NESIC CAIRO OFFICE

DESCRIPTION ON
HOW TO USE PATHLOSS SOFTWARE AS A COMPLETE MICROWAVE SYSTEM PLANNER

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Contents

1- Required Software

1.2- Necessary Data for Microwave Network Design & How to place it in your PATHLOSS Program

The followings data must be placed in PATHLOSS program folder to be able to use the program as a full Microwave system Planner

1- Rain File
2- Equipment File
3- Gopo30303 (Terrain Data File)

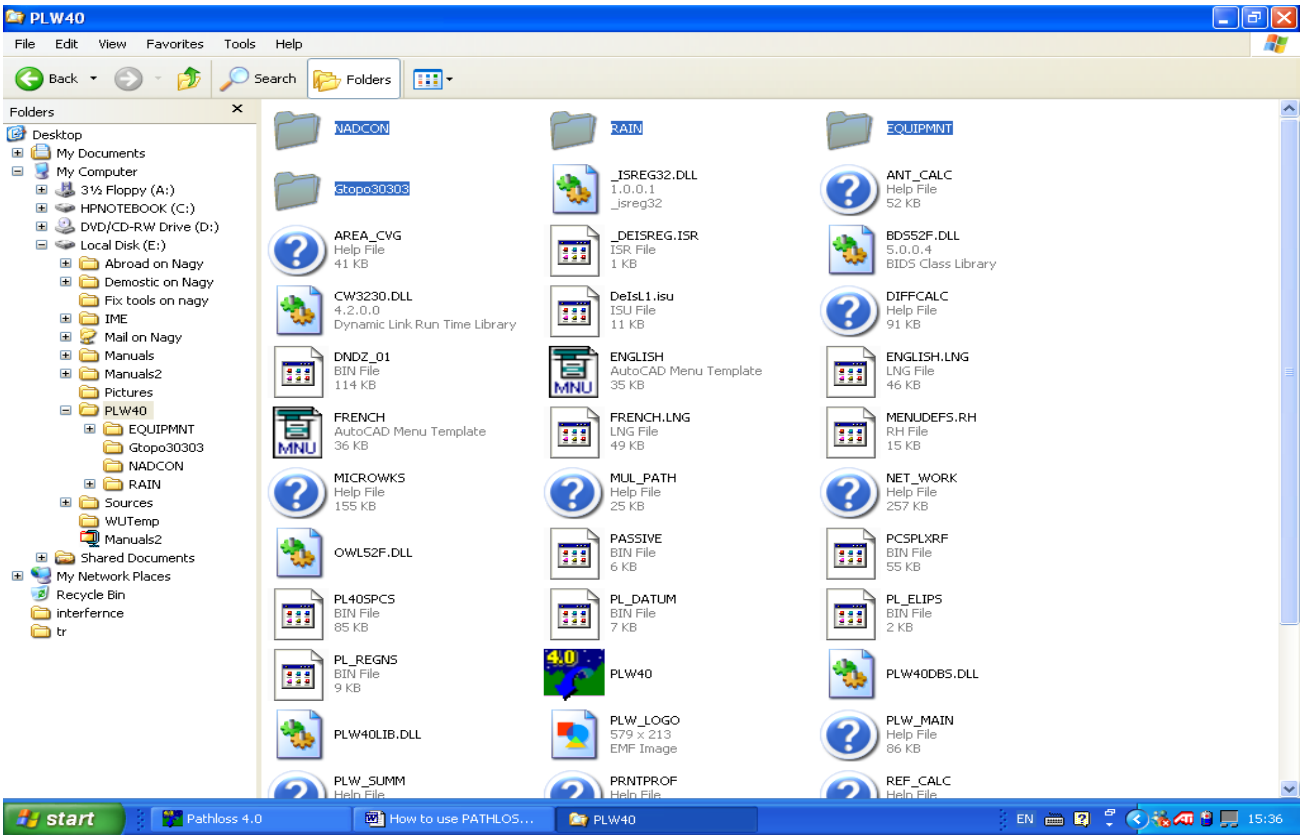


Fig. 1.2.1

How to place those data? & what must it contents

1- Rain files

This folder contents Rain data for each area of the world according to 4 standards (Canada, Crane, Crane_96 & ITU) as shown in Fig. 1.2.2
Usually we work according to ITU standard (ITU-R-P.530-7/8) which contents Rain Data for each area of the world according to the map shown in Fig. 1.2.3

THIS DATA WILL AUTOMATICALLY PLACED IN PATHLOSS FOLDER AFTER PROGRAM SET UP

EXPLANATION ABOUT HOW TO USE THIS DATA WILL COME IN (2.5 LINK BUDGET CALCULATIONS)

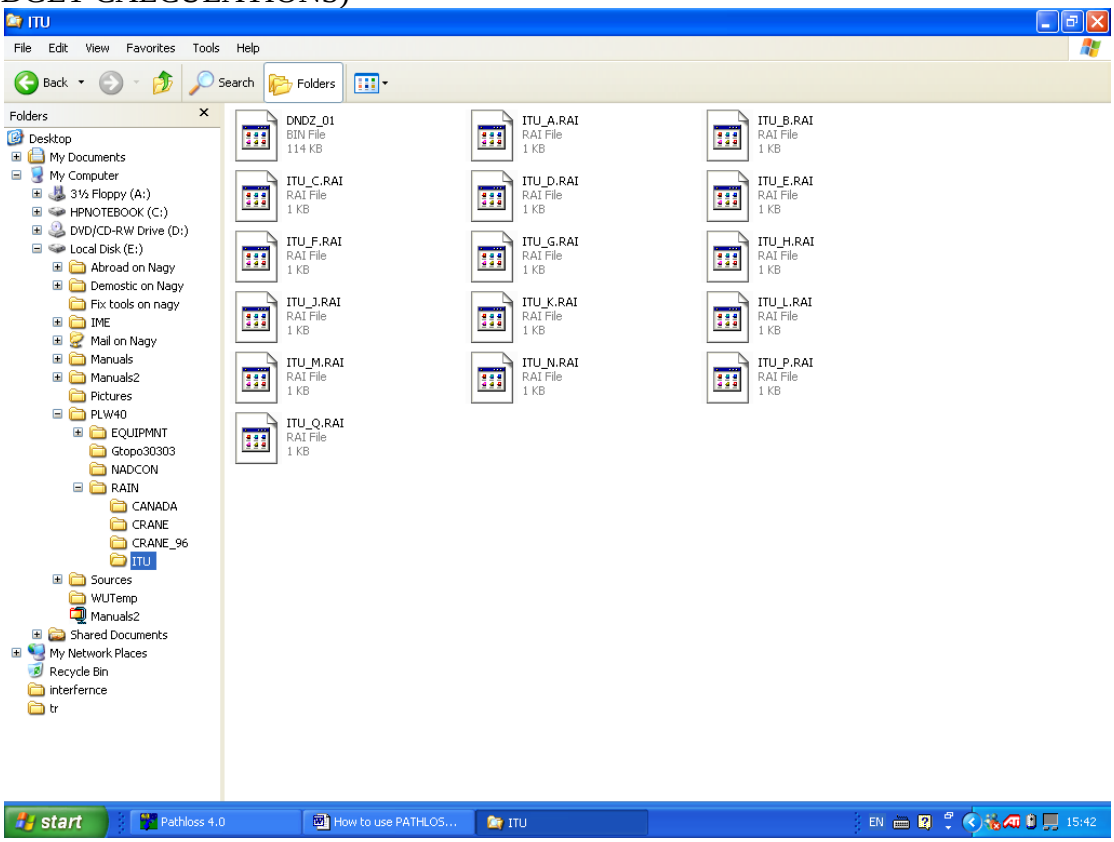


Fig. 1.2.2

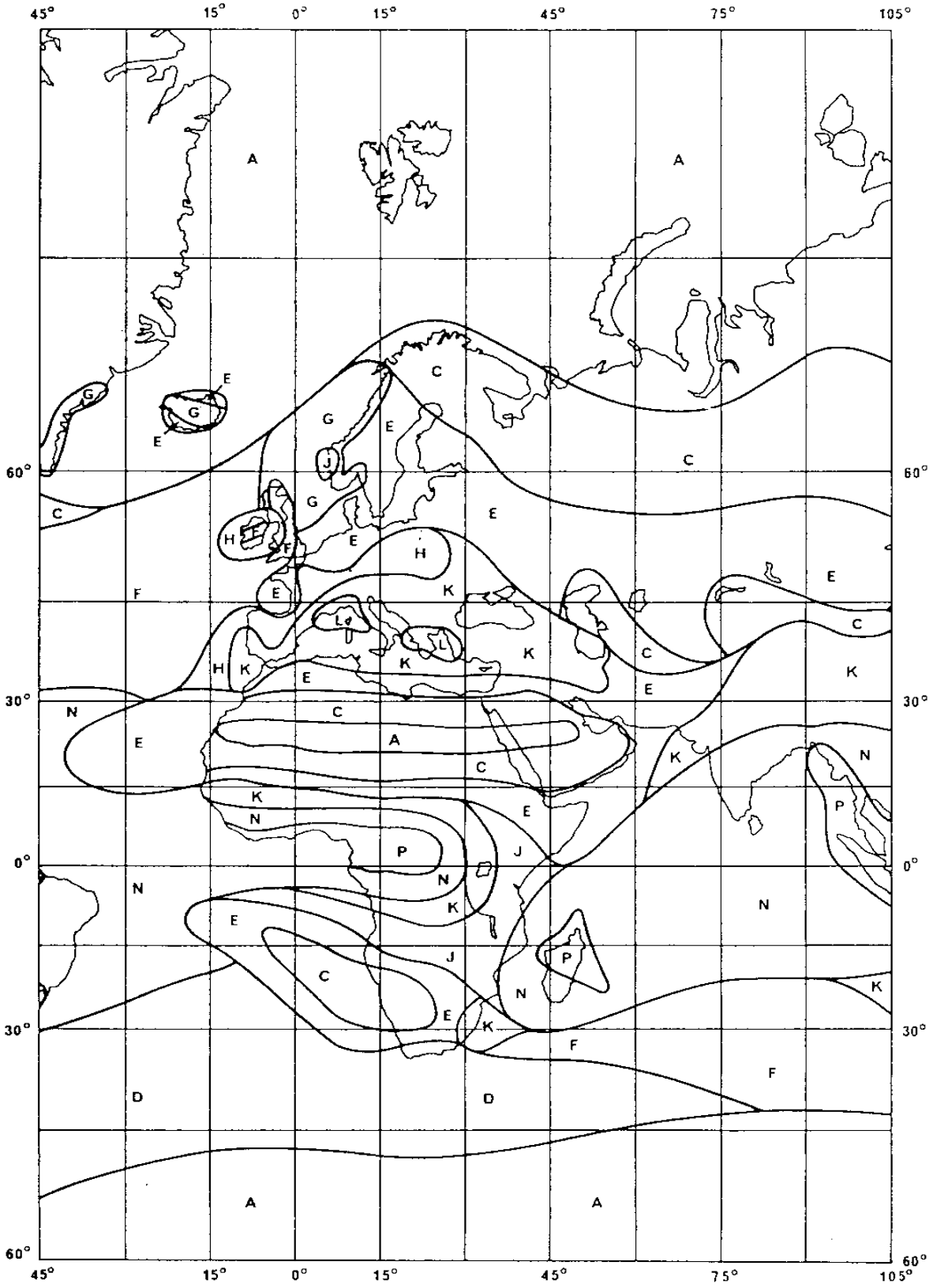


Fig. 1.2.3

2- Equipment

This folder contents 4 folders but for our Microwave design we just use 2 folders as the followings

1- MAS which contents Microwave Antenna Data for different Antenna Manufacturer (Andrew , RFS , ERICSSON , ……..) as shown in Fig. 1.2.4
2- MRS which contents Microwave Radio Data for different Manufacturers

NOTE: We just concern of NEC Equipment which is not included with our PATHLOSS software.
NEC data will be attached with this documents as Soft copy so please kindly place it in your PATHLOSS folder (inside MRS folder) to be used
As shown in Fig. 1.2.5

NOTE: EQUIPMENT FOLDER IS AVAILABLE ON PATHLOSS PROGRAM CD. SO PLEASE KINDLY COPY TO YOUR PATHLOSS FOLDER

EXPLANATION ABOUT HOW TO USE THIS DATA WILL COME IN (2.5 LINK BUDGET CALCULATIONS)

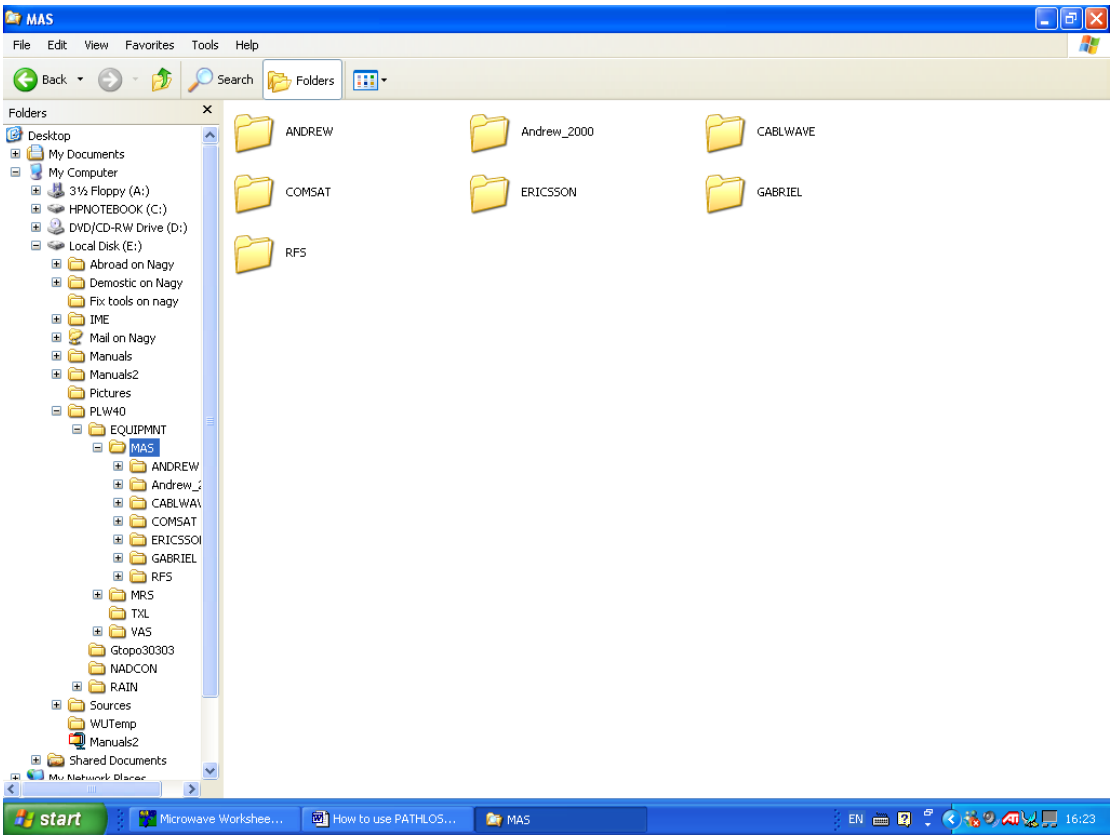


Fig. 1.2.4

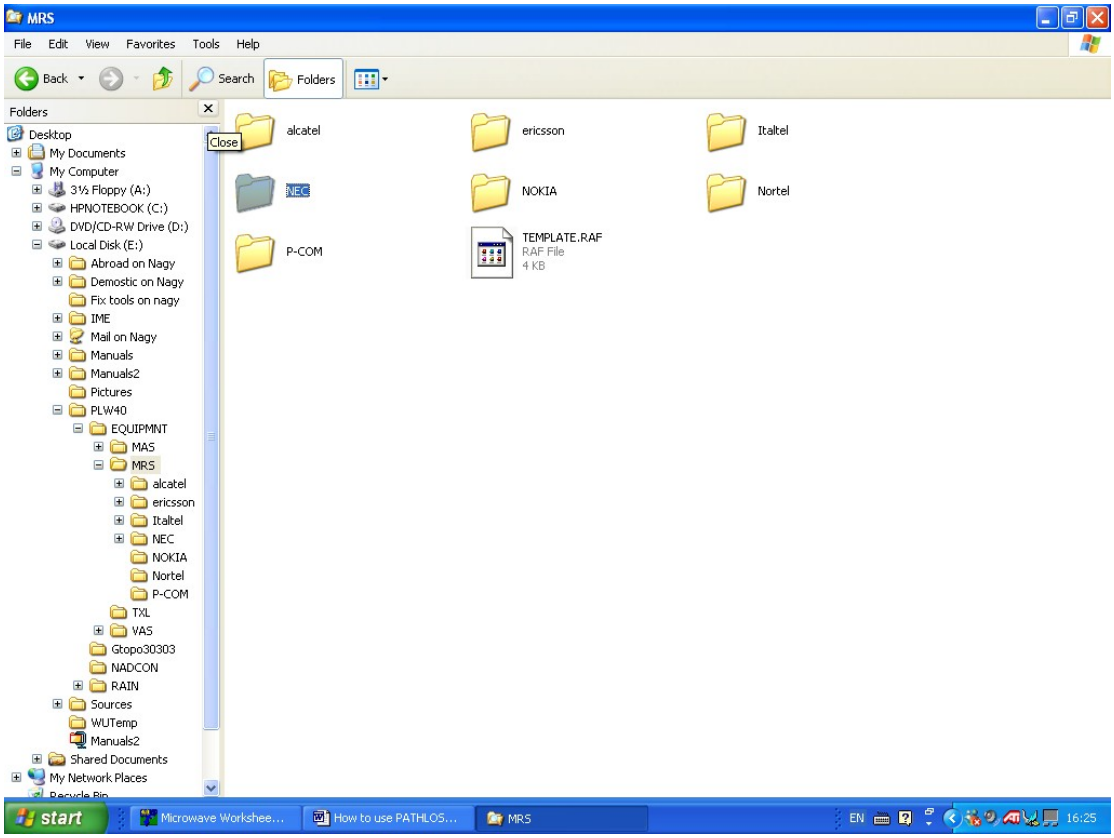


Fig. 1.2.5

3- Gopo30303 (Terrain Data File)

This folder contents the Terrain data for all the world but this data is very big size so it will be better if you take only some areas where you expected to do your survey as shown in Fig. 1.2.6

WARNING

This data is not accurate so we usually get terrain data from contours maps or from path survey.
Just we use this data for reference
So it isn't allowed to use this data to create path profile

How to set this data?

1- Create new folder in your PATHLOSS folder & name it as Gopo30303
2- Copy inside it the necessary area files (each area has 2 files)
3- Run pathloss program
4- Go to configure menu & click terrain database as shown in fig. 1.2.7
5- Set Primary (No Selection) & Secondary (GTopo30 Global 30sec) as shown in Fig. 1.2.8
6- Click Set Up Secondary – Set Directory – choose Gtopo30303 folder then kick OK – click Close – click OK as shown in Fig.1.2.9

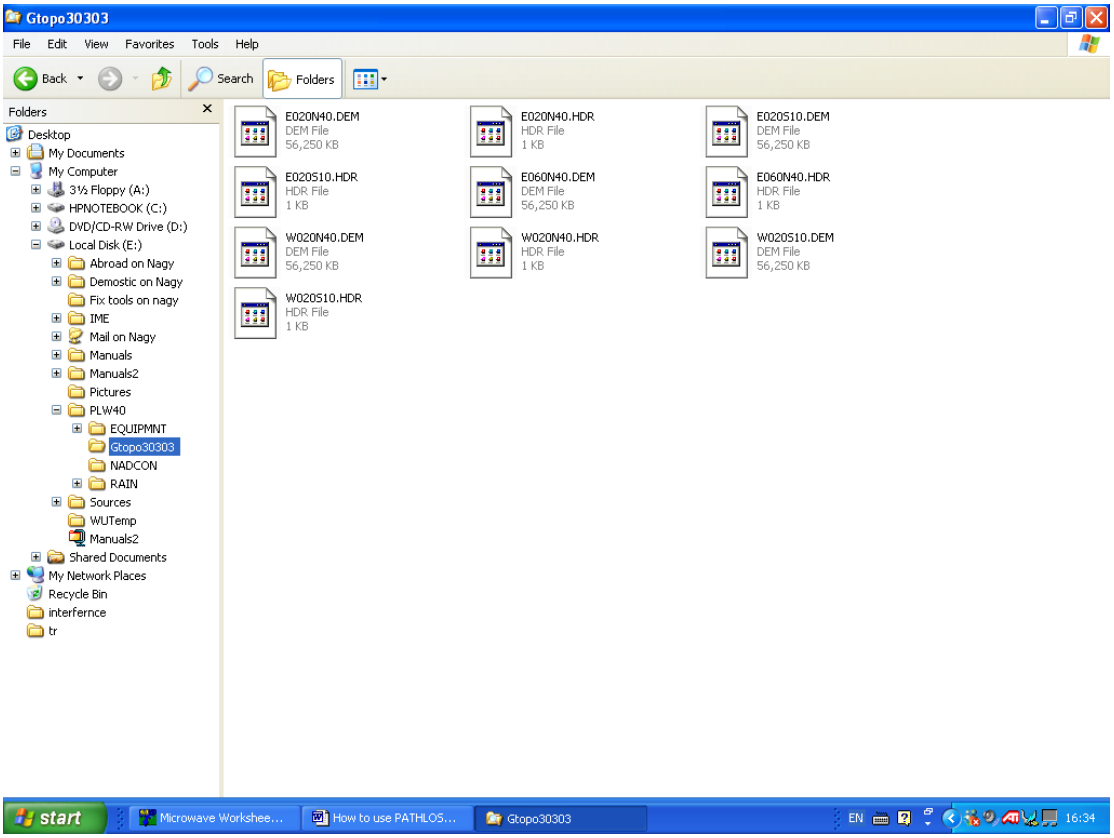


Fig. 1.2.6

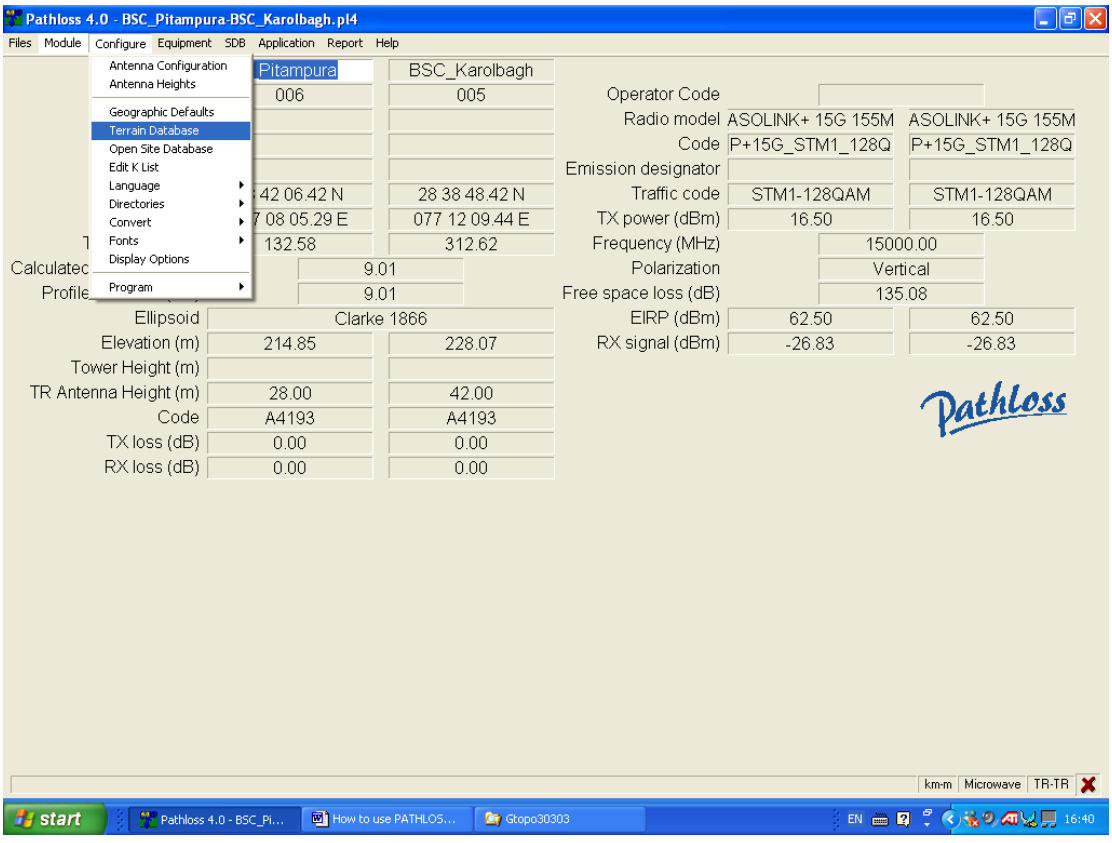


Fig. 1.2.7

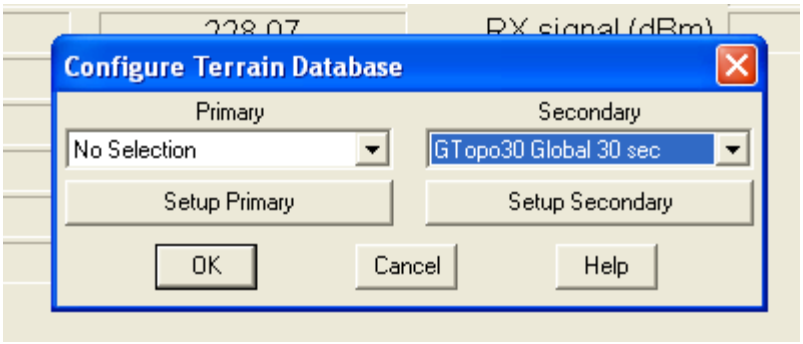


Fig. 1.2.8

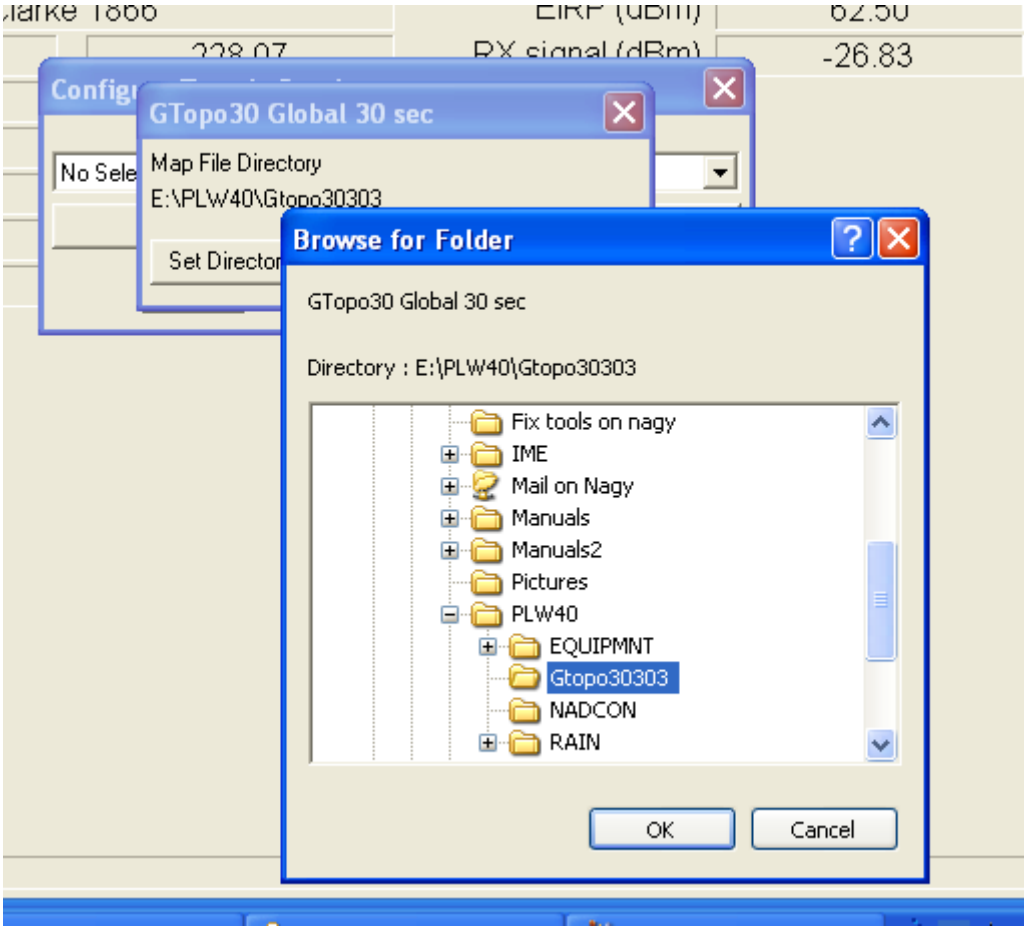


Fig. 1.2.9

2- How to operate PATHLOSS

PATHLOSS program is full Microwave Network design software.
For our work we shall use PATHLOSS for the following

a) Make Network Configuration
b) Make Path Profile to find antenna height in each station
c) Calculate Link Budget to find Antenna diameters , RX level & Link Availability
d) Frequency Plan for overall network
e) Frequency Interference calculations for overall network

To do all the above we shall go as the followings step by step

2.1- Sites Data Entry & Creation of Network

To enter sites data to PATHLOSS program please follow the following steps

2.1.1- Run PATHLOSS & go to Module & Click Network or just Press Ctrl N to go to Network screen as per shown in Fig. 2.1.1

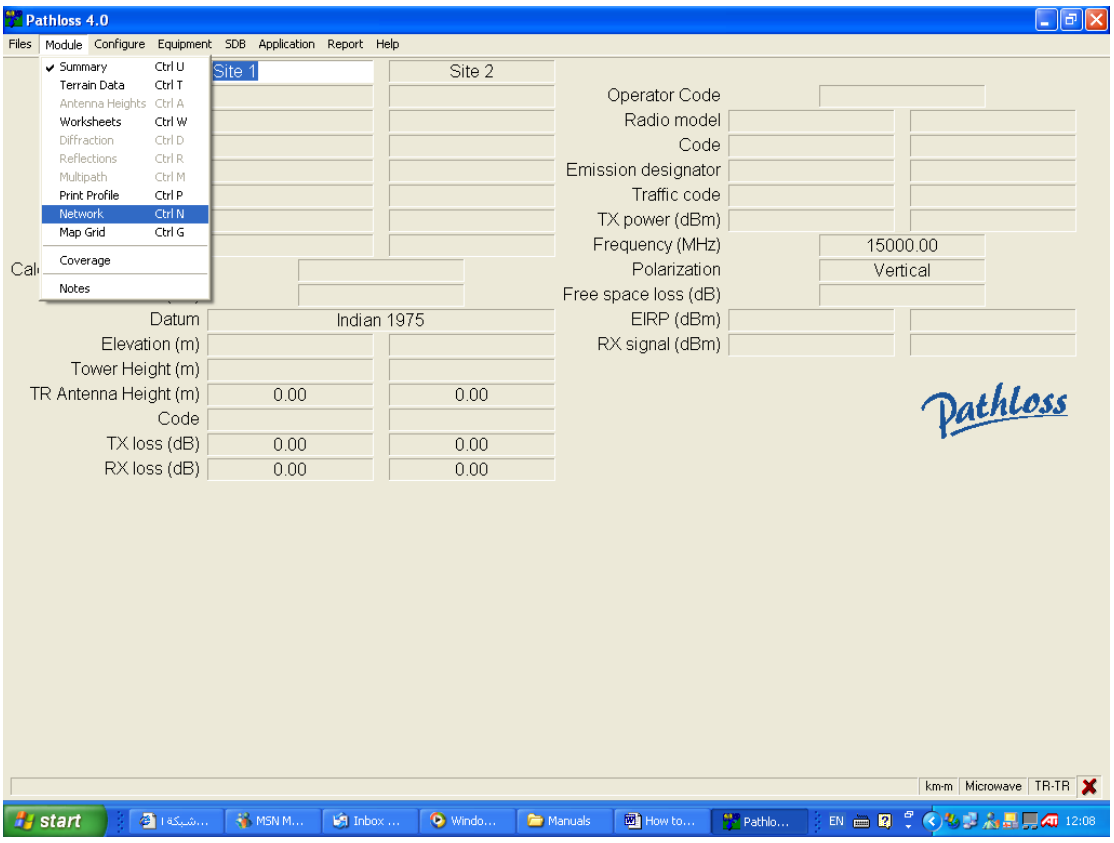


Fig. 2.1.1

2.1.2- In Network screen Click on Site Data & choose Site List as shown in Fig. 2.1.2

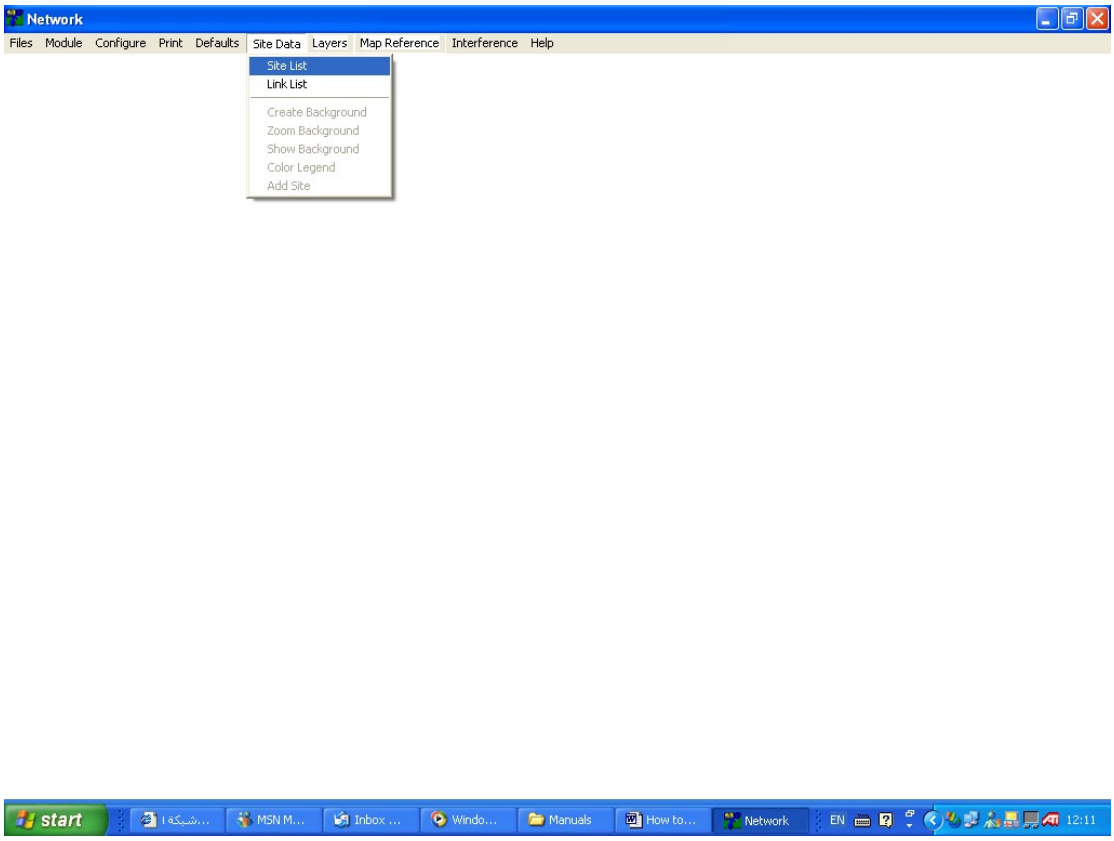


Fig. 2.1.2

2.1.3- In Site List Page Click on Edit then Add as shown in Fig. 2.1.3

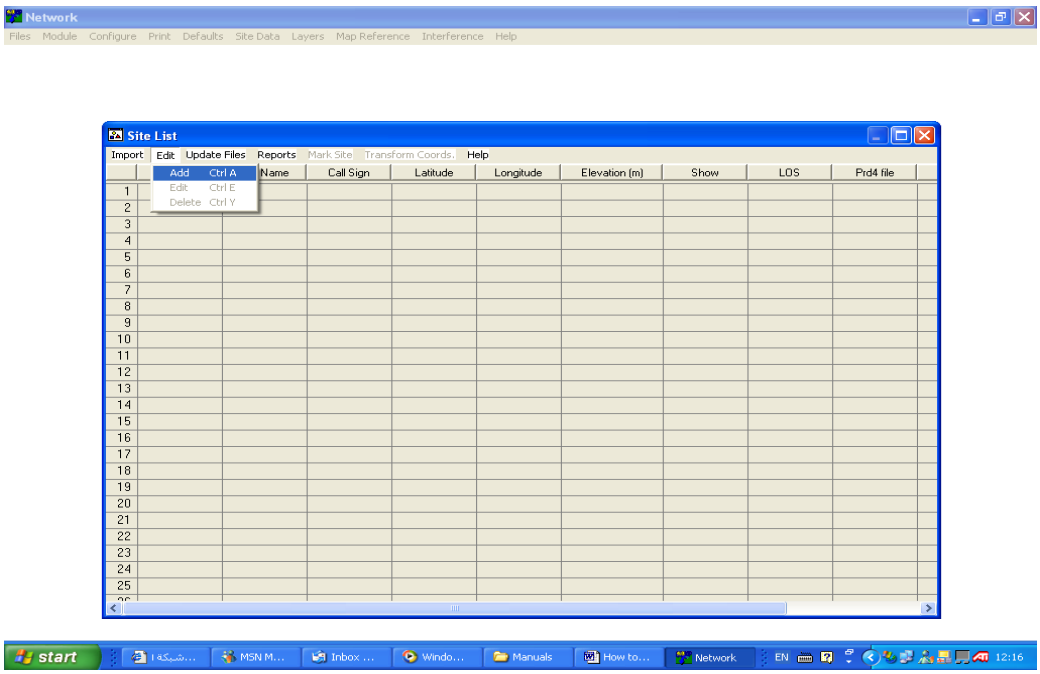


Fig. 2.1.3

2.1.4- Inter Site Name, Call Sign (Station ID. This is important for Frequency Interference calculations. So if there is not Station ID you can give numbers for each station as Example 1 , 2, 3,….) , Latitude & Longitude then click OK as shown in Fig. 2.1.4

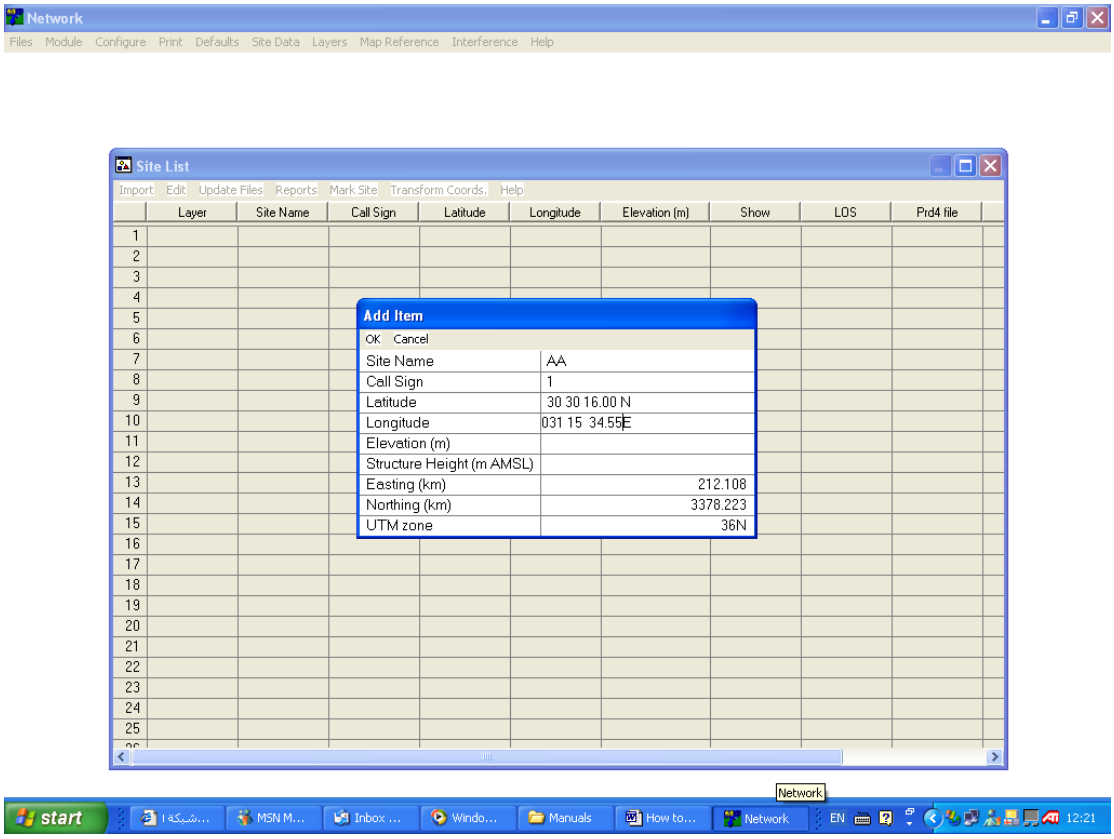


Fig. 2.1.4

2.1.5- Repeat steps 2.1.3 & 2.1.4 to enter other sites data then close Site List Page. Then you get Map grid with locations, Names of the entered sites data as shown in Fig. 2.15

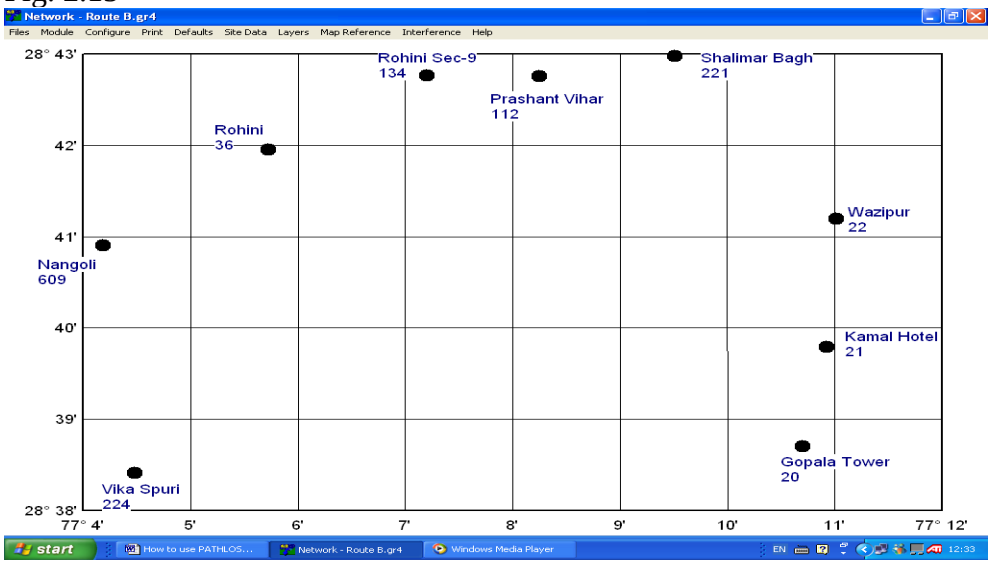


Fig. 2.1.5

2.1.6- Connect between stations according to actual links configuration by press & drag from site to opposite site as shown in Fig. 2.1.6
Then repeat the above to connect all the links

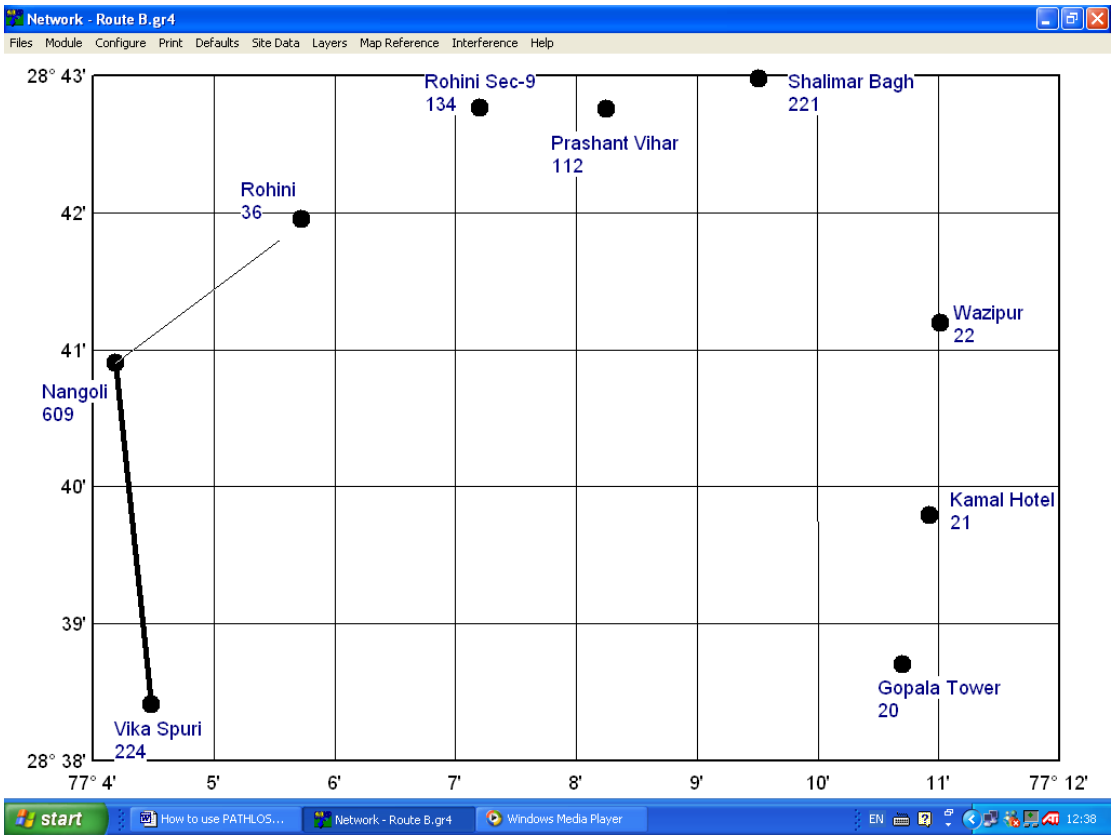


Fig. 2.1.6

2.1.7- Save this network in pre prepared folder

2.2- Link by Link PATHLOSS Files Creation

After we finished of all sites data entry & making the link connections correct according to actual links configuration we have to go through link by link & create its pathloss file as the followings

2.2.1- Press on the link & click Summary as per shown in Fig. 2.2.1

2.2.2- In Summary Page Inter the design frequency band as shown in Fig. 2.2.2

2.2.3- Save this file in the same folder you saved the network

2.2.4- Repeat the above for the other links

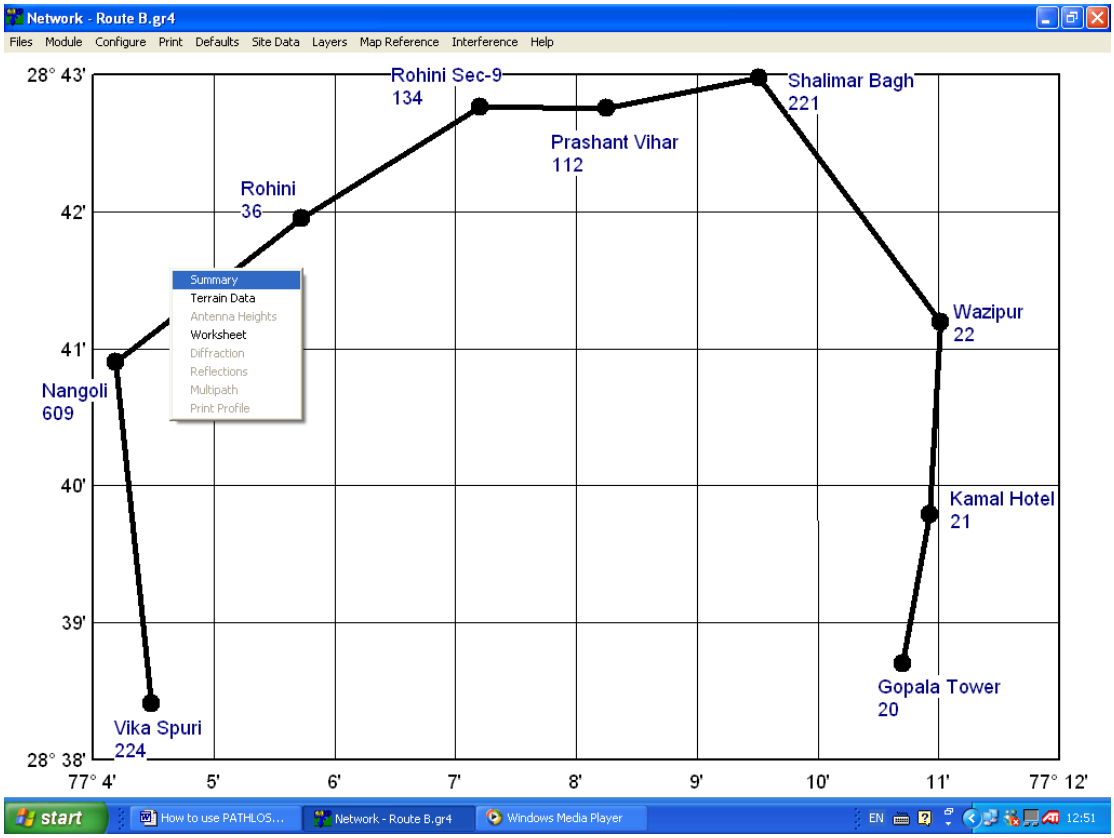


Fig. 2.2.1

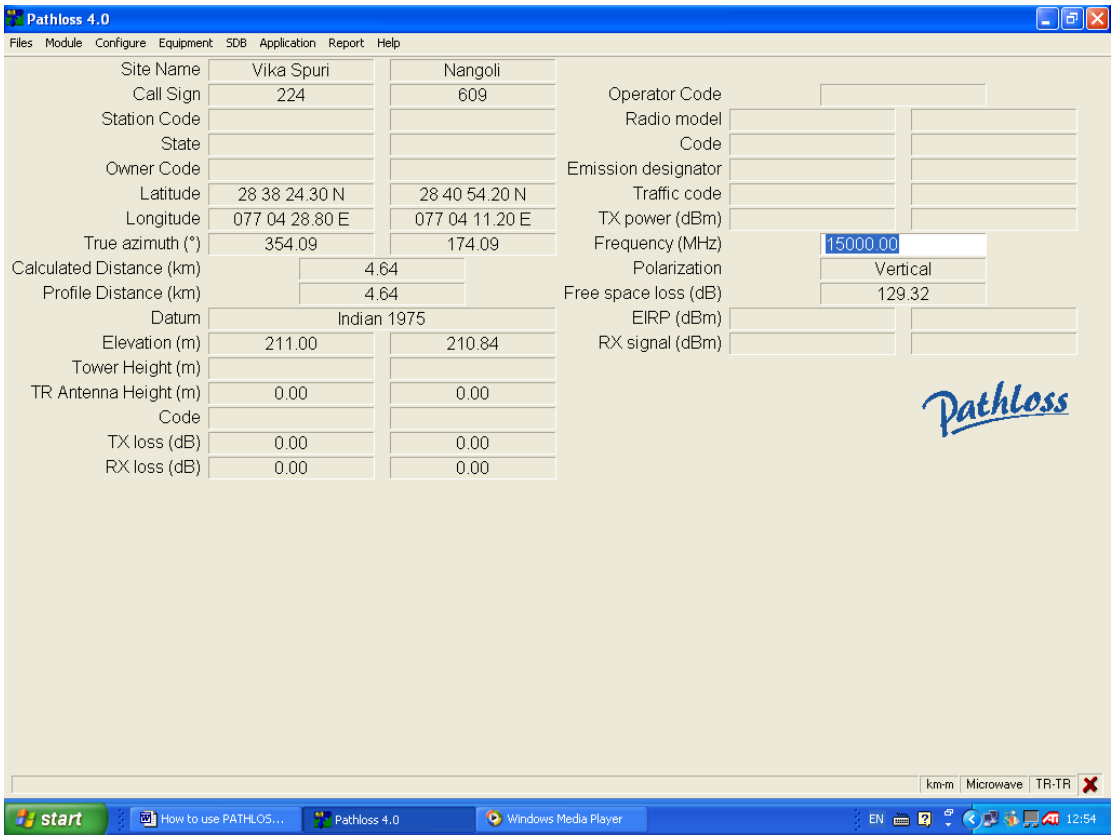


Fig. 2.2.2

2.3- Terrain Data & Obstruction Entry

This Terrain Data should be got from accurate Contour Map or from Actual Path Survey. Actual Obstruction Location, Height & Type should be get from Path Survey

How to enter Terrain Data & Obstruction?

2.3.1- Go to Terrain Data Page from Module Menu. Or by Pressing ctrl T

2.3.2- Enter you Terrain data according to Map Scale as shown in Fig. 2.3.2

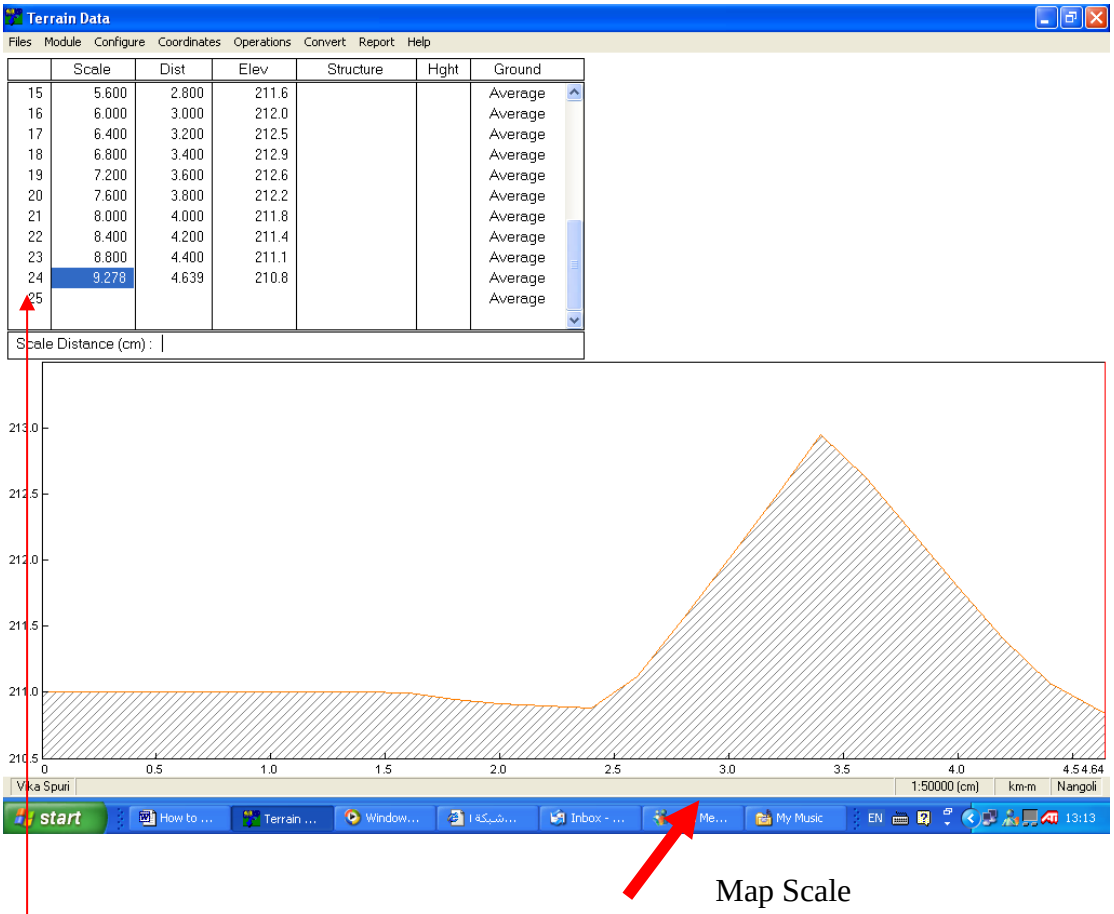


Fig. 2.3.2

2.3.3- Enter Obstructers by clicking on Structure position. Then choose structure type (Tree, Building or Water Tower). Enter this structure height in meters as per shown in Fig. 2.3.3

2.3.4- Repeat the above for the other obstacles

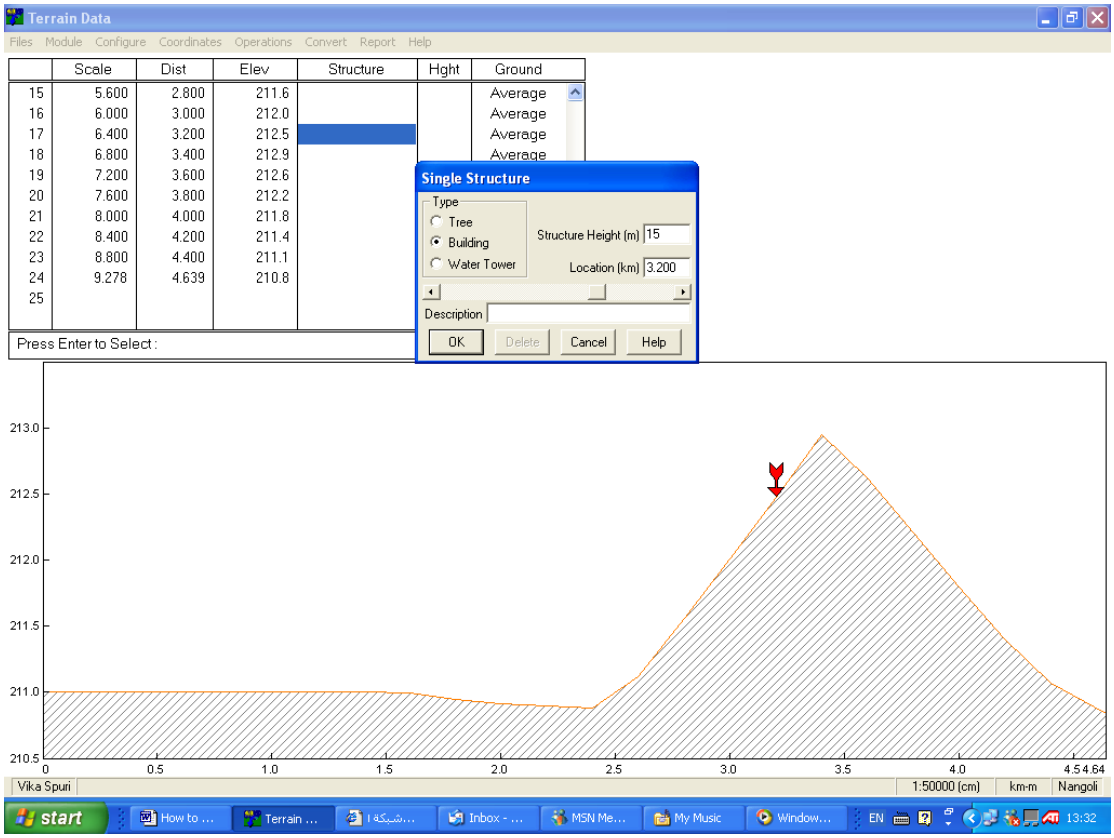


Fig. 2.3.3

2.4- Finding Suitable Antenna Heights

After we entered Terrain Data & Obstacles Heights we have to find the suitable Antenna heights in each sites to grantee clear Line Of Sight (LOS) as the following steps

2.4.1- Go to Antenna Height page from Modules menu or by pressing ctrl A as shown in Fig. 2.4.1

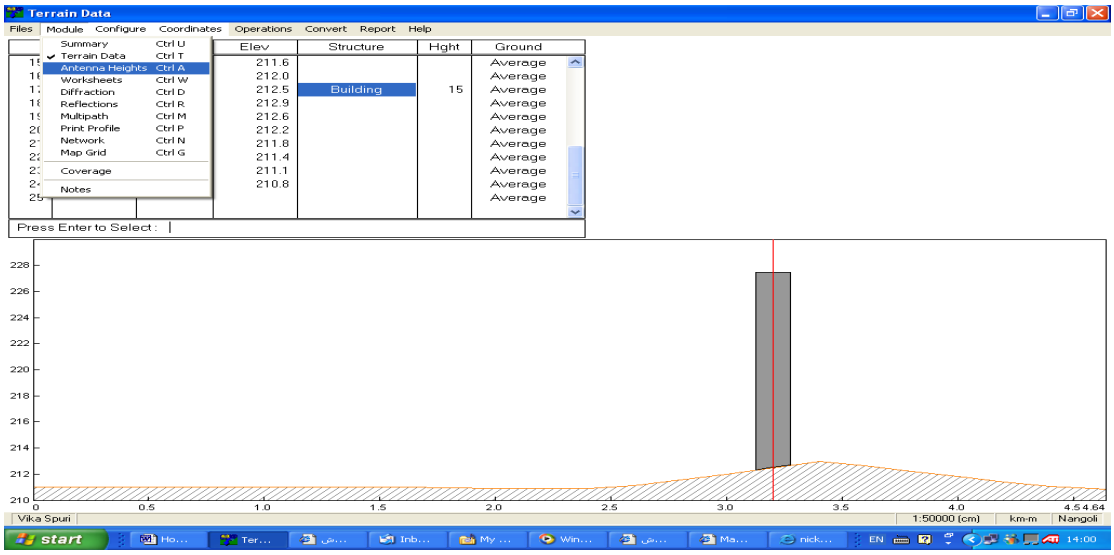


Fig. 2.4.1

2.4.2- In Antenna Height page click on Optimize to get optimize antenna height for reference only as shown in Fig. 2.4.2

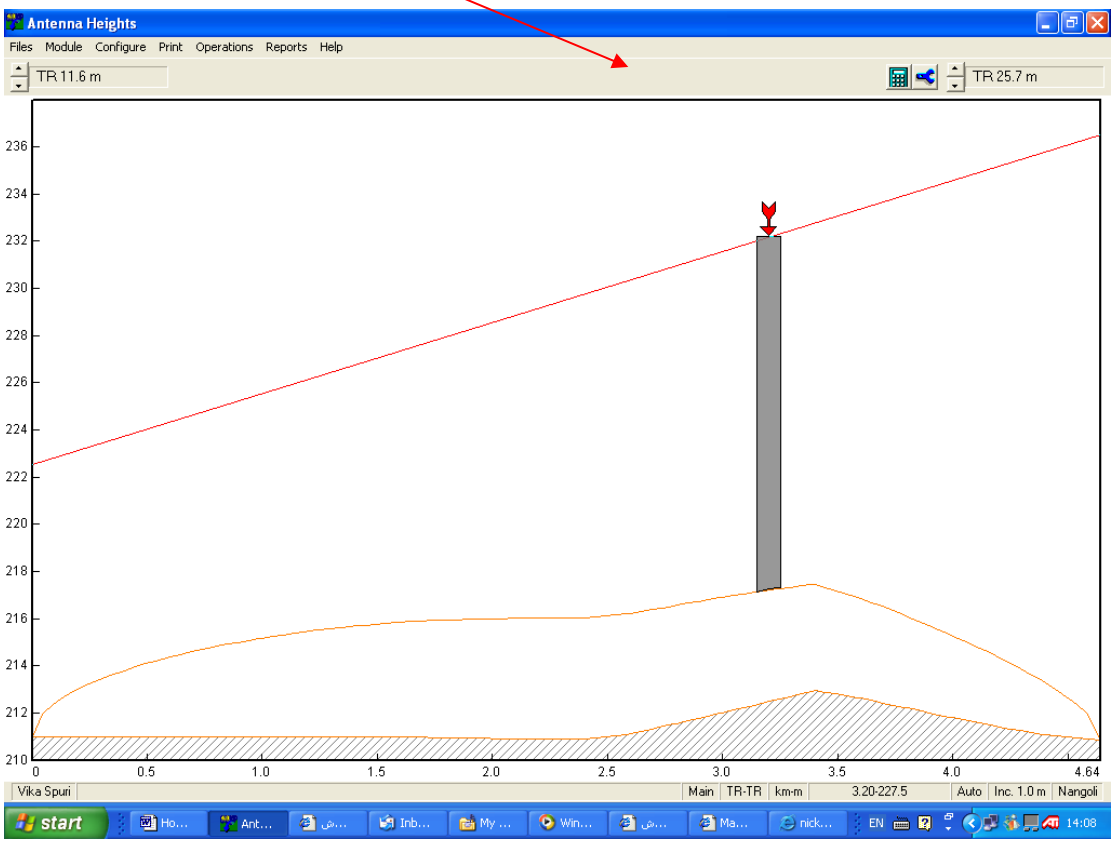


Fig. 2.4.2

2.4.3- The above Antenna is only for reference while the final antenna height will be decided according to the actual tower conditions & space availability

2.4.4- Go to Summary page & enter antenna heights which you think it will have clear LOS according to your path survey (mirror test or any other physical check) as shown in fig. 2.4.3

2.4.5- Go to Print Profile page from Module menu or by pressing ctrl P to confirm that link Fresnel zone has clear LOS above obstacles as shown in Fig. 2.4.5

2.4.6- If antennas heights which you entered still low to get clear LOS. Increase antenna height again according to available tower height till you get clear LOS with enough margin above obstacles

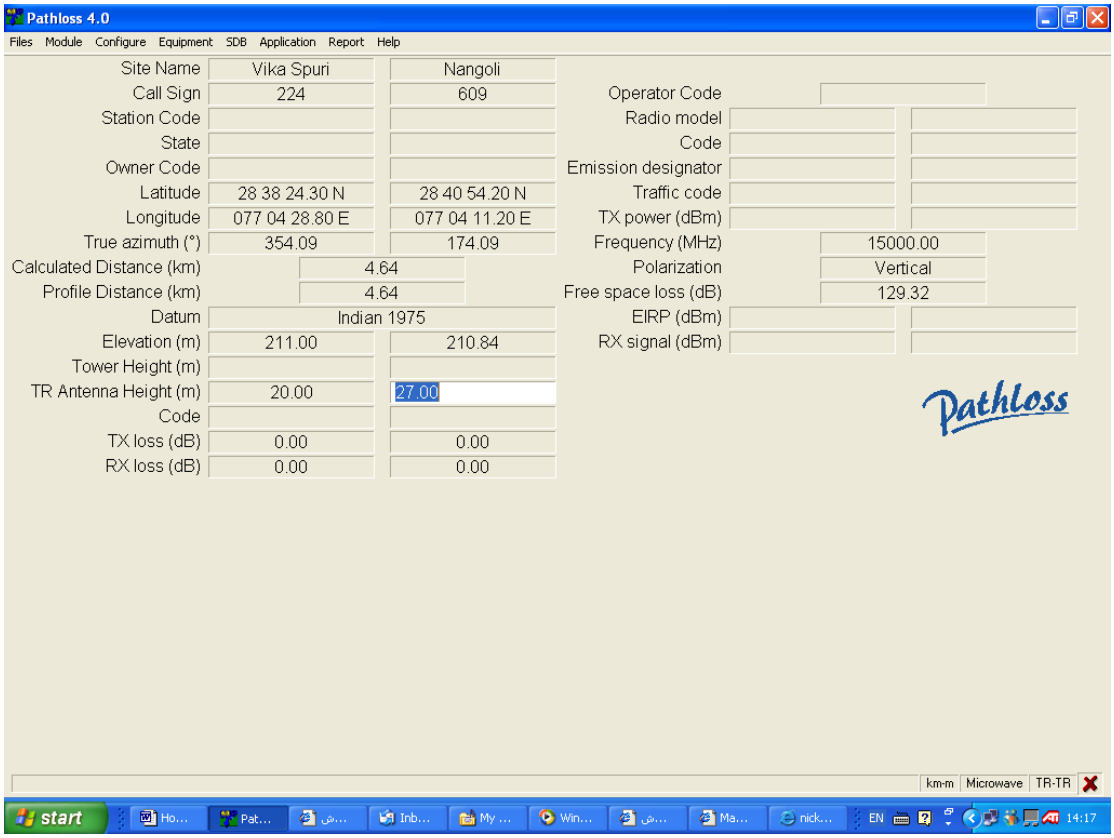


Fig. 2.4.3

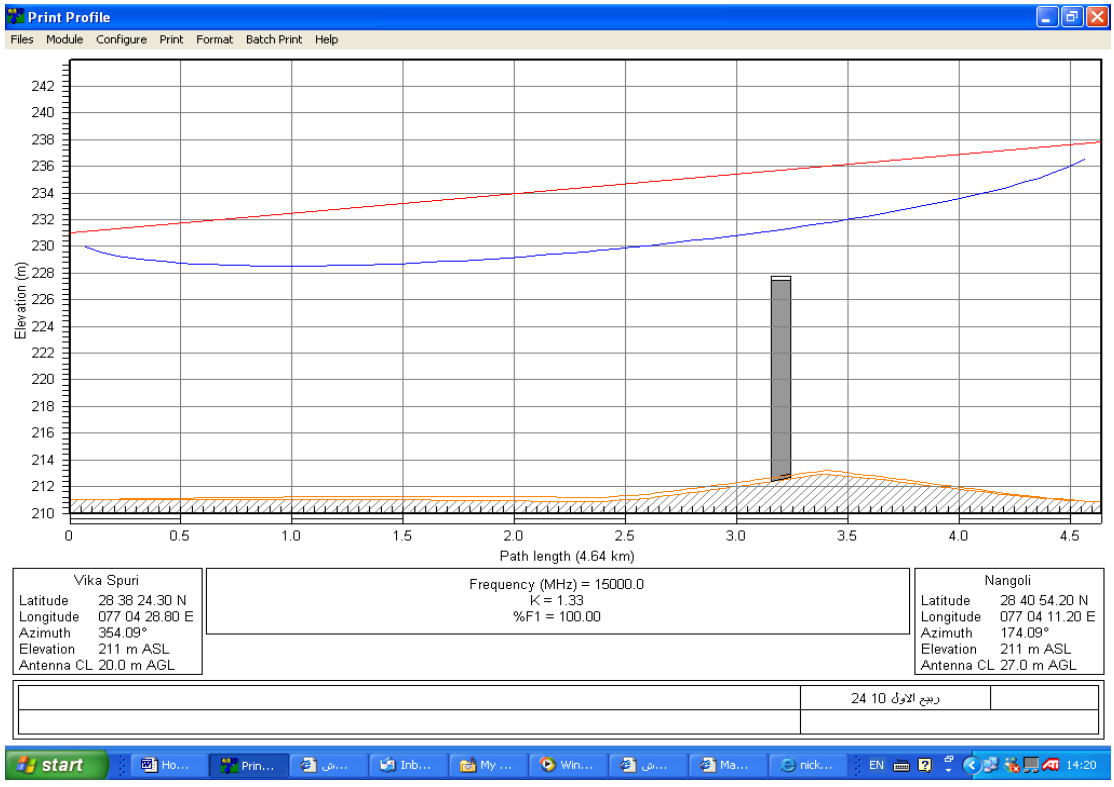


Fig. 2.4.5

2.5- Link Budget Calculations

After we already decided antenna heights for each link we should calculate link budget for each link to find antenna diameter, link RX & Availability as the following steps

2.5.1- Go to Worksheets from Modules menu or by pressing ctrl W. you get work sheet page as shown in Fig. 2.5.1

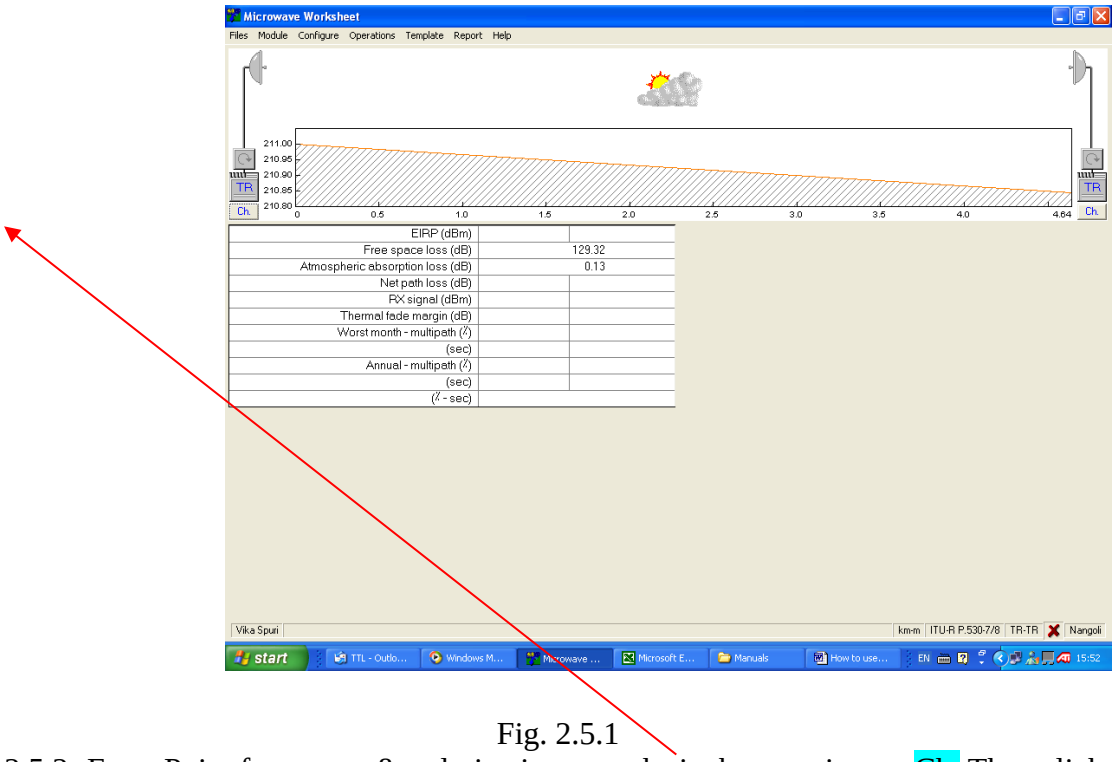


Fig. 2.5.1

2.5.2- Enter Point frequency & polarization at each site by pressing on Ch. Then click OK As shown in Fig. 2.5.1 & 2.5.2

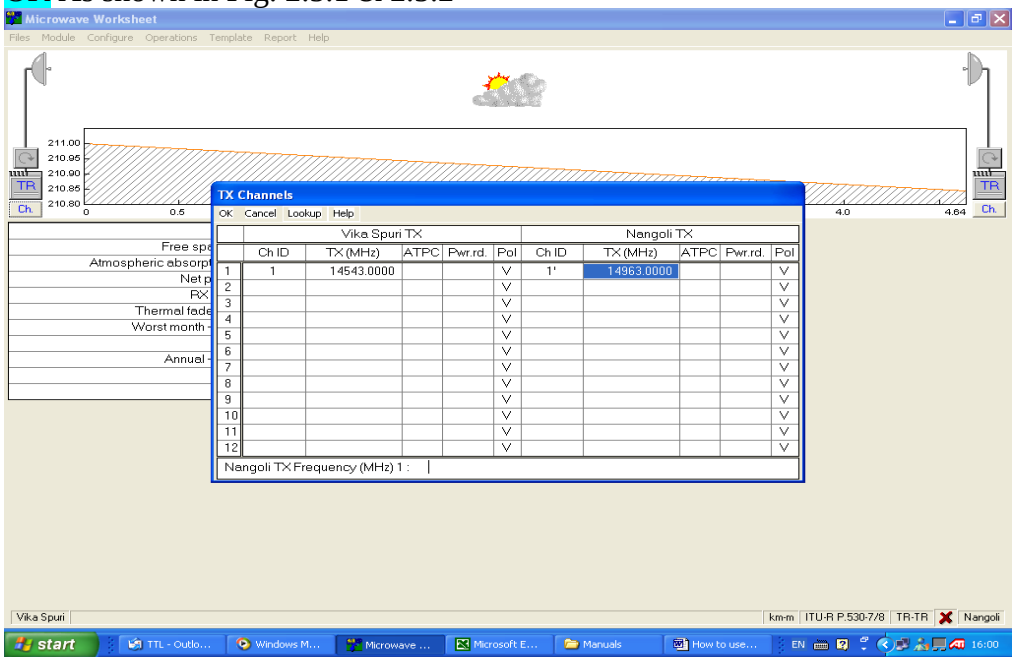


Fig. 2.5.2

2.5.3- Select Radio Equipment type by clicking on TR you will get Radio Equipment page as shown in Fig. 2.5.3

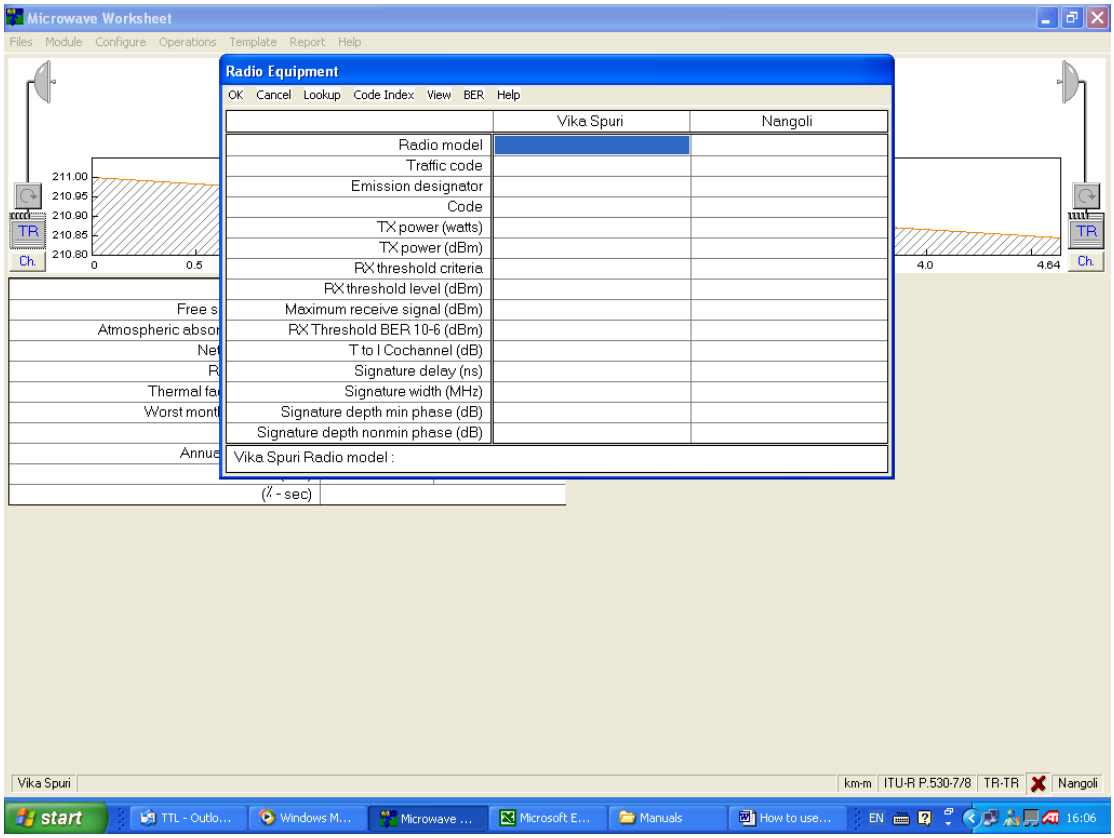


Fig. 2.5.3

2.5.4- click on Code Index then New Index. Go to your pathloss folder – Equipment – MRS – NEC (where you placed NEC equipment folder) as shown in Fig. 2.5.4

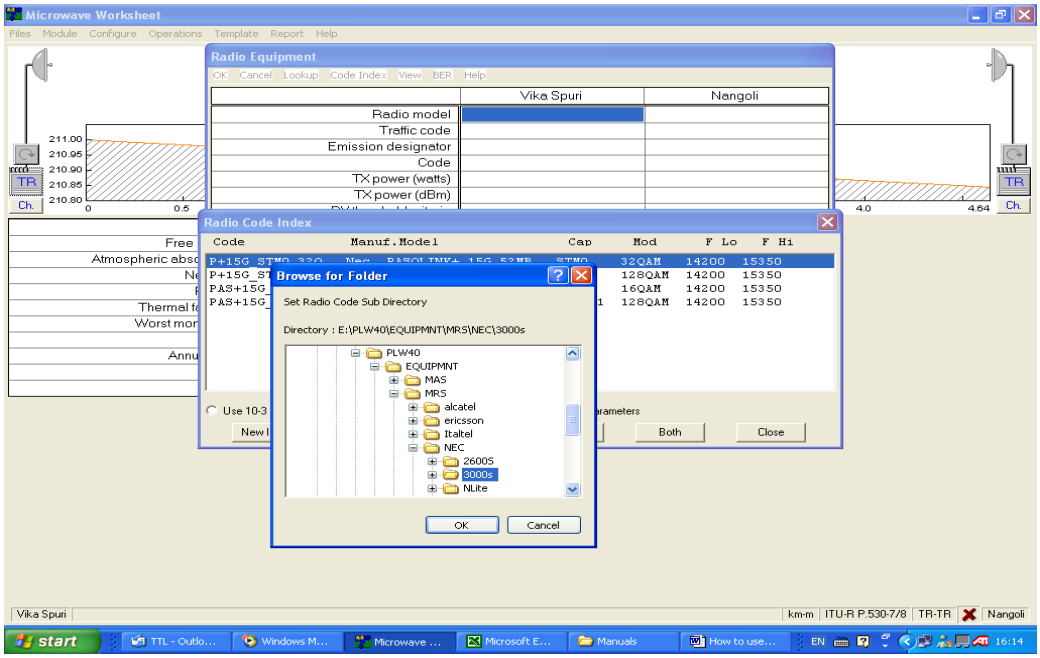


Fig. 2.5.4

2.5.5- Select your radio according to Type (3000S , Pasolink , Pasolink+ , …..) , Frequency ban (7G , 8G , 11G, …….) Modulation (16 QAM , 32 QAM , 128 QAM,….) Capacity (PDH x E1 , STM-0 , STM-1) then click Both to set same Radio for both stations then Press OK as shown in Fig. 2.5.5

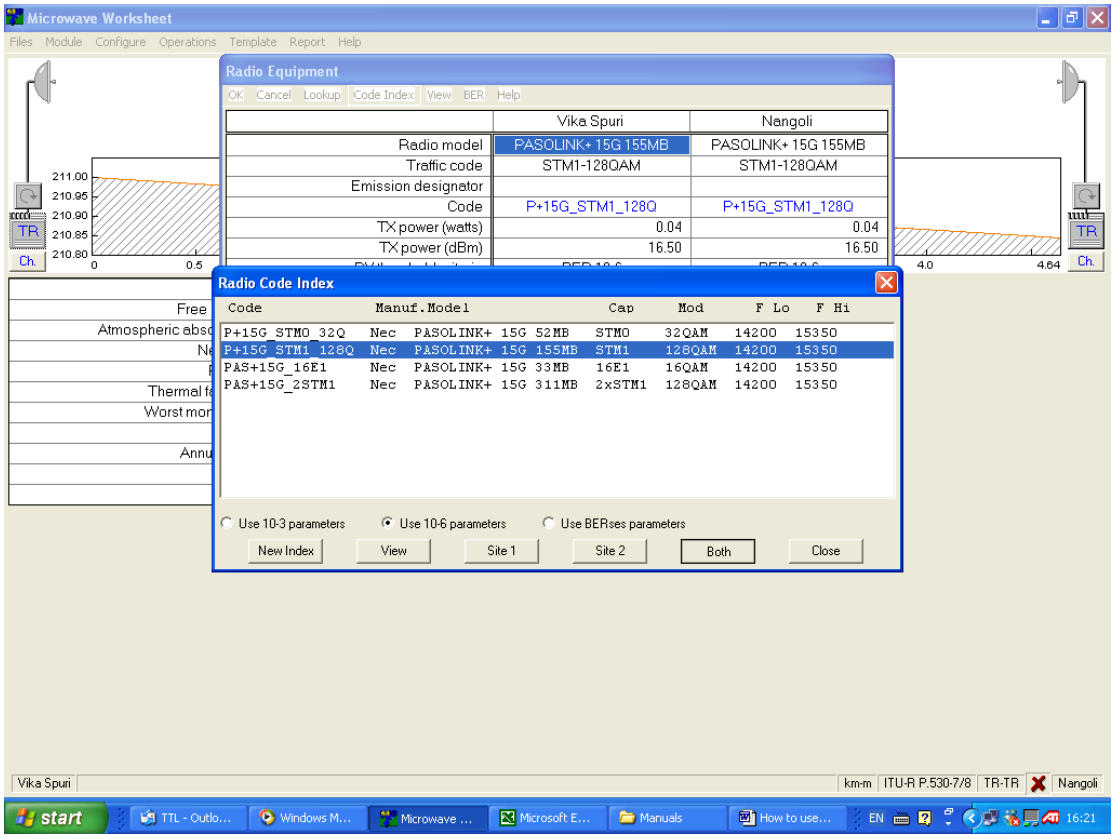


Fig. 2.5.5

2.5.6- Set Branching Circuit or Hybrid Loss by clicking on its Symbol (above TR) then press OK as shown in Fig. 2.5.6

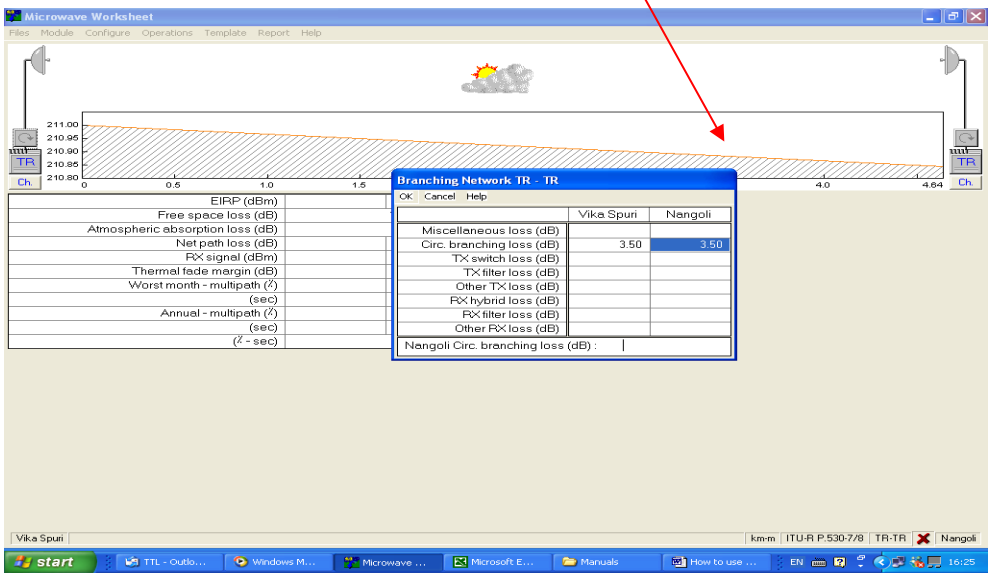


Fig. 2.5.6

2.5.7- Enter Feeder Data & connection losses by pressing on Wave Guide symbol then kick OK as shown in Fig. 2.5.7

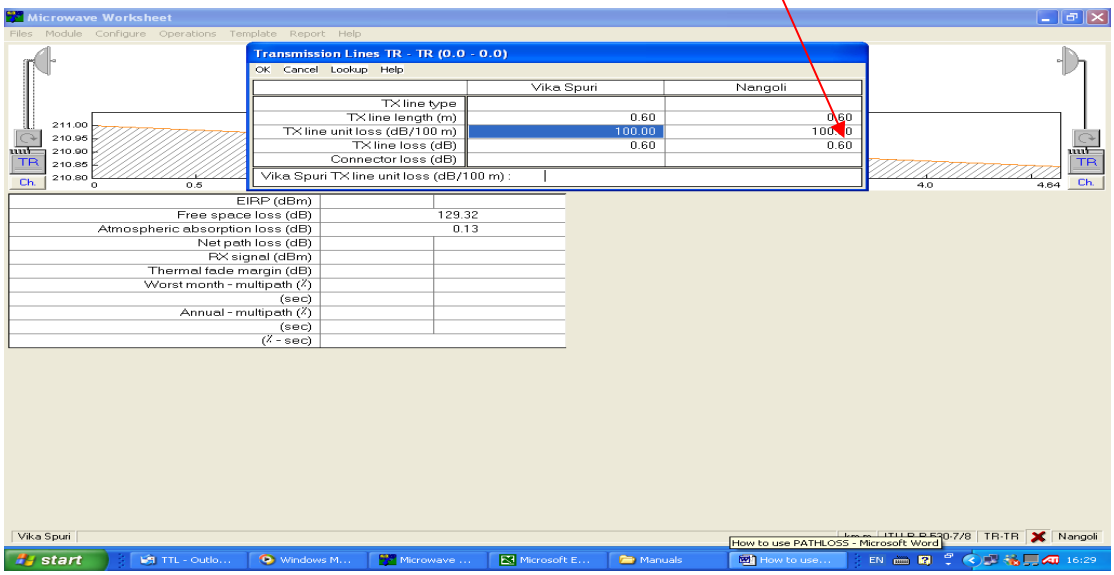


Fig. 2.5.7

2.5.8- Select antenna type for each station by clicking on antenna symbol then press as shown in Fig. 2.5.8

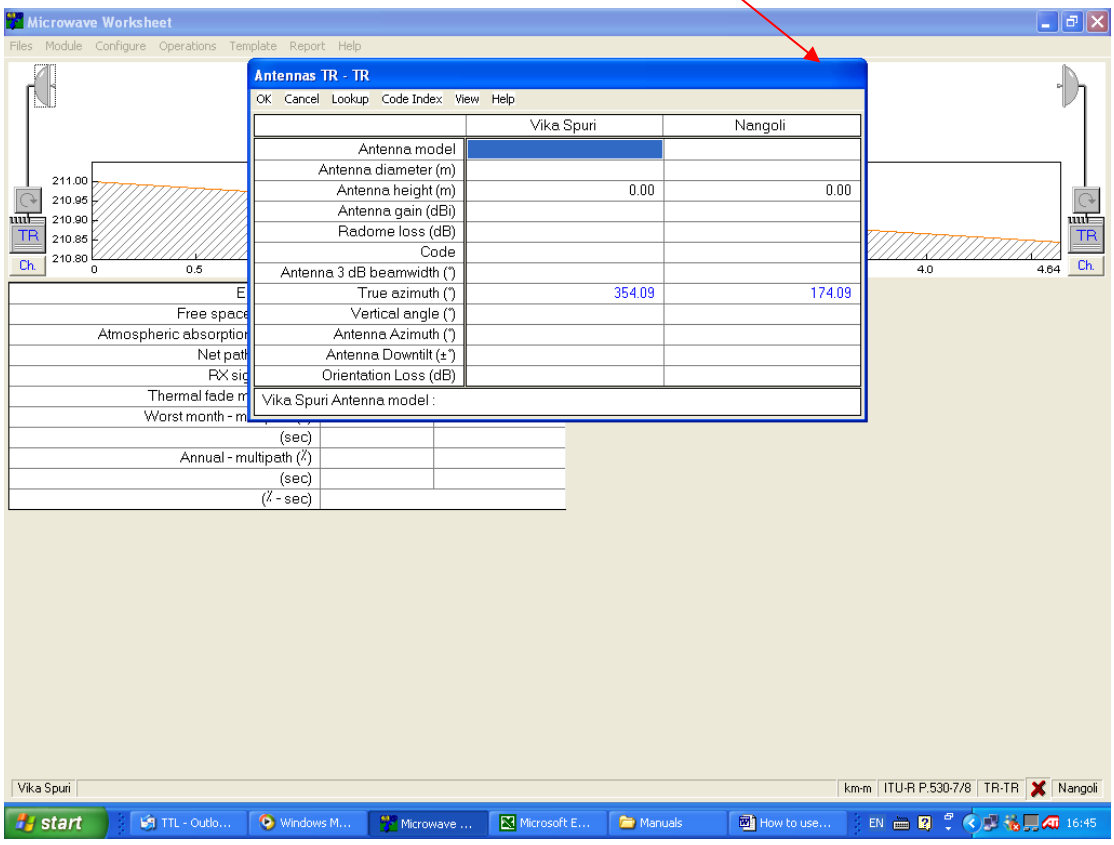


Fig. 2.5.8

2.5.9- Press on Code Index then New Index then brows for pathloss folder (where you placed it) – Equipment – MAS – Antenna manufacturer (Andrew, RFS, …..) – Frequency Range (102-132 , 122 – 132 , 142 – 153 , …….)then press OK as shown in Fig. 2.5.9

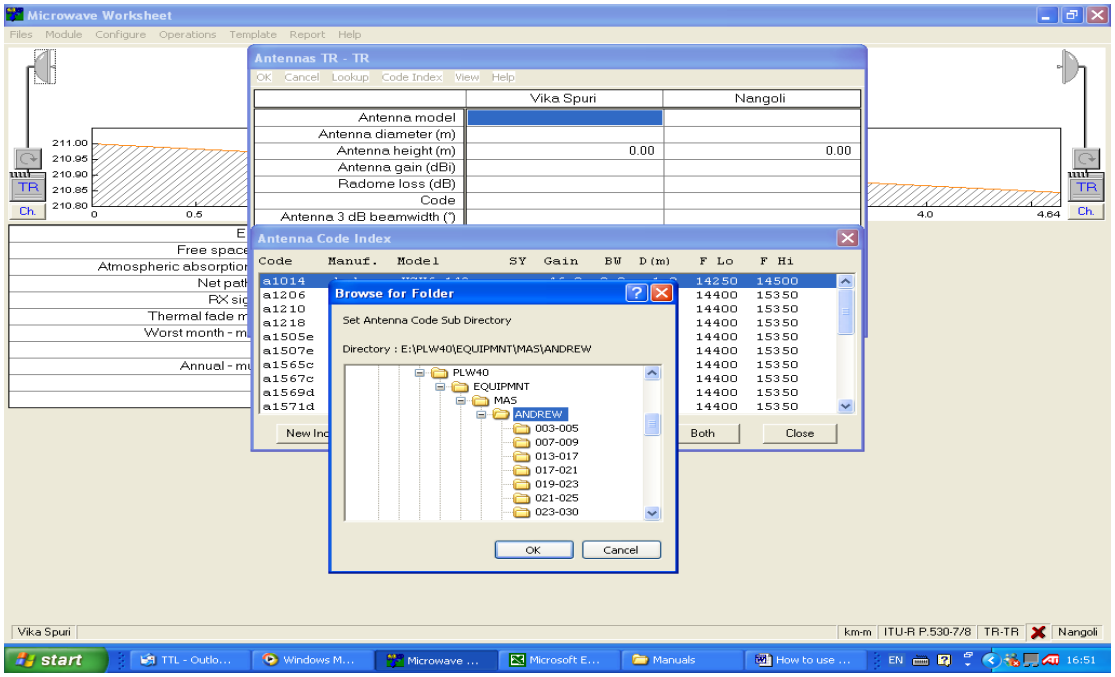


Fig. 2.5.9

2.5.10- Select antenna for site 1 & press on Site 1 & select antenna for site 2 & press Site 2 or in case of both sites have same antenna press on Both. The press Close – OK as shown in Fig. 2.5.10

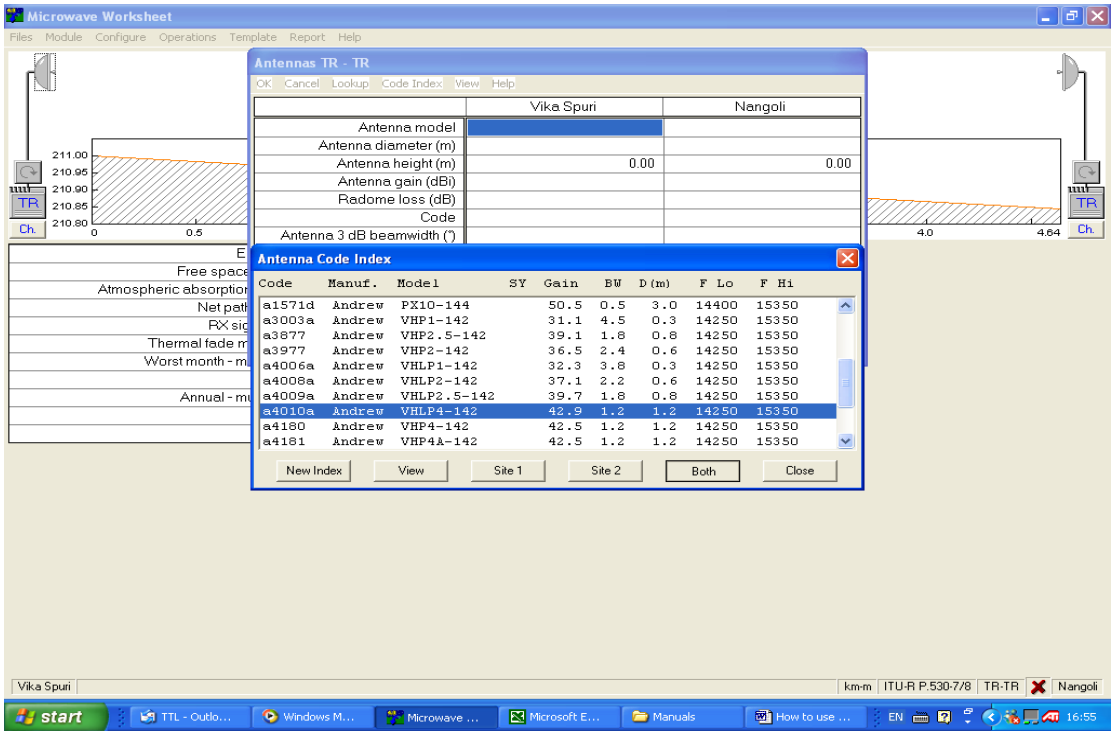


Fig. 2.5.10

2.5.11- Set Reliability Method

In worksheet page go to Operation Menu – reliability Methods as per attached in Fig. 2.5.11

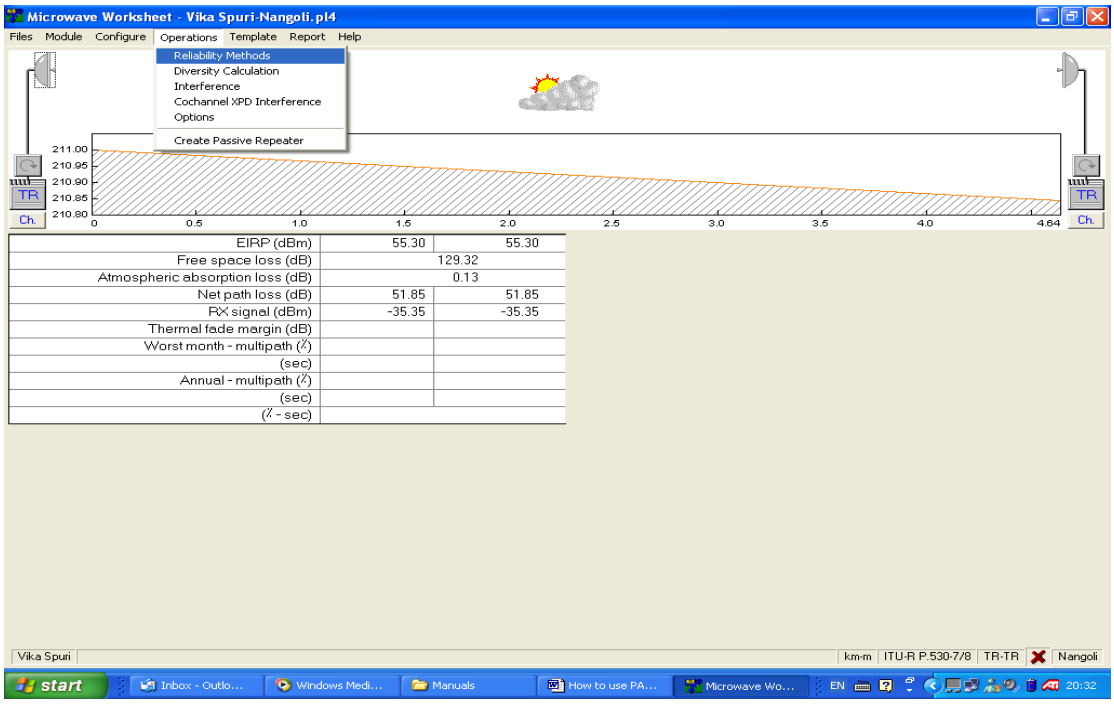


Fig. 2.5.11

Set Reliability criteria as per shown in Fig. 2.5.11-1 for SDH or as Project & Customer requirement & press OK

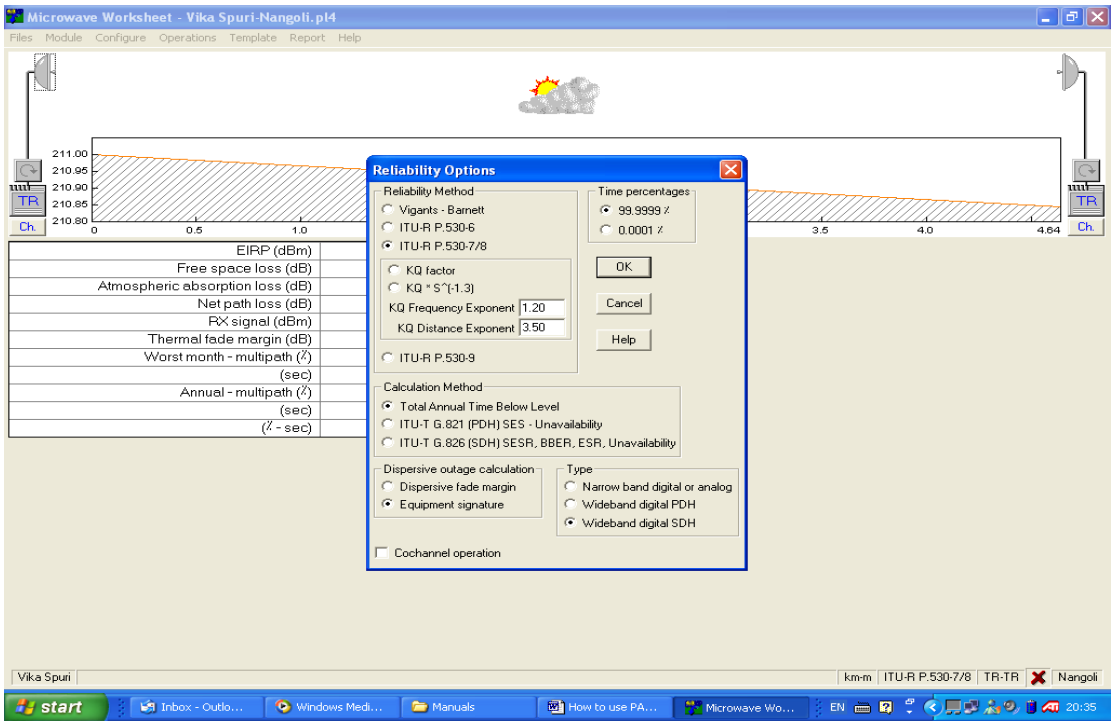


Fig. 2.5.11.1

2.5.12- Set of Rain factor

Press on Rain symbol – select ITU-R-P-530. 6/8 – press Load Rain File – Select Rain area according to ITU-530 Map Fig. 1.2.3 (Rain Files are placed in Pathloss folder – Rain) – Press Close as per shown in Fig. 2.5.12

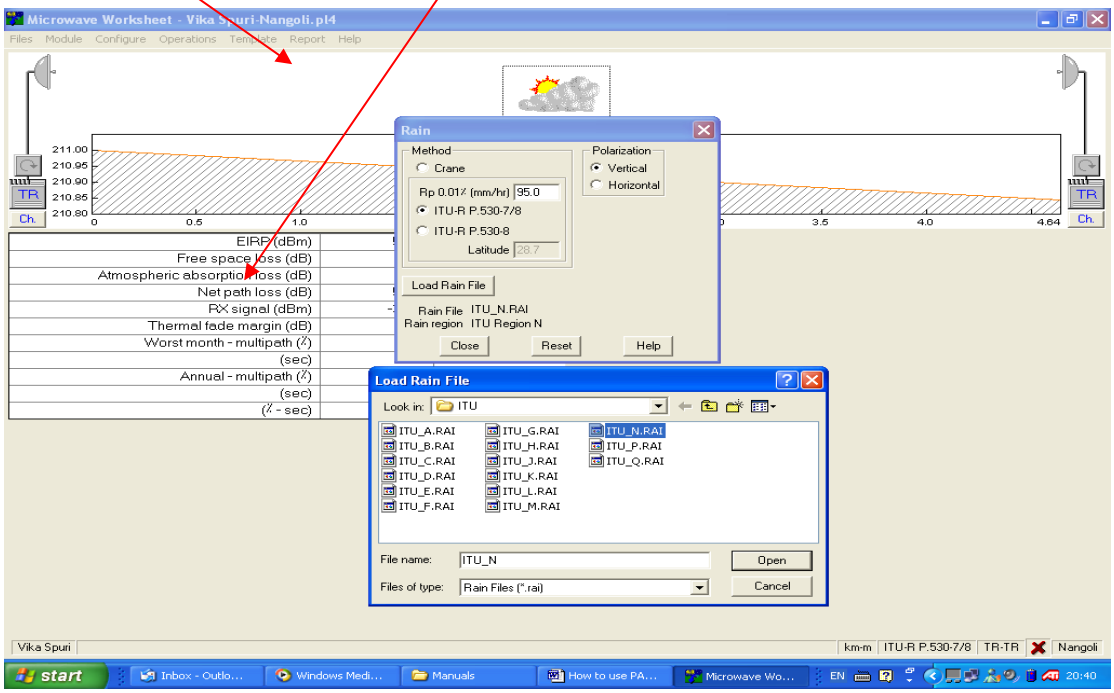


Fig. 2.5.12

2.5.13- Set Geoclimatic Factor

Press on the Ground Symbol (as shown in Fig. 2.5.13-1) – Set Geoclimatic Factor according to ITU-R-P-453 as Shown in Fig. 2.5.13-2)

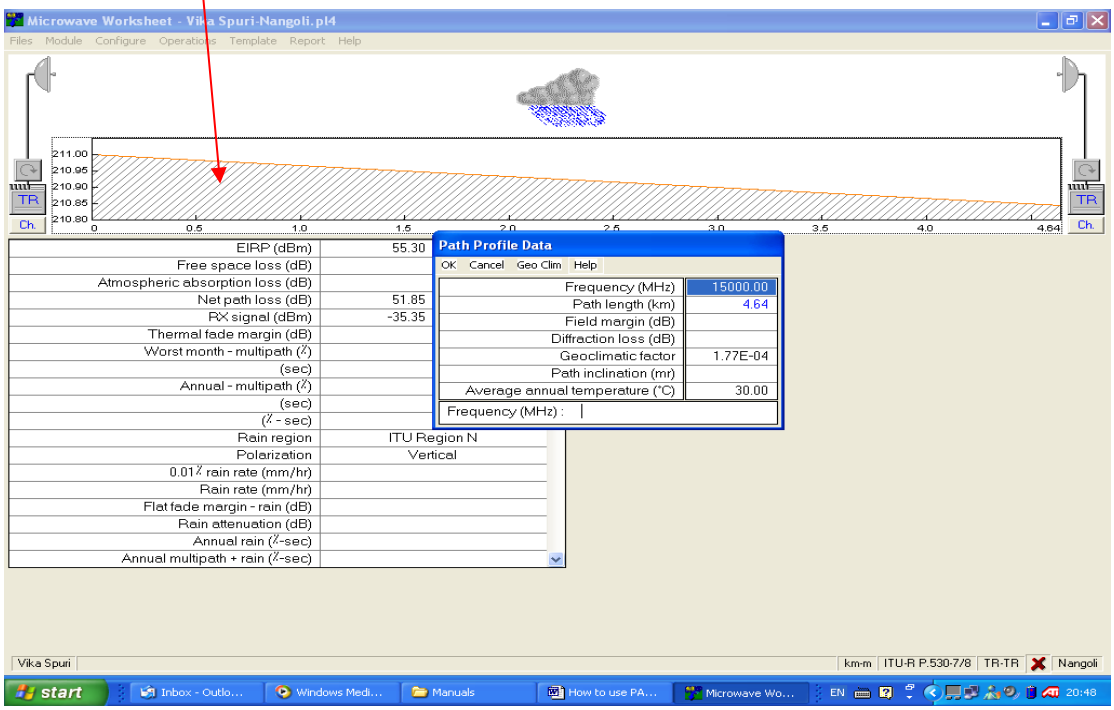
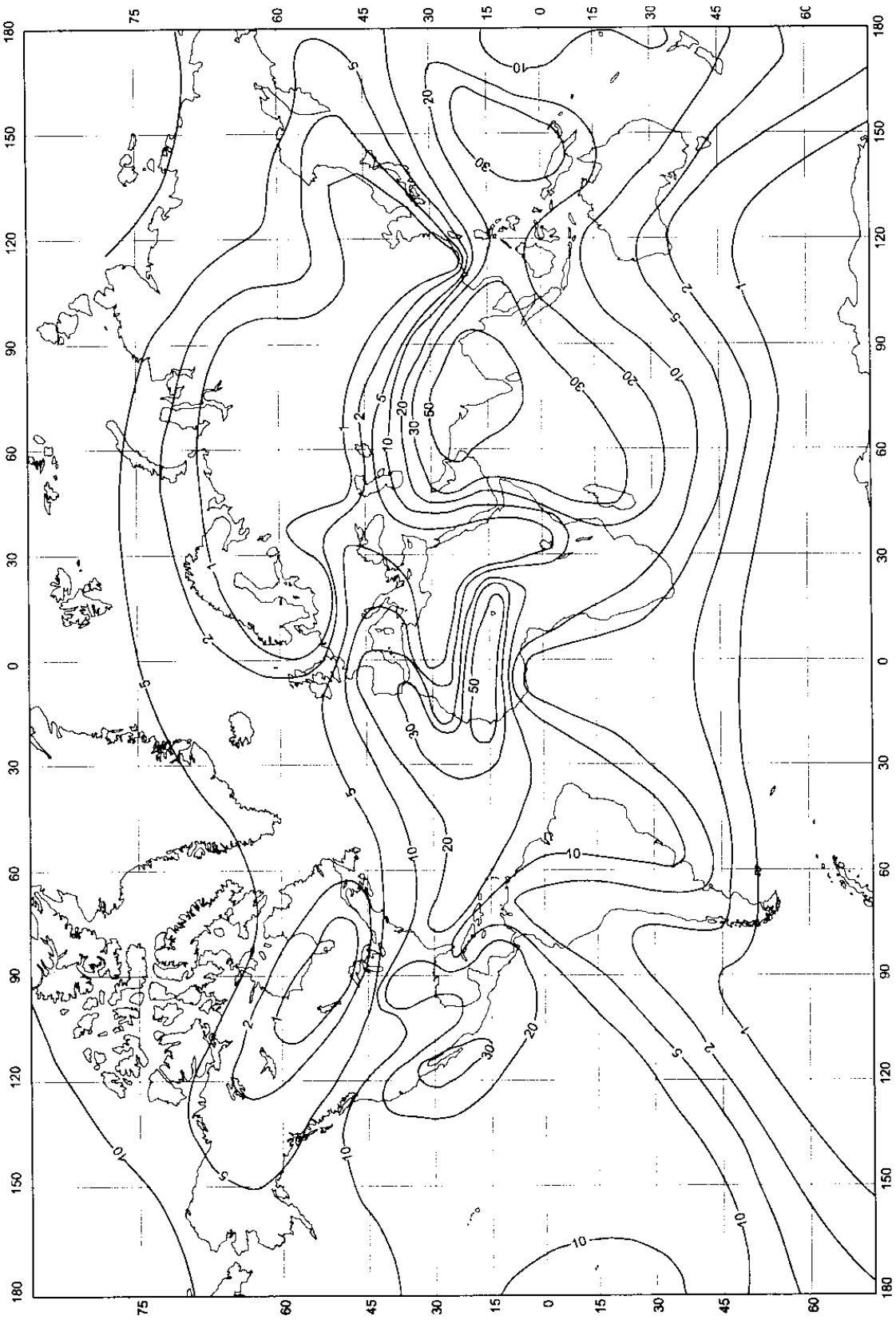


Fig. 2.5.13-1



Percent of Time Gradient ≤ 100 N units / km - November

Fig. 2.5.13-2

2.5.14- Make sure of either our Path Calculation is correct or we need to revise again. To do that please check the followings

- Make sure that your worksheet page has Green Correct sign in Right Bottom of screen. If it is wrong sign that's mean there are some data mistake
- Have a look to RX Signal, Fade Margin & (Annual Availability with rain) Percentage as per shown in Fig. 2.5.14

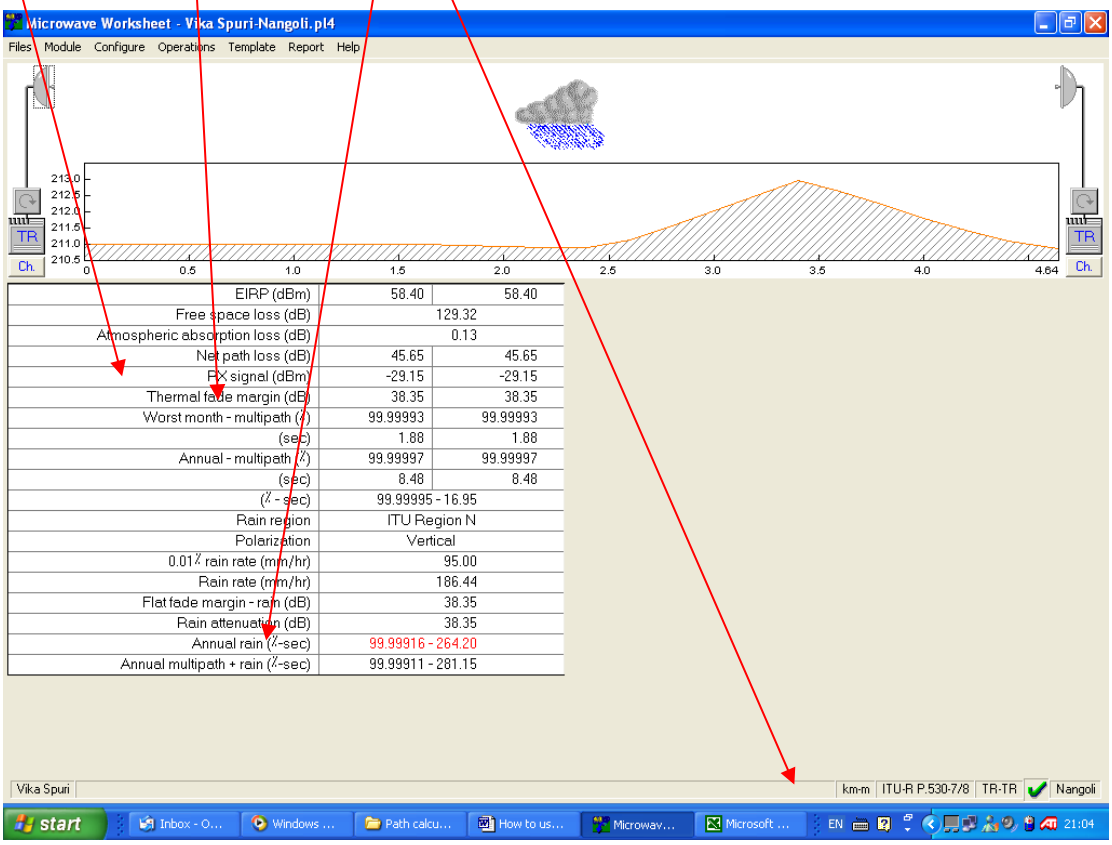


Fig. 2.5.14

- If any of (RX, Margin, Availability) is less than the required to meet the Spec. & recommendations. You have to increase antenna diameter or add Space Diversity Radio to reach to the required Spec.
- So you go to step 2.5.10 again & select new antennas

2.5.15- After finish of path calculations go to Report Menu in Worksheet page – click Full Report

You will get full path calculation report as below one. You can copy it to Word or Excel sheet & save it for reference & submitting with your survey report

Microwave Worksheet - Vika Spuri-Nangoli.pl4

	Vika Spuri	Nangoli
Elevation (m)	211.00	210.84
Latitude	28 38 24.30 N	28 40 54.20 N
Longitude	077 04 28.80 E	077 04 11.20 E
True azimuth (°)	354.09	174.09
Vertical angle (°)	-0.02	-0.01
Antenna model	VHP6-142	VHP6-142
Antenna height (m)	0.00	0.00
Antenna gain (dBi)	46.00	46.00
TX line length (m)	0.60	0.60
TX line unit loss (dB /100 m)	100.00	100.00
TX line loss (dB)	0.60	0.60
Circ. branching loss (dB)	3.50	3.50
Frequency (MHz)	15000.00	
Polarization	Vertical	
Path length (km)	4.64	
Free space loss (dB)	129.32	
Atmospheric absorption loss (dB)	0.13	
Net path loss (dB)	45.65	45.65
Radio model	PASOLINK+ 15G 155MB	PASOLINK+ 15G 155MB
TX power (watts)	0.04	0.04
TX power (dBm)	16.50	16.50
EIRP (dBm)	58.40	58.40
TX Channels	1 14543.0000V	1' 14963.0000V
RX threshold criteria	BER 10-6	BER 10-6
RX threshold level (dBm)	-67.50	-67.50
RX signal (dBm)	-29.15	-29.15
Thermal fade margin (dB)	38.35	38.35
Geoclimatic factor	1.77E-04	
Path inclination (mr)	0.03	
Average annual temperature (°C)	30.00	
Worst month - multipath (%)	99.99993	99.99993
(sec)	1.88	1.88
Annual - multipath (%)	99.99997	99.99997
(sec)	8.48	8.48
(% - sec)	99.99995 - 16.95	
Rain region	ITU Region N	
0.01% rain rate (mm/hr)	95.00	
Flat fade margin - rain (dB)	38.35	
Rain rate (mm/hr)	186.44	
Rain attenuation (dB)	38.35	
Annual rain (%-sec)	99.99916 - 264.20	
Annual multipath + rain (%-sec)	99.99911 - 281.15	

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Reliability Method - ITU-R P.530-7/8
Rain - ITU-R P530-7

2.6- Frequency Interference Calculations for the Network

After completing all the above processes for all the link you should calculate if there will be any frequency interference cases in the designed Network (if there are any existing links working with the same frequency band you have to add it to your network before calculating interference)

How to Calculate frequency Interference

2.6.1- Go to Network Page by clicking ctrl N – Defaults menu – Link Label Select TX Frequency & Polarization – Press Rest All as per shown in Fig. 2.6.1

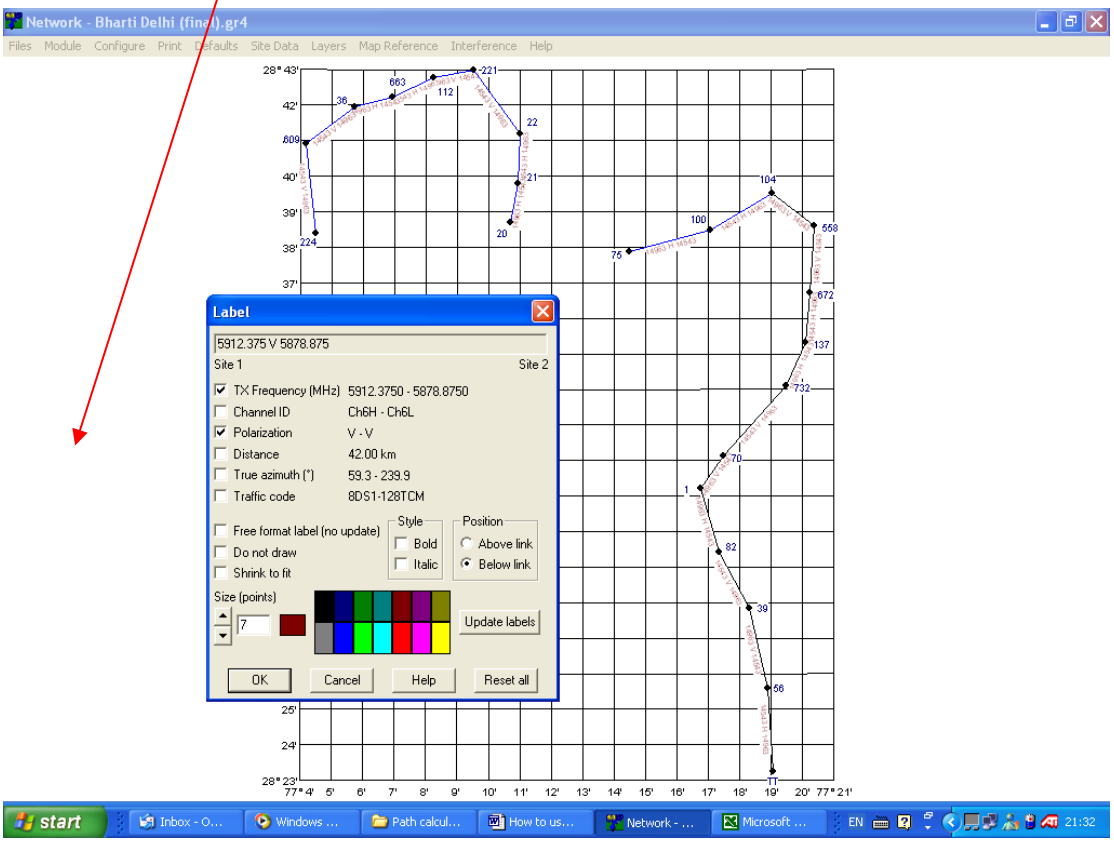

Fig. 2.6.1

Have a look to your network & make sure that all links Frequencies & Polarizations are correct according to your plan. If there is any mistake in any link please go to its work sheet & make it correct

2.6.2- Go to Interference Menu & Click Calculate Intra as per shown in Fig. 2.6.2

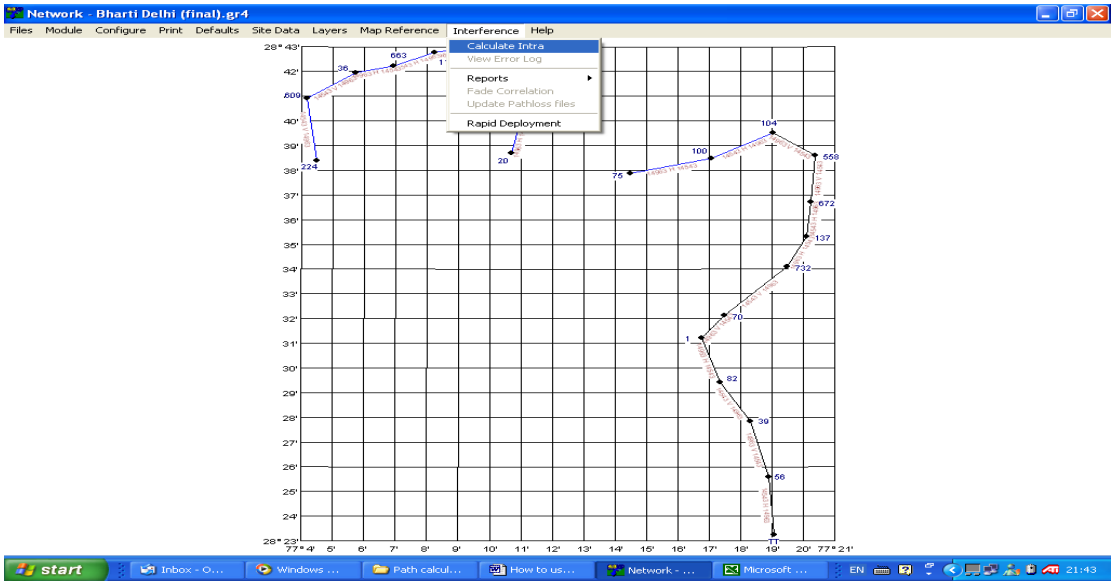

Fig. 2.6.2

2.6.3- Set the Interference Calculation criteria according to Specs. & press Calculate as per shown in Fig. 2.6.3

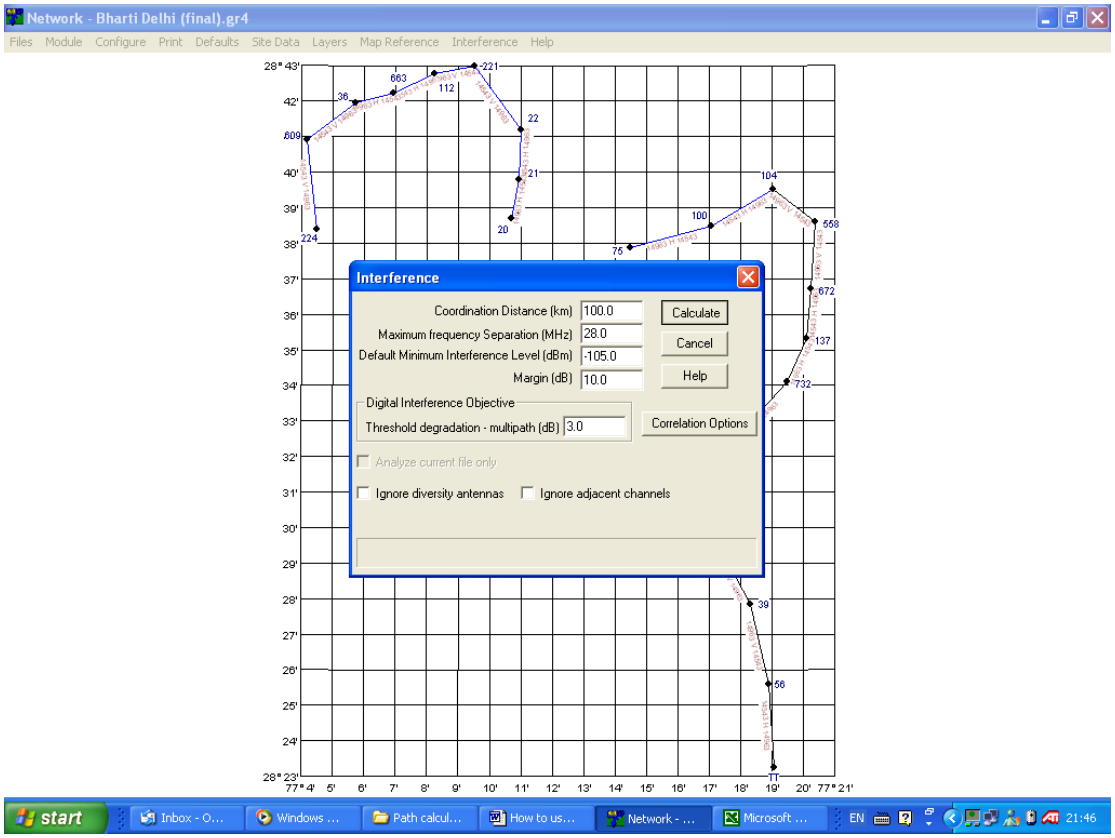

Fig. 2.6.3

2.6.4- Go to Interference Menu – Report – Cross Reference as shown in Fig. 2.6.4

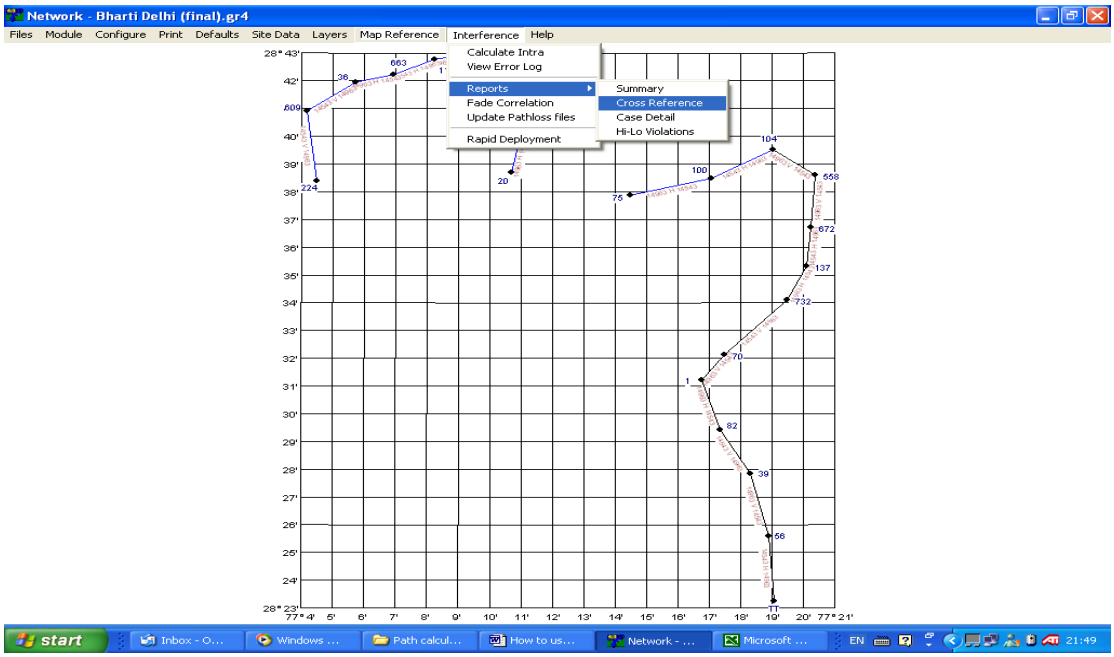

Fig. 2.6.4

2.6.5- You will get Interferences cases as below example.

Study carefully those interference cases & if any one of them is dangerous case please re-plan you network frequencies or change your antenna type to higher XPD antennas. Also you can use ATPC function to keep lower TX power which will help to avoid some interference cases

Interference Cross Reference - Bharti Delhi (final).gr4

Coordination Distance (km)	100.00	obj	Interference level objective (dBm)
Maximum frequency Separation (MHz)	28.00	v-i	Victim to interferer path length (km)
Default Minimum Interference Level (dBm)	-105.00	tad	Total antenna discrimination (dB)
Margin (dB)	10.00	ifl	Interfering Signal (dBm)
Threshold degradation objective (db)	3.00	td	Threshold Degradation (dB)
Total number of cases calculated	87	*	OHLOSS

Calculation made on ÇáÇÍÏ, ÑÈíÚ ÇáÃæá 10 1424 09:46:00 ã

Case 1 Charmwood (Okhla), VHP4A-142, 14963.0000H, STM1-128QAM, obj = -98.6
1-1 Faridabad (Charmwood), VHP2-142, 14963.0000V, STM1-128QAM, v-i = 3.3, tad = 70.0 (i 0.0° v -191.9°), ifl = -102.0 (3.5), td = 1.6
1-2 Okhla (Sarita Vihar), VHP2-142, 14963.0000V, STM1-128QAM, v-i = 3.5, tad = 68.0 (i 128.8° v 0.0°), ifl = -100.2 (1.7), td = 2.2

Case 2 Okhla (Charmwood), VHP2-142, 14543.0000H, STM1-128QAM, obj = -98.6
2-1 Charmwood (Faridabad), VHP4A-142, 14543.0000V, STM1-128QAM, v-i = 3.5, tad = 67.0 (i 191.9° v 0.0°), ifl = -99.1 (0.5), td = 2.7
2-2 Faridabad19 (Faridabad), VHP2-142, 14543.0000V, STM1-128QAM, v-i = 11.0, tad = 52.2 (i -5.7° v -2.3°), ifl = -100.3 (1.7), td = 2.2 *

2-3 Sarita Vihar (Okhla), VHP2-142, 14543.0000V, STM1-128QAM, v-i = 2.0, tad = 68.0 (i 0.0° v -128.8°), ifl = -101.4 (2.9), td = 1.8

Case 3 Faridabad (Charmwood), VHP2-142, 14543.0000V, STM1-128QAM, obj = -98.6
3-1 Charmwood (Okhla), VHP4A-142, 14543.0000H, STM1-128QAM, v-i = 3.3, tad = 70.0 (i -191.9° v 0.0°), ifl = -101.8 (3.2), td = 1.7
3-2 Faridabad19 (Faridabad), VHP2-142, 14543.0000V, STM1-128QAM, v-i = 4.2, tad = 62.0 (i 0.0° v -164.7°), ifl = -102.0 (3.4), td = 1.6
3-3 Shalimar Bagh (Wazipur), VHP4A-142, 14543.0000V, STM1-128QAM, v-i = 31.4, tad = 30.1 (i 9.4° v 1.0°), ifl = -81.5 (-17.0), td = 17.1 *
3-4 Kamal Hotel (Gopala Tower), VHP2-142, 14543.0000H, STM1-128QAM, v-i = 25.2, tad = 48.3 (i -38.8° v -0.5°), ifl = -103.8 (5.2), td = 1.1 *

Case 4 Charmwood (Faridabad), VHP4A-142, 14963.0000V, STM1-128QAM, obj = -98.6
4-1 Okhla (Charmwood), VHP2-142, 14963.0000H, STM1-128QAM, v-i = 3.5, tad = 67.0 (i 0.0° v 191.9°), ifl = -99.3 (0.8), td = 2.6
4-2 Faridabad (Faridabad19), VHP2-142, 14963.0000V, STM1-128QAM, v-i = 3.3, tad = 62.0 (i 164.7° v 0.0°), ifl = -94.1 (-4.4), td = 5.7

Case 5 Faridabad19 (Faridabad), VHP2-142, 14963.0000V, STM1-128QAM, obj = -98.6
5-1 Okhla (Charmwood), VHP2-142, 14963.0000H, STM1-128QAM, v-i = 11.0, tad = 52.2 (i -2.3° v -5.7°), ifl = -100.5 (2.0), td = 2.1 *
5-2 Faridabad (Charmwood), VHP2-142, 14963.0000V, STM1-128QAM, v-i = 4.2, tad = 62.0 (i -164.7° v 0.0°), ifl = -102.2 (3.7), td = 1.6
5-3 Touch Tel (Faridabad19), VHP4A-142, 14963.0000H, STM1-128QAM, v-i = 4.4, tad = 68.0 (i 0.0° v -170.3°), ifl = -102.5 (3.9), td = 1.5
5-4 Mayur Vihar Ph-3 (Noida Sec10), VHP2-142, 14963.0000H, STM1-128QAM, v-i = 20.6, tad = 50.3 (i 1.3° v -341.0°), ifl = -104.2 (5.6), td = 1.0 *

Case 6 Faridabad (Faridabad19), VHP2-142, 14543.0000V, STM1-128QAM, obj = -98.6
6-1 Charmwood (Faridabad), VHP4A-142, 14543.0000V, STM1-128QAM, v-i = 3.3, tad = 62.0 (i 0.0° v 164.7°), ifl = -93.9 (-4.7), td = 5.9
6-2 Faridabad19 (Touch Tel), VHP2-142, 14543.0000H, STM1-128QAM, v-i = 4.2, tad = 68.0 (i 170.3° v 0.0°), ifl = -108.0 (9.4), td = 0.5

Case 7 Touch Tel (Faridabad19), VHP4A-142, 14543.0000H, STM1-128QAM, obj = -98.6
7-1 Faridabad19 (Faridabad), VHP2-142, 14543.0000V, STM1-128QAM, v-i = 4.4, tad = 68.0 (i -170.3° v 0.0°), ifl = -102.2 (3.7), td = 1.5
7-2 Vaishali (Mayur Vihar Ph-3), VHP4A-142, 14543.0000V, STM1-128QAM, v-i = 28.5, tad = 50.7 (i 0.7° v -352.4°), ifl = -95.1 (-3.5), td = 5.1 *

Case 8 Faridabad19 (Touch Tel), VHP2-142, 14963.0000H, STM1-128QAM, obj = -98.6
8-1 Faridabad (Faridabad19), VHP2-142, 14963.0000V, STM1-128QAM, v-i = 4.2, tad = 68.0 (i 0.0° v 170.3°), ifl = -108.2 (9.7), td = 0.4