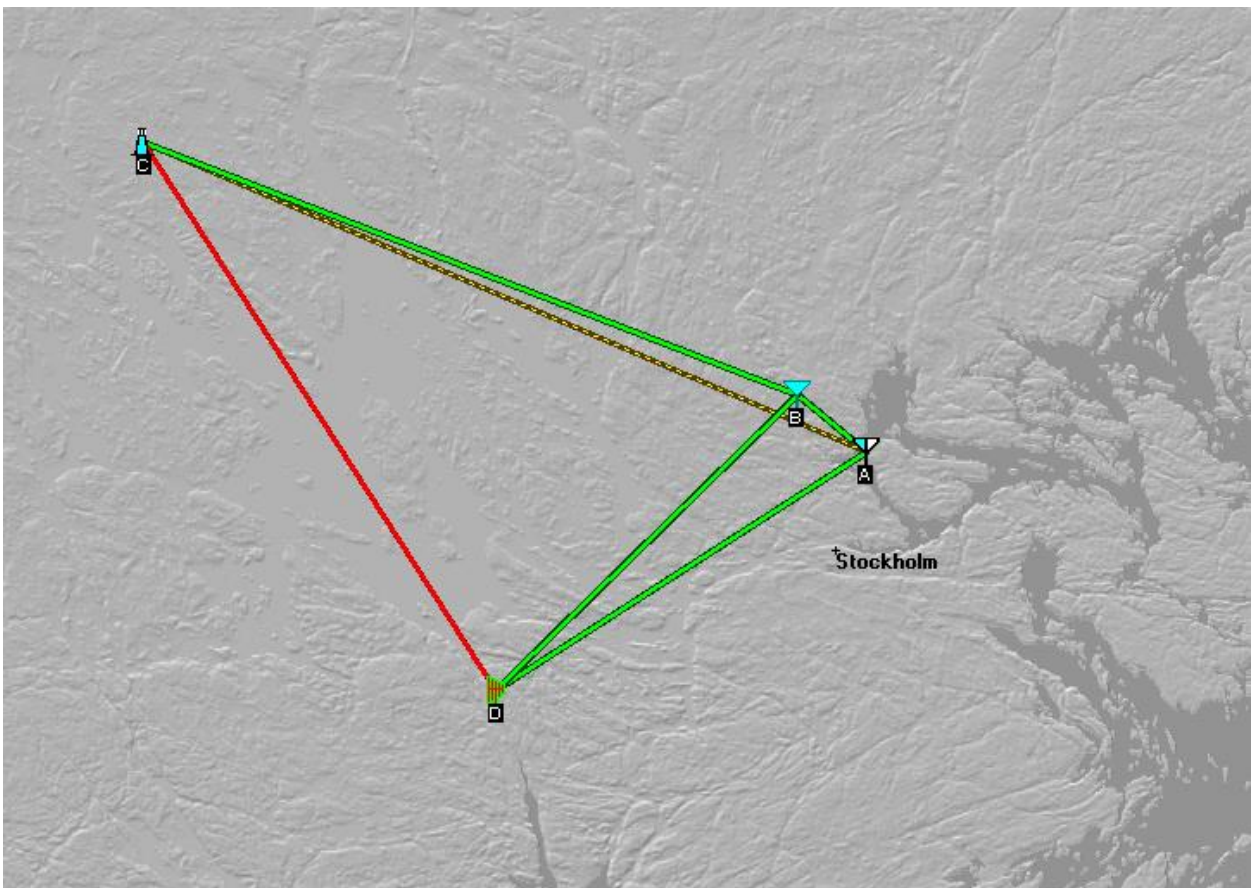
$$BC = BC - AC = -101 - (-112.3) = 11.3 > 10$$

So, we see the signal to interference ratio, SIR for both AD and BC is 21.6 dB and 11.3 which is greater than 10dB. [showed]

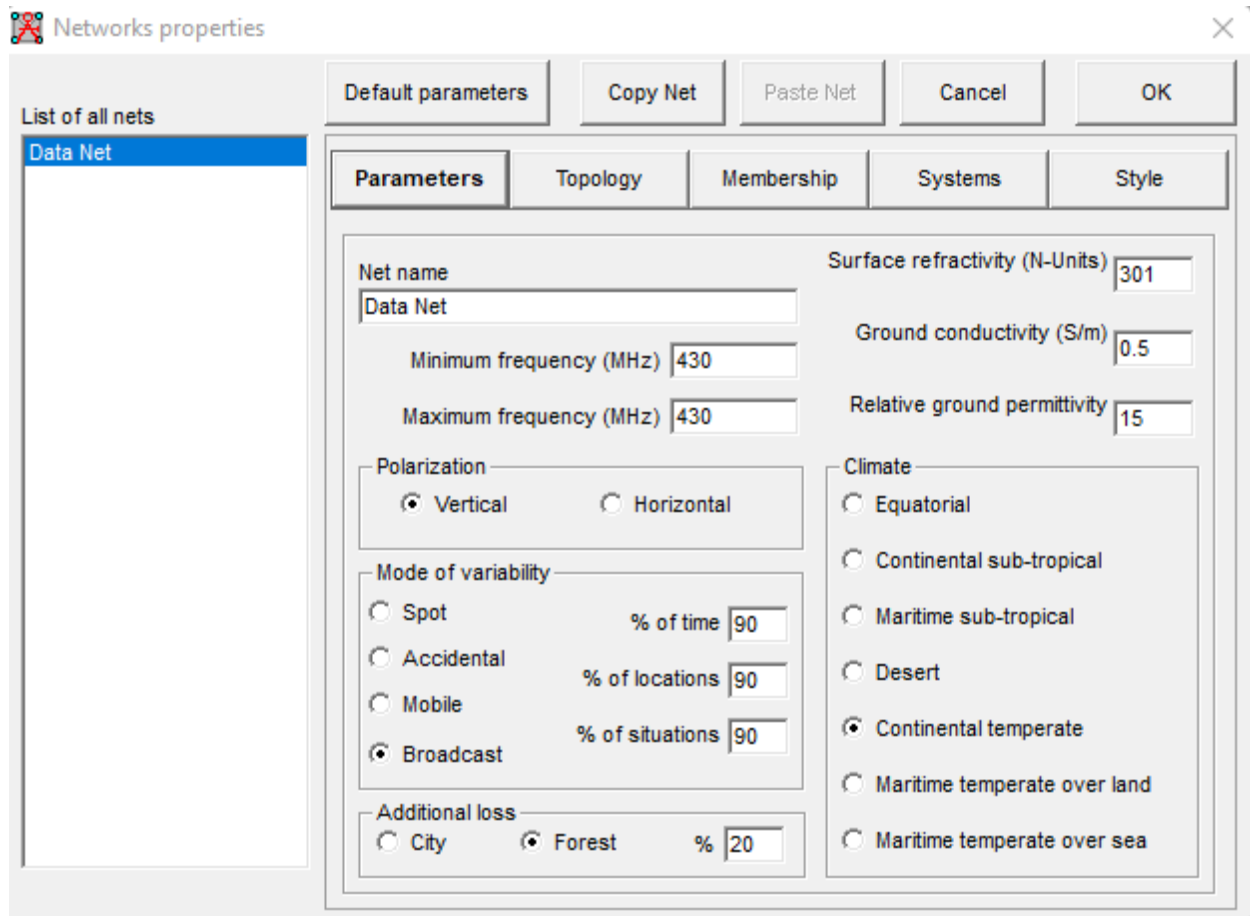
4. Briefly explain your solution method and results. In your explanation, use the screenshots of Radio Link profiles of both links and Interference plots at both receivers.

Ans: Solution method steps are given below:

- First open network-ex-interf.net
- Then go to new picture, click on grayscale slope and draw
- Check show network—all



- Then go to the network properties and parameters.
- Make net name: data net, polarization: vertical, mode of variability: broadcast, additional loss, forest: 20%



- Now go to the systems & make 4 nodes named: node A, node B (for transmitter), node C, node D (for receiver)
- Here, some default parameters for all nodes:
 Transmit power= 50 Watt
 Receiver threshold= 0.7 uV
 Line loss= 2dB
 Antenna type= yagi.ant
- Now make some changes on antenna height.
 Make node A, B height 100 meter
 & C, D height 25 meter.
- Then go to the membership & click list of all units: A, B, C, D.
- Set the orientations for each nodes means change the antenna direction.
- Then go to the tools--- radio link.
- Check A to D, A to C, B to C, B to D. Here we can see some solutions like: Tx and Rx power, line loss, antenna gain, EIRP.

Radio link profiles screenshots are given:

Radio Link

Edit View Swap

Azimuth=237.52°	Elev. angle=-0.157°	Clearance at 22.00km	Worst Fresnel=0.6F1	Distance=31.97km
Free Space=115.2 dB	Obstruction=0.0 dB	Urban=0.0 dB	Forest=2.9 dB	Statistics=22.9 dB
PathLoss=141.0dB	E field=46.8dBμV/m	Rx level=-72.1dBm	Rx level=55.91μV	Rx Relative=38.0dB

Transmitter

S9+10

A

Role

Node

Tx system name

Node A

Tx power

50 W

46.99 dBm

Line loss

2 dB

Antenna gain

13 dBi

10.8 dBd

Radiated power

ERP=629.46 W

ERP=383.82 W

Antenna height (m)

100

-

+

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

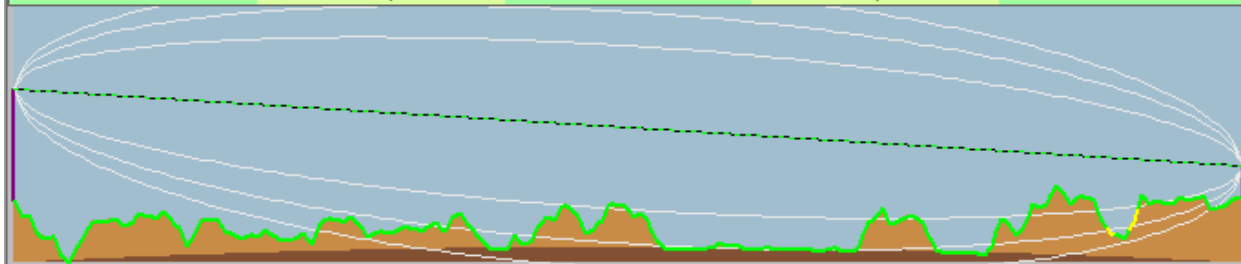
430

Maximum

430

Edit View Swap

Azimuth=225.82°	Elev. angle=-0.150°	Clearance at 25.94km	Worst Fresnel=0.5F1	Distance=30.62km
Free Space=114.8 dB	Obstruction=2.8 dB	Urban=0.0 dB	Forest=2.9 dB	Statistics=23.0 dB
PathLoss=143.4dB	E field=26.9dB μ V/m	Rx level=-93.7dBm	Rx level=4.64 μ V	Rx Relative=16.4dB



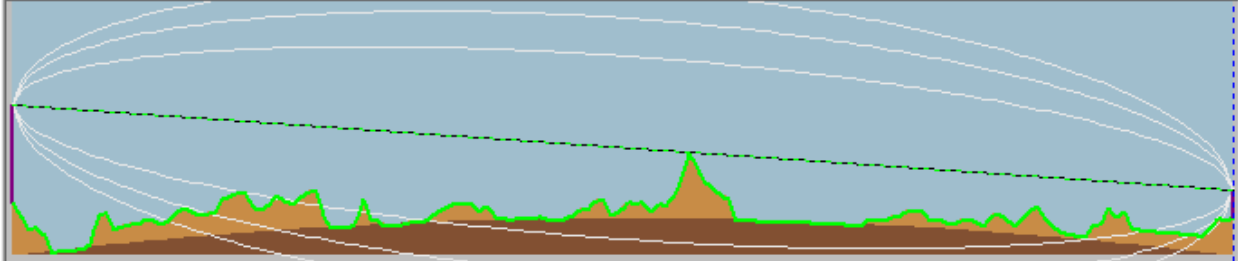
Transmitter	Receiver
<div><div></div><div>S6</div></div>	<div><div></div><div>S6</div></div>
<div>B</div>	<div>D</div>
Role Node	Role Node
Tx system name <div>Node B</div>	Rx system name <div>Node D</div>
Tx power <div>50 W</div> <div>46.99 dBm</div>	Required E Field <div>10.5 dBμV/m</div>
Line loss <div>5 dB</div>	Antenna gain <div>11.3 dBi</div> <div>9.1 dBd</div> <div>+</div>
Antenna gain <div>-1.5 dBi</div> <div>-3.6 dBd</div> <div>+</div>	Line loss <div>2 dB</div>
Radiated power <div>EIRP=11.19 W</div> <div>ERP=6.83 W</div>	Rx sensitivity <div>0.7μV</div> <div>-110.1 dBm</div>
Antenna height (m) <div>100</div> <div>-</div> <div>+</div> <div>Undo</div>	Antenna height (m) <div>25</div> <div>-</div> <div>+</div> <div>Undo</div>
Net	Frequency (MHz)
<div>Data Net</div>	Minimum <div>430</div> Maximum <div>430</div>

Radio Link



Edit View Swap

Azimuth=291.53°	Elev. angle=-0.388°	Clearance at 28.17km	Worst Fresnel=0.0F1	Distance=50.83km
Free Space=119.2 dB	Obstruction=18.2 dB	Urban=0.0 dB	Forest=2.9 dB	Statistics=23.7 dB
PathLoss=163.9dB	E field=20.9dBμV/m	Rx level=-101.0dBm	Rx level=2.00μV	Rx Relative=9.1dB



Transmitter

S4

B

Role Node

Tx system name Node B

Tx power 50 W 46.99 dBm

Line loss 5 dB

Antenna gain 13 dBi 10.8 dBd +

Radiated power EIRP=315.48 W ERP=192.37 W

Antenna height (m) 100 - + Undo

Receiver

S4

C

Role Node

Rx system name Node C

Required E Field 11.78 dBμV/m

Antenna gain 13 dBi 10.8 dBd +

Line loss 5 dB

Rx sensitivity 0.7μV -110.1 dBm

Antenna height (m) 25 - + Undo

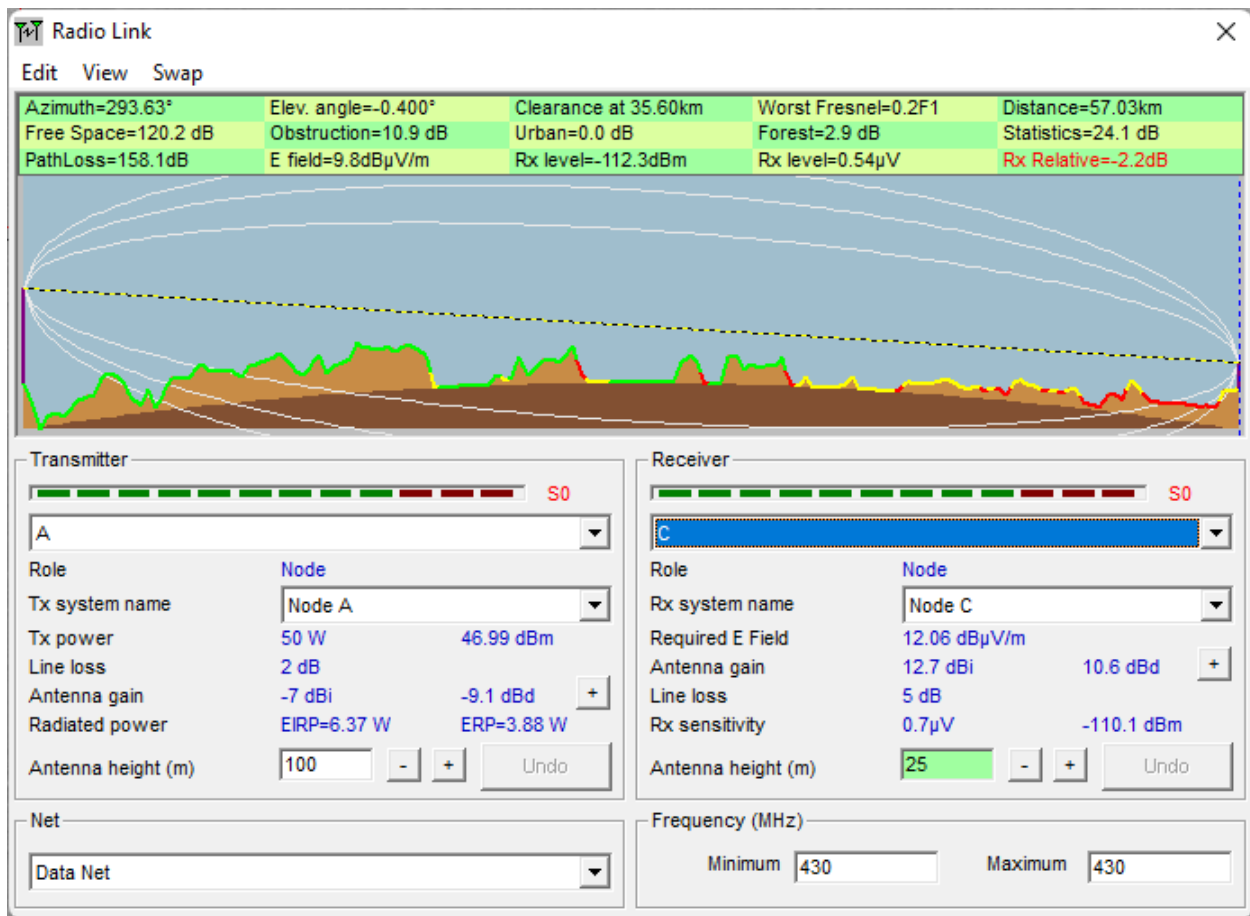
Net

Data Net

Frequency (MHz)

Minimum 430

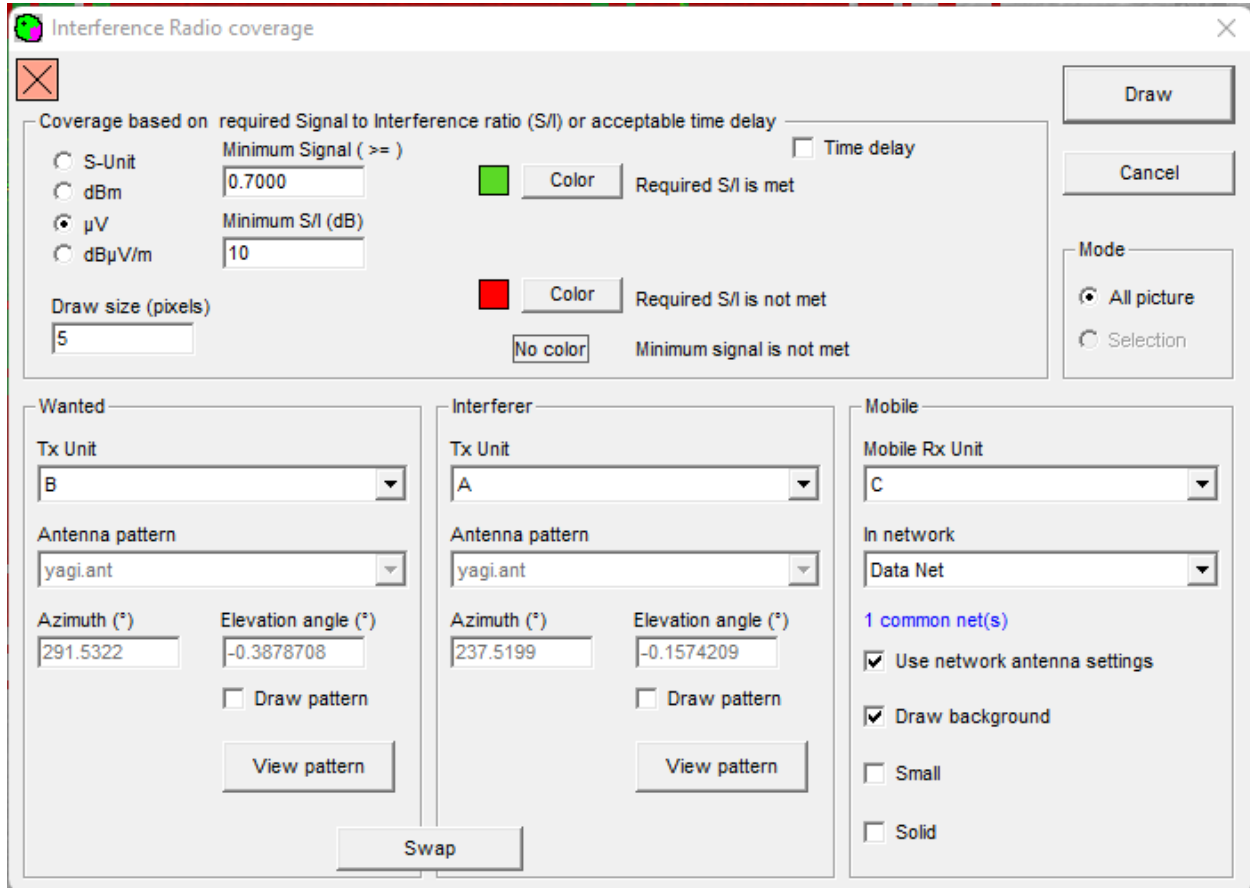
Maximum 430



- Then go to tools—radio coverage—interference
- Here, first draw for Tx unit A and Rx unit D. Between A and D interference is Tx unit B. Then draw the plot.

We see A to D there is green plot shows that required S/I has met.

- Now again draw new picture and go to interference radio coverage.
- Draw for Tx unit B and Rx unit C. Between B and C interference is Tx unit A. Then draw the plot.



The dialog box is titled "Interference Radio coverage" and contains several sections for configuring the simulation. At the top, there is a "Coverage based on" section with radio buttons for "S-Unit", "dBm", "μV", and "dBμV/m". The "dBm" option is selected, and the "Minimum Signal (>=)" is set to "0.7000". A green color swatch is shown next to the "Required S/I is met" label. Below this, there is a "Draw size (pixels)" field set to "5". To the right, there are "Draw" and "Cancel" buttons. Below the "Coverage based on" section, there are three color swatches: a green one for "Required S/I is met", a red one for "Required S/I is not met", and a "No color" option for "Minimum signal is not met". The "Mode" section on the right has radio buttons for "All picture" (selected) and "Selection". The "Wanted" section has a "Tx Unit" dropdown set to "B", an "Antenna pattern" dropdown set to "yagi.ant", and fields for "Azimuth (°)" (291.5322) and "Elevation angle (°)" (-0.3878708). There is a "Draw pattern" checkbox and a "View pattern" button. The "Interferer" section has a "Tx Unit" dropdown set to "A", an "Antenna pattern" dropdown set to "yagi.ant", and fields for "Azimuth (°)" (237.5199) and "Elevation angle (°)" (-0.1574209). There is also a "Draw pattern" checkbox and a "View pattern" button. A "Swap" button is located between the "Wanted" and "Interferer" sections. The "Mobile" section has a "Mobile Rx Unit" dropdown set to "C", an "In network" dropdown set to "Data Net", and a "1 common net(s)" label. There are checkboxes for "Use network antenna settings" (checked), "Draw background" (checked), "Small" (unchecked), and "Solid" (unchecked).

Interference Radio coverage

Coverage based on required Signal to Interference ratio (S/I) or acceptable time delay

☐ S-Unit Minimum Signal (>=) ☐ Time delay

☐ dBm 0.7000 ☐ Color Required S/I is met

☒ μV Minimum S/I (dB)

☐ dBμV/m 10

Draw size (pixels) 5

Color Required S/I is not met

No color Minimum signal is not met

Draw

Cancel

Mode

☒ All picture

☐ Selection

Wanted

Tx Unit B

Antenna pattern yagi.ant

Azimuth (°) 291.5322 Elevation angle (°) -0.3878708

☐ Draw pattern View pattern

Interferer

Tx Unit A

Antenna pattern yagi.ant

Azimuth (°) 237.5199 Elevation angle (°) -0.1574209

☐ Draw pattern View pattern

Swap

Mobile

Mobile Rx Unit C

In network Data Net

1 common net(s)

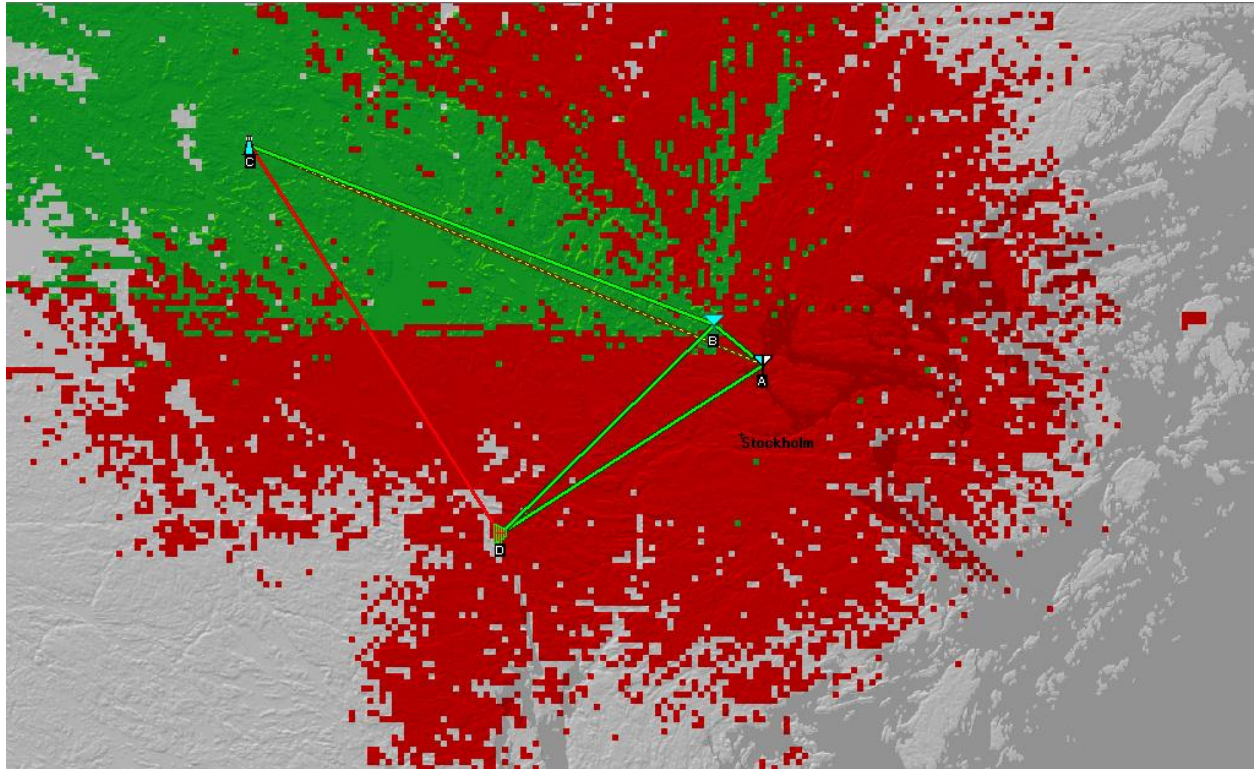
☒ Use network antenna settings

☒ Draw background

☐ Small

☐ Solid

Resulting plot:



We see B to C the green plot is the coverage area shows that required S/I has met.