



East West University

Department of CSE

Lab Report 01

CSE 453

Wireless Networking

Submitted To:

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Planning Terrestrial Radio Networks

(1st Part)

1. How is the coverage in Kista area according to your simulation results? What is the received signal level in Kista?

Ans: As required receiver threshold for good reception is $200\mu\text{V}$. We set the threshold for Kista receiver $200\mu\text{V}$. In our network, there are 2 receivers: Kista and Arlanda Airport. For receiver we set the threshold $200\mu\text{V}$ according to the manual. We know, if received value is more than threshold value, coverage will be good.

Single polar Radio coverage

Centre unit: Nacka Transmitter

Mobile unit: Kista Receiver

Network: SR p4

Link Direction:

- ☒ Centre Tx - Mobile Rx
- ☐ Centre Rx - Mobile Tx
- ☐ Worst case

Radial range (km)

Minimum: 0.01 Maximum: 50

Plot:

- ☐ Contour line
- ☒ Fill area
- ☐ Solid
- ☐ Network style
- ☐ Rainbow
- ☐ Blur
- ☐ Complete.wav

Threshold:

- ☐ S-Unit
- ☐ dBm
- ☒ μV
- ☐ dB $\mu\text{V}/\text{m}$

Auto set: ☐

From: 200.0000

To: 19999.9987

Azimuth range (°)

Minimum: 0 Maximum: 360 Step: 1

Antenna pattern:

☒ Use network antenna settings

omni.ant

View pattern

☐ Draw ☒ Draw background ☐ Small

Figure 1: Setting up threshold value

Then we found out, the received signal level for kista, Rx,

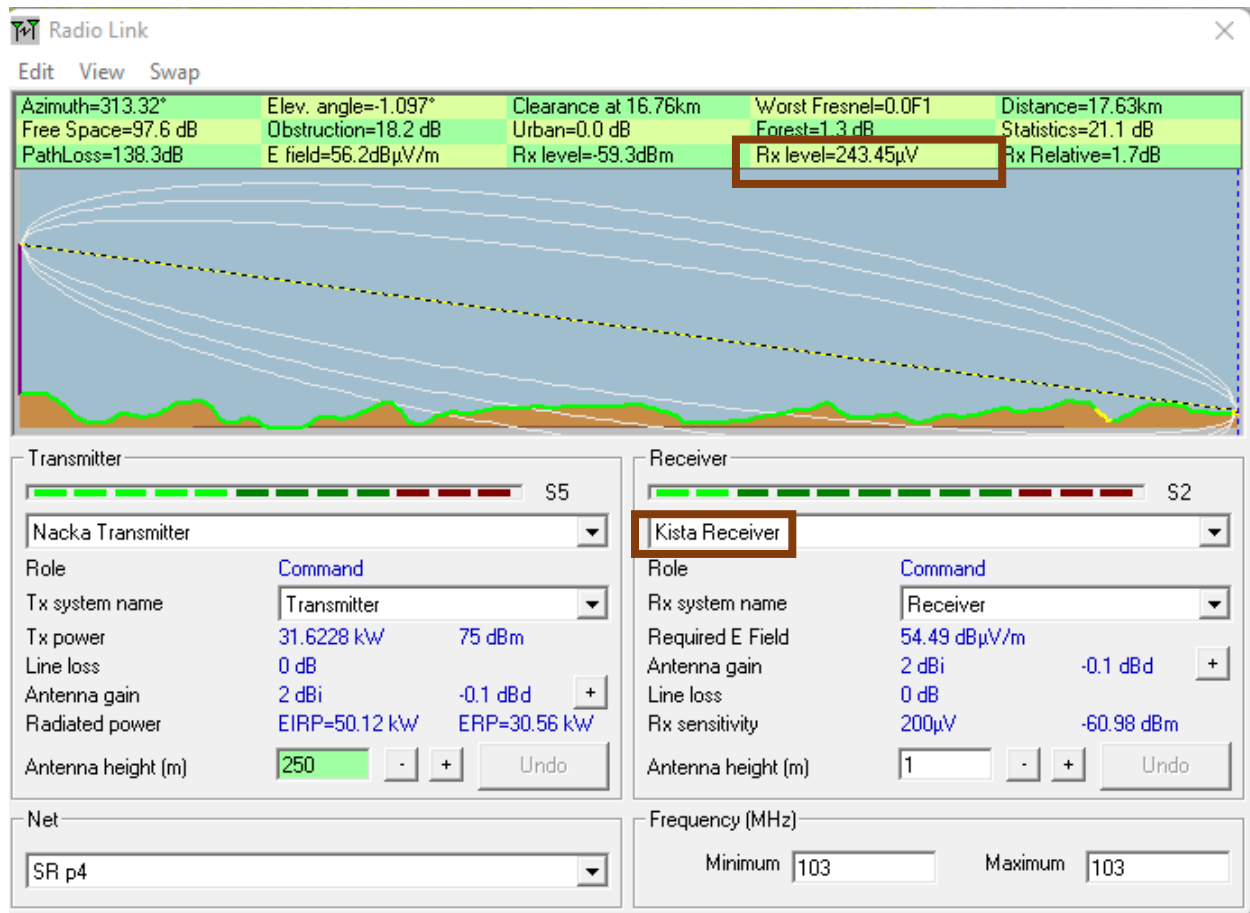


Figure 2: Showing received signal in Kista area

Here we can see Rx level from Nacka transmitter to Kista = 243.45 μV which is greater than threshold 200 μV . From figure 2, we also see the dotted line which presents the better coverage across Nacka to Kista. So, we can say according to my simulation result, the coverage area for receiver Kista area is good.

2. What is the received signal level in Arlanda? Can you listen to the P4 radio at Arlanda airport?

Ans: The received signal level in Arlanda is 91.93 μV according to my simulation.

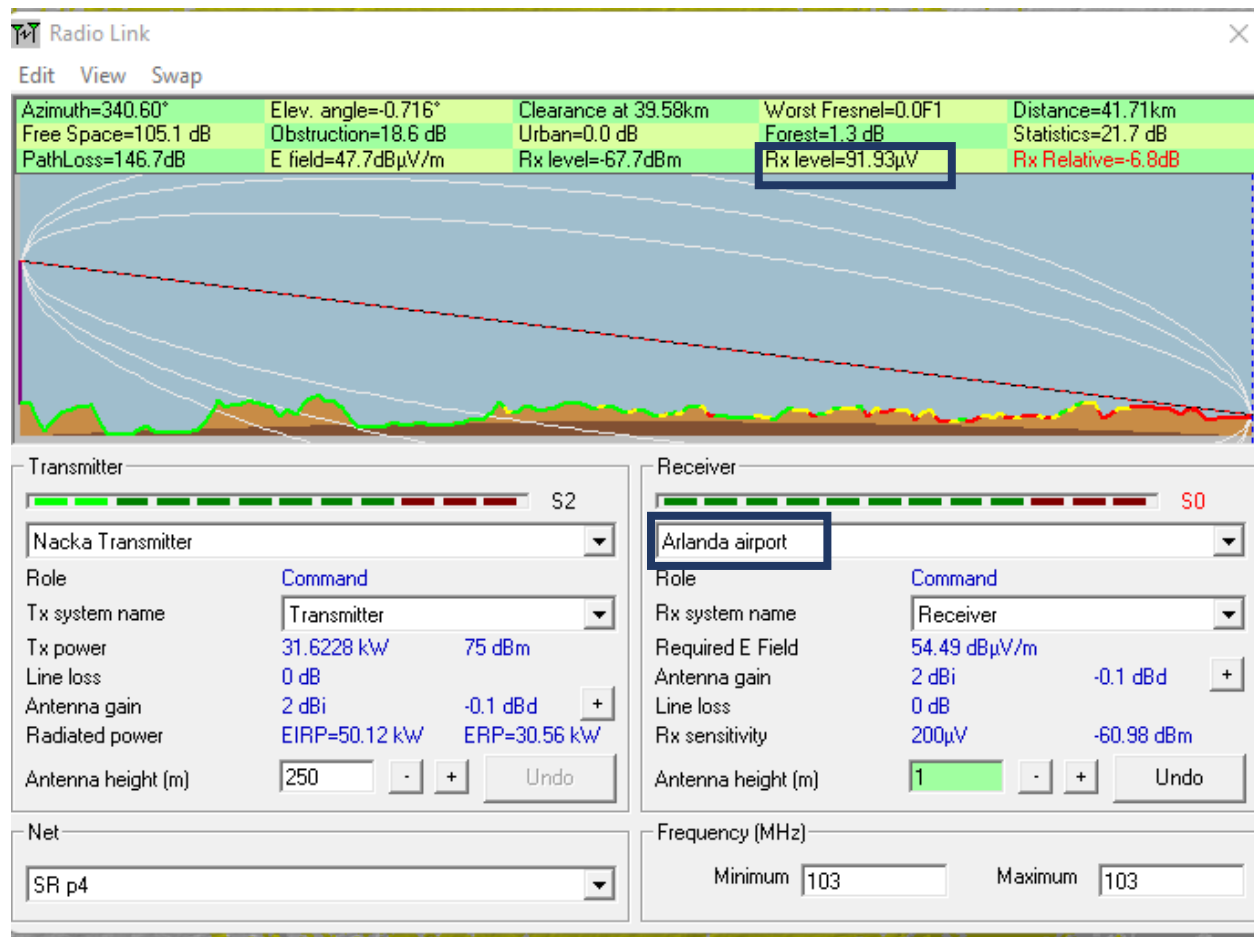


Figure 3: Showing received signal in Arlanda airport area

From figure 3, we observe the red straight line which represents very poor coverage for Nacka to Arlanda. Also, we know, if received level value is more than threshold value receiver can listen the P4 radio. We set threshold value 200 μ V for each receiver.

Figure 4: Setting up threshold value for Arlanda Airport

So, we see received signal for Arlanda receiver is 91.93 μV which is less than threshold value 200 μV . So, I can't listen P4 radio at Arlanda airport.

- What is the reception limit in kilometers approximately? To find the approximate coverage radius, you can drag your mouse across the screen to make a line segment. Then you can read out the length of the segment in the information bar at the bottom of the screen.**

Ans: From simulation, we can observe reception limit in kilometers approximately 30.148 Km. To find the approximate coverage radius, I drag my mouse across the screen to make a line segment and found out the result below.

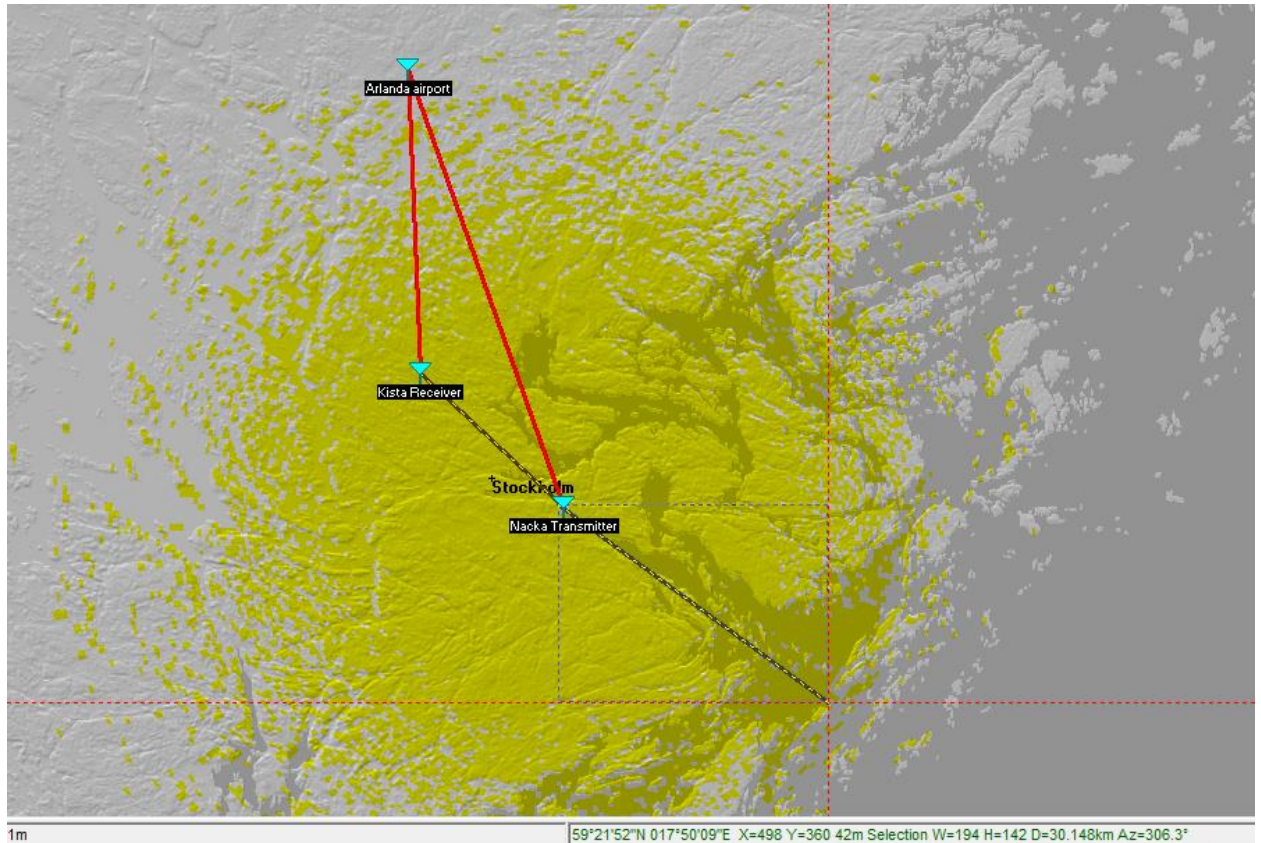


Figure 5: Showing reception limit in kilometers

4. Briefly explain your solution method and results.

Ans: My solution method and results are given below:

- First, I opened the radio lab and clicked on file. Then clicked on new network to create new network.
- Then opened default map.
- Clicked on new picture where draw mode is grayscale slope. Then clicked on draw.
- Go to file and then network properties: and make system1 to transmitter and system 2 to receiver.
- Kept transmitter's transmit power 75 dBm. Keep the antenna type omni.ant. Antenna gain 2dBi. Antenna height: 250 meters.
- Then changed the receiver threshold at 200 μ V. Make antenna gain 2dBi. And antenna height 1m.

- Then went to unit properties. Make a unit Nacka Transmitter and enter LAT LON or QRA and put the coordinates given on manual. N59° 17' 45'', E18° 10' 33''.
- Made another unit Kista receiver and enter LAT LON or QRA and put the coordinates given on manual. N59° 24' 16'', E17° 56' 57''.
- Made another unit Arlanda airport receiver and enter LAT LON or QRA and put the coordinates given on manual. N59° 24' 16'',
- Then went to network properties and created a network named SR p4. On SR p4 network marked 3 list of units. Nacka transmitter and set the system as transmitter from drop down box.
- On the same way, check kista and arlanda airport and set their system as receiver.
- Then made land cover disable and again go to network properties.
- Selected network SR p4. And change the parameters. Set frequency 103 MHz. Make polarization vertical, mode of variability Broadcast. Additional loss forest which is 30%. Surface refractivity 301, ground conductivity 0.02 (s/m). And clicked on ok.

Networks properties

List of all nets

- SR p4
- Net 2
- Net 3
- Net 4
- Net 5
- Net 6
- Net 7
- Net 8
- Net 9
- Net 10
- Net 11
- Net 12
- Net 13
- Net 14
- Net 15
- Net 16
- Net 17
- Net 18
- Net 19
- Net 20
- Net 21
- Net 22
- Net 23
- Net 24
- Net 25

Default parameters Copy Net Paste Net Cancel OK

Parameters Topology Membership Systems Style

Net name: SR p4

Surface refractivity (N-Units): 301

Ground conductivity (S/m): 0.02

Relative ground permittivity: 25

Minimum frequency (MHz): 103

Maximum frequency (MHz): 103

Polarization: ☒ Vertical ☐ Horizontal

Mode of variability: ☐ Spot ☐ Accidental ☐ Mobile ☒ Broadcast

% of time: 90

% of locations: 90

% of situations: 90

Additional loss: ☐ City ☒ Forest %: 30

Climate: ☐ Equatorial ☐ Continental sub-tropical ☐ Maritime sub-tropical ☐ Desert ☒ Continental temperate ☐ Maritime temperate over land ☐ Maritime temperate over sea

Figure 6: Setting up parameters for network SR p4

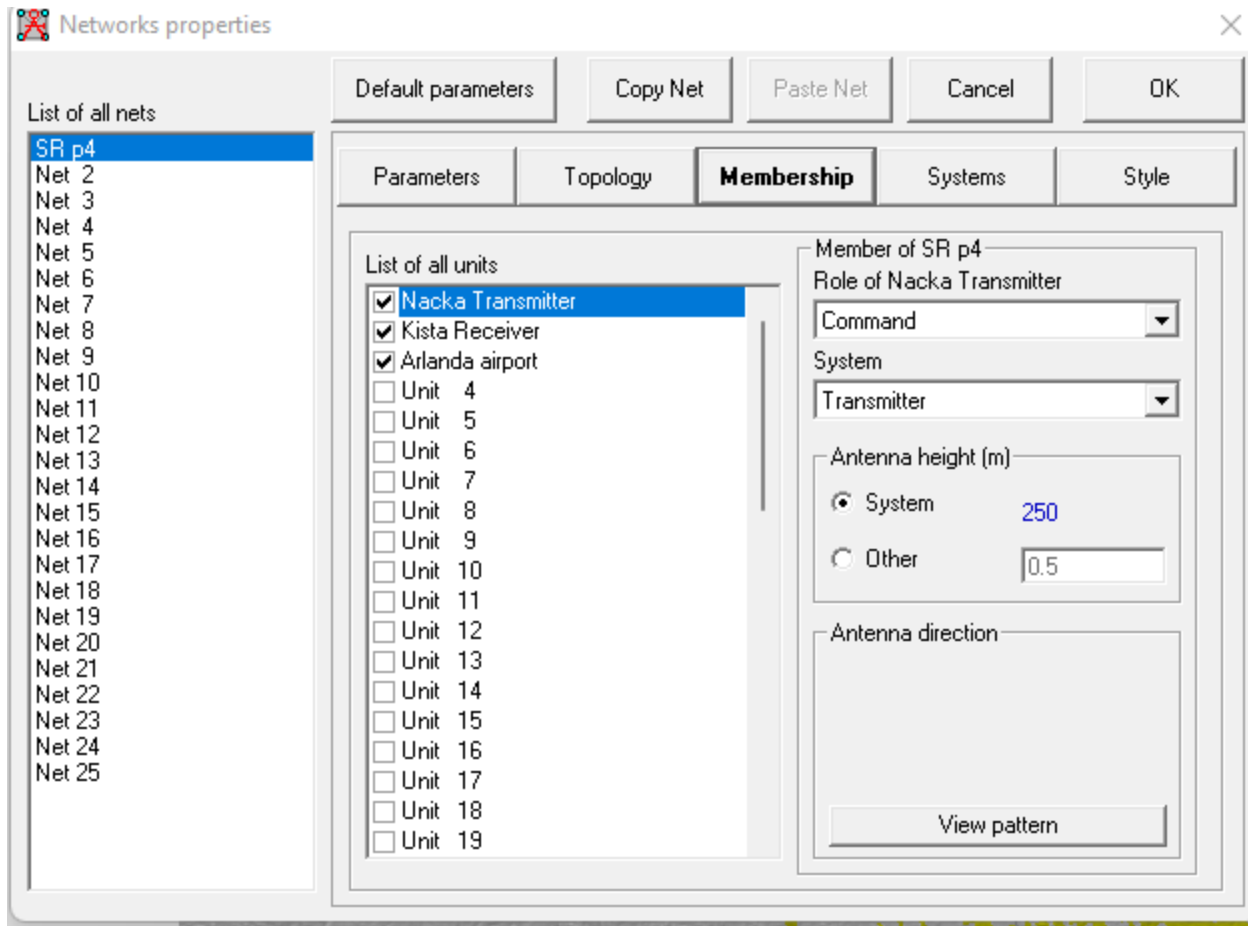


Figure 7: Setting network system for transmitter and receiver

- Went to tools and radio coverage. Clicked on single polar radio coverage. Then set some parameters according to the manual.
- EIRP (radial range) maximum 50. Link direction Centre Tx - Mobile Rx. Plot: fill area. Threshold from 200 μ V. And draw.
- Finally, we will see all the networks accordingly.
- Click on view-show network-all.
- Drawing is complete. Go to radio link and check the simulations results.
- By view we can see details, range, and distribution.

Here are some results are given,

Results:

Nacka to Kista receiver:

Radio Link

Edit View Swap

Distance between Nacka Transmitter and Kista Receiver is 17.6 km (11.0 miles)

True North Azimuth = 313.32°, Magnetic North Azimuth = 306.67°, Elevation angle = -1.0975°

Terrain elevation variation is 62.5 m

Propagation mode is line-of-sight, minimum clearance 0.0F1 at 16.8km

Average frequency is 103.000 MHz

Free Space = 97.6 dB, Obstruction = 18.2 dB, Urban = 0.0 dB, Forest = 1.3 dB, Statistics = 21.1 dB

Total propagation loss is 138.3 dB

System gain from Nacka Transmitter to Kista Receiver is 140.0 dB

System gain from Kista Receiver to Nacka Transmitter is 151.0 dB

Worst reception is 1.7 dB over the required signal to meet

90.000% of time, 90.000% of locations, 90.000% of situations

Transmitter

S0

Nacka Transmitter

Role Command

Tx system name Transmitter

Tx power 31.6228 kW 75 dBm

Line loss 0 dB

Antenna gain 2 dBi -0.1 dBd +

Radiated power EIRP=50.12 kW ERP=30.56 kW

Antenna height (m) 250 - + Undo

Receiver

S0

Kista Receiver

Role Command

Rx system name Receiver

Required E Field 54.49 dBµV/m

Antenna gain 2 dBi -0.1 dBd +

Line loss 0 dB

Rx sensitivity 200µV -60.98 dBm

Antenna height (m) 1 - + Undo

Net

SR p4

Frequency (MHz)

Minimum 103 Maximum 103

Figure 8: Nacka to Kista details

We find here details of the map like distance between Nacka to Kista is 17.6 Km. Then we see propagation loss, system gain etc.

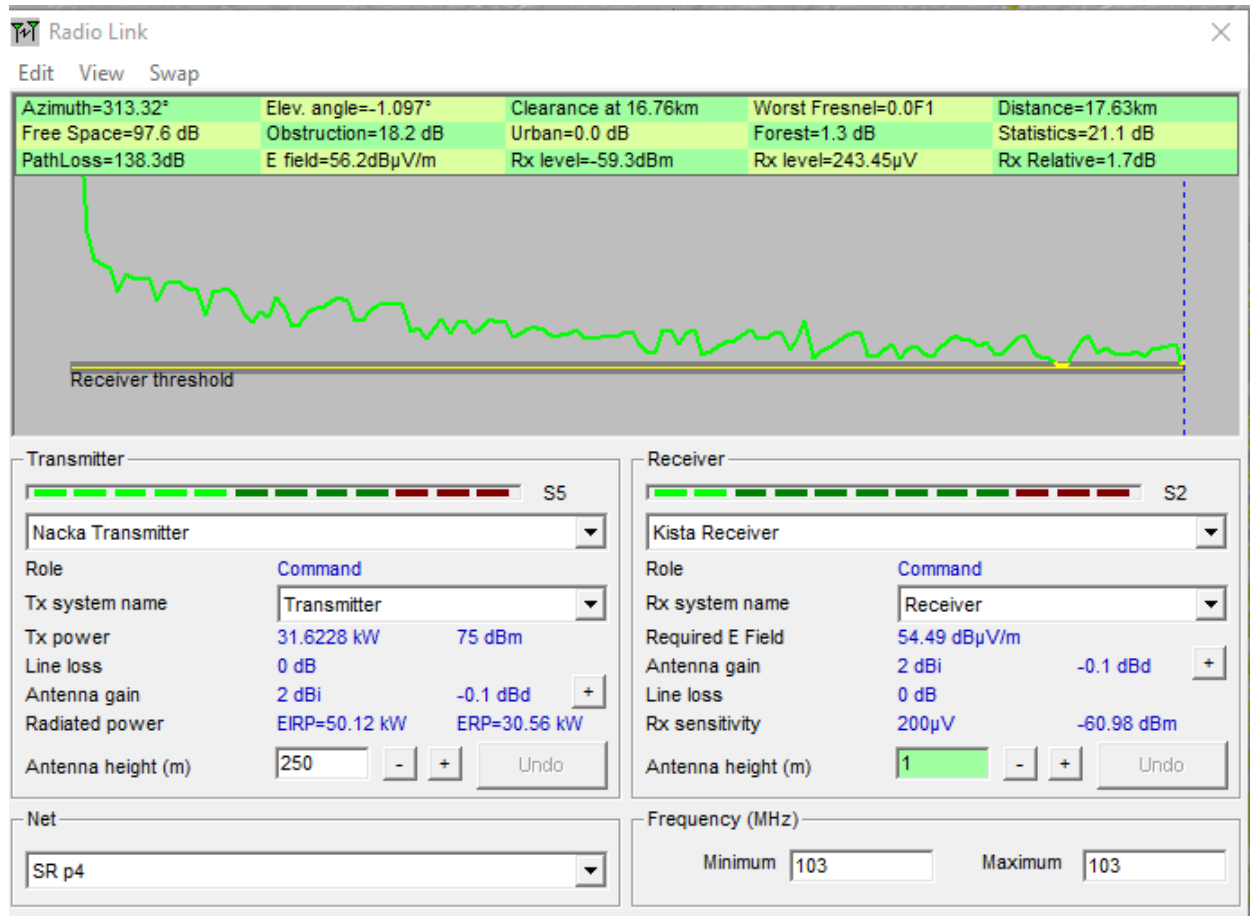


Figure 9: Nacka to Kista range

We see, there are no failure in signal distribution from Nacka to Arlanda airport. The positive green line on the graph shows the success rate of transmission.

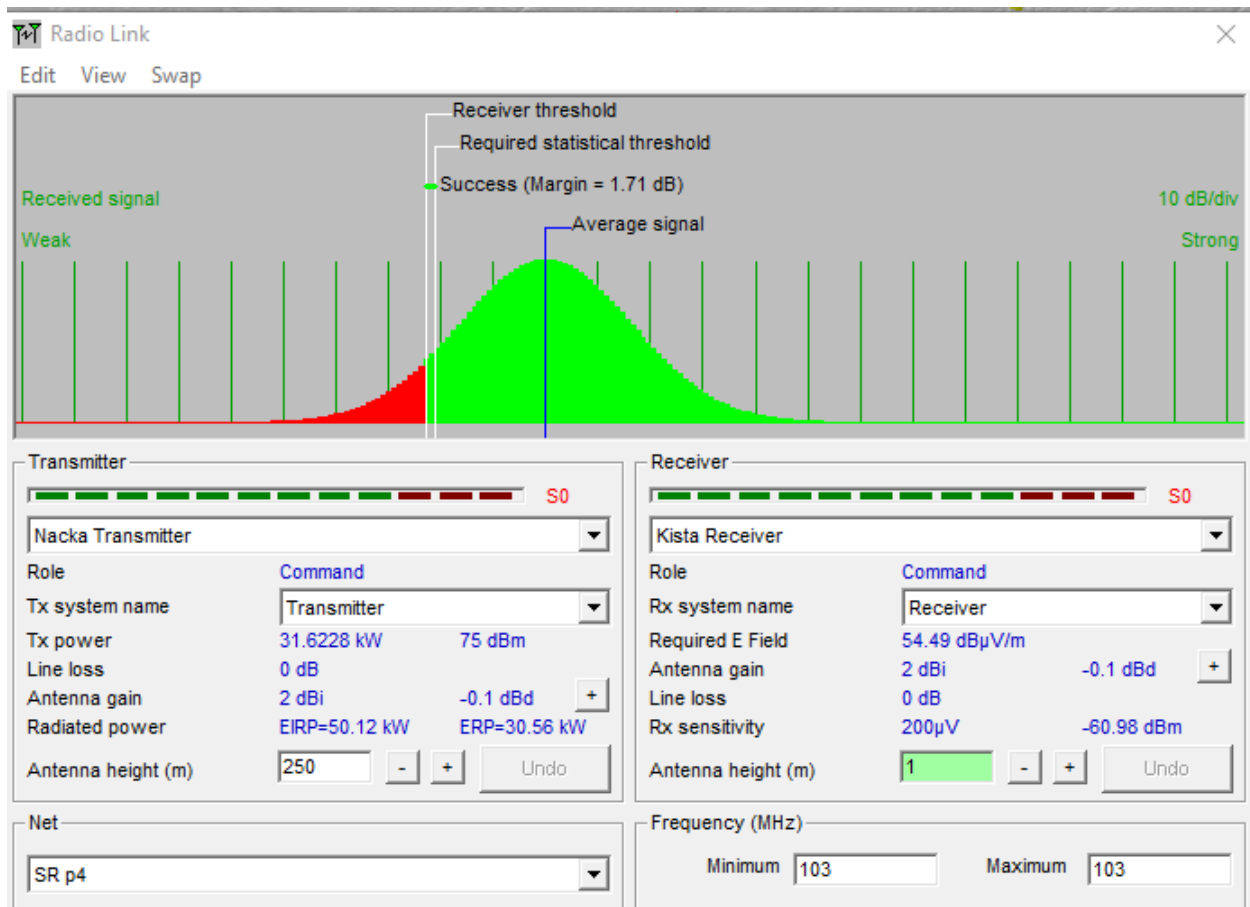


Figure 10: Nacka to Kista distribution

From distribution, we see for the threshold signal, receiving signal is successfully distributed from Nacka to Kista receiver.

Nacka to Arlanda airport receiver:

Radio Link

Edit View Swap

Distance between Nacka Transmitter and Arlanda airport is 41.7 km (25.9 miles)

True North Azimuth = 340.60°, Magnetic North Azimuth = 333.94°, Elevation angle = -0.7160°

Terrain elevation variation is 63.0 m

Propagation mode is line-of-sight, minimum clearance 0.0F1 at 39.6km

Average frequency is 103.000 MHz

Free Space = 105.1 dB, Obstruction = 18.6 dB, Urban = 0.0 dB, Forest = 1.3 dB, Statistics = 21.7 dB

Total propagation loss is 146.7 dB

System gain from Nacka Transmitter to Arlanda airport is 140.0 dB

System gain from Arlanda airport to Nacka Transmitter is 151.0 dB

Worst reception is 6.8 dB below the required signal to meet 90.000% of time, 90.000% of locations, 90.000% of situations

Transmitter

S0

Nacka Transmitter

Role Command

Tx system name Transmitter

Tx power 31.6228 kW 75 dBm

Line loss 0 dB

Antenna gain 2 dBi -0.1 dBd +

Radiated power EIRP=50.12 kW ERP=30.56 kW

Antenna height (m) 250 - + Undo

Receiver

S0

Arlanda airport

Role Command

Rx system name Receiver

Required E Field 54.49 dBµV/m

Antenna gain 2 dBi -0.1 dBd +

Line loss 0 dB

Rx sensitivity 200µV -60.98 dBm

Antenna height (m) 1 - + Undo

Net

SR p4

Frequency (MHz)

Minimum 103 Maximum 103

Figure 11: Nacka to Arlanda details

We find here details of the map like distance between Nacka to Arlanda is 41.7Km. Then we see propagation loss, system gain etc.

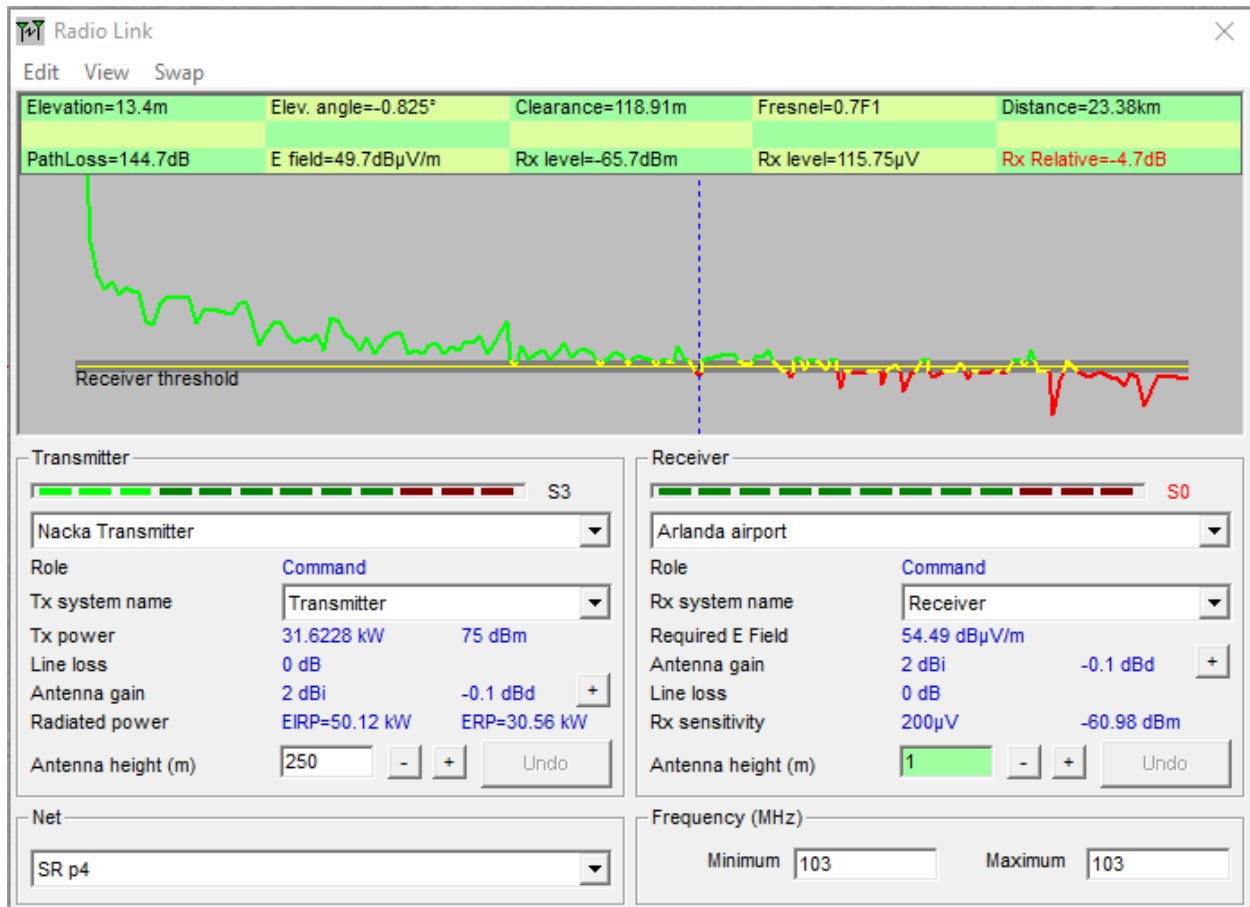


Figure 12: Nacka to Arlanda range

We see, there are so much failure in signal distribution from Nacka to Arlanda airport.

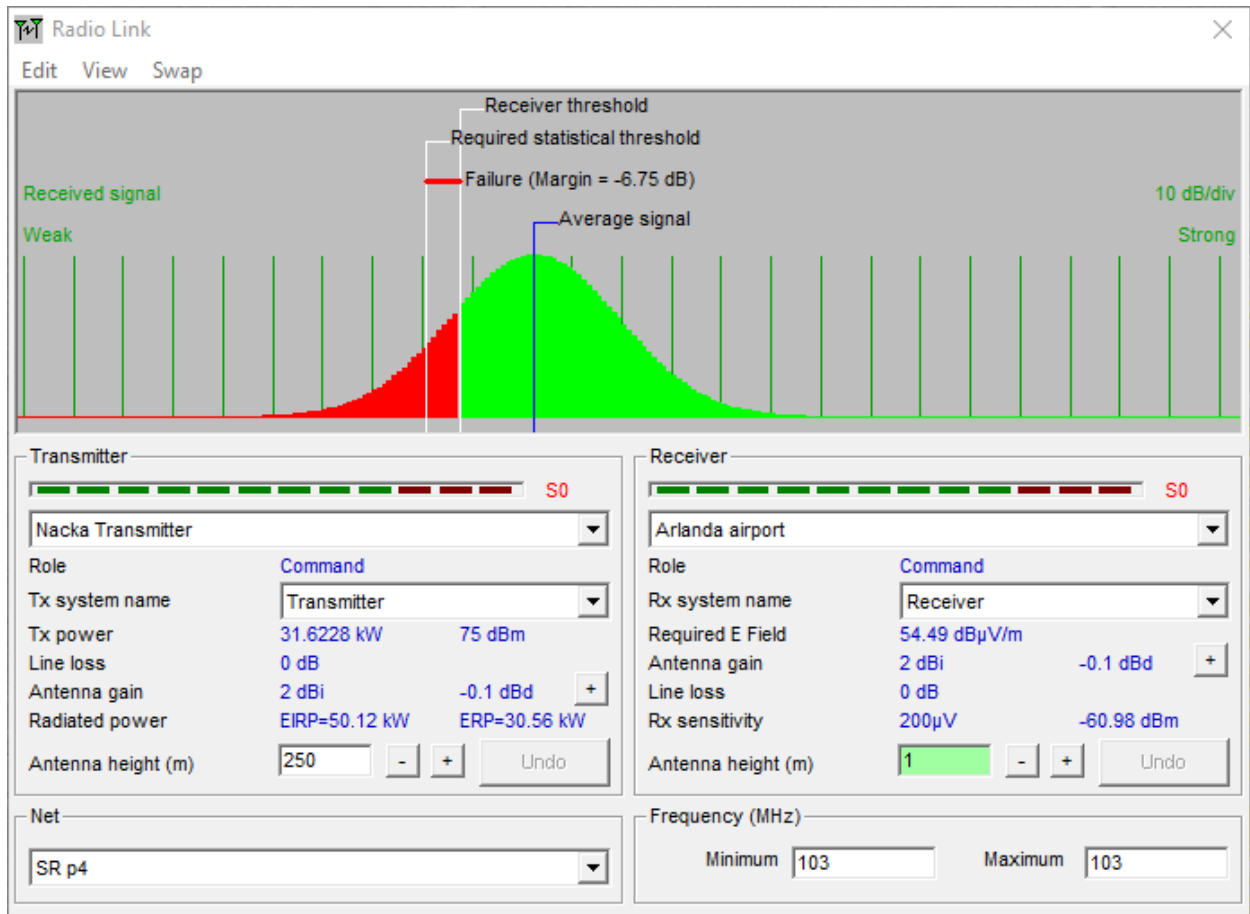


Figure 13: Nacka to Arlanda distribution

From distribution, we see for the required threshold received signal comes to failure from Nacka to Arlanda airport.

5. Include screenshots of the Radio Link results for both links as well as Single Polar radio coverage plot of the Nacka transmitter (see Appendix on how to produce the polar coverage plot).

Ans:

Radio link: From Nacka transmitter to Kista receiver,

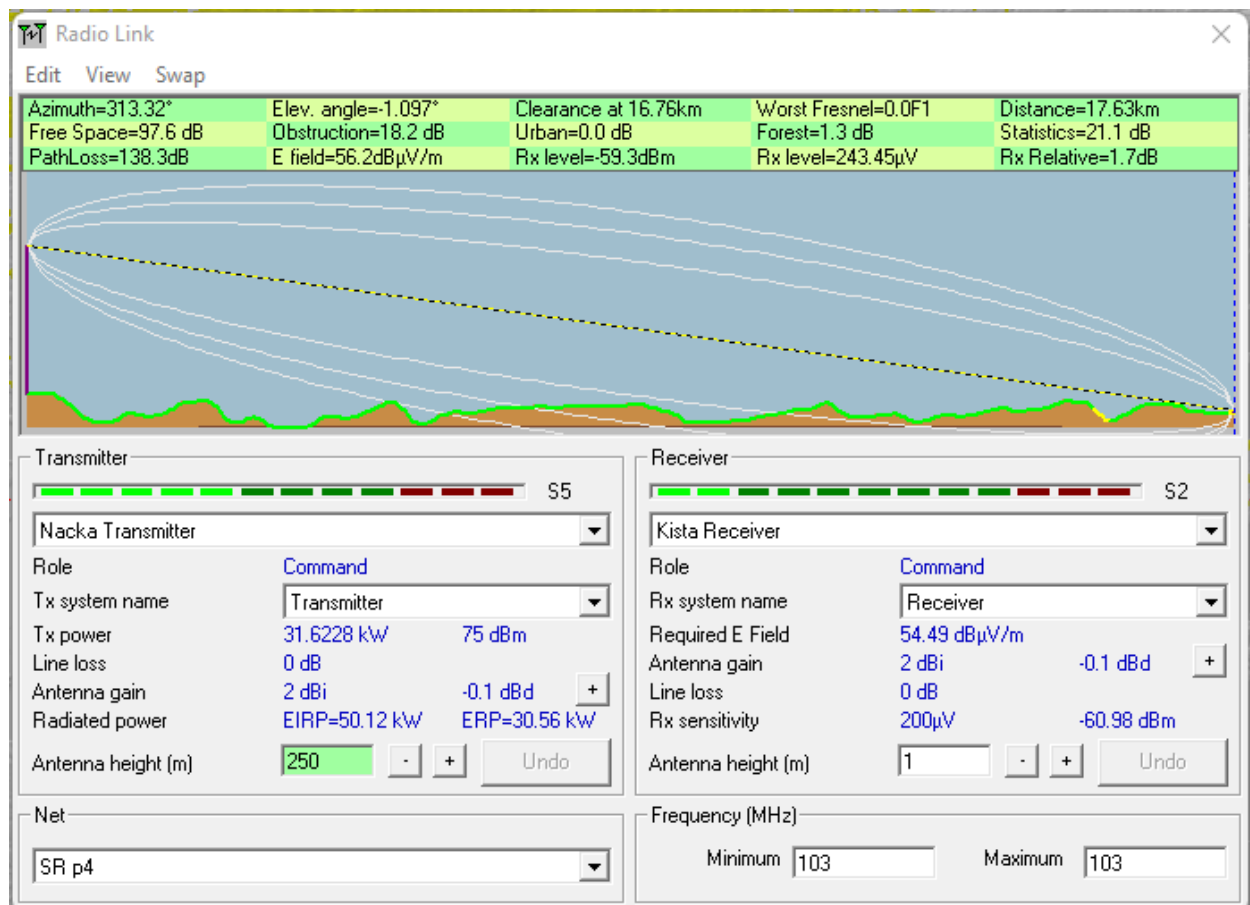


Figure 14: Radio link results for Nacka to Kista

From Nacka transmitter to Arlanda airport receiver,

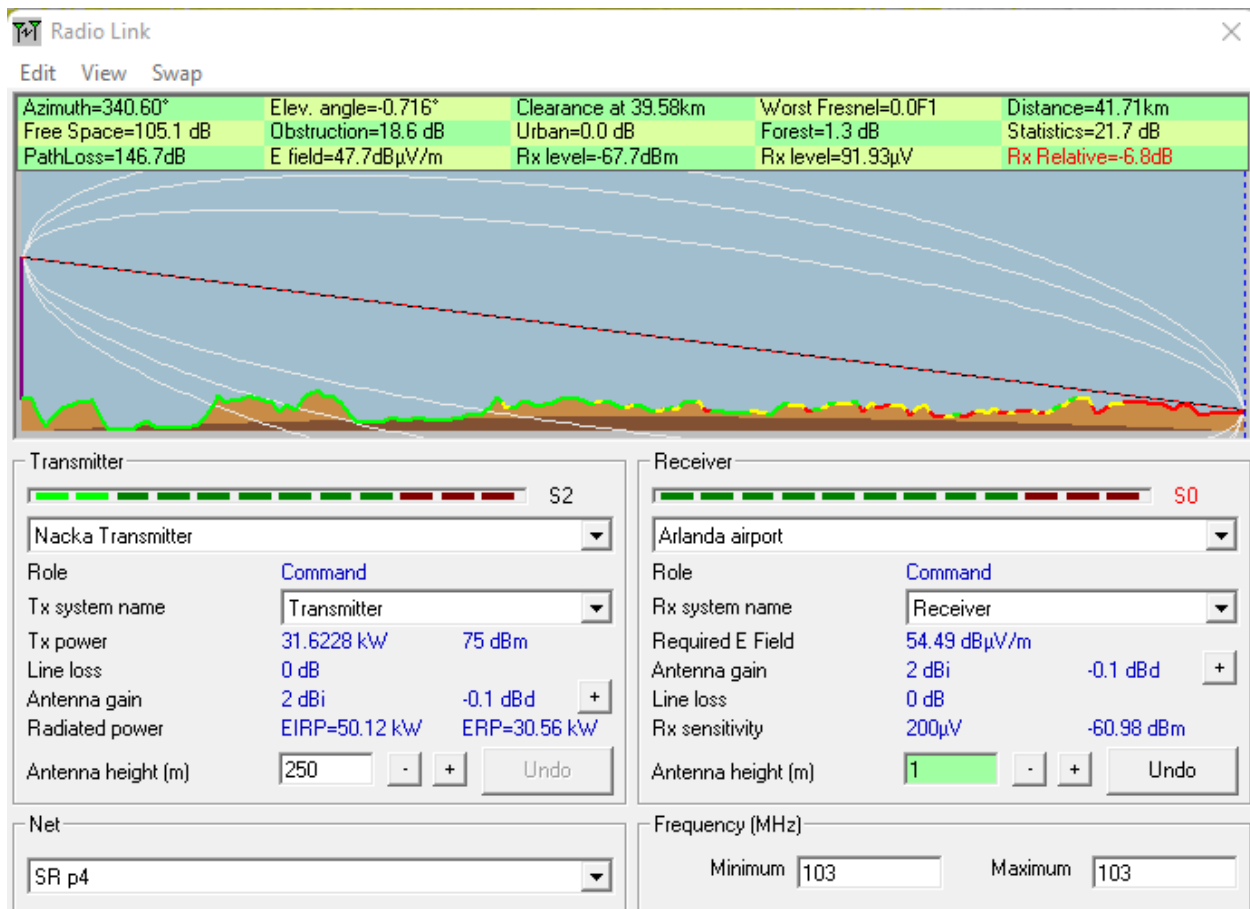


Figure 15: Radio link results for Nacka to Arlanda

Single Polar radio coverage:

From Nacka transmitter to Kista receiver,

Single polar Radio coverage

Centre unit: Nacka Transmitter

Mobile unit: Kista Receiver

Network: SR p4

Link Direction:

- ☒ Centre Tx - Mobile Rx
- ☐ Centre Rx - Mobile Tx
- ☐ Worst case

Radial range (km)

Minimum: 0.01 Maximum: 50

Plot:

- ☐ Contour line
- ☒ Fill area
- ☐ Solid
- ☐ Network style
- ☐ Rainbow
- ☐ Blur
- ☐ Complete.wav

Threshold:

- ☐ S-Unit
- ☐ dBm
- ☒ μ V
- ☐ dB μ V/m

Auto set: ☐

From: 200.0000 To: 19999.9987

Azimuth range (°)

Minimum: 0 Maximum: 360 Step: 1

Antenna pattern:

☒ Use network antenna settings

omni.ant

View pattern

☐ Draw ☒ Draw background ☐ Small

Figure 16: Single polar radio coverage for Nacka to Kista

From Nacka transmitter to Arlanda airport,

Single polar Radio coverage
✕

Centre unit
Nacka Transmitter

Mobile unit
Arlanda airport

Network
SR p4

Draw

Cancel

Link Direction

- ☒ Centre Tx - Mobile Rx
- ☐ Centre Rx - Mobile Tx
- ☐ Worst case

Radial range (km)

Minimum
0.01

Maximum
50

Plot

- ☐ Contour line
- ☒ Fill area
- ☐ Solid
- ☐ Network style
- ☐ Rainbow
- ☐ Blur
- ☐ Complete.wav

Color

Azimuth range (°)

Minimum
0

Maximum
360

Step
1

Threshold

- ☐ S-Unit
- ☐ dBm
- ☒ μ V
- ☐ dB μ V/m

☐ Auto set

From
200.0000

To
19999.9987

Antenna pattern

☒ Use network antenna settings

omni.ant

View pattern

☐ Draw

☒ Draw background

☐ Small

Figure 17: Single polar radio coverage for Nacka to Arlanda