# VSAT Installation and Maintenance

# What is a VSAT?

A VSAT ( Very Small Aperture Terminal) is  a type of  Satellite Earth Station (SES) or simply "E/S" that is designed and built purposely for "ender- user" deployment.

# How "small"  is a VSAT?

- VSATs as the name implies are characterised by a " very small"  "aperture"

- Satellite  antenna belongs to the class of antennas that  have a parabolic-shaped "mirror" or " reflector"  that focuses electromagnetic waves to its focal point where the feed is located.

- But as the shape of  parabolic antenna is similar to that of a household dish,  the antenna is also commonly referred to as a "Dish".

- The reflector diameter of a VSAT ranges between about 3.8 m and 0.6 m

- The weight of  the outdoor hardware may be anything from 50 kg to 500 kg including the mouthing hardware

# Typical setting for VSAT Installions
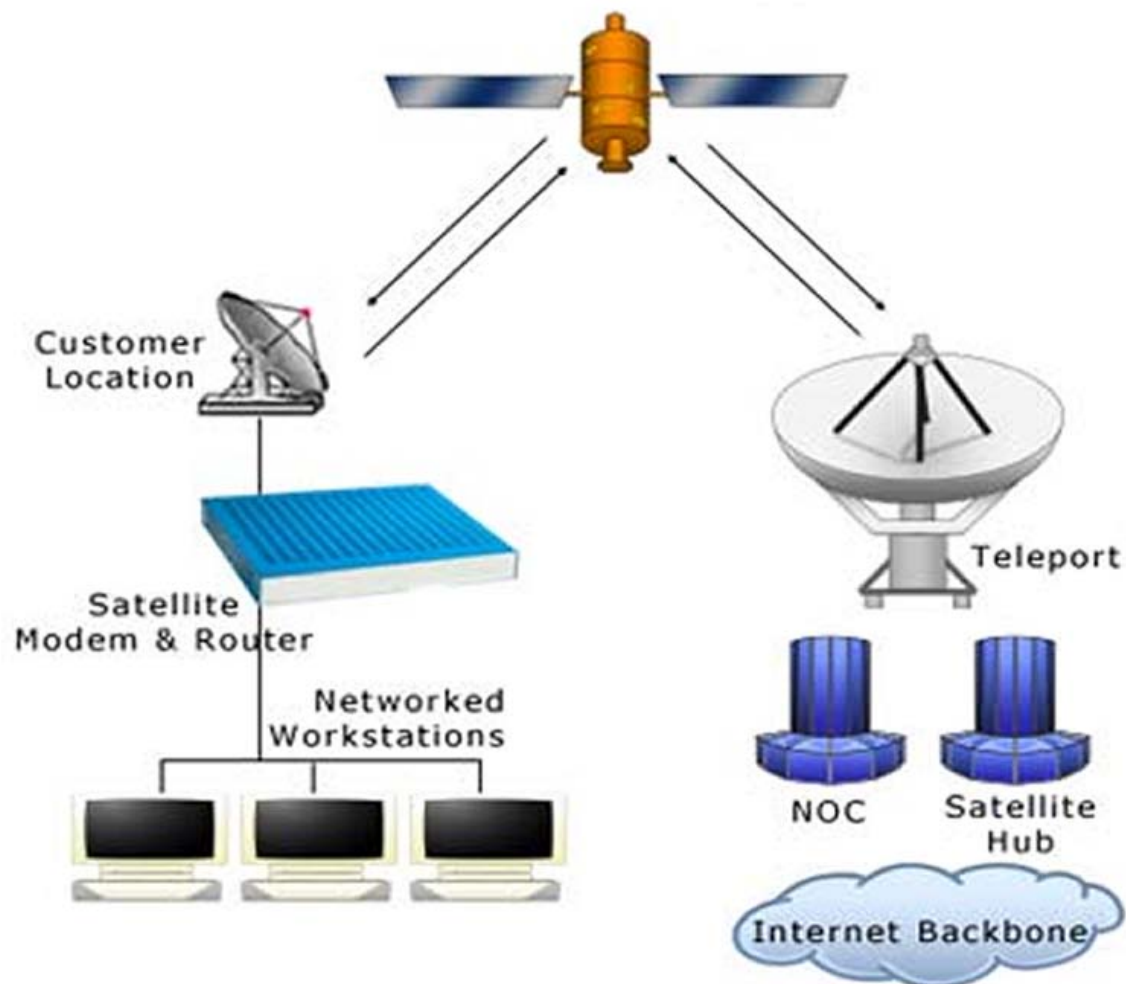
# VSAT hardware list 1/3

VSATs ( Very Small Aperture Terminal) come in a variety of configurations and sizes depending  intended application, band of operation, and network topology.

However for any VSAT, we can group the hardware into two:

- Outdoor unit assembly

- Indoor unit assembly

# 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 (Inter-Facility Link) cabling carries the inbound and the outbound signals and the 24 VDC for the LNB.
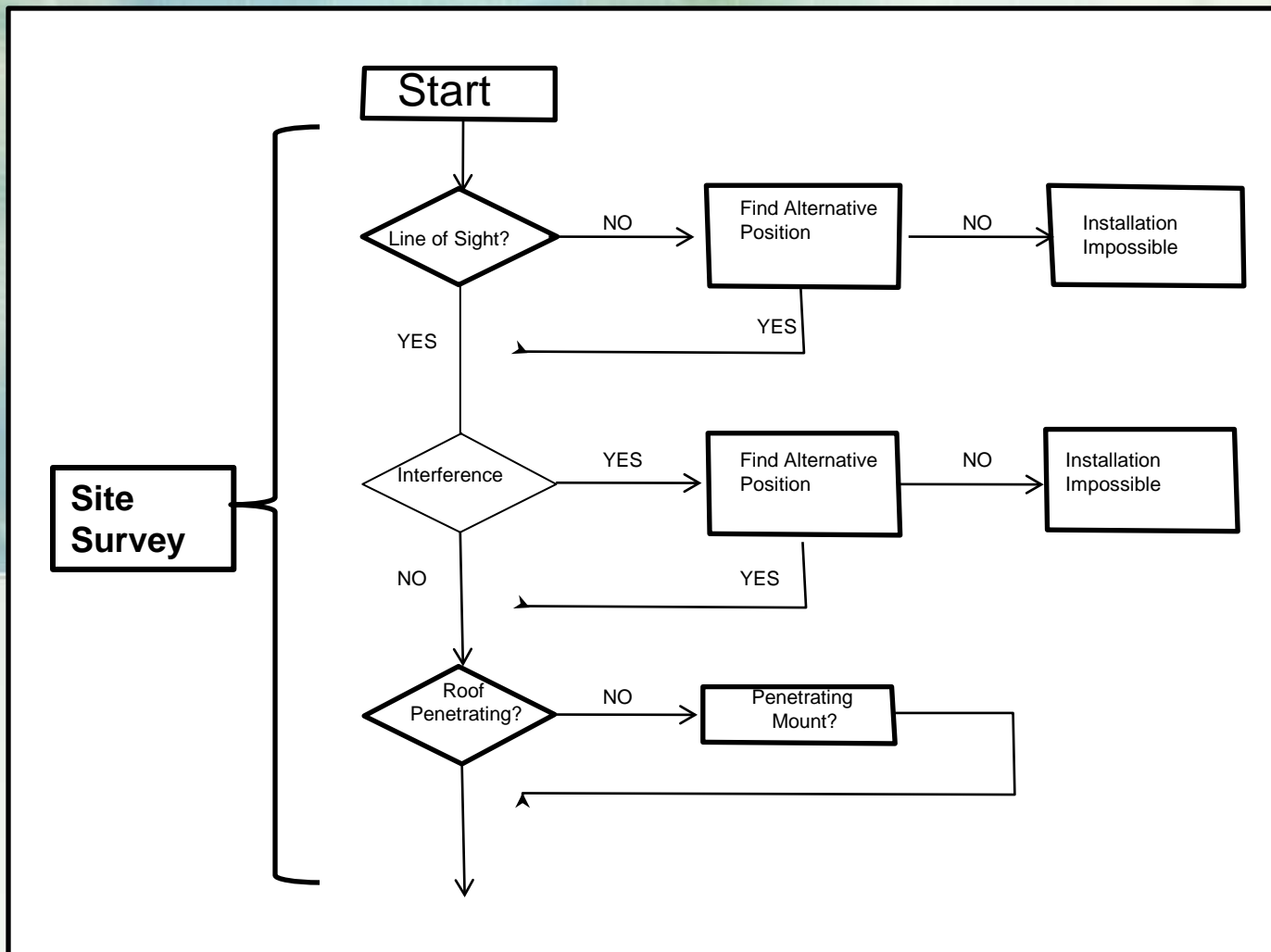
# Sample Hardware list 3/3

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

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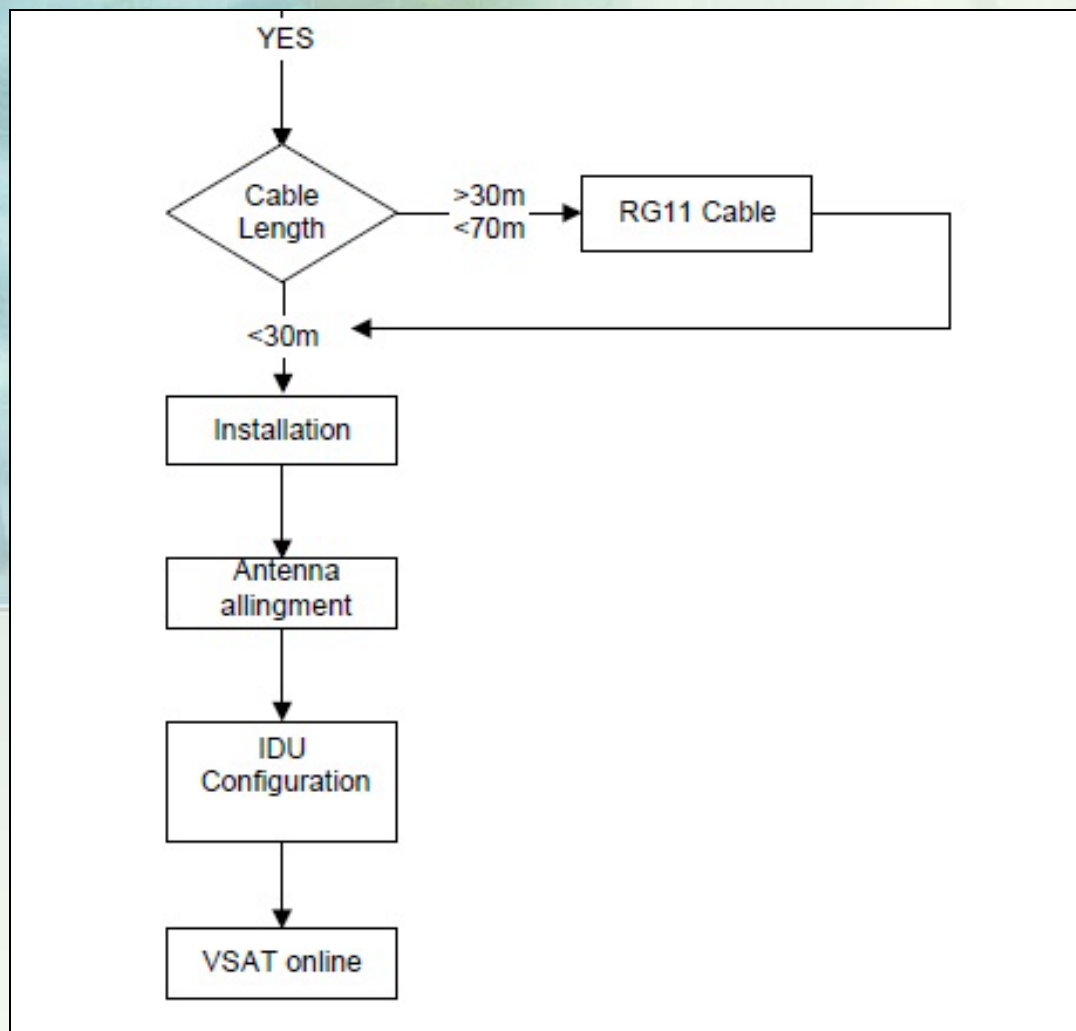- The Demodulator
- Two serial and one Ethernet port.
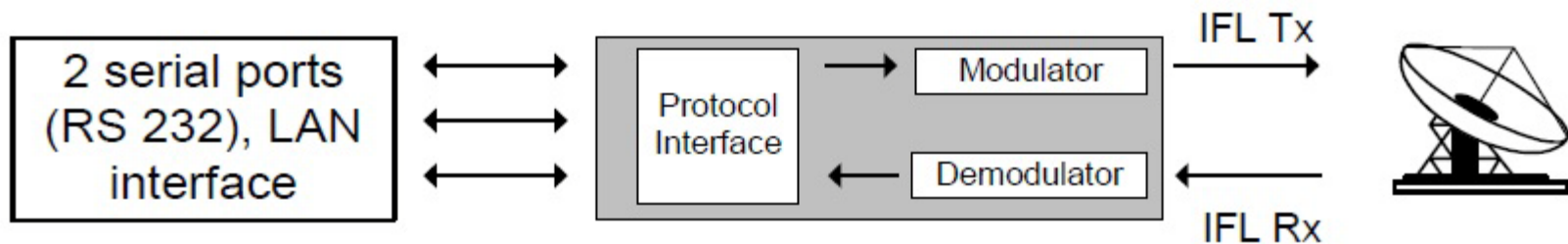


VSAT system architecture (block diagram)

# VSAT installation Flowchart$_{1/2}$

# VSAT installation Flowchart$_{2/2}$

# Site Survey Checklist

- Absence of high-rise buildings, trees etc, which may block the Line of Sight ( LOS).

- Absence of interference

- Existence of AC power (required during installation)

- Existence of a clear, unobstructed line of sight to the designated satellite

- Note the longitude and latitude of site ( or confirm LBA assumption)

- Existence of a LAN network near the IDU.

- Estimation of the maximum cable length.

- Free access to the roof of the building (if roof top installation)

# "Work arounds" to avoid LOS obstructions

Absence of high-rise buildings, trees etc, which may block the signal path.

If the elevation is between 30° and 60° Imagine an arc ranging from 30 to 60 degrees above the horizon.
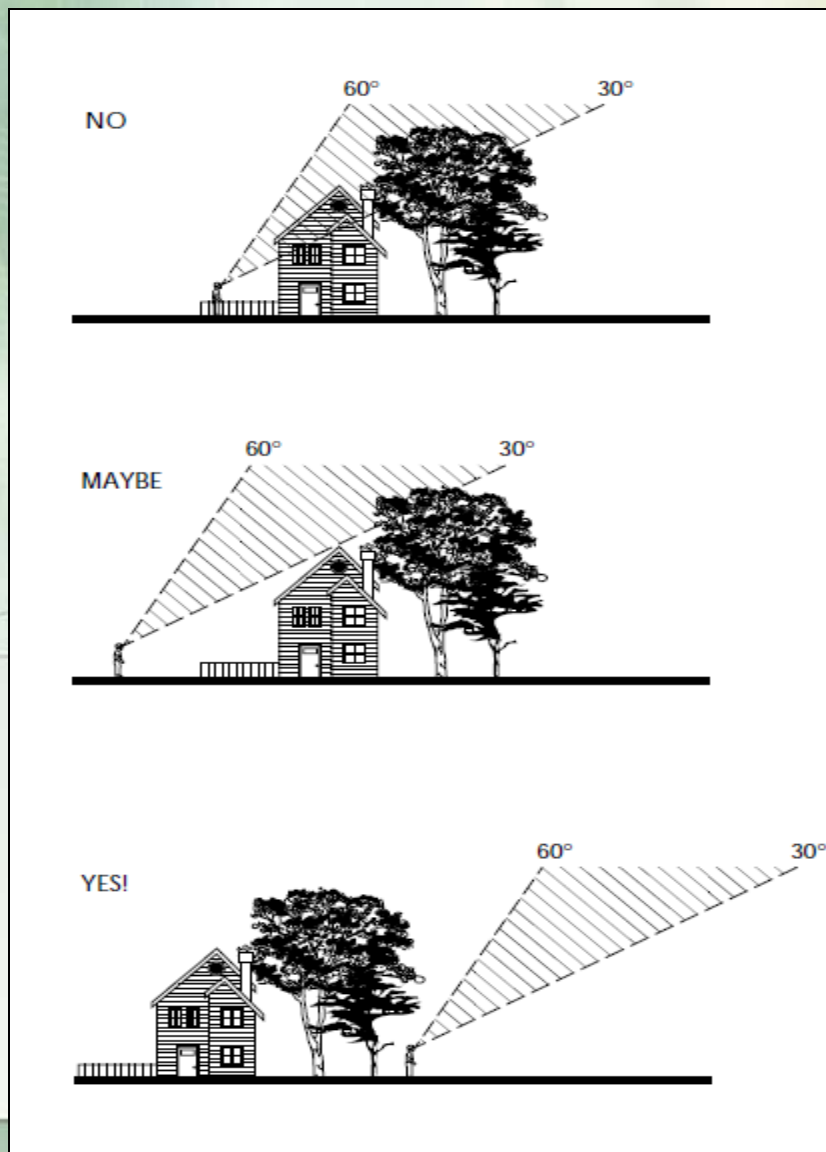
# Questions so far?

# Dish Assembly

A properly assembled sat dish.
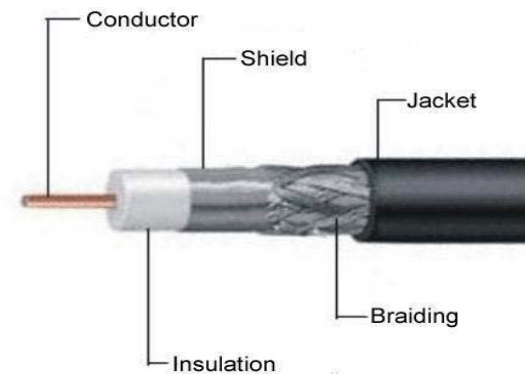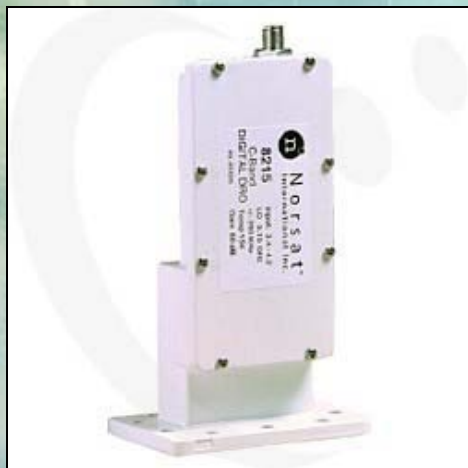
# Dish Assembly



Factory pre-assembled mount.



Fine azimuth and elevation adjustments
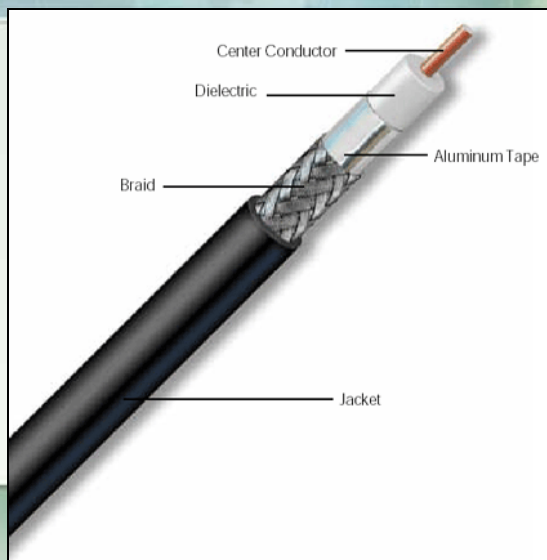


RG-11U

# Feed, BUC, LNB, RF Cable

Feed Assembly

LNB

RG11

LMR 400

BUC
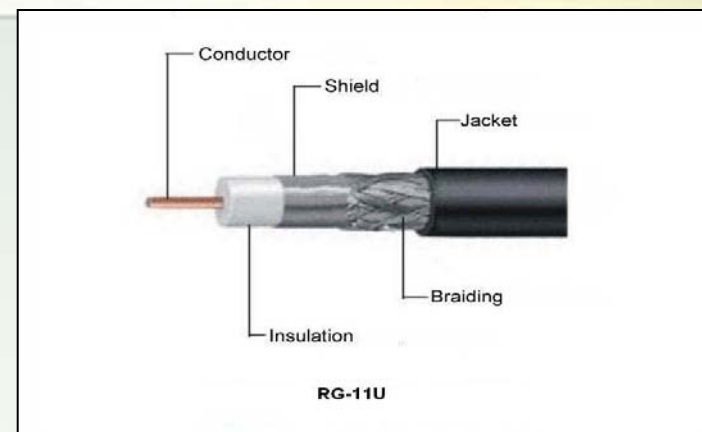
# VSAT MOUNT

# Check list for Indoor Unit (IDU) Installation

- 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.

## Roof Installations

- If penetrating the roof is allowed, secure the pole to the roof with 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.

# Typical VSAT Setup
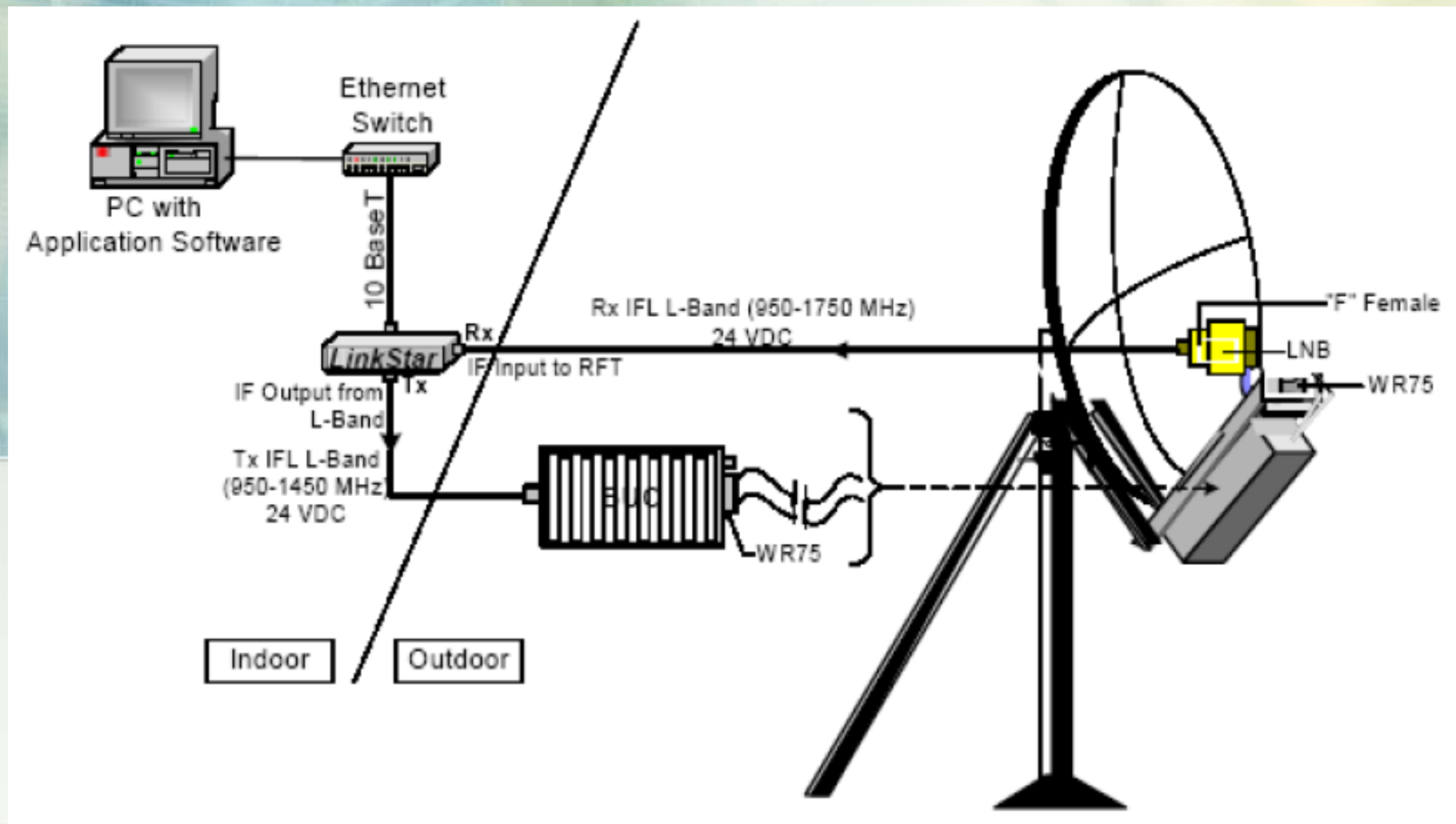
## ODU assembly and installation

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.

## 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.

Verify that the wave-guide polarization is correct both in the LNB and the transmitter.

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

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

# ODU assembly and installation
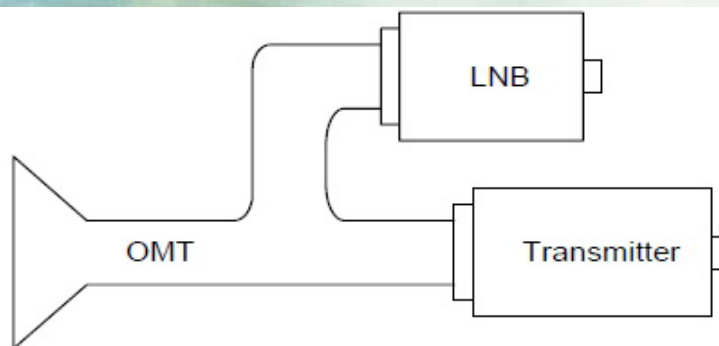


figure 1: LNB and Transmitter assembly
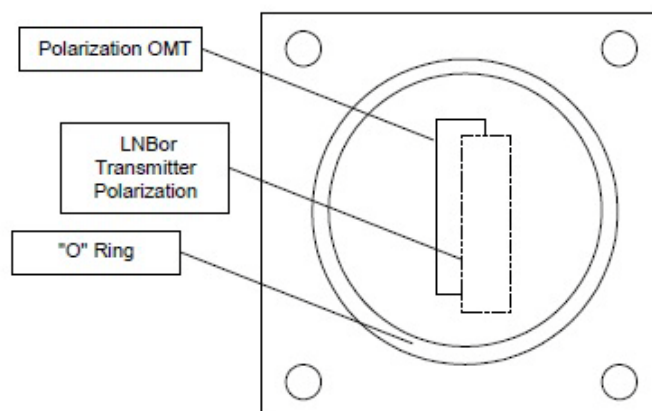


figure 2: correct wave guide polarization

## ODU assembly and installation

Tighten the screws. Assemble the feed legs to the antenna. 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.

# Questions so far?

## 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 MHz L-band frequency (the output of the VSAT is L-band) and try to maximize it by slowly turning 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)
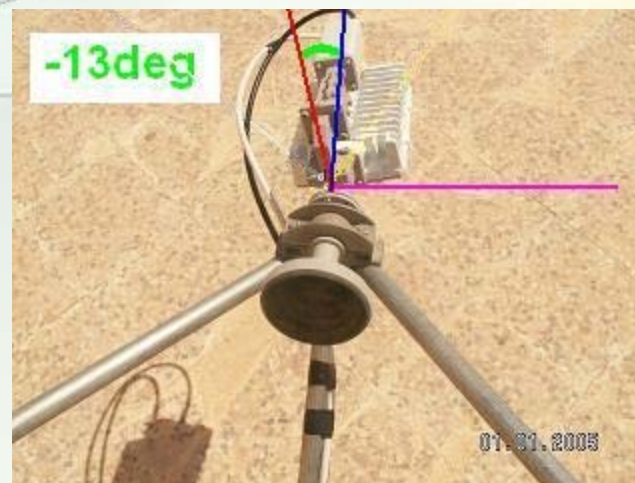


Horizontal polarization adjusted by -13 deg anticlockwise, while facing the satellite

## Antenna alignment

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

Channel Master antenna, for example, have 17 degrees offset. The offset has therefore to be added 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, tighten the antenna hardware.

## 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 LNB to 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

## 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.

# Configuring the IDU 1/4

Follow the supplier's provided configurations instructions.  Typically for VSAT remotes working off a hub, much of the configuration will be carried out remotely from the hub

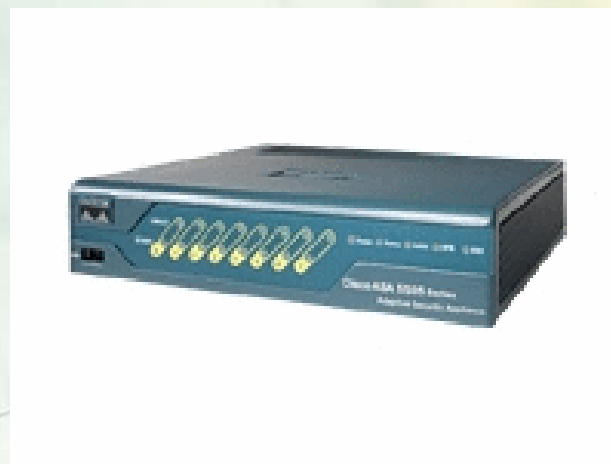For  SCPC VSATs, typically the configuration will be  performed via configuration port on the IDU and supplier provided cable. Follow the supplier's instructions

## Connecting Cables



Cables connection
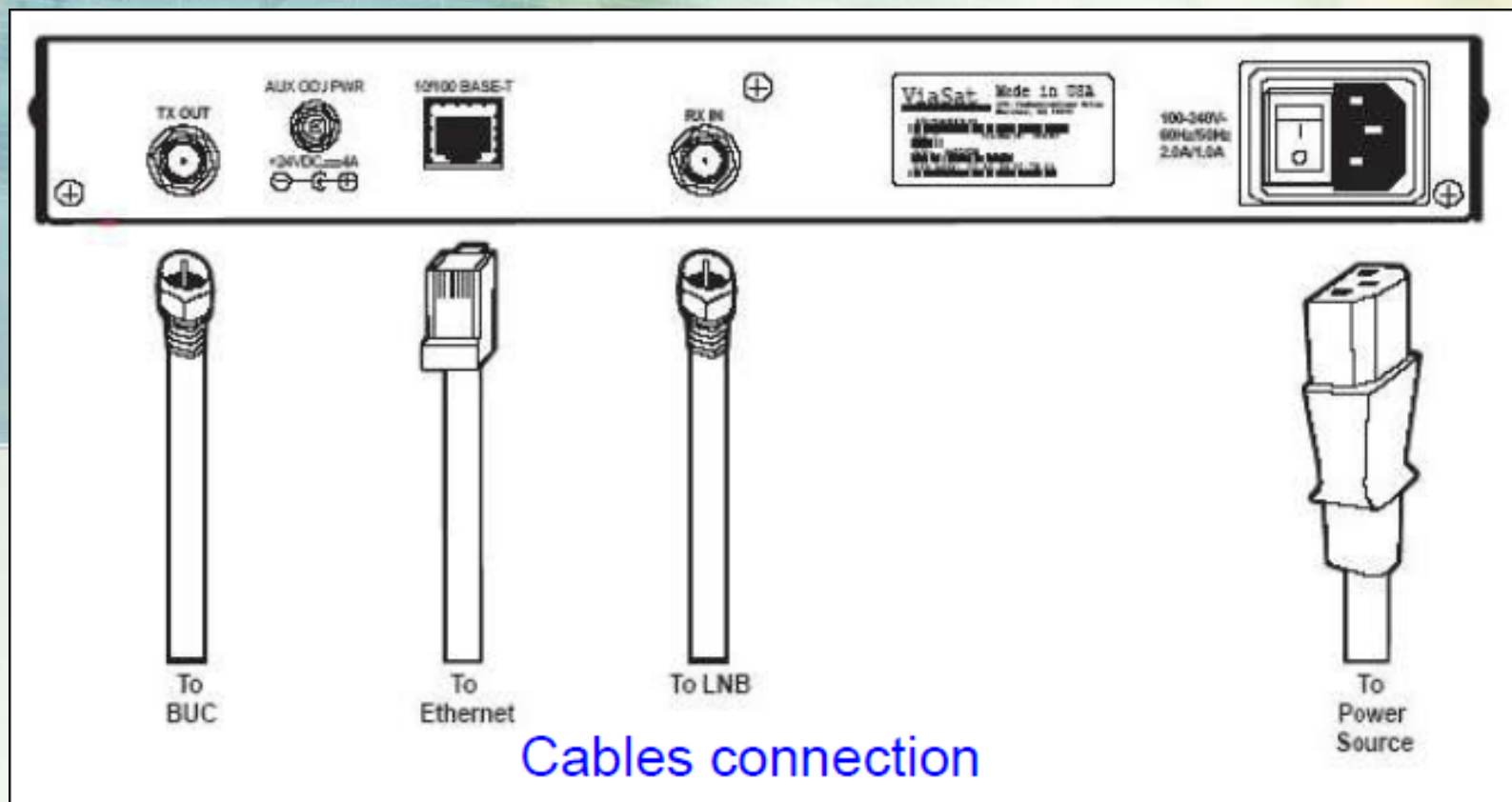
# Modems and Sat Routers

# VSAT antenna pointing 1/5



Elevation _____
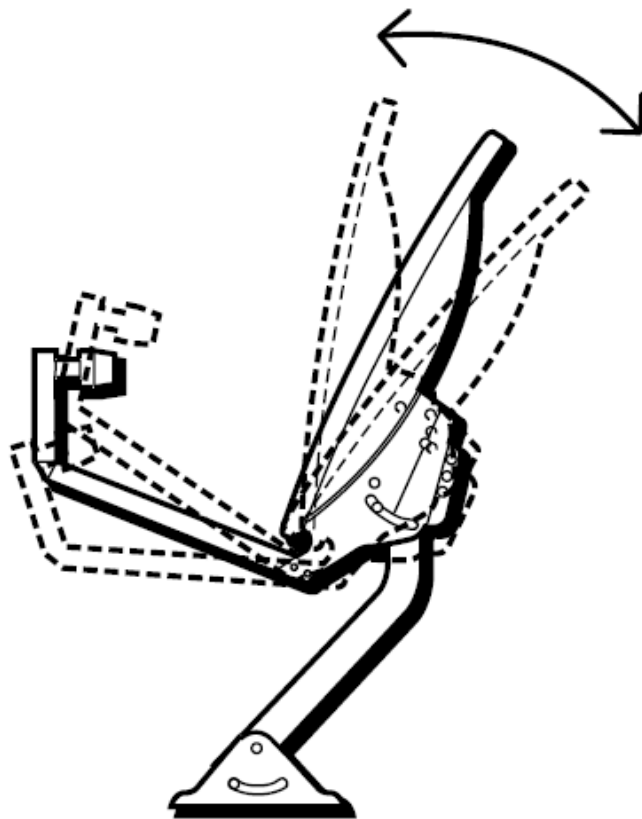
Azimuth _____

Elevation is the up/down angle
that the dish is pointed
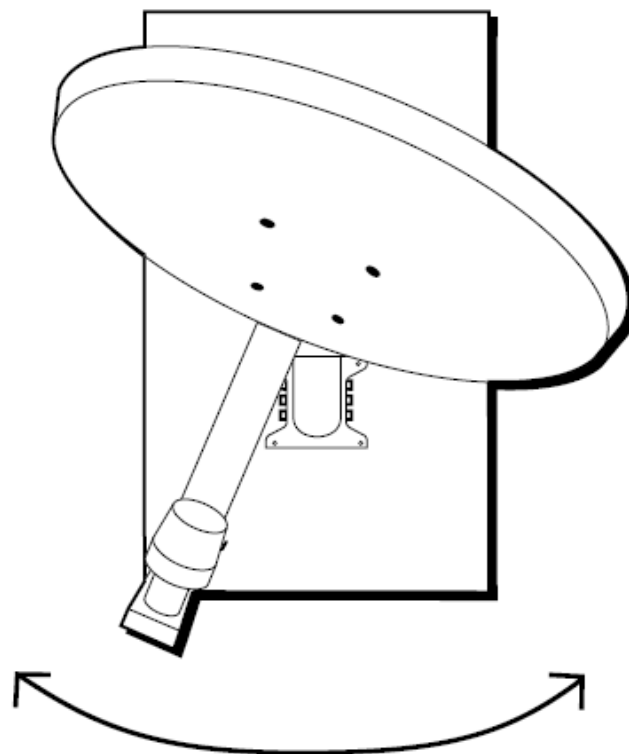
Azimuth is side to side direction
that the dish is pointed

## VSAT antenna pointing 2/5

Before you start radiating power towards the satellite...

- Make sure you have a site specific Antenna and radio configuration (ARC) sheet.

- Schedule the installation with NOC.

- Make sure you have the required tools (inclinometer and compass are key)

- Note: The antenna and radio configuration sheet gives you're the true elevation (or the elevation for a prime focus antenna). In the case of offset antennas, make sure to subtract the antenna offset form the elevation given in the field installation documentation.

# VSAT antenna pointing 3/5

**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° |

## VSAT antenna pointing

Azimuth:

Take note that a compass doesn't work well near steel obstructions and frameworks commonly found in buildings. Strong magnetic fields dramatically affect compass reading as well.

# VSAT antenna  pointing 5/5

**Using a spectrum analyzer for pointing**

- Note:

  Since the LNB is powered with DC over coax it is not possible to connect the spectrum analyzer straight to the LNB. You could blow up the spectrum analyzer input!

# Questions so far?

# Preventive Maintenance <sub>1/5</sub>

Good maintenance, knowledge of the site and well maintained records are the basis for avoiding any 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 scheduled antenna inspection and maintenance program.

# Preventive 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:

- Equipment incl. the antenna error
- Human error
- Lack of experience on equipment and test equipment
- 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.

# Preventive Maintenance 3/5

- Generally the maintenance procedure takes from one hour to half a day, depending on the environmental conditions under which the antenna operates.

- All the maintenance activities must not only be scheduled in advance with the customer but also coordinated with the different support organizations in the same way installation activities are scheduled.

- Reliable and effective maintenance depends upon good test equipment which is regularly calibrated in accordance with manufacturer's recommendations

# Preventive Maintenance 4/5

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.

A dated log (started from day one) with photographs should be prepared when the antenna (and the other parts of the site) are installed. Entries into the log should be made during each inspection so a complete record of the entire antenna system and its condition is available.

Maintenance logs should be stored with the equipment or within the equipment rack.

# Preventive Maintenance 5/5

## Check List

Appearance

Hardware tightening

Earthing (or grounding) connections

Outdoor enclosures inspection

Antenna pointing

Equipment fans

# Troubleshooting 1/3

## WHAT TO DO WHEN THINGS GO WRONG

Obviously, if you need help, the NOC is available. But before you call, please take a bit of time to track down and fix your problem yourself. Ensure you are up to date with your preventive maintenance.

# Troubleshooting <sub>2/3</sub>

And don't rule out hardware errors. A great way to test this is to use an alternate bypass such as switching network cables, coax cables, or a different computer when all else fails.

If you are having signal related problems… try to locate the error by checking your dish.

The idea is not to panic and that most problems are normally an easy fix… once the problem is located.

# Troubleshooting

## Escalation procedure

The process set up to define the steps taken when service levels don't meet upon standards. This may involve determining fault for missed measures, reporting, problem resolution within a specified time and -- when the problem still isn't resolved -- executive intervention on both the client and service provider sides.

# Maintenance Outsourcing 1/3

Companies operating VSATs , often delegate maintenance to specialized companies that will be responsible of the maintenance of the VSAT.

A contract is then signed between the two companies where an Service Level Agreement (SLA) is stated.

The SLA must be complete to avoid misunderstanding between the two parties and permit an excellent operation of the VSAT.

# Maintenance Outsourcing 2/3

An SLA is a formally negotiated agreement between two parties. It is a contract that exists between customers and their service provider, client or between service providers. It records the common understanding about services, priorities, responsibilities, guarantee, and such — collectively, the *level of service*. For example, it may specify the levels of availability, serviceability, performance, operation, or other attributes of the service like billing and even penalties in the case of violation of the SLA.

# Maintenance Outsourcing 3/3

## SLA Content

The SLA may include :

- Bandwidth availability

- Response times for problem resolution

- Escalation procedures

- Links performance

- Penalties in case of violation,…

# Spares Management

For ease and fast maintenance it is necessary for customer to have on site some spare parts. The following hardware can sometimes be faulty, and so need some spare parts to be kept for possible replacement:

- BUC

- LNB

- Modem

- Feed horn

# End

## Thank You!

## Questions?