INTERNSHIP REPORT

ON

MICROWAVE LINK PLANNING, INSTALLING AND COMMISSIONING

BY

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Approval Letter

To whom it may concern

This is to certify that Avijit Hira and Mahfuz Alam, student ID 2006-1-80-009 and 2006-1-80-001 have successfully completed the project work that was assigned to them as part of the internship program. I, Farabi Firdaus, on behalf of TRX OPTIMIZATIONS am recommending this work as the fulfillment for the requirement of EEE 499 Industrial Training. I wish them success.

FFirdous
19.01.10

Farabi Firdaus

Acknowledgment

First of all I would like to thank Mr. Farabi Firdaus my superintendent Engineer and the engineers of microwave planning division of TRX OPTIMIZATIONS Ltd. for allowing me to do the internship and work in their team.

I would also like to thank my advisor Dr. Khairul Alam, Assistant Professor Department of Electrical & Electronic Engineering, East West University, Bangladesh.

I would also like to mention the name of Dr. Anisul Haque, Chairperson & Professor of the Department of Electrical & Electronic Engineering and Dr. Ishfaqur Raza, Associate Professor, Department of Electrical & Electronic Engineering, Bangladesh for being so kind during the period of my internship. I am also grateful to all my teachers and friends for their cooperation and encouragement throughout my whole academic life in EWU.

Executive Summary

In today's world it has become a challenge to provide cellular connectivity as an –"anytime, anywhere and anyhow" basis. Microwave link is one of the most important parts of this cellular service. Only a proper microwave planning, installation and commissioning can provide the best service to the customers. The internship we did in TRX OPTIMIZATIONS, gave us the opportunity to learn about how the planning, installing and commissioning is really done in the practical field. So this report is about the topics that we have learned in our short intern period. Form this internship we have learned how to work in a team. We have also familiarized with a corporate environment. In our internship we have gathered lots of knowledge about many real life problems. Some of these problems are very interesting and not included in textbook.

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Chapter 01

1.1 Report Origin

This report entitled "Microwave link planning, installation and commissioning" is a connived depiction of the three months long internship program at the "TRX OPTIMIZATIONS".

1.2 Purpose of Study

The purpose of this report cognates the internship purpose. The objective of internship was to gather practical knowledge and experiencing the implementation of theoretical study in real world. To this regard this report is contemplating the knowledge and experience accumulated from the internship program. With the set guidelines by the EEE Department of East West University and our internship Supervisor this report comprises of an organization part and a project part. The prime objective of the organization part is to present a background and introduction of TRX Optimizations Ltd. And the prime objective of the project part is to make an analysis of the Microwave planning, installation and commissioning.

1.3 Sources and Methods of Data Collection

To conduct the project the following sources have been used.

- Primary Information: The primary source of information is based on the collecting reports of different BSC (Base Station Conroller) of different mobile companies.
- Secondary Information: The secondary source of information is based on Internet Searching, Reference Books etc.

1.4 Benefits of Study

The analysis in the project part is based on optimization of Microwave Planning, Installing and Commissioning. In a word this report will give a short scenario of how the optimization unit works on the organization. We hope this report will be helpful for the students who have interest to work on Microwave Planning and Commissioning of any company.

Chapter 02

Overview of TRX OPTIMIZATIONS Ltd.

2.1 Introduction

TRX OPTIMIZATIONS recognized the strategic importance and potential market for telecommunication market in Bangladesh and committed to become a major specialist vendor. TRX OPTIMIZATIONS is a fast growing telecommunication service provider company, actively involved in different telecommunication projects such as GSM, GPRS and CDMA network planning, installing & optimization, troubleshooting, surveillance, objective measurement and problem anticipation.. Previously TRX worked under the name of Sai-An Electro mech. Industries Ltd. Due to the increasing demand of telecommunication services, TRX formed as a separate company in order to provide exclusive services dedicated for telecommunication needs.

2.2 Company Overview

TRX is rapidly establishing itself as an innovative leader in providing expertise to support telecommunication companies in Bangladesh. They deliver the most advanced engineering services and solutions for the wireless industry such as RF infrastructure (Radio Network Solutions, MSC, BSC, and BTS), in-building solution, wireless project management and outsourcing quality audit, end-end performance management of network etc. TRX's wireless technology house aims at providing tools, technology, expertise, and manpower for technology transfer to the clients' organization. TRX believes in the concept of true partnership from the beginning of the project to complete rollout and optimization phases.

2.3 Visions & Mission

The vision of TRX Optimizations is to be the best one-stop-shop for all RF planning and optimization in Bangladesh telecommunication sector especially for telecom operators, key vendors & private telecommunication investors. TRX Optimizations is committed to provide high mobility telecom solutions that are efficient and cost effective. They also provide services utilizing the latest available technology and maintain high standards of quality.

Chapter 03

Microwave link planning

3.1 Things to Consider for Microwave Link

Most installers know that clear line of sight is required between two antennas, but there is a lot more to it than that. In this article, the basic of designing and planning a microwave radio link will be discussed. Before getting to the nuts and bolts of designing a link, some fundamental terms and concepts need to be reviewed [1].

- Free Space Loss
- Fresnel Zone
- Receive Signal Level
- Antenna Gain
- Transmit Power
- Effective Isotropic Radiated Power
- System Operating Margin
- Multi path Interference
- Signal-to-Noise Ratio

3.2 Free Space Loss

As signals spread out from a radiating source, the energy is spread out over a larger surface area. As this occurs, the strength of that signal gets weaker. Free space loss (FSL), measured in dB specifies how much the signal has weakened over a given distance [1].

Figure 3.1: Free Space Loss

Figure 3.1 shows the formula to calculate FSL and what the theoretical loss would be at sample distances. The type of antenna used has no effect on FSL, since at any appreciable distance all antennas look like a point-source radiator

3.3 Fresnel Zone

Radio waves travel in a straight line, unless something refracts or reflects them. But the energy of radio waves is not "pencil thin." They spread out once they get radiated from source like ripples from a rock thrown into a pond. The area that the signal spreads out into is called the Fresnel zone. If there is an obstacle in the Fresnel zone, part of the radio signal will be diffracted or bent away from the straight-line path. The practical effect is that on a point-to-point radio link, this refraction will reduce the amount of RF energy reaching the receiving antenna. The radius of the Fresnel zone depends on the frequency of the signal. If the frequency becomes high, the Fresnel zone becomes smaller. Figure 2 illustrates that the Fresnel zone is fattest in the middle of the range [1].

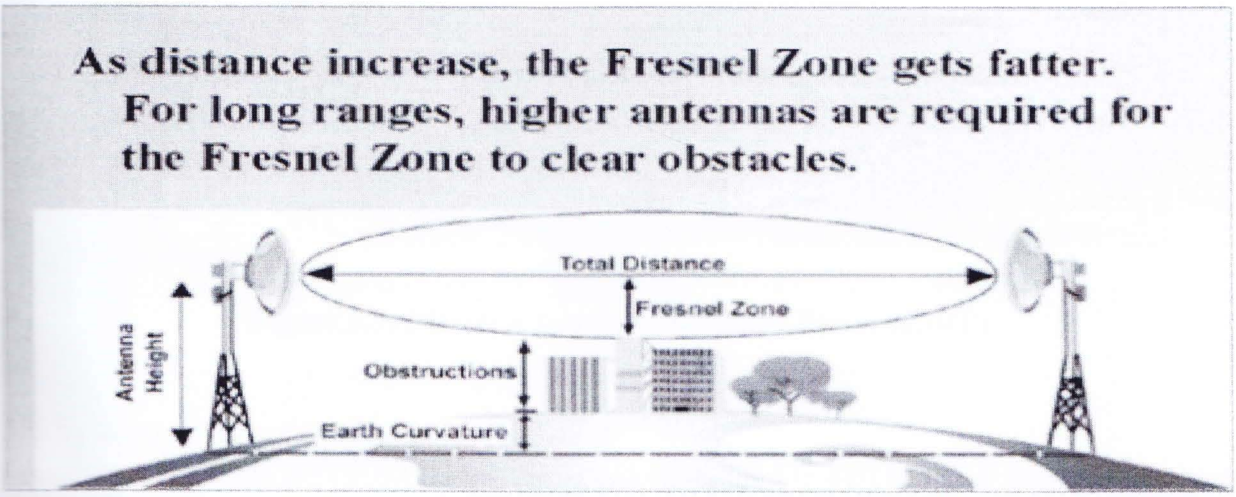


Figure 3.2: Fresnel Zone

3.4 Receiver Sensitivity

Received signal level (usually measured in negative dBm) is very much dependent on receiver sensitivity. The minimum level of the received RF signal required to demodulate and decode it without error is called the sensitivity of receiver [1].

3.5 Antenna Gain

Antenna gain is the ratio of how much an antenna boosts the RF signal over a specified low-gain radiator. Antennas achieve gain simply by focusing RF energy. If this gain is compared with an isotropic (no gain) radiator, it is measured in dBi. If the gain is measured against a standard dipole antenna, it is measured in dBd, Gain applies to both transmitting and receiving signals [1].

3.6 Transmit Power

The transmit power is the RF power coming out of the antenna port of a transmitter. It is measured in dBm, Watts or milli Watts and does not include the signal loss of the coaxial cable or the gain of the antenna [1].

3.7 Effective Isotropic Radiated Power

Effective isotropic radiated power (EIRP) is the actual RF power measured in the main lobe (or focal point) of an antenna. It is equal to the sum of the transmit power into the antenna (in dBm) and the dBi gain of the antenna. It is a power level, the result is measured in dBm. Figure 3.3 shows how +24 dBm power (250 mW) can be boosted to +48 dBm or 64 Watts of radiated power [1].

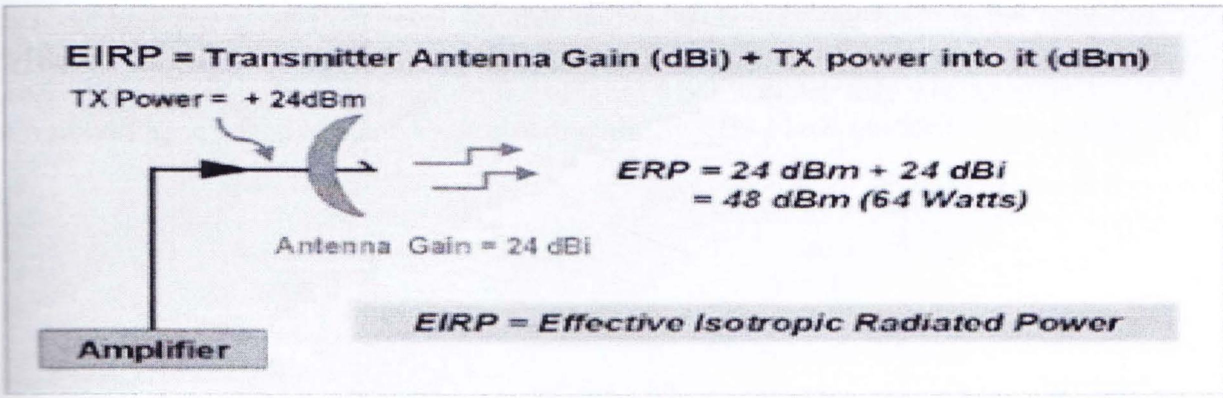


Figure 3.3: Effective Isotropic Radiated Power (EIRP)

3.8 System Operating Margin

System operating margin (SOM) is the difference (measured in dB) between the nominal signal level received at one end of a radio link and the signal level required by that radio to assure that a packet of data is decoded without error (Figure 3.4) [1].

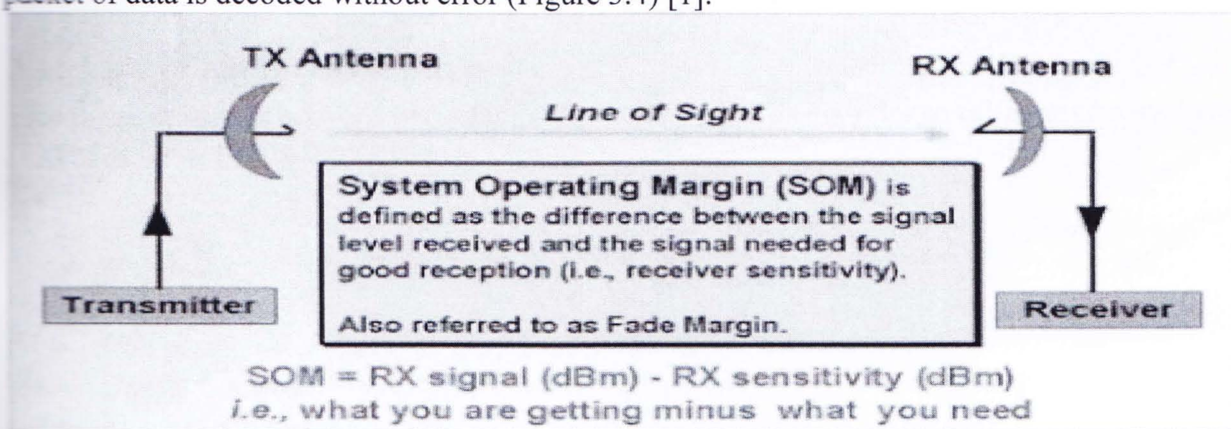


Figure 3.4: System Operating Margin (SOM)

Another word, SOM are the difference between the signal received and the radio's specified receiver's sensitivity. SOM is also referred to as link margin or fade margin.

3.9 Multi Path Interference

When signals arrive at a remote antenna after being reflected off the ground or refracted back to earth from the sky (sometimes called ducting), they will subtract (or add) to the main signal and cause the received signal to be weaker (or stronger) throughout the day [1].

3.10 Signal -to- Noise Ratio

Signal-to-noise ratio (SNR) is the ratio (usually measured in dB) between the signal level received and the noise floor level for that particular signal. The SNR is the only thing that receiver's demodulators really care about. Unless the noise floor is extremely high, the absolute level of the signal or noise is not critical. Figure 3.5 illustrates that weaker signals are larger corresponding to negative numbers. It also graphically shows how the SNR is computed [1].

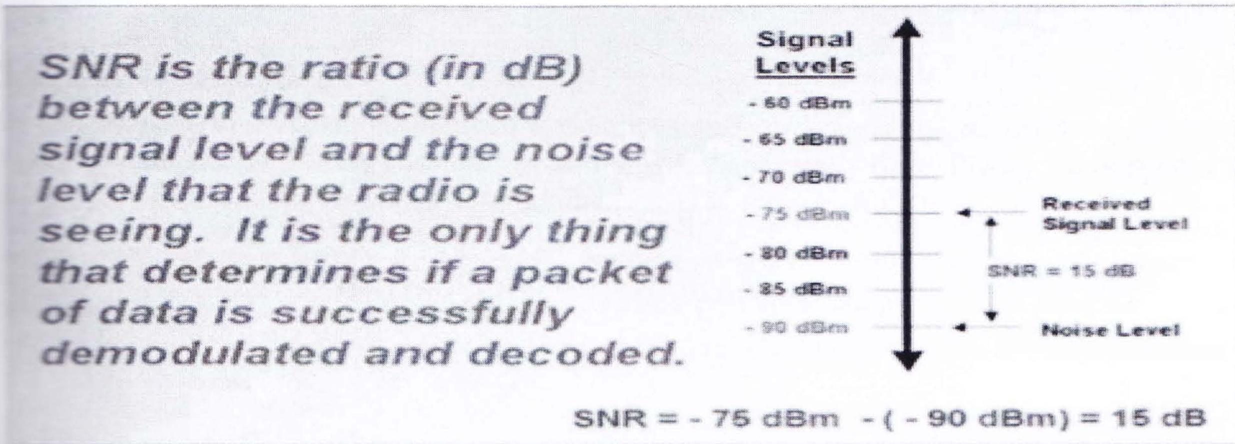


Figure 3.5: Signal-to-Noise Ratio (SNR)

3.11 Line of Sight (LOS) Survey

Line of Sight survey between two sites is also done by Engineers prior to microwave installation [1].The equipments used by surveyors are:

- GPS
- Binoculars
- Altimeter
- Compass
- Digital Camera
- Topographic maps
- Flag

The surveyors need to reach a site where the survey has to be conducted and look towards another site B for the line of sight with the help of above equipments. All the obstructions which are observed in the path are recorded and applied in to the software for determine the height with reference to AMSC (Average Mean Sea Level) of MW antenna. Whether the link is point-to-point or point-to-multipoint, the first thing to do is to verify that it will have not only clear line of sight, but at least 60 percent of the first Fresnel zone clear of obstructions as well. The longer the distance, the more important this is. If the Fresnel zone is blocked, then it will get a lower signal level on the distant end than expected even if it can literally see the other antenna in the distance. But even if the Fresnel zone is partially blocked, it is still possible to get a link, provided that the system was designed to have a strong signal at the other end of the link. In planning long-range microwave links where it is not sure that it has unobstructed line of site and clear Fresnel zone, an RF path analysis should be done. Although there are many software packages available that have geographical surface data and can create a path profile from a set of latitude/longitude coordinates. But these programs can only indicate for certain situation, such as terrain (Terrain is the third or vertical dimension of land surface) obstruction. A clear path on paper is not a guarantee that the link will work, since it does not show trees or buildings. A clear link might have 80-foot trees in the way that could block the signal [1].

3.12 SOM calculation

By doing an SOM calculation, you can test various system designs and scenarios to see how much fade margin (or "safety cushion") your link will theoretically have. Figure 3.6 illustrates a sample SOM calculation on a point-to-point link.

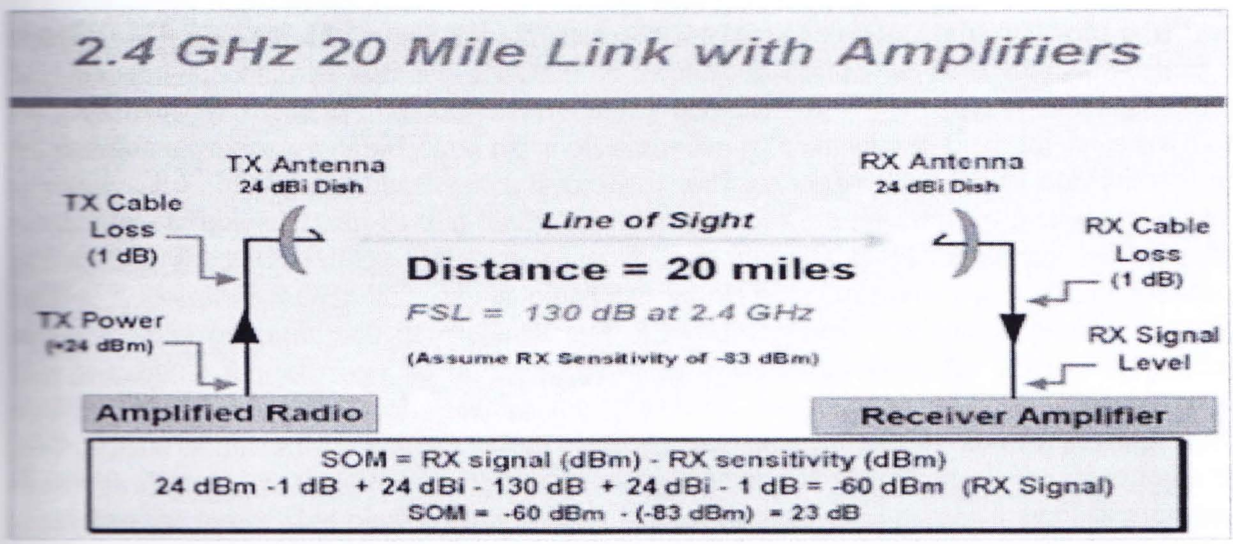


Figure 3.6: SOM Calculation

It presumes that the antennas are aimed at each other properly (i.e., they are in each others' main lobe). To calculate SOM in the example, we start with the transmitted power (+24 dBm), subtract the coaxial cable loss (1 dB) and add the transmit antenna gain (24 dBi). This gives us the effective isotropic radiated power:

EIRP = TX Power – Coaxial Cable Loss + TX Antenna Gain.

Then we subtract the FSL (130 dB), add the receiver antenna gain (24 dBi), subtract the coaxial cable loss (1 dB) and we get the signal reaching the receiver:

RX Signal = EIRP – FSL + RX Antenna Gain – Coax Cable Loss.

Then we compute the difference between the received signal and the radio's receiver sensitivity to determine the SOM. In this example, the received signal is –60 dBm and the receiver's sensitivity is –83 dBm, giving a theoretical SOM of 23 dB.

3.13 Minimum SOM

Regarding the minimum SOM needed, there is no absolute answer to this question, but the higher it is, the better. Most engineers agree that 20 dB or more is quite adequate. Some operators think as low as 14 dB is still good. Others operate systems down to 10 dB or less. The problem with accepting a lower SOM is that you have a smaller safety margin. When a system run with 14 dB SOM, the system have the risk of going down for such things as interference, atmospheric conditions, moisture in coaxial cable, ice on the surface of antenna. So while a 14 dB SOM would work, there is not much margin [1].

3.14 Real World Issues

In practice, the SOM is not the only determining factor. It's the actual SNR at the receiver that makes a link reliable. If we are getting noise or interference on our channel, our SNR will deteriorate. This could be an issue if we are co-locating at a site with other radios operating in the same band. We need to find out what frequency spectrum these radios are occupying. If these transmitters have energy or sideband noise on our received channel and their antennas are close to yours, we will likely get interference from them, perhaps to the point where our link will not work. Another consideration is that the SOM is calculated for a vacuum. In fact, there is some atmospheric absorption of the RF energy that scatters and attenuates the signal. For example, tests on a 23-mile 5.8 GHz link vary as much as +/-6 dB over course of a day. This variation is mostly caused by multipath interference and other atmospheric variations. Notice that with coaxial cable at the receiver and no amplifier at the receiver antenna, the SNR at the antenna does not survive when it actually reaches the radio itself. In this case, the noise generated in the RF front-end of the radio is a factor. Note that if you do use an amplifier on the receiving end, as shown in Figure 3.6, the SNR as it appears at the antenna is preserved all the way down the coaxial to the radio. This phenomenon largely occurs because the low-noise amplifier mounted on the pole sets the noise floor for the system. To have some certainty as to whether your wireless link will be reliable, an RF path analysis and SOM calculations need to be performed [1].

3.15 Link Budget

The basic parameters in a Point-to-Point Radio Link are put together in the Radio Link Equation. The Radio Link Equation computes the Rx Power in the absence of any propagation anomaly (free space propagation). The equation is given below:

PR = PT + GT + GR - 92.4 - 20 Log (F) - 20 Log (L)

PT = Transmitted power (dBm)
PR = Received power (dBm) (normal propagation)
GT = Tx antenna gain (dB)
GR = Rx antenna gain (dB)
F = Frequency (GHz)
L = Hop length (km)

By using Logarithmic units (dB, dBm), the Radio Link Equation is put in a very convenient form. Gains and Losses are added with positive or negative sign, as in financial budgets. The Radio Link Equation is presented in the form of a simple Link Budget.

Chapter 04

Basic Transmission System

4.1 Layers of Transmission Systems

The transmission system is categorized into 3 layers, according to traffic hierarchy viz. Access Network, Metropolitan Network and Backbone Network [2].

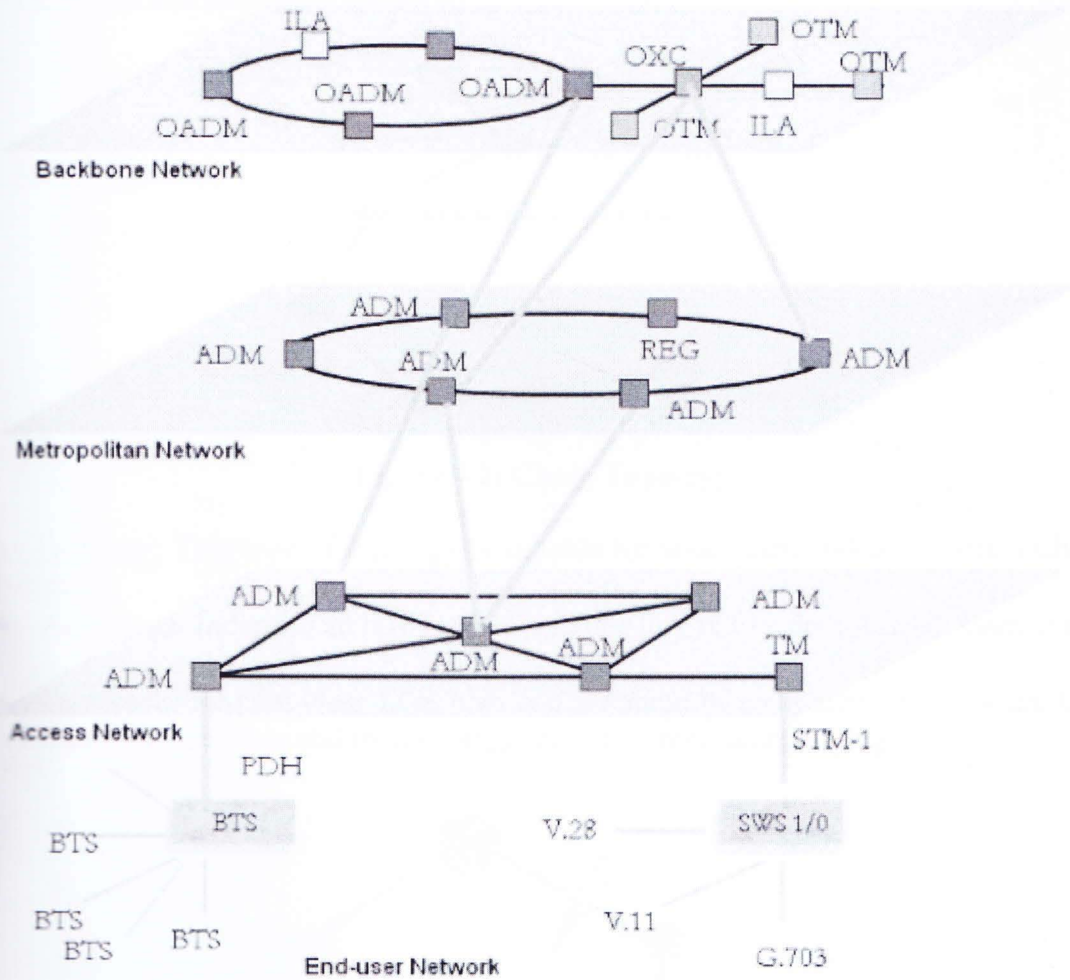


Figure 4.1: Basic Transmission System

We have only described the Access Network in this report.

4.2 Access Network Topology

There are some categories. They are given below:

1. Chain Topology: This type of network is suitable for long distant narrow transmission system like along roads.
    - Advantage: Low concentration of equipment at TX point and frequency planning is easier.
    - Drawback: High capacity requires near TX end. One link failure affects all sites after that link and extended bandwidth.

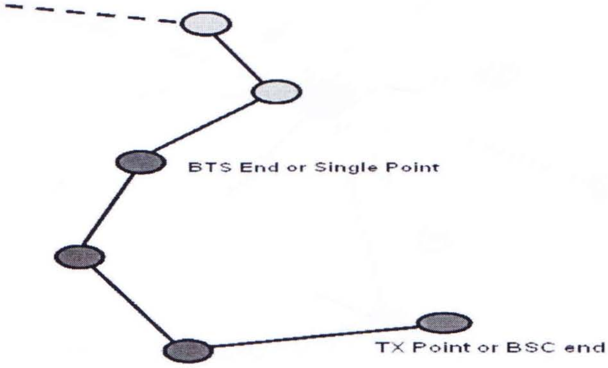


Figure 4.2: Chain Topology

2. Star Topology: This type of topology is suitable for small surrounded network such as city urban area.
    - Advantage: Independent link for BTS and one link failure do not affect many links.
    - Drawback: Require clear LOS high concentration of equipment at TX point. Difficult frequency planning and require large space for antennas mounting.

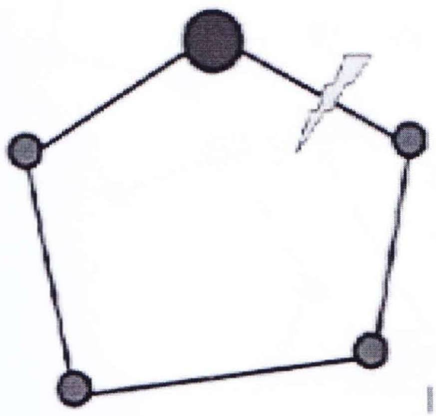


Figure 4.3: Star Topology

3. Tree Topology: This type of topology is suitable for small or medium surrounded network such as city urban area.
    - Advantage: Independent link for BTS short hop distance and so require small antenna system. Easy to find LOS and frequency reuses is easier.

    - Drawback: One link failure may affect many link and high concentration of equipment at TX point. 1+1 protection may be implemented for high capacity link.

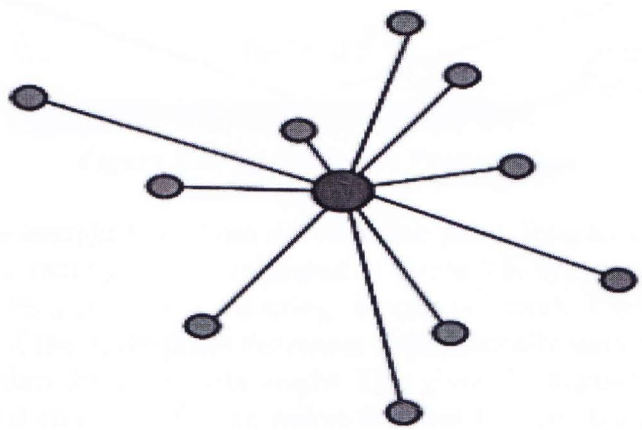


Figure 4.4: Tree Topology

4. Ring Topology: This type of topology is normally used in metropolitan area where high availability of network is required.
    - Advantage: Traffic can be rerouted easily if any link fails and easy to monitor from Management System.
    - Drawback: Every site must be connected with its two neighbor's sites. High bandwidth required. MUX equipment is required for digital cross connection.

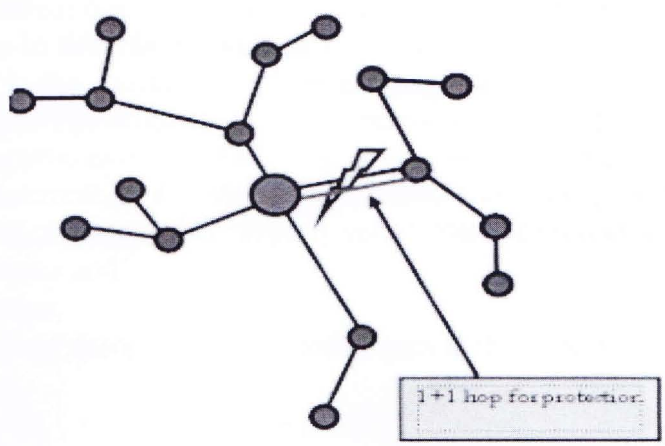


Figure 4.5: Ring Topology

4.3 Radio Wave Propagation

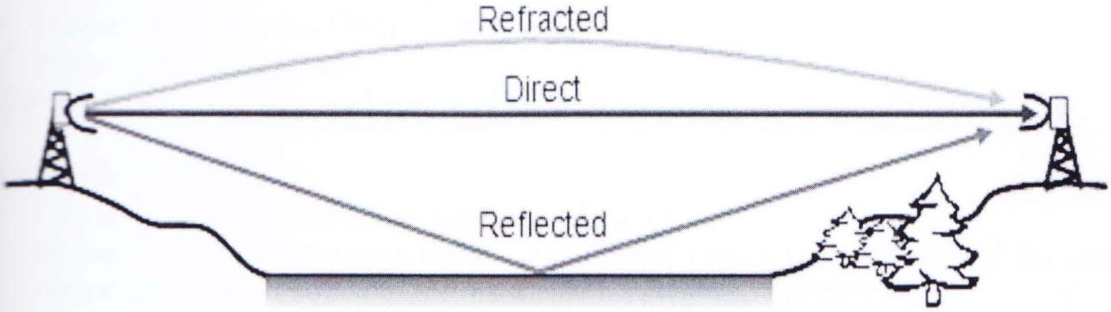


Figure 4.6: Radio Wave Propagation

The radio waves follow straight lines from the radiation point. Interaction with the molecules in the atmosphere bend the radio waves as indicated in figure 4.6. Waves are bent towards regions with higher index of refraction (e.g.: ducting in coastal area). Under normal atmospheric conditions the density of the atmosphere decreases monotonically with height above ground, so that the index of refraction decreases with height. This gives the highest index of refraction near the surface of earth, and consequently the waves are bent towards the ground as indicated [4]. Radio waves may be treated with ray optics. Several types of propagation technique are given below:

- Free space propagation
- Refraction
- Reflection and scattering
- Diffraction
- Absorption

4.4 Modulation Technique

Modulation, in communications is a process in which some characteristics of a wave (the carrier wave) is made to vary in accordance with an information-bearing signal wave (the modulating wave); demodulation is the process by which the original signal is recovered from the wave produced by modulation. The original, unmodulated wave may be of any kind, such as sound or, most often, electromagnetic radiation, including optical waves. The carrier wave can be a direct current, an alternating current, or a pulse chain. In modulation, it is processed in such a way that its amplitude, frequency, or some other property varies. Basic modulation techniques are:

- Analog Modulation and
- Digital Modulation

We have described both of those modulation techniques in this report.

4.5 Analog Modulation Techniques

- Amplitude modulation (AM)
- Angle modulation
- Frequency modulation (FM)
- Phase modulation (PM)

The feature of each type of modulation is given below:

1. Amplitude Modulation:
    - This is the simplest and oldest form of modulation.
    - In this type, the information signal (intelligence) causes the amplitude of the carrier to vary in time, in proportion to the instantaneous magnitude of their sum.

2. Frequency Modulation:
    - Uses a higher frequency carrier.
    - Usually more bandwidth.
    - Time and Frequency Domain.
    - Resistant to some Noise.

3. Angle Modulation:
    - Compared to AM, FM and PM it requires less bandwidth.
    - Angle modulation includes cos (E (t)) which produces a wide range of frequencies.

4. Frequency Modulation:
    - Uses a higher frequency carrier
    - Usually more bandwidth
    - Time and Frequency Domain
    - Resistant to some Noise

4.6 Digital Modulation Techniques

- Amplitude-shift keying (ASK)
    - Amplitude difference of carrier frequency
- Frequency-shift keying (FSK)
    - Frequency difference near carrier frequency
- Phase-shift keying (PSK)
    - Phase of carrier signal shifted

Some features are given below:

Amplitude-Shift Keying:

- One binary digit represented by presence of carrier, at constant amplitude
- Other binary digit represented by absence of carrier

Frequency-Shift Keying (FSK):

- Two binary digits represented by two different frequencies near the carrier frequency

Phase Shift Keying (PSK):

- The signal carrier is shifted in phase according to the input data stream level PSK, also called binary PSK or BPSK or 2-PSK, uses 2 phase possibilities over which the phase can vary, typically 0 and 180 degrees -- each phase represents 1 bit.
- Can also have n-PSK -- 4-PSK often is 0, 90, 180 and 270 degrees --- each phase then represents 2 bits.
- Each phase called a 'symbol'.
- Each bit or groups of bits can be represented by a phase value (e.g., 0 degrees, or 180 degrees), or bits can be based on whether or not phase changes (differential keying, e.g., no phase change is a 0, a phase change is a 1) --- DPSK.

Chapter 05

Working with TRX OPTIMAIZATIONS

5.1 General Description

During our internship period we joined with a RF antenna installing team. We went to Pangsha, Rajbari for installing a microwave site. From that tour we gathered knowledge about the stalling process. First we give some small description of different part of RF site and after that the hole installing procedure is given briefly.

For a microwave link we need two types of equipment, indoor equipment and outdoor equipment. They are called IDU (Indoor Unit) & ODU (Outdoor Unit). The indoor equipment (IDU) is in a protected room. The outdoor equipment (ODU) is behind or near the antenna. The possible cable length between IDU and ODU may be about 300 to 400m. The IDU contains the tributary, modems, alarm control unit and some auxiliary service units. The ODU contains the RF part. There is a necessity of only one connection between IDU and ODU. A DC voltage supply is required for ODU.

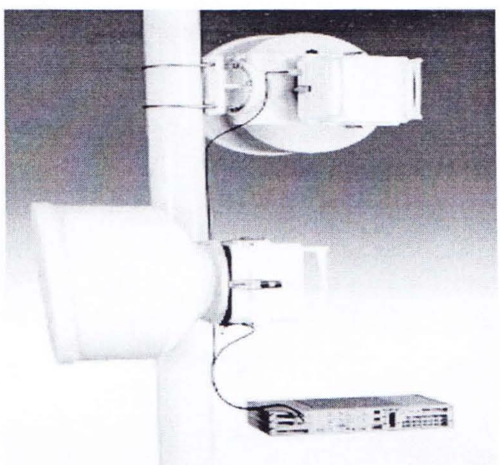


Figure 5.1: Antenna & ODU mounted on a pole connected to IDU

5.2 IDU and ODU

The basic description of SIEMENS – SRAL brand IDU and OUD is given in this report [5].

IDU: The SRAL IDU system deals with the entire digital network interfaces and generates signals which are transmitted via unique coaxial cable to ODU unit. Each IDU rack is made up of the following units:

- Controller
- Alarm Unit
- Fan Unit
- Modem

Figure 5.2: IDU

The control and supervision is made up by the controller unit. The fan unit and the alarm unit are always in the IDU rack.

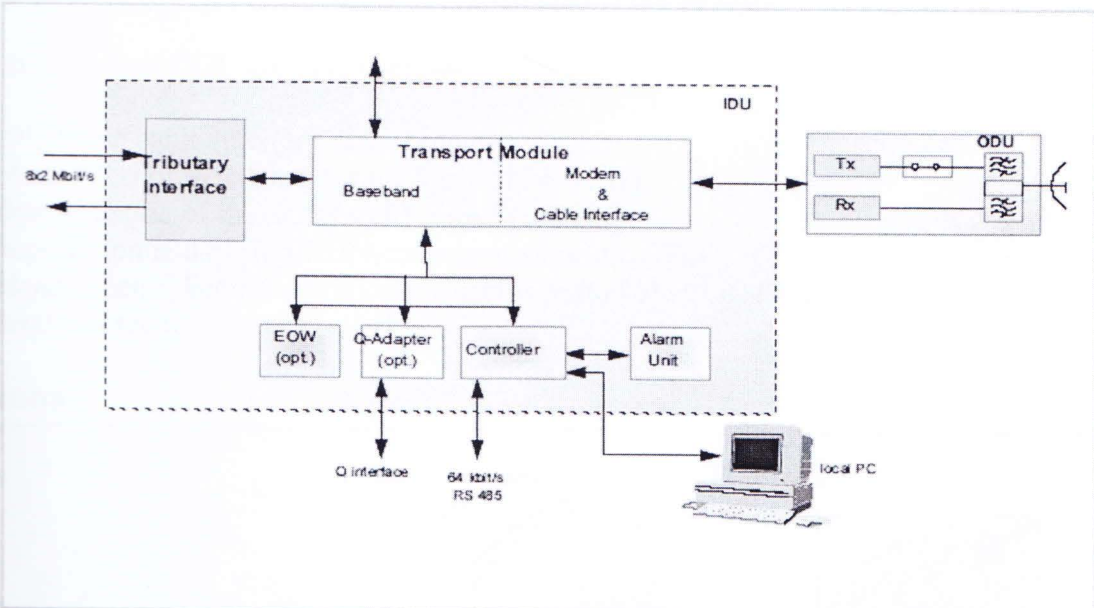


Figure 5.3: Diagram of different IDU units

The basic functions of IDU are given below:

- System interfacing to external world
- Base band digital signal processing
- IDU-ODU cable interface management (from/to ODU)
- Supervision and configuration/management of the equipment
- Control management
- Equipment's power supply management

ODU: It is always placed behind or near the antenna.

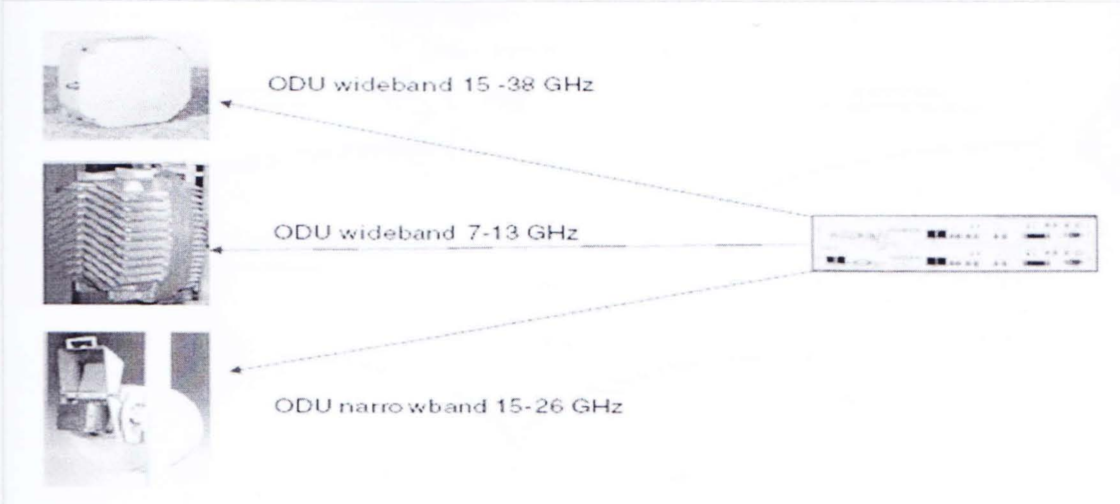


Figure 5.4: Different types of ODU

The basic functions of ODU are given below:

- IDU-ODU cable interface management
- Modulation of base band digital signal (from IDU)
- Demodulation of the received RF signal (to IDU)
- Supervision and configuration/management of the ODU
- Management of communication channel from/to IDU CONTROLLER
- Send and receive signal.

5.3 Antenna

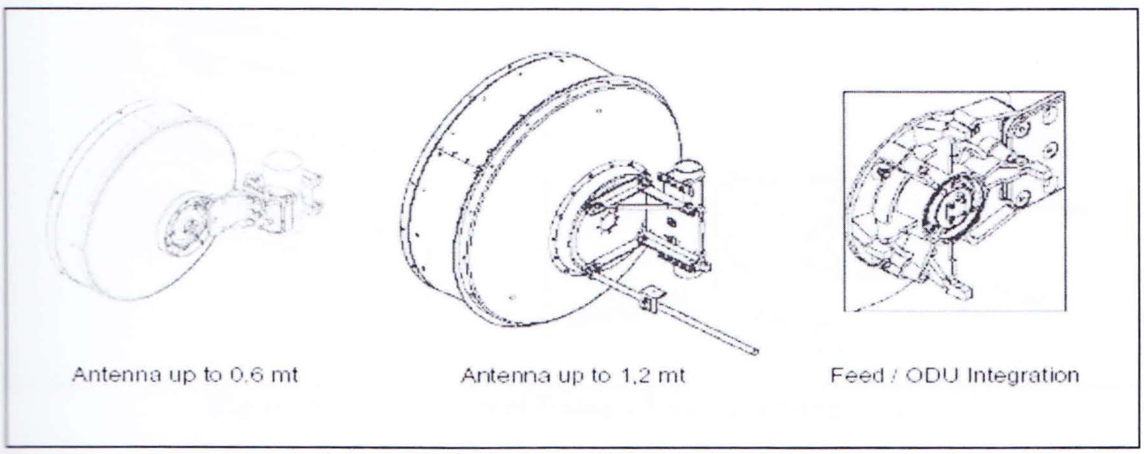


Figure 5.5: Antenna type up to 1.2 m

Figure 5.5 shows the back side of the antenna. The antenna is connected to the pole by the connector placed behind it [6].

5.4 System Architecture

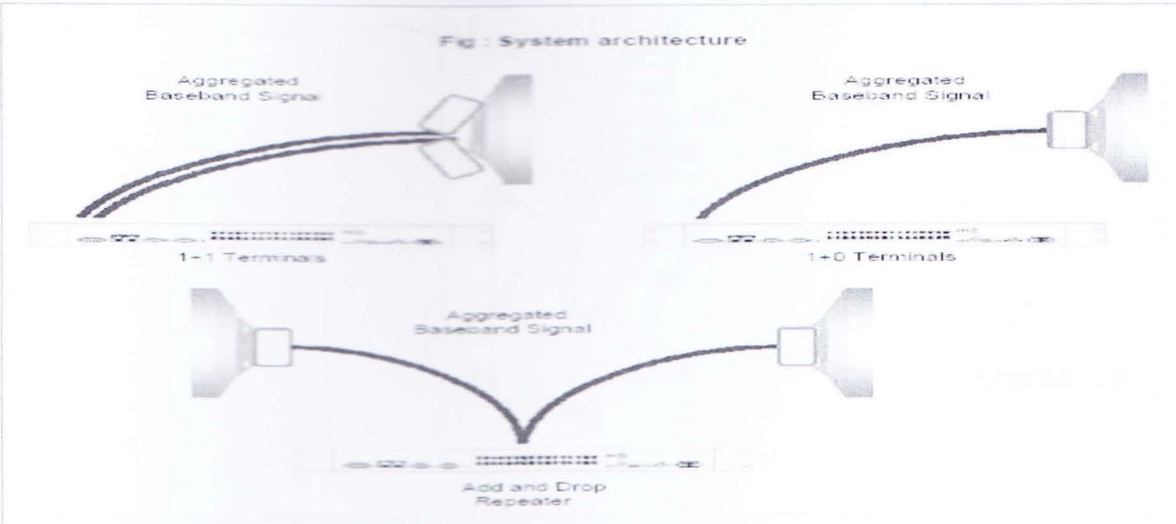


Figure 5.6: One ODU in case of (1+0) and Two ODU in case of (1+1) or (2+0)

Antenna can be installed in one direction, which is done usually but it also can be in two directions if the system architecture required [6].

5.5 Equipment Installation

Step 1: Fixing the frame for the ODU with pole

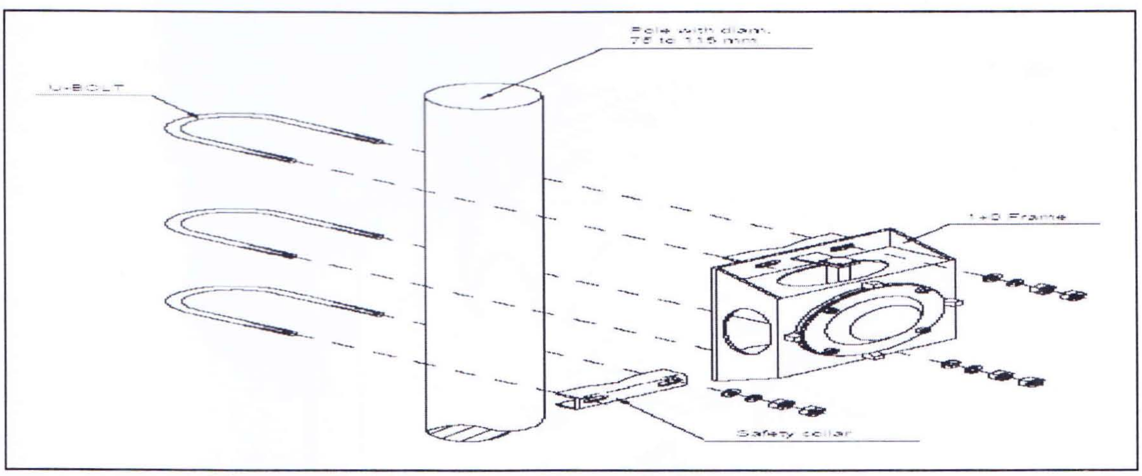


Figure 5.7: 1+0 vertical frame - Pole mounting

The frame is connected to the pole using U-BOLT. Figure 5.7 shows the process [6].

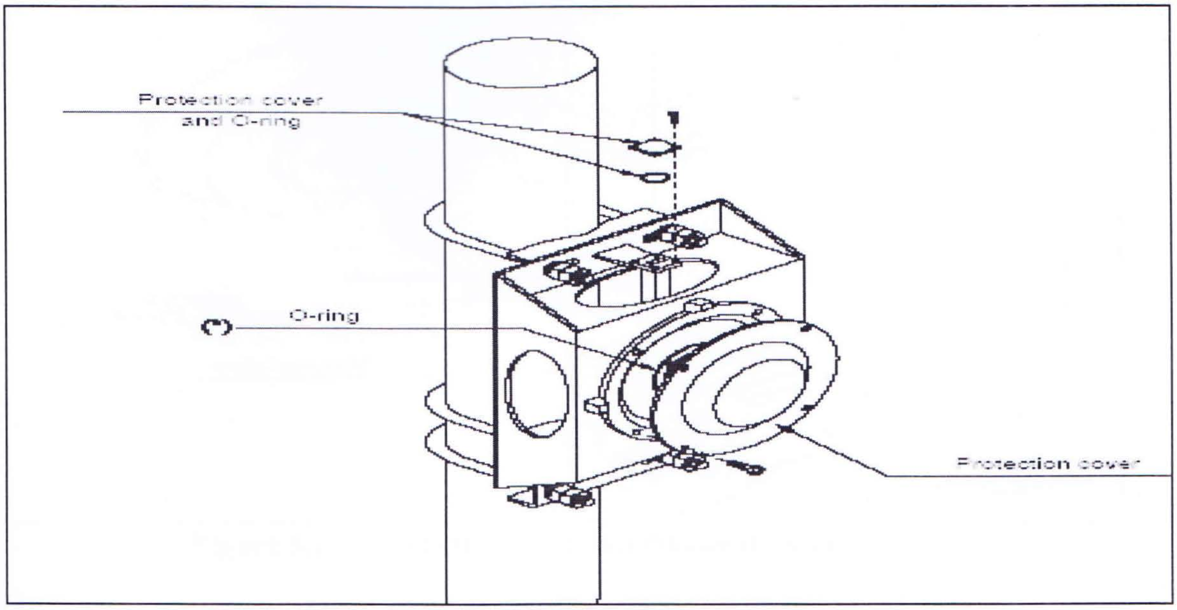


Figure 5.8: 1+0 vertical frame - O-rings-protection cover

The O-ring and the Protection cover are shown in figure 5.8 [6].

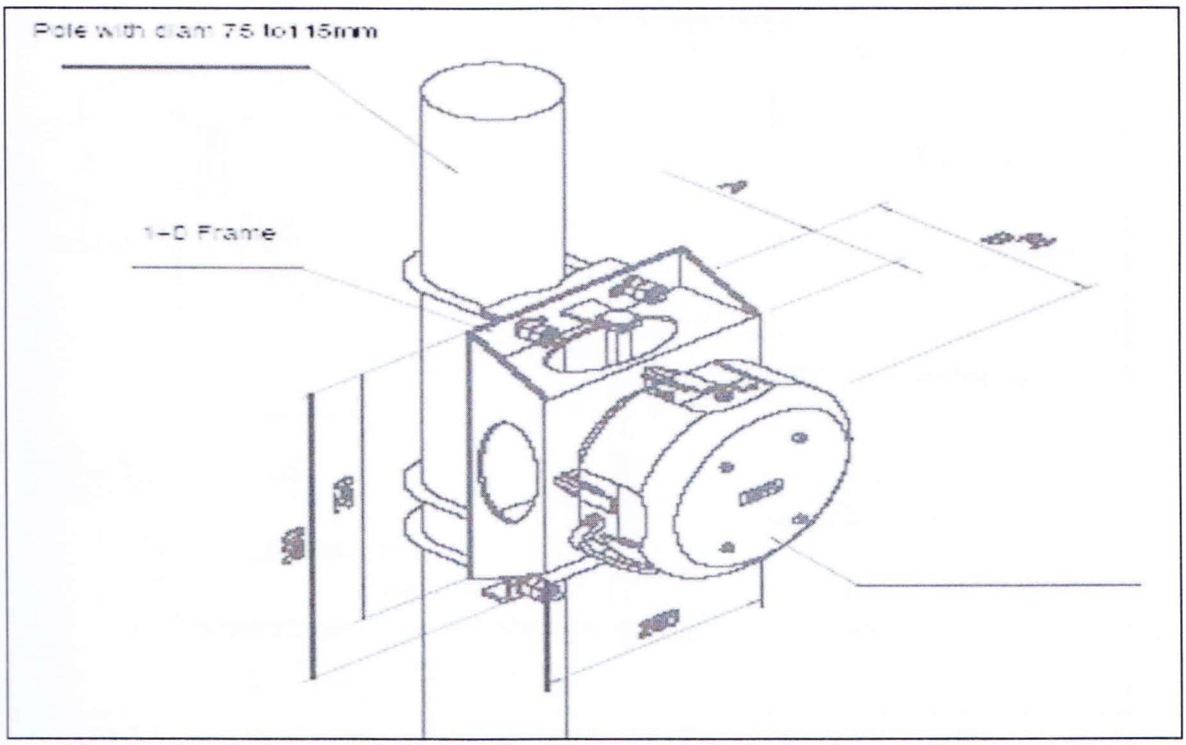


Figure 5.9: 1+0 vertical frame dimensions with independent antenna

The O-ring and the Protection cover are connected in figure 5.9 [6].

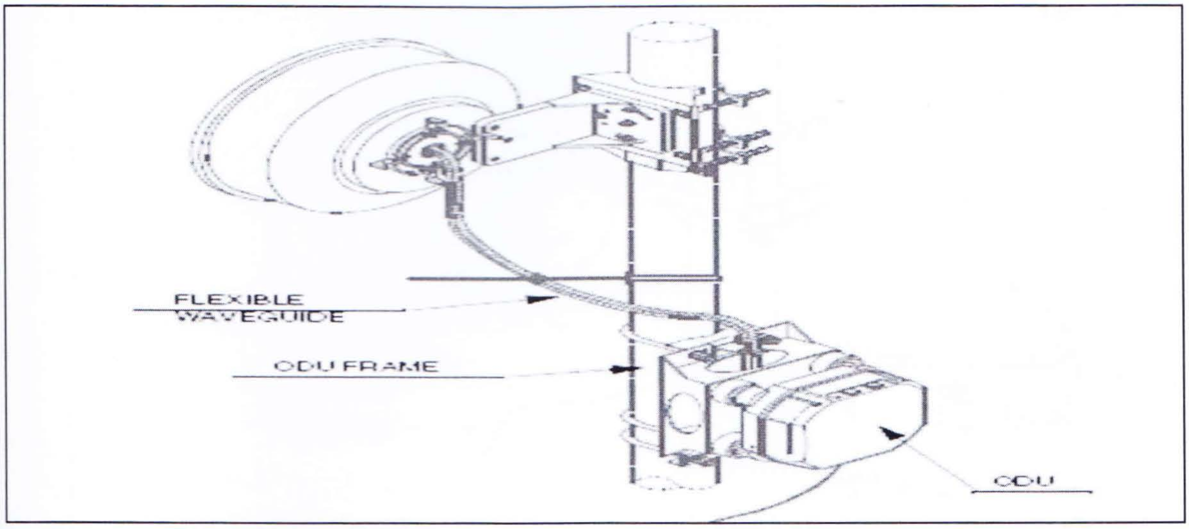


Figure 5.10: 1+0 system with independent antenna

The waveguide is connected to the ODU in figure 5.10 [6].

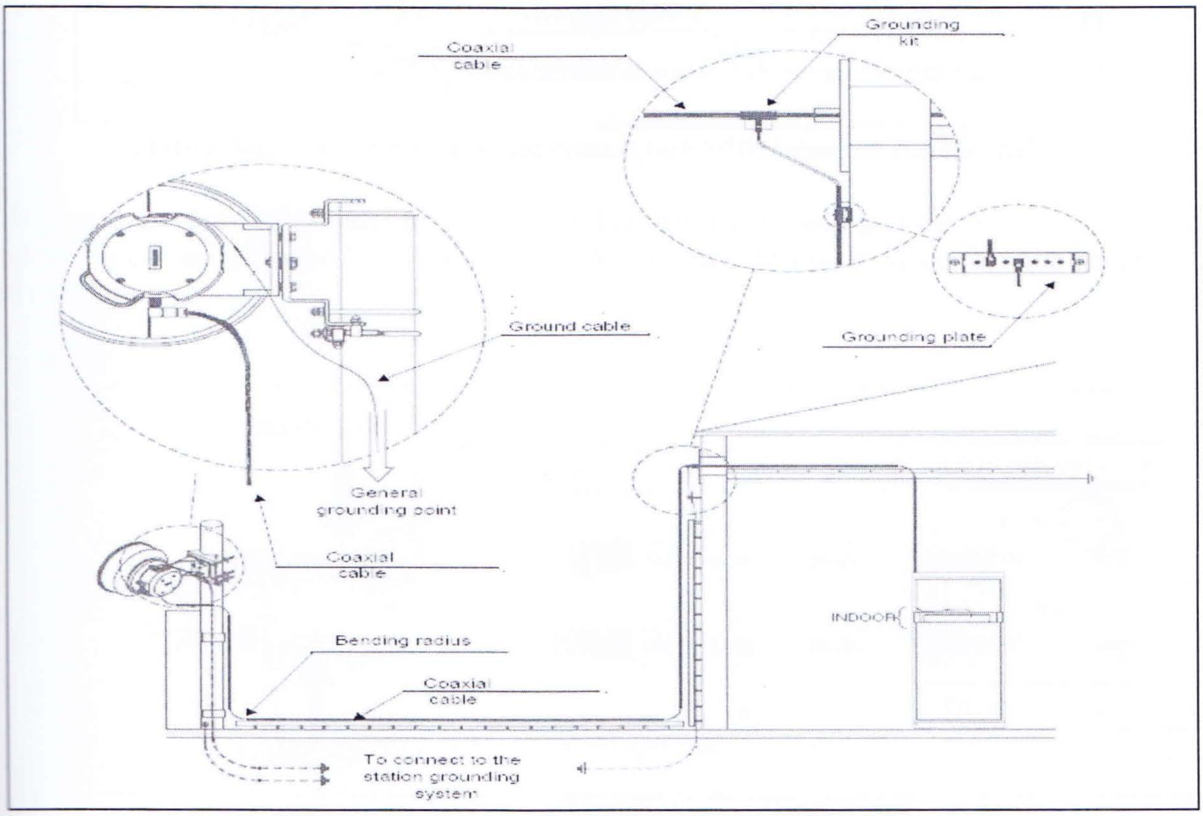


Figure 5.11: Coaxial cable & Grounding connections (Integrated Antenna)

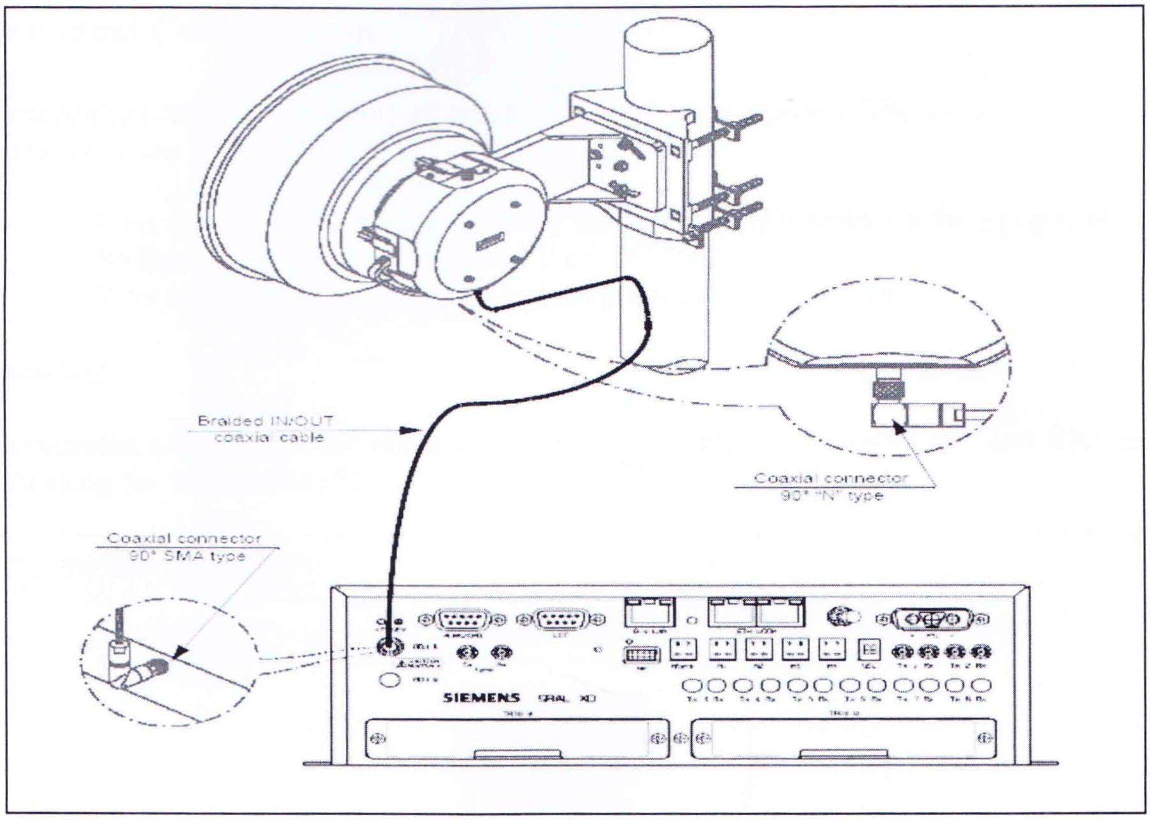


Figure 5.12: IDU/ODU typical connection with braided coaxial cable

IDU is connected with the ODU by a coaxial cable. After completion of the physical connection we have to commission the installed site. For that we have to know different types of interface and indicator lights.

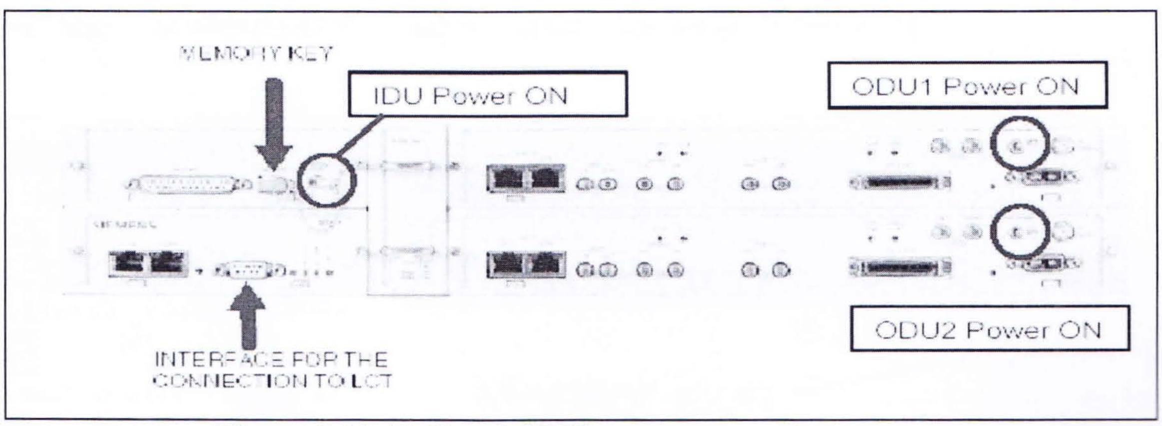


Figure 5.13: IDU and ODU power connections

The Memory Key is inserted on the IDU and ODU and IDU Power are switched on [5].

5.6 Equipment Configuration

Equipment configuring is the next step after connecting all the equipment. The steps of configuring are given below [5]:

- First check that the Backup Memory Key is properly inserted on the equipment.
- Switch ON the IDU unit and after the ODU Units.
- Wait until controller unit ends the boot phase (about30 / 60 sec.).

PC Connection:

IDU is connected to PC to set the operating frequency and other parameters. PC and IDU are connected using the serial cable [5].

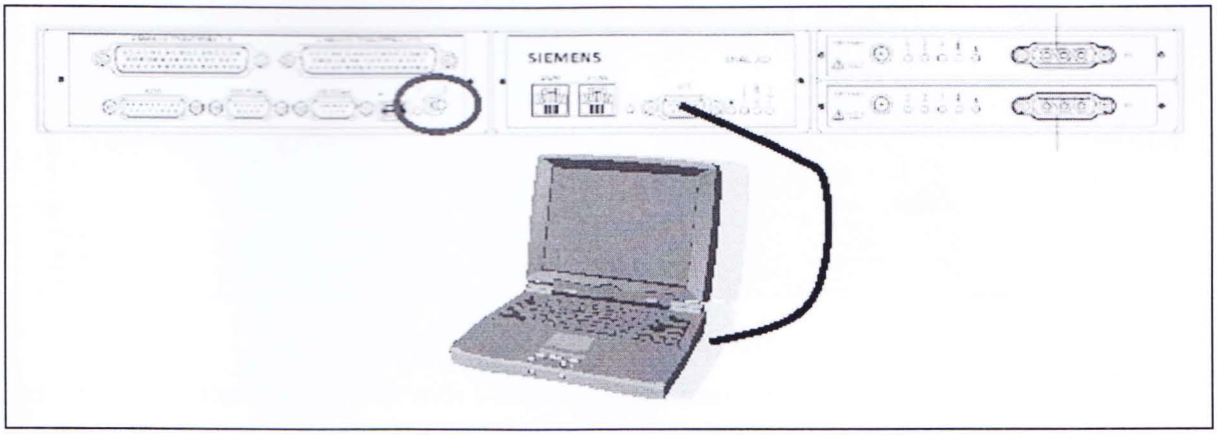
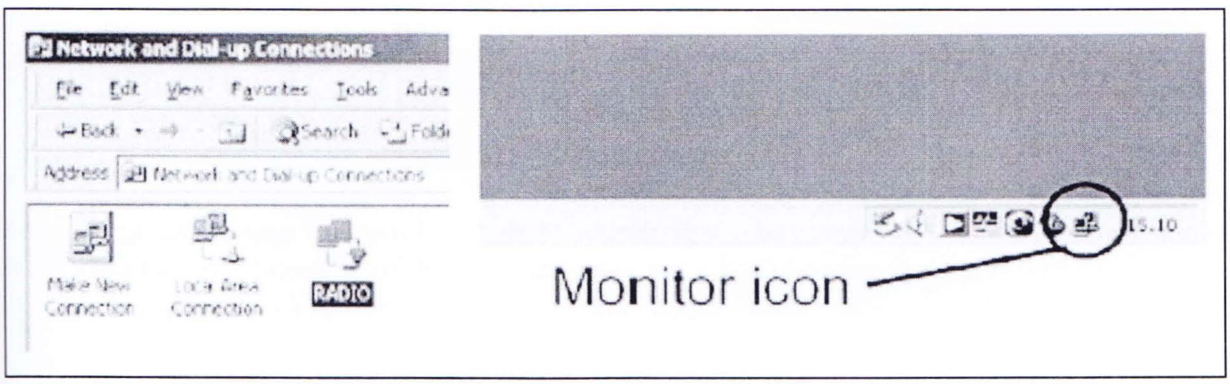
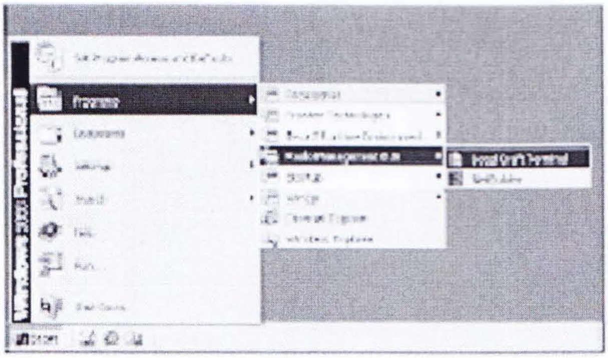
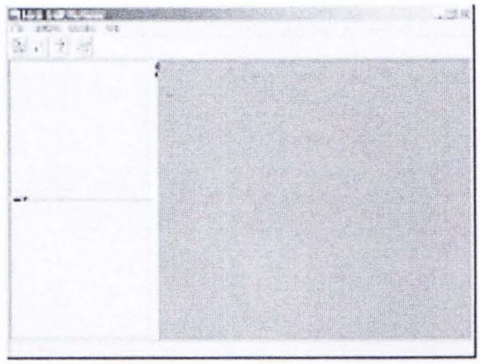


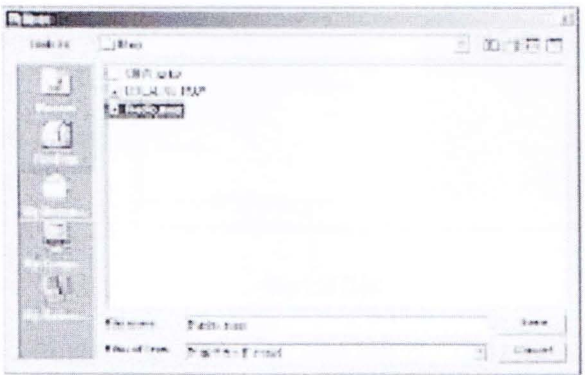
Figure 5.14: PC connection with IDU/ODU

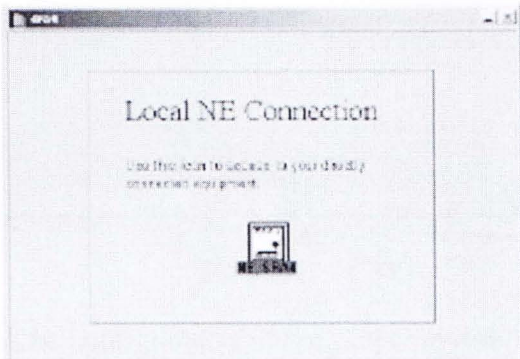
After connecting PC to IUD the Local Craft Terminal application is run which contains the "LocalNe" Map. The pictures of the windows for the steps are given below [5].



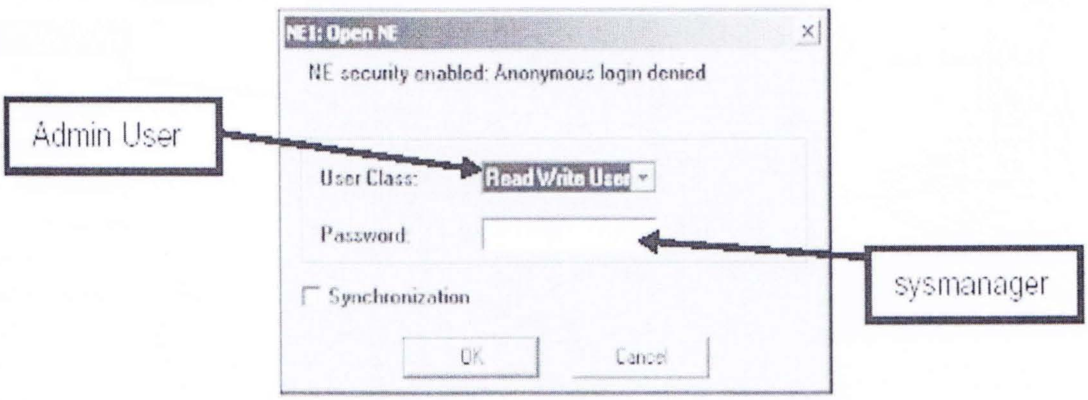




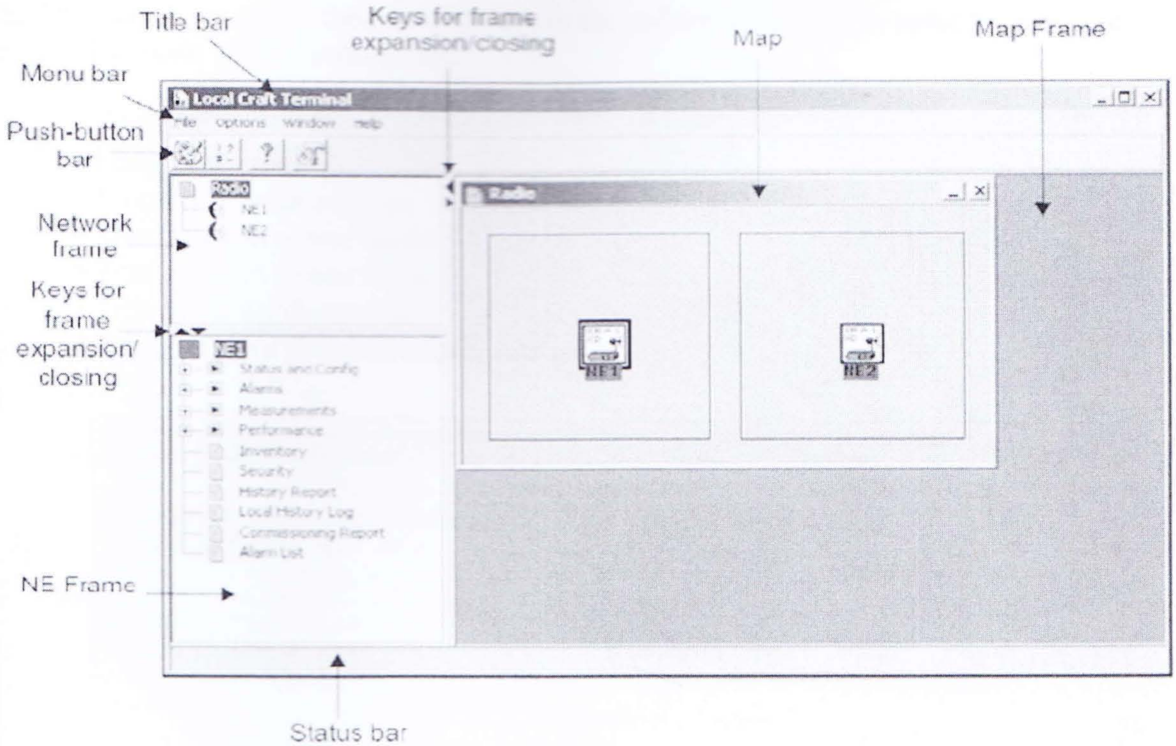




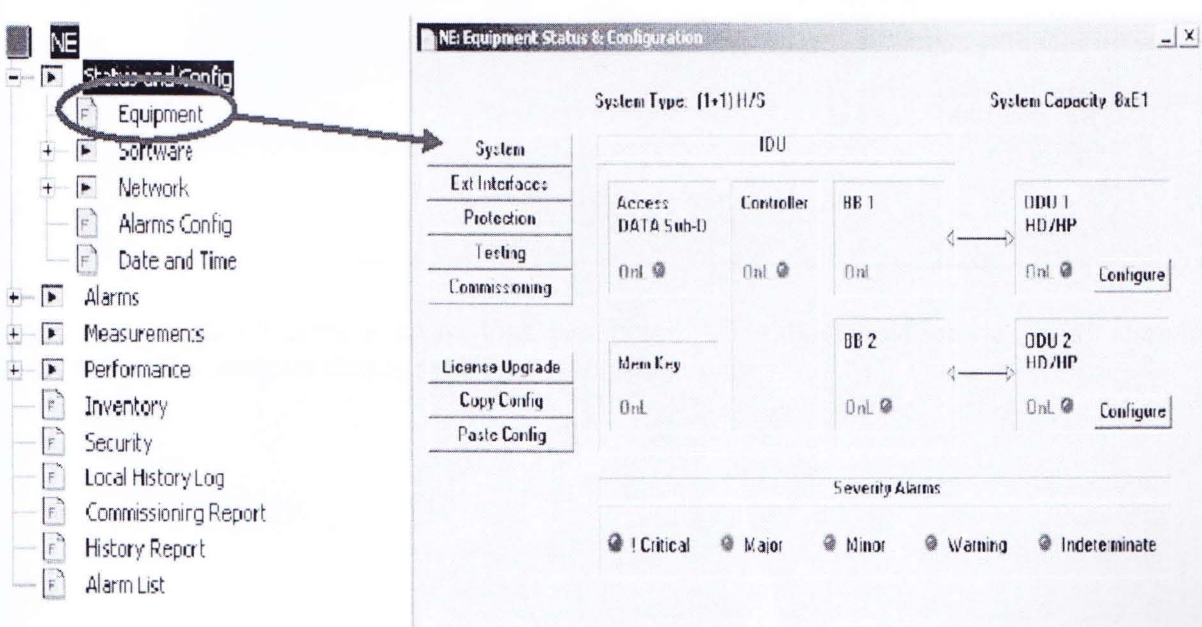
Next a Security window appears with a user class and password to be filled out.



We used the user name "Admin User" and "sysmanager" for password. After the acquisition of all NE data the GUI interface of the LCT are descript in the following figure:

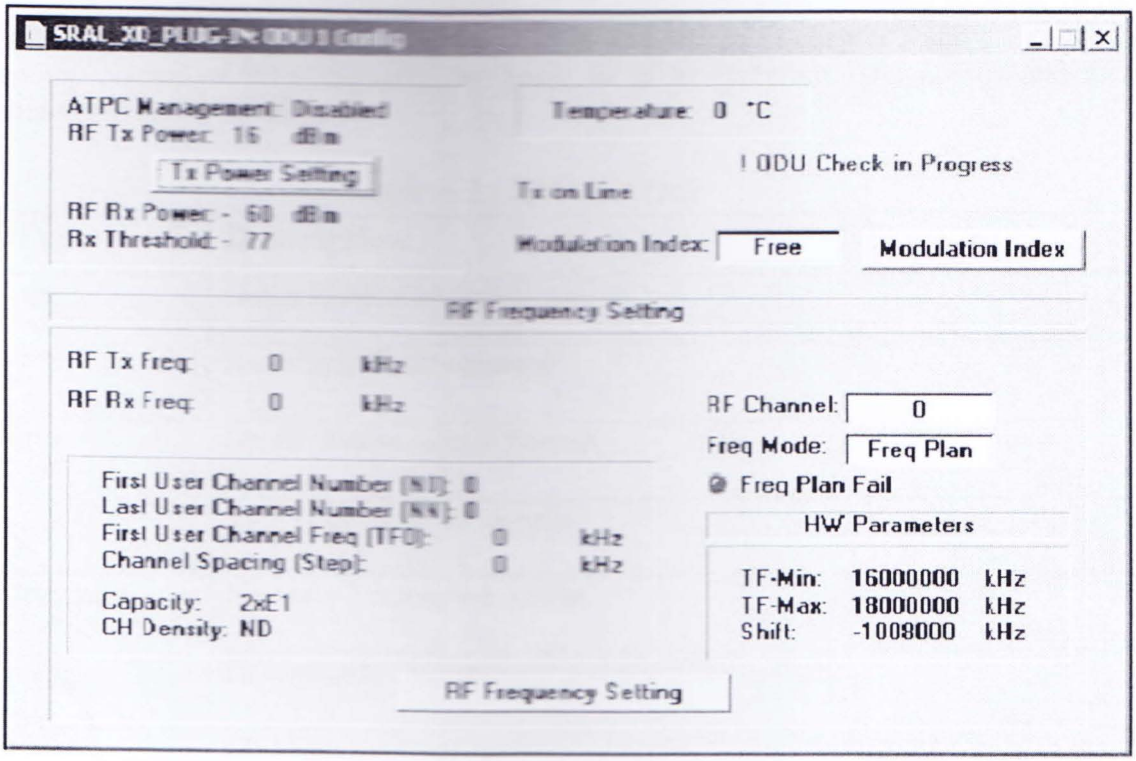


According to the planning and the equipment, it must be configured with the proper system type configuration. It is done from the main menu, Status and Config > Equipment > System:



The final step is to set all the relevant data to the software window in order to insert the system on line. The main system settings are:

- Capacity
- Frequency mode
- Frequency value settings
- Transmission power mode
- Transmission power value
- Tributaries configuration
- Other services (User interface, Alarms)



Sample data are shown in the window. Our team placed accurate data which we are not showing in this report. The accurate data is measured from site survey.

Chapter 06

Alarm Monitoring

6.1 Microwave IDU Alarm

Microwave IDU alarms can be checked from MSC or from BTS. In MSC there are visual monitors which always indicate the alarms. Another way to check the alarm is to go to BTS and check the alarm lights manually. There are three ways to solve the faults which cause the alarm lights to blink- soft reset, hard reset and remove the faulty part from IDU. The first one can be done from MSC but other two methods cannot be implemented without going to BTS. In our internship, first we did the commissioning part which is described in chapter 5 and after that we monitored the alarms of BTS manually by going to BTS. Different IDU alarms and their descriptions are given in the table 6.1.

Table 6.1: IDU Alarms

Alarm Type	Description
Cable alarm	Green Blink: Cable OK
	Red Blink: Fault occurred
Power alarm	Green: Power supply Normal
	Red: Fault in power supply
Transmitter alarm	M: Main Transmitter Active
	D: Diversity (Redundancy) Transmitter Active
Receiver alarm	M: Main Receiver Active
	R: Diversity (Redundancy) Receiver Active
Synchronizing alarm	Synchronizing Problem Detected
Radio signal alarm	Radio signal problem Detected
Remote BTS alarm	Problem in neighbor BTS connected
General alarm	Other problem

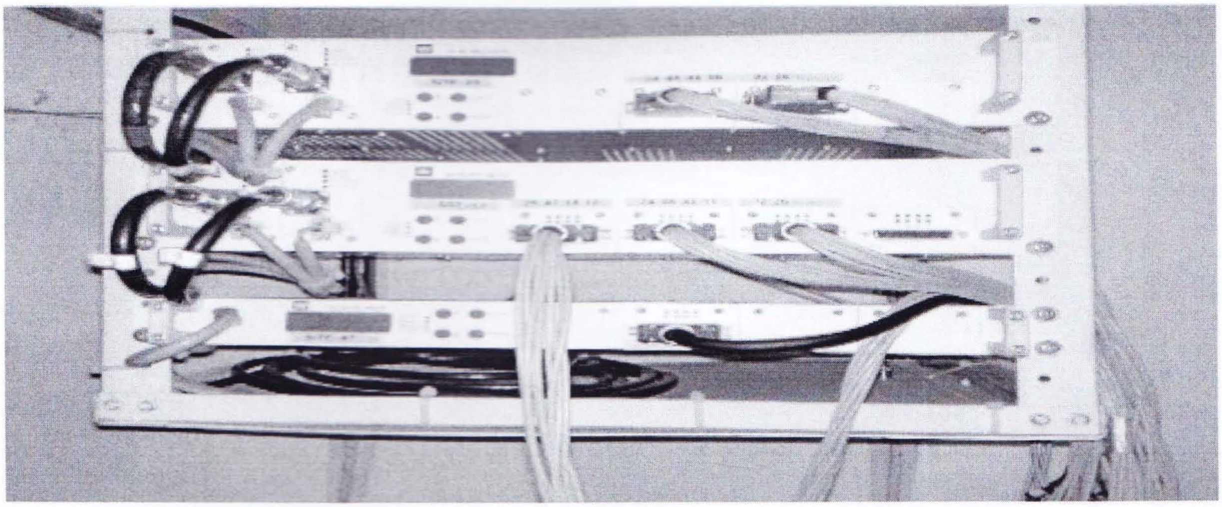


Figure 6.1: IDU

6.2 BTS/RBS Alarm:

We have also learned about the alarms of Controller & Maintenance Module (CMM). Different CMM alarms and their descriptions are given in the table 6.2.

Table 6.2: CMM Alarms

Alarm Name	Alarm Type	Description
PWR	Power Alarm	Green Blink: OK Red Blink: Problem occurred in power supply
RUN	Running Condition alarm	Green blink: OK Red blink: CMM can't Run
SYN	Synchronizing alarm	Green blink: OK Red blink: CMM can't synchronized with BSC
CLK	Clock Alarm	Green blink: OK Red blink: BTS cabinets has different clock cycle
MST	Master-Slave Alarm	If OFF: OK Red blink: Master CMM down, Slave CMM up; NO Backup
STA	Statistical Alarm	Green blink: OK Red blink 1time per sec: CMM can't communicate with BTS Red blink 4time per sec: CMM can't communicate with CDU or TRMD

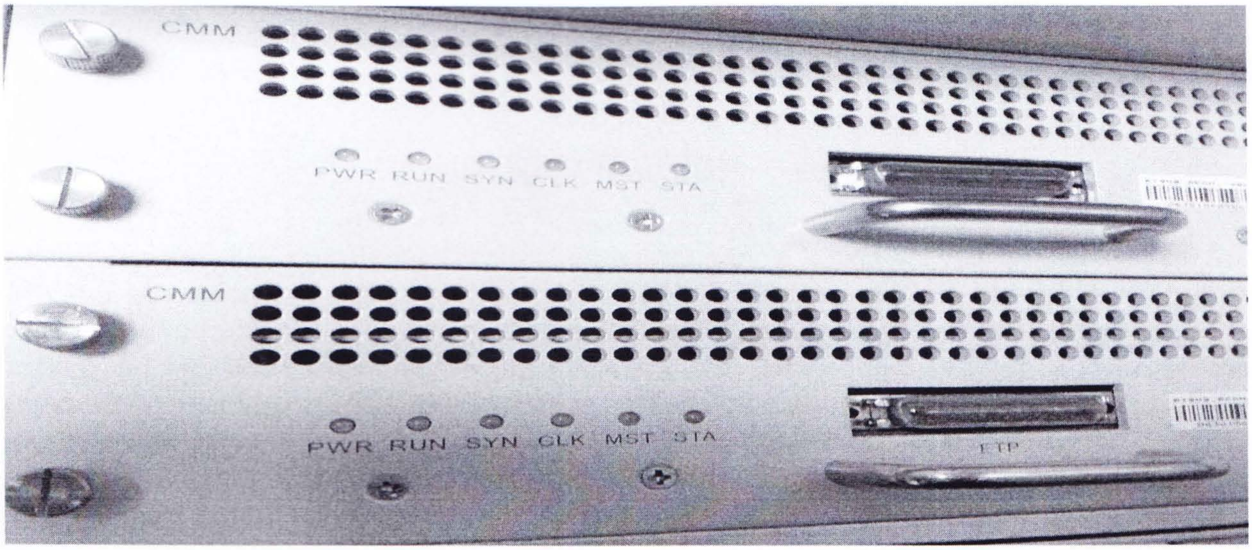


Figure 6.2: Controller & Maintenance Module (CMM) Alarm

Chapter - 07

Conclusion

Microwave planning, installing and commissioning is quite a large sector of cellular system. We give our best effort to learn as much as possible in this short period of internship. From this internship we joined in a team to install a RF site. The initial work, site survey was done earlier and we were given a basic idea of how it was done. Then we learned to install the microwave antennas and we after installing antennas we did the commissioning part of the site. We also learned how to check the alarms of BTS and eventually we monitored the alarms of some BTSs. We have also familiarized with a corporate environment. From our internship we have gathered lots of knowledge and many experiences.

References

[1] Michael F. Young, Former President and CTO (YDI Wireless), *microwave link planning* http://www.terabeam.com/solutions/whitepapers/plan_micro_link.php

[2] ATIS committee PRQC. "Network Topology"-ATIS Telecom Glossary 2007.

[3] "Impact of the access network topology on the handoff performance"- Liesbeth Peters, Ingrid Moerman, Bart Dhoedt, and Piet Demeester- Department of Information Technology (INTEC), Ghent University - IBBT - IMEC, Gent, Belgium.

[4] The Basics of Radio Wave Propagation- Edwin C. Jones, MD, PhD (AE4TM) Department of Physics and Astronomy, University of Tennessee, Knoxville.

[5] SIEMENS – SRAL brand IDU and OUD installation guide.

[6] ZTE-Antenna installation guide.

Appendix

MS: Mobile Station

MSC: Mobile Services Switching Center
OMC: Operation and Maintenance Center

EIR: Equipment Identification Register

HLR: Home Location Register
VLR: Visitor Location Register
MS: Mobile Station
ISDN: Integrated Services Digital Network
PSTN: Public Switched Telephone Network
PSPDN: Packet Switched Public Data Network
PLMN: Public Land Mobile Network

IDU: Indoor Unit
ODU: Outdoor Unit

SNR: Signal-to-Noise Ratio
EIRP: Effective Isotropic Radiated Power
SOM: System Operating Margin

AN: Access Network
ATM: Asynchronous Transfer Mode
AUC: Authentication Center

BCCH: Broadcast Control Channel
BCFE: Broadcast Control Functional Entity
BCH: Broadcast Channel
BER: Bit Error Rate
BSS: Base Station Subsystem
BSC: Base Station Controller
BTS: Base Transceiver Station

CCCH: Common Control Channel
CDMA: Code Division Multiple Access
CMM: Controller & Maintenance Module
CN: Core Networks