Day 4 course

VSAT Installation, Maintenance

By NIAMEOGO W. Eric

1- Sample Hardware list

The VSAT system consists of the following hardware:

- The Outdoor unit assembly
- The Indoor unit assembly

1- Sample Hardware list

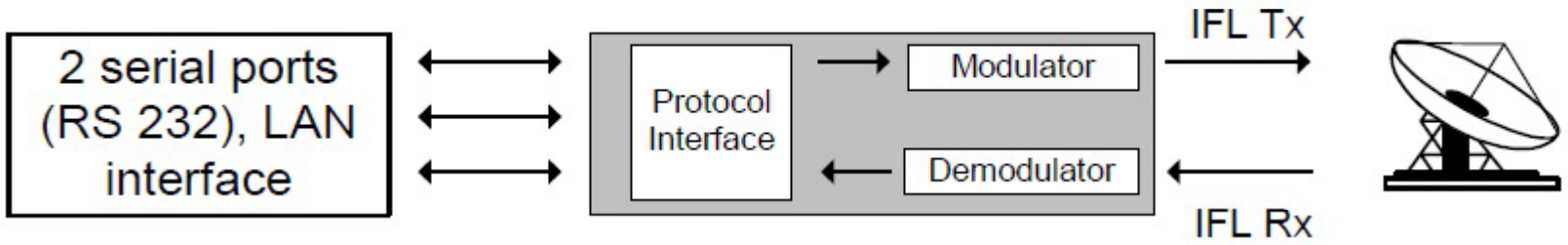
The outdoor unit assembly consists of:

- 1.2 m antenna operating in the Ku band
- Standard L-band LNB for the receiving signal. The LNB converts the Ku band signal received from the satellite into an L band signal.
- Transmitter for the transmitting signal. The transmitter converts the L band signal transmitted from the VSAT into a Ku band signal.
- OMT (Orthomode Transducer) separates the transmit signal from the received signal, taking advantage of their different polarization and frequency.
- Two IFL cables connecting the indoor unit assembly with the outdoor unit assembly. The IFL cabling carries the inbound and the outbound signals and the 24 VDC for the LNB.

1- Sample Hardware list

The indoor unit assembly consists of the Indoor Unit (IDU) witch contains the following:

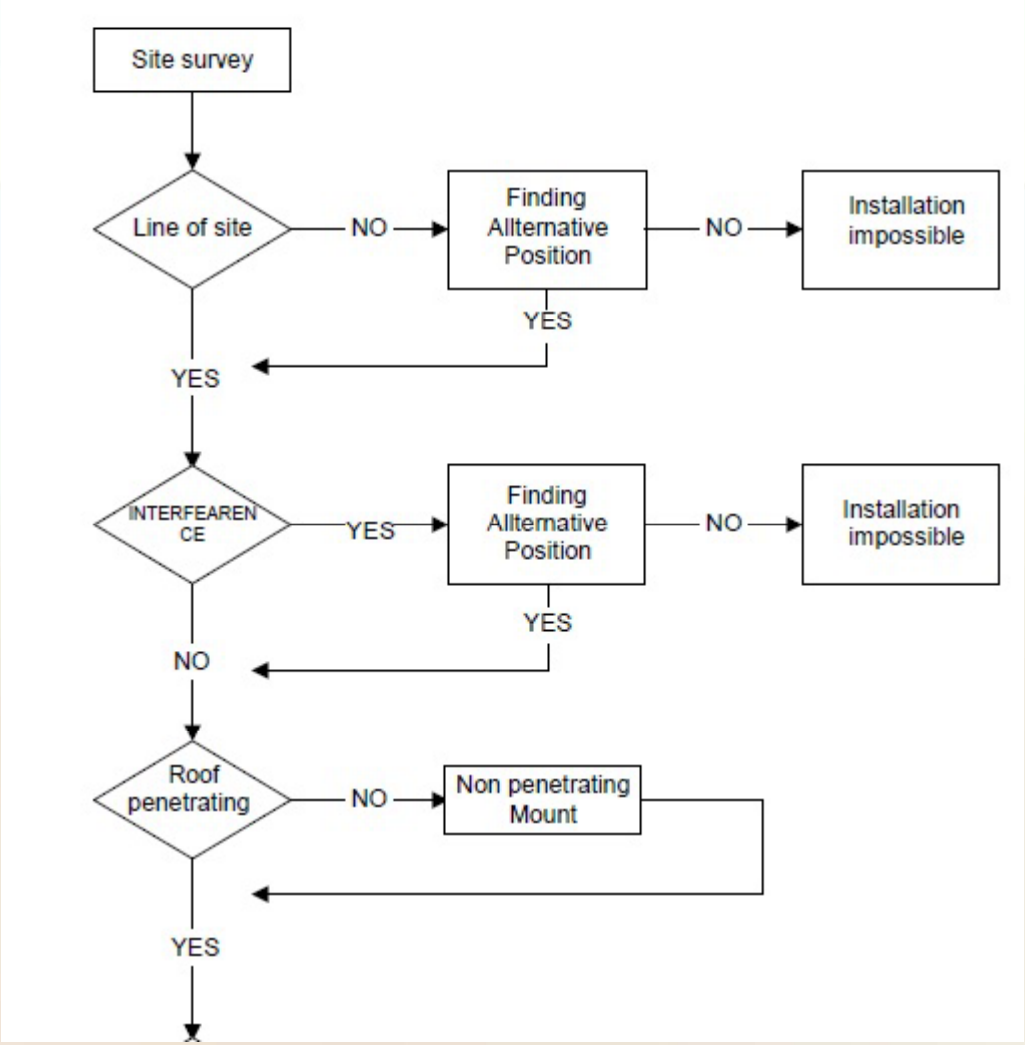
- The Modulator
- The Demodulator
- Two serial and one Ethernet port.



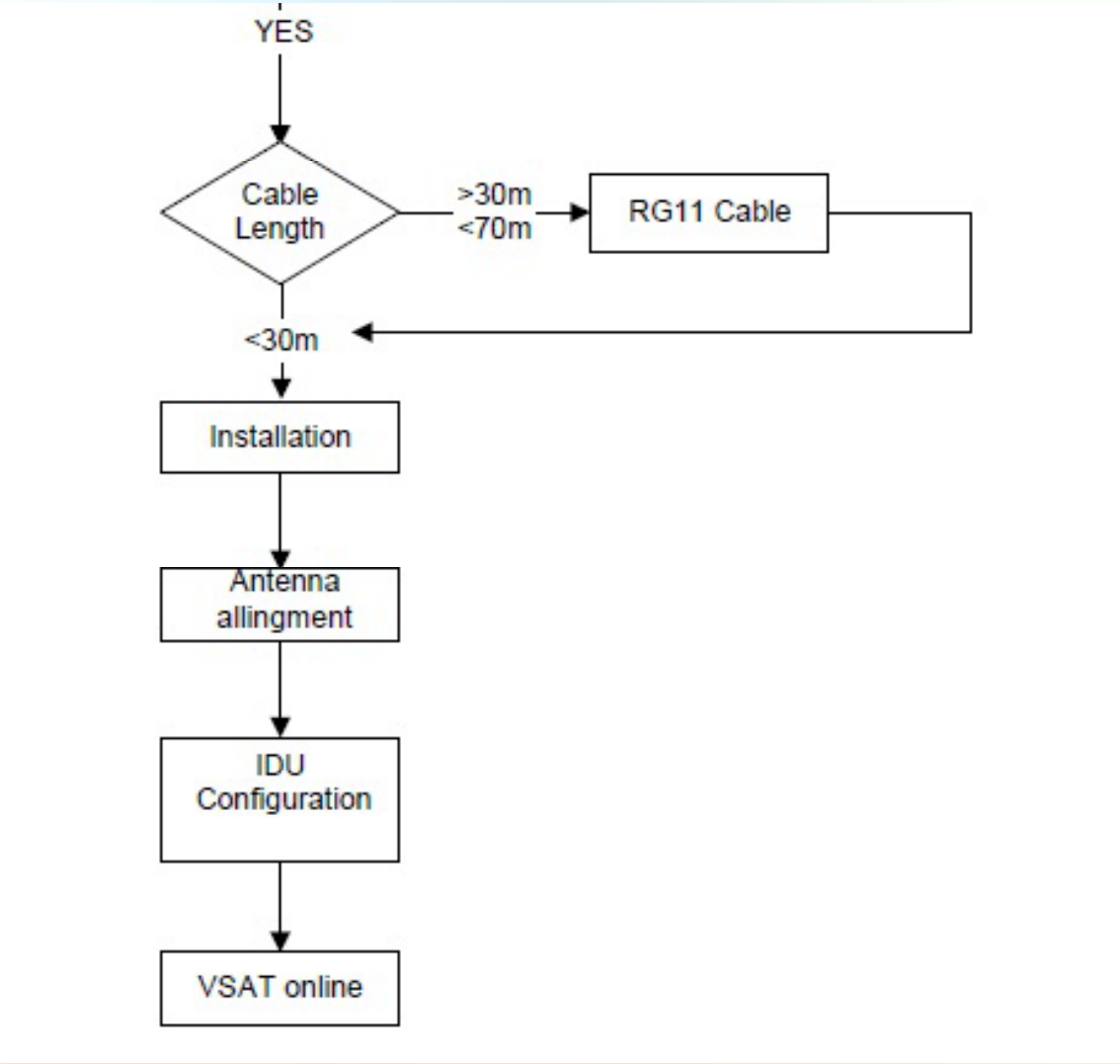
VSAT system architecture (block diagram)

2-General flow chart concerning VSAT installation

The actions that will follow the site survey until bringing the VSAT online are:



2-General flow chart concerning VSAT installation



3-Site Survey

Before installation, a field operations engineer should visit the site that the VSAT is to be installed. The engineer has to take care of the following:

- Absence of high-rise buildings, trees etc, which may block the signal path.
- Absence of interference by using a gun and a field meter.
- Existence of AC power during installation.
- Existence of a clear, unobstructed line of sight to the designated satellite
- Acquisition of the longitude and latitude using GPS.
- Existence of a LAN network near the IDU.
- Estimation of the maximum cable length.
- Free access to the roof of the building.

3-Site Survey

The IDU is designed for installation indoors. It may be placed on top of a bench or on a shelf in a rack. While placing the IDU the following requirements should be met:

- The IDU includes a fan for ventilation. To allow proper airflow and to guarantee safe operation of the VSAT equipment, make sure that:
- The rear panel of the IDU is not covered.
- The IDU is not placed in an unventilated enclosure.
- At least 10 cm of space along the IDU sides are left for ventilation.
- The maximum ambient temperature is 50 oC.
- Place the IDU where it can be easily accessed by a technician during maintenance.
- **Place the IDU away from electromagnetic field emitting devices.**

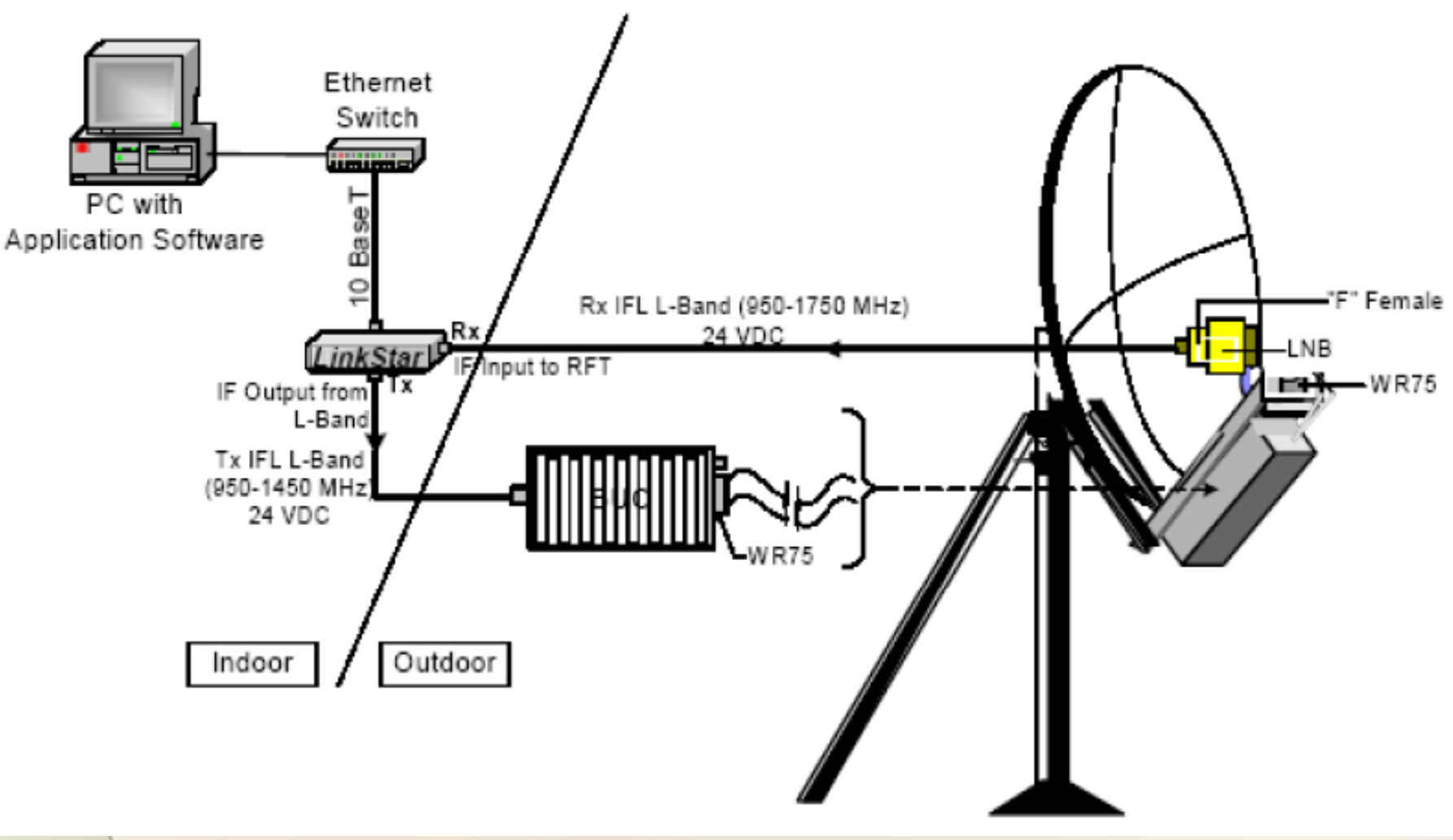
4- Installing a VSAT

Roof penetrating

- If penetrating the roof is allowed, secure the pole to the roof by penetrating large bolts. Apply silicon for additional rain protection.
- In case penetration of the roof is not possible, a non-penetrating mount should be used.

4- Installing a VSAT

Standard VSAT Setup



4- Installing a VSAT

ODU assembly and installation

Install the AZ/EL cap on the ground pole by inserting the four plow bolts into the holes in the reflector face and insert the exposed portion of the bolts into the holes in the antenna mount flange. Tighten the clamp nuts so that the cap is held stationary on the pole.

After setting the antenna to the approximate azimuth and elevation angles,assemble and attach the ODU to the antenna as described in the following sections.

4- Installing a VSAT

ODU assembly and installation

Attach the LNB and the transmitter to the OMT (Orthomode Transducer) after placing the “O”- Ring on its corresponding groove on them.(figure 1)

Verify that the wave-guide polarization is correct both in the LNB and the transmitter.(figure 2)

The correct polarization is set by rotating the outdoor electronics to the appropriate position (this is need to be made through a phone call to the NOC).

The VSAT is designed to receive and transmit on opposite polarization.

4- Installing a VSAT

ODU assembly and installation

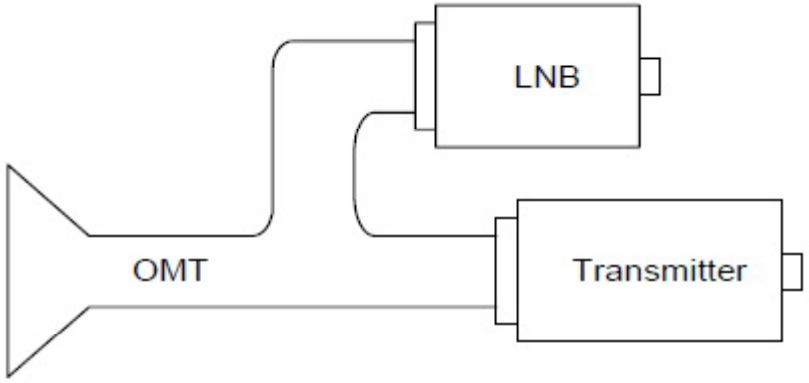


figure 1: LNB and Transmitter assembly

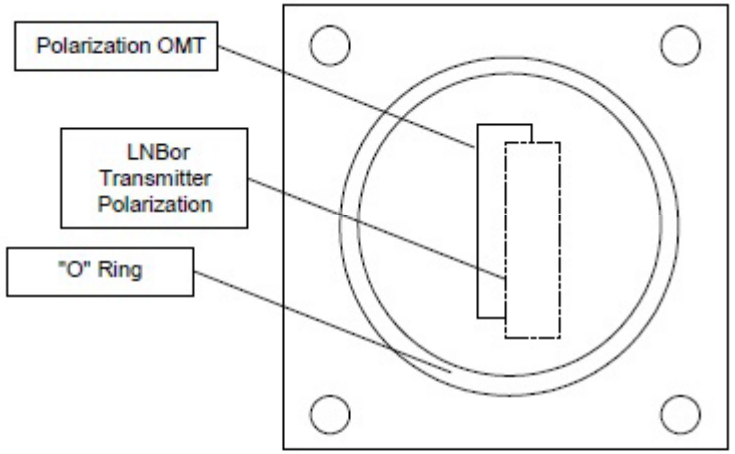


figure 2: correct wave guide polarization

4- Installing a VSAT

ODU assembly and installation

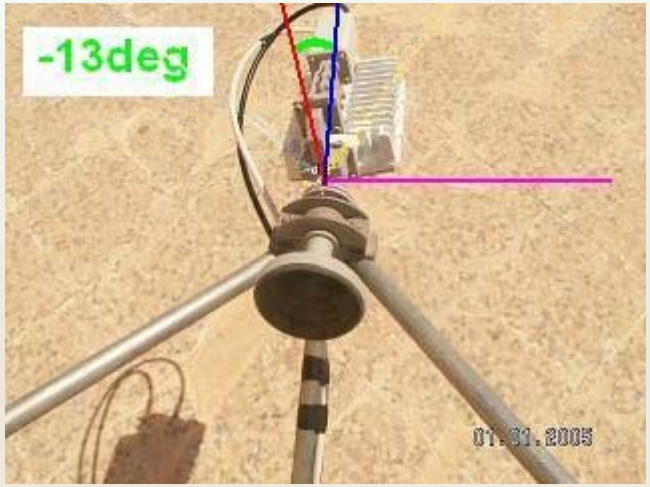
Tight the four screws. Assemble the feed legs to the antenna. The bottom feed leg is the shortest one. Assemble the feed mounting block to the feed support legs. Tighten the hardware securing side and the bottom feed legs to the feed support block and the reflector.

Place the ODU assembly on the antenna support arm. Tighten the nuts and finally connect the two coaxial cables to the LNB OUT port and the Transmitter IN port.

4- Installing a VSAT

Antenna alignment

Point your dish to the satellite, if you have a spectrum analyzer, you can see your signal at for example 11597.408 MHz RF frequency, or 1597.408 L-band frequency (the output of the VSAT is L-band) and try to maximize it by slowly turn the feeder to the left or right. Screwing the feeder back, will have to be done extremely cautiously (one screw at a time, just 1 turn until all screws are in place)



Horizontal polarization adjusted by -13 deg anticlockwise, while facing the satellite

4- Installing a VSAT

Antenna alignment

Set the antenna to the approximate azimuth and elevation angle. The exact azimuth and elevation angles come out of the exact geographical longitude and latitude.

Notice that the specific channel master antenna has a 17 degrees offset. So, add 17 degrees to the calculated elevation angle. Connect a field meter to the receive IFL cable.

Set the antenna elevation, using the antenna adjust mechanism, until the inclinometer indicates the calculated elevation. Move the antenna's azimuth and elevation until carriers are displayed on the field meter. Adjust the field meter controls.

Slowly rotate the antenna for largest possible carrier amplitude. When found, tight the antenna hardware.

4- Installing a VSAT

IFL cable connections

Connect the ODU to the IDU using two IFL coaxial cables as follows:

Connect one IFL cable from the transmitter to the RF OUT port of the IDU.

Connect the second IFL cable from the RF IN port of the IDU.

The cable length should not exceed the 30 meters for an RG 6 type cable.

Use RG 11 type coaxial cable for longer distances

4- Installing a VSAT

Final checklist

Ensure that all the cables are connected to the correct terminals and are firmly tightened. Tie wrap cables to the antenna assembly. Leave enough extra cable at the antenna. Tie wrap the cable to the mast. Make sure that all outdoor connectors are weatherproofed after any necessary testing has been completed.

Polarization adjustment

Contact the hub operator. The final step in alignment is the Peak and Pole procedure with the satellite operations center. They will insist on correct alignment of the antenna and the polarizer in order to insure that the antenna is not interfering with adjacent satellites or with other poles on the same satellite.

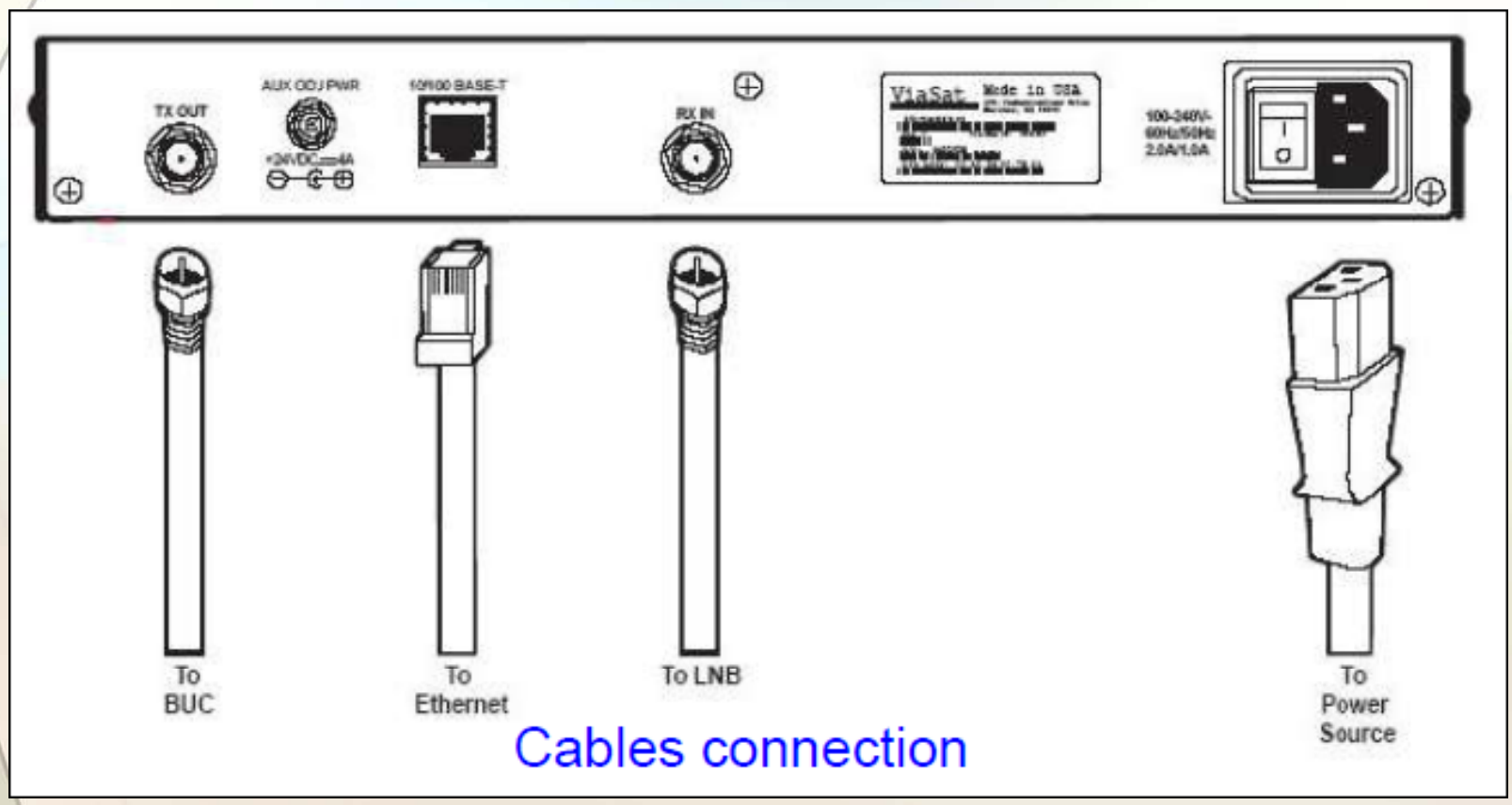
5- Configuring the IDU

The IDU configuration is performed via a VT 100 terminal or a PC emulating VT 100 operation using configuration cable. Attach from the VT 100 serial port to the port 1 of the VSAT's rear panel a 25-pin RS-232 cable [**You just need a typical PC-to-modem (9pin-->25pin) straight through serial RS-232 cable**], set dip switch 1 ON and power on the IDU. Set the communication parameters according to VT 100 configuration as follows:

- Bits per second: 9600
- Data bits: 8
- Parity: None
- Stop bits:1
- Flow control: None

5- Configuring the IDU

Connecting Cables



5- Configuring the IDU

The following Setting should be configured based on setting provided by the provider

- Radio frequency Tuner
- Symbol Rate
- RF Frequency
- Polarization

LAN

- The IP Address and Subnet Mask

5- Configuring the IDU

THE SATELLITE MODEM

The satellite modem provides modulation of your signal. The following parameters should be configured based on values provided by the provider :

- Forward error correction
- Modulation techniques
- Intermediate frequency 70/140 MHz
- Data rates
- Data interfaces
- Management & control

5- Configuring the IDU

On the circuit commencement date, the duty engineers at Standard set-up a conference call between the satellite operator and the client, in order to fully activate the link. Each side sends up a test transmission at the approved frequencies. The satellite operator measures the strength of signals and requests any power adjustments that may be required.

When both sides have achieved signal lock and the signal levels are running at the correct level, the satellite operator gives approval for commencement of service. The final step is the connection of the data port at Standard to the Internet routers to enable the client to begin voice or Internet services.

6- Example of installation

SATELLITE DISH ASSEMBLY

The Andrew Corporation Type 243 2.4m Class III RxTx Antenna is a rugged commercial grade product suitable for the most demanding applications.

The reflector is thermoset-molded for strength and surface accuracy. Molded into the rear of the reflector is a network of support ribs which not only strengthens the antenna, but also helps to sustain the critical parabolic shape necessary for transmit performance.

6- Example of installation

SATELLITE DISH ASSEMBLY

The Az/El mount is constructed from heavy-gauge steel to provide a rigid support to the reflector and feed support arm. Heavy-duty lockdown bolts secure the mount to any 6.63” (168mm) O.D. mast and prevent slippage in high winds.

Hot-dip galvanizing is standard for maximum environmental protection.

- Two-piece precision offset thermosetmolded reflector.
- Fine azimuth and elevation adjustments.
- Factory pre-assembled mount.
- Galvanized feed support arm and alignment struts.
- Galvanized and stainless hardware for maximum corrosion resistance.
- Includes C-Band Circular Polarized RxTx Feed Assembly.
- Heavy-duty Class III mount for 25lb. (11kg.)
- RF electronics (LNB & BUC).

6- Example of installation

SATELLITE DISH ASSEMBLY

Factory pre-assembled mount.

Fine azimuth and elevation adjustments

6- Example of installation

SATELLITE DISH ASSEMBLY

Factory pre-assembled mount.

Fine azimuth and elevation adjustments

RF electronics (LNB & BUC).

6- Example of installation

SATELLITE DISH ASSEMBLY

LNB

With extensive proven reliability in the field the 8000 series remains Norsat's premium quality digital C-Band DRO LNB. The 8000 series is designed to provide commercial quality for VSAT and select digital applications such as:

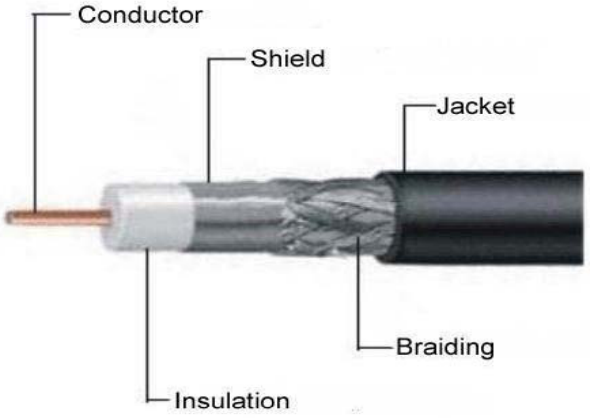
- Higher data rate digital video or commercial an
- SCPC digital or analog audio applications
- Any SCPC data rate above 1 Mbps

6- Example of installation

CABLES AND CONNECTORS

RG11

Coaxial cables are necessary for rooftop antennas and dish antennas in order to provide crystal-clear sound and audio input. RG-11 bands typically have 75-ohm wires made of copper. Polyethylene dielectric makes sure that there is minimal loss of picture and sound while the antenna receives audio or video feeds.



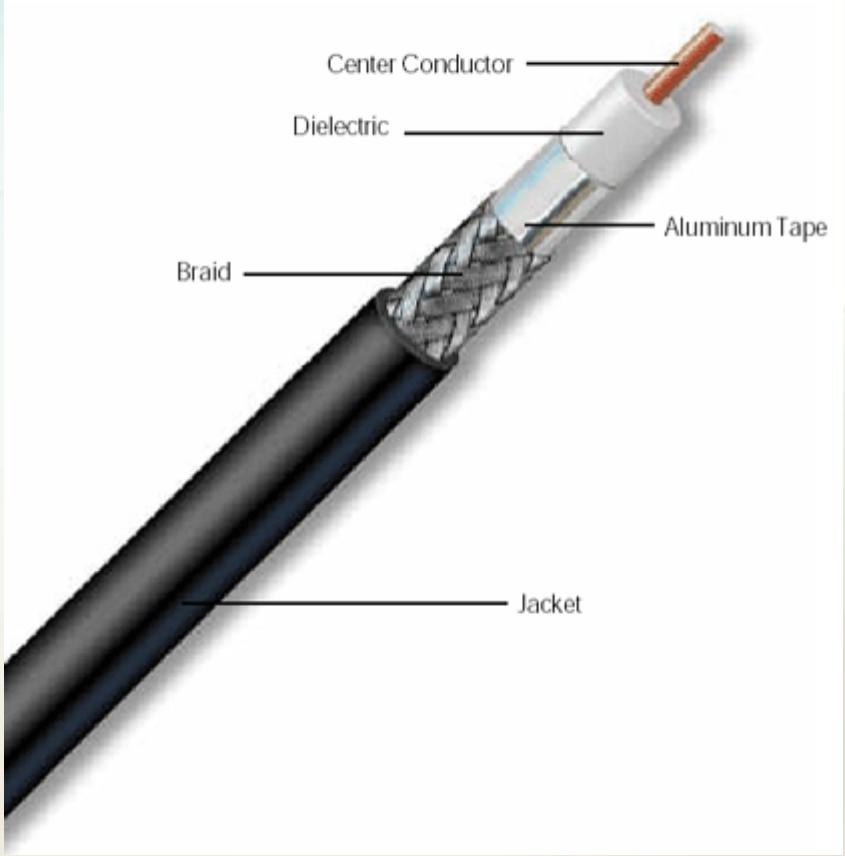
RG-11U

6- Example of installation

CABLES AND CONNECTORS

LMR 400

This is a high-quality braided coax cable, transmission line and radiating cable for both indoor and outdoor uses. LMR cables have RF performance comparable to traditional corrugated copper cables, but also offer flexibility, non-kinking and easy, fast connector installation that copper can't match. And when compared with other RG type braided cables, LMR cables offer far lower loss and better RF shielding.



6- Example of installation

VSAT MOUNT

6- Example of installation

BUC

BUC is an abbreviation of "Block Up-Converter". It is attached direct to the transmit waveguide flange of the filter/feed assembly of a VSAT dish, used for satellite communications, The IFL cable from the indoor equipment supplies DC power, a 10 MHz frequency reference plus the actual signals to be transmitted. The signals to be transmitted are in a 575 or 300 MHz wide band, between 0.95 - 1.525 GHz and 1.1 - 1.4 GHz in the cable, which will be up-converted in the BUC to C band (5.85 - 6.425 GHz or 6.725 - 7.025 GHz, using a local oscillator mixer frequency of 4.9 or 5.625 GHz. So, Output frequency (GHz) = Input frequency (MHz) + 4.9 GHz or Output frequency (GHz) = Input frequency (MHz) + 5.625 GHz (INSAT).

6- Example of installation

Satellite Modems

EMR 1600

The Edge Media Router (EMR) series of satellite receivers and routers are versatile and powerful networking platforms that receive and manage content at the network edge .The EMR series provides a complete satellite Internet solution. The Micro-EMR-1600 is a compact satellite receiver and media router for cost-effective satellite connectivity to the SOHO environment.

6- Example of installation

Satellite Modems

DMD 20 Satellite Modem

Radyne's DMD20 Satellite Modem breaks new ground in flexibility, operation and cost. With standards including IDR, IBS and DVB, and covering data rates up to 20 Mbps, this 1RU duplex modem covers virtually all your Satellite IP, Telecom, Video and Internet applications.

6- Example of installation

Routers

Cisco router 1841

The Cisco 1841 Integrated Services Router provides the following support:

- Wire-speed performance for concurrent services at T1/E1 WAN rates
- Enhanced investment protection through increased performance and modularity
- Enhanced investment protection through increased modularity
- Increased density through High-Speed WAN Interface Card Slots (two)
- Support for over 90 existing and new modules
- Support for majority of existing WICs, VWICs, and VICs (data mode only)
- Two Integrated 10/100 Fast Ethernet ports

6- Example of installation

Routers

Cisco router 1841

Security

o On-board encryption

o Support of up to 800 VPN tunnels with the AIM Module

o Antivirus defense support through Network Admission Control (NAC)

o Intrusion Prevention as well as stateful Cisco IOS Firewall support and manymore essential security features

6- Example of installation

Firewall

Cisco ASA 5505 Firewall

Cisco ASA 5500 Series adaptive security appliances are purpose-built solutions that combine best-of-breed security and VPN services with the innovative Cisco Adaptive Identification and Mitigation (AIM) architecture. Designed as a core component of the Cisco Self-Defending Network, the Cisco ASA 5500 Series provides proactive threat defense that stops attacks before they spread through the network, controls network activity and application.

6- Example of installation

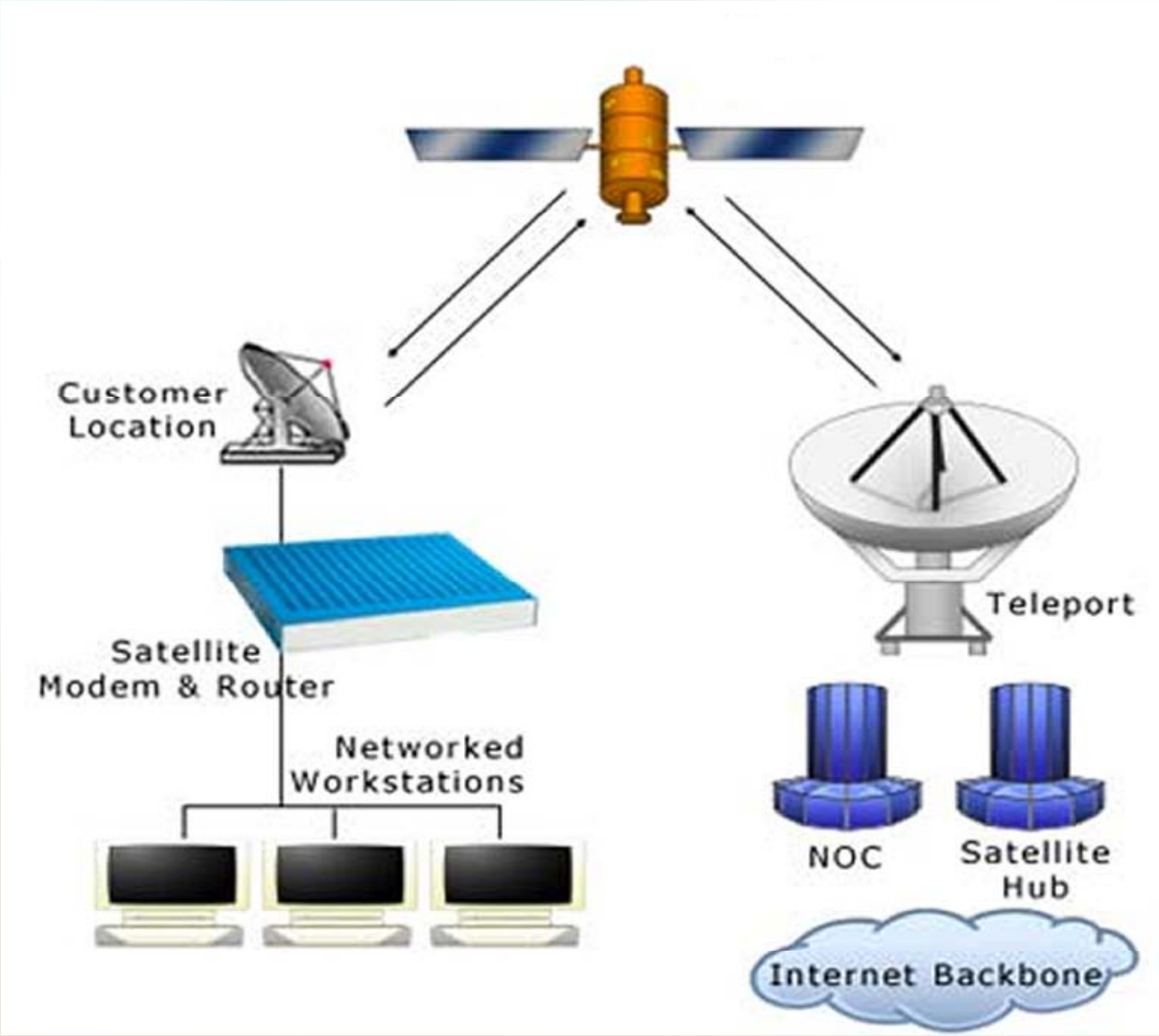
IDIRECT ROUTER

The Idirect 3000 Series Satellite Router is a star-topology remote satellite router designed as an easy-to-deploy solution integrating a satellite modem, IP router, TCP acceleration and advanced QoS and prioritization capabilities. The 3000 Series Satellite Routers support IP data rates up to 18 Mbps downstream and up to 5 Mbps upstream. The routers also come as a narrow-band model capable of delivering the same downstream IP data rates, but limited onthe upstream to 200 kbps.

This replaces the use EMR 1600 and Satellite Modem

6- Example of installation

Typical settings



6- Example of installation

Satellite pointing

Before you start radiating power towards the satellite

- Make sure you have a site specific Antenna and radio configuration (ARC) sheet. This ARC sheet which is a part of the Field installation documentation is the full responsibility of the satellite service provider.
- Contact the satellite control center at least 24 hours prior to the actual antenna lineup to schedule your action. Inform the satellite control center about the site-specific details as name of the customer and the site code (or carrier ID). Confirm transmit and receive frequencies.
- Build the antenna according to the “Antenna assembly procedure”,
- Point the antenna to the correct satellite
- Set azimuth and elevation
- Allow the radio to warm up for at least 15 minutes before any transmission
- Call the satellite control center and act in accordance with their instructions

6- Example of installation

Satellite pointing

The goal is to achieve the best possible elevation, azimuth and cross-pol isolation on receive. Elevation, azimuth and polarization offset are normally given in the Antenna and Radio configuration (ARC) sheet. In the event you do not have the sheet on site while doing an installation you can easily calculate some of the necessary parameters.

With the Latitude, Longitude and Elevation of the site and also satellite position, you can calculate the Azimuth and Elevation of the antenna.

Useful software can be found on the internet.

The elevation and azimuth values for the antenna are given in the “antenna and radio configurations” sheet which is a part of the field installation documentation. Indispensable for setting the elevation is an inclinometer.

6- Example of installation

Satellite pointing

Elevation

- Place the inclinometer on the metal frame at the rear of the antenna
- Adjust the elevation until the inclinometer indicates the correct value. Be advised that if you are off the correct elevation you will never find the satellite. Bigger apertures require more accuracy.

Note: The antenna and radio configuration sheet gives you're the true elevation (or the elevation for a prime focus antenna). Many companies prefer the use of offset antennas. To achieve the correct inclinometer readout simply subtract the antenna offset form the elevation given in the Field installation documentation.

6- Example of installation

Satellite pointing

Elevation

Antenna Offset Examples

Andrew 0.96m	1 piece 0.875f/d	15.40°
Andrew 1.2m	1 piece 0.875f/d	16.97°
Andrew 1.8m	1 piece 0.6f/d	22.62°
Prodelin 1.8m	1 piece 0.6f/d	22.30°
Andrew 2.4 m	2 piece 0.6f/d	22.62°
Prodelin 2.4m	4 piece 0.8f/d	17.35°
Prodelin 3.8m	4 piece 0.8f/d	22.62°

6- Example of installation

Satellite pointing

Azimuth

Azimuth can be measured using a compass. However, a compass doesn't work well near steel obstructions and frameworks commonly found in buildings. Strong magnetic fields dramatically affect compass reading as well. This is called deviation. Besides a compass always points at the magnetic north. The given azimuth in the antenna and radio configuration sheet always refers to the geographic north. This means that you always have to deal with a difference between the magnetic north and the geographic north.

This is called the variation and depends very much on where you are on earth. To find the true azimuth you first must subtract or add the variation to your compass reading.

6- Example of installation

Satellite pointing

Connect the spectrum analyzer

- Read the compass at ground level. Stay away from motors and large steel constructions.
- Identify a landmark in the assigned azimuth pointing direction and refer to the landmark when pointing the antenna.
- Since the LNB is powered with DC over coax it is not possible to connect the spectrum analyzer straight to the LNB. Connect the spectrum analyzer to the monitor output of the receiver. If your receiver does not support a monitor output use a sufficient inserter (ordinary splitters can't be used). Be very careful not to feed the spectrum analyzer with DC power. In most of the cases you will blow up the spectrum analyzer input immediately.
- Program the spectrum analyzer center frequency for one of the pilot carriers on the satellite. Use a wide span and maximum sensitivity.

6- Example of installation

Satellite pointing

Connect the spectrum analyzer

T11 Pilot Frequency [Khz] / Polarization	Type of LNB
12 528 000 / V	Euro High Band
11 656 260 / V	Euro Low Band
11 728 000 / H	Noram

LNB BAND	LNB Input Frequency [GHz]	LNB Local Oscillator [GHz]	LNB Output Frequency [MHz]	LNB Bandwidth [MHz]	T11 Pilot After down Conversion [MHz]
Noram	11.70 – 12.20	10.75	950 – 1450	500	978
Euro Low	10.95 – 11.70	10.00	950 – 1700	750	1656.26
Euro High	12.25 – 12.75	11.30	950 - 1450	500	1228

6- Example of installation

Satellite pointing

- Move the antenna slowly (not faster than two degrees per second) from the left to the right. Move the antenna while looking at the spectrum analyzer.
- If you “hit” the satellite a bunch of signals will appear on the spectrum analyzer. When using a DRO LNB (a LNB with a free running local oscillator) and you bring your spectrum analyzer back to a very narrow span you will see that the pilot carrier is not stable. This is normal.
- Top the level of the pilot roughly. The C/N should be better than 20 dB
- Top the level of the pilot. Go for the best result. Do this by fine-tuning azimuth and elevation.

6- Example of installation

Satellite pointing

- Secure azimuth and elevation
- Find a minimum for the pilot level. Do these by adjusting the polarizer (position of the feed) only, in most of the cases you will find two notches. Choose the one, which gives you the best result (the difference between minimum and maximum should be at least35 dB). Mark this position on the donut and move the feed exactly 90º. The level ofyour pilot carrier is topped now and you are receiving exactly the polarization in which the pilot carrier comes down.
- If the downlink polarization given in the ARC sheet is opposite of the pilot polarization then set the polarizer in its correct position (90º swing)

6- Example of installation

Basic Configuration

THE EMR 1600

CONFIGURATION PARAMETERS

The EMR 1600 configuration is performed via internally provided web based configuration system via a VT 100 terminal or a PC emulating VT 100 operation using configuration cable.

The following Setting should be configured based on setting provided by the provider

Radio frequency Tuner

- Symbol Rate
- RF Frequency
- Polarization

LAN

- The IP Address and Subnet Mask

6- Example of installation

Basic Configuration

THE SATELLITE MODEM

The satellite modem provides modulation of your signal. The following parameters should be configured based on values provided by the provider

- Forward error correction
- Modulation techniques
- Intermediate frequency 70/140 MHz
- Data rates
- Data interfaces
- Management & control

THE CISCO ROUTER

The router basic configuration has to be provided by the ISP

7- Maintenance

PREVENTATIVE MAINTENANCE

Good maintenance, knowledge of the site and well maintained records are the basis for avoiding the unexpected faults. However, an unexpected failure may cause outages and emergency repairs may be necessary by the on-shift technician or VSAT technician.

To meet the guarantee, and to keep the link functioning, you need to have a regularly schedule, through, antenna inspection and maintenance program.

7- Maintenance

PREVENTATIVE MAINTENANCE

The lack of a well implemented preventive maintenance program could trigger a wave of problems. An electrical or physical failure could lead to a complete antenna failure, causing downtime or even loss of contract. It is known that 50-70 percent of all outages are caused by:

1. Equipment incl. the antenna error
2. Human error
3. Lack of experience on equipment and test equipment
4. Improper or mal-function test equipment.

This means that most failures can be avoided and outages

Maintaining an earth station antenna is much less costly than to repairing one that has failed.

7- Maintenance

PREVENTATIVE MAINTENANCE

The maintenance program should include maintenance to the following items:

- Inspect the total appearance of the equipment including radio, LNC, feed horn and deice
- Inspect the antenna mount hardware
- Inspect the ground connection s
- Inspect the power equipment and facilities
- Inspect the IF equipment and terminal equipment (including modems, mux and M&C equipment)
- Inspect the enclosures
- Inspect the cables and connections
- Inspect areas exposed to the weather to insure they are adequately waterproofed
- Evaluate antenna's overall performance

7- Maintenance

PREVENTATIVE MAINTENANCE

Reliable and effective maintenance depends upon good test equipment which is regularly calibrated in accordance with manufacturer's recommendations. In the maintenance we should :

- Check appearance
- Check Mount Hardware
- Verify ground connections
- Inspect enclosures
- Maintain cables
- Maintain equipment
- Antennas move
- Monitor & Control
- Radio equipment and rack fan

End of Day 4 course

VSAT Installation, Maintenance