www.rfwireless-world.com

VSAT System Overview

Introduction:

This article describes basics of satellite communication, VSAT subsystems and installation procedure.

Basics of Satellite communication:

Following table mentions Band versus various frequency range used in RF/wireless communication.

Band	Frequency Range
L	1-2 GHz
S	2-4 GHz
C	4-8 GHz
X	8-12.5GHz
Ku	12.5 to 18 GHz
K	18 to 26.5 GHz
Ka	26.5 to 40GHz

Satellite basically composed of three main parts transponder, antenna systems and solar cells. Transponder converts higher frequency received from earth to lower frequency and transmit back to earth. For C band as mentioned below it converts 6.175 GHz to 3.950 GHz as 2225MHz LO is used in the satellite.

The various frequency bands used in VSAT communications are as below –

Frequency Band	**Uplink (GHz) Earth Station to Satellite**	**Downlink (GHz) Satellite to Earth Station**
C Band	5.925 to 6.425	3.700 to 4.200
Extended C	6.725 to 7.025	4.500 to 4.800

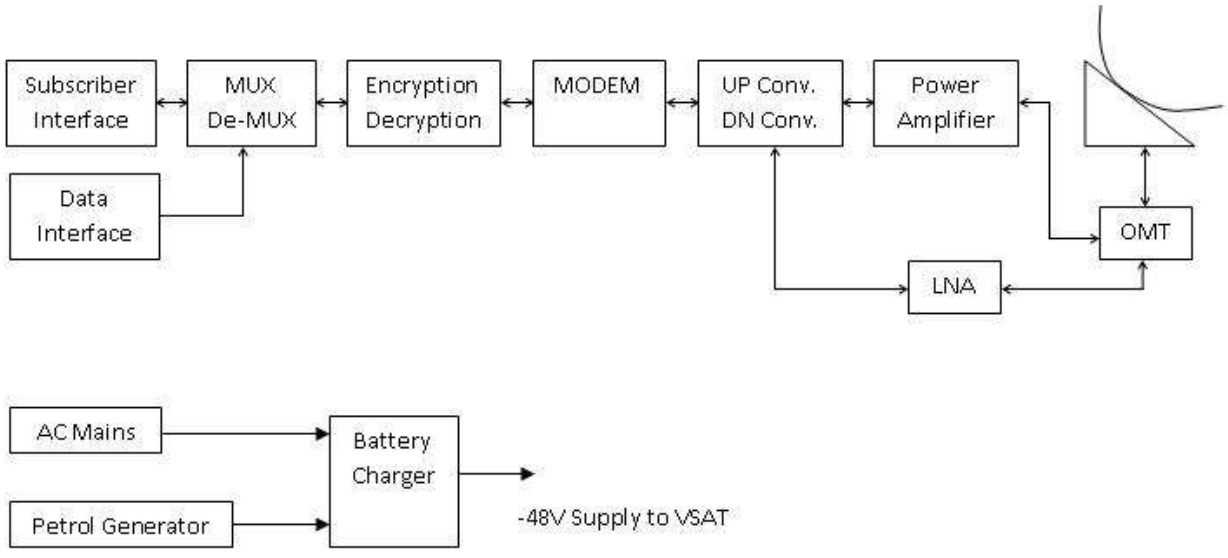
Band

Ku Band	14.000 to 14.500	10.950 to 11.700

The term Very Small Aperture Terminal (VSAT) refers to a small fixed earth station. VSATs provide the important communication link to set up a satellite based communication network. VSATs can be used for voice, data, or video transmission and reception.

The VSAT comprises of two modules viz. an outdoor unit and an indoor unit. The outdoor unit consists of an Antenna and Radio Frequency Transceiver. The antenna size is typically 1.8 or 2.4 meter in diameter, although smaller antennas are also in use. The indoor unit functions as mux-demux, modem and interfaces with the end user equipments like PCs, LANs, Telephones or an EPABX.

Following diagram describes typical schematic consisting various VSAT subsystems.



Outdoor Unit

The Outdoor unit is usually mounted near the antenna systems outside hence the name. It consists of RF frequency converters (Up/Down converter), Power Amplifier, Low Noise Amplifier (LNA), OMT and Antenna system.

The Up/Down converters convert frequencies IF to RF frequencies and vice versa. For example, Up converter converts 70MHz to 6175 MHz and Down converter converts 3950MHz to 70MHz for C band application.

Power Amplifier will amplify the signal before transmitting to the feed horn of the Antenna system.

LNAs are designed to amplify the noise added received signal received from the satellite. It is designed such that it will amplify the signal and not the noise. Noise temperature is the parameter used to describe the performance of a LNA.

The antenna system comprises of a reflector, feed horn and a mount. VSAT antenna usually varies from 1.8 meters to 2.4 or 3.8 meters. The feed horn is mounted on the antenna frame at its focal point by support arms. The feed horn directs the transmitted power towards the antenna dish or collects the received power from it. It consists of an array of microwave passive components. Antenna size is used to describe the ability of the antenna to amplify the signal strength.

The outdoor unit is connected through coaxial cable to the indoor unit, which is situated inside the room/building. Length of the cable is usually about 300 foot (approx. 90 meter).

Indoor Unit

The IDU consists of MUX/DEMUX, EDU (Encryption Decryption Unit), modem (modulator-demodulator).

MUX will interface with end user equipments viz. telephone, computers and sometime with EPABX and LAN or router, if it has to carry more information. MUX will multiplex all the channels connected with it using TDM. On receiver side DEMUX is used to de-multiplex the channels and passed on to respective end user equipments.

EDU is basically the Encryption-Decryption unit which provides security by modifying the information to be transmitted. On receiver side encryption technique will be conveyed so that the information can be retrieved back again.

MODEM is basically performs modulator-demodulator functionality on transmit and receive side respectively. Modulator inserts information on intermediate frequency (IF), usually called carrier. This is done based on modulation scheme set. Usually QPSK scheme is used in satellite communication and Forward Error Correction is also employed in modem which enhances the BER for the same transmitter power usually used in non-FEC systems. In order to communicate between VSAT 1 and VSAT 2, modulator frequency of VSAT 1 and demodulator frequency of VSAT 2 need to be same and vice versa to complete full duplex communication channel. Based on frequency assignments as per FDMA various modem and RF frequency converters are set.

Installation procedure:

Step 1: Open all the sub systems from the received boxes. Sub systems include

- Antenna and accessories

- Feed Horn
- OMT
- BUC
- LNB
- Satellite Modem
- MUX

Step 2: Mount Antenna along with support, Do not tight all the screws.

Step 3: Check satellite latitude and longitude with which VSAT has to be tuned. Calculate Azimuth and Elevation required for antenna alignment using calculators' available inputting latitude and longitude of the place where VSAT need to be installed.

Step 4: Adjust Antenna Azimuth using compass and also elevation using tools available

If tools are not available roughly place antenna and first complete all other steps as mentioned below then connect the spectrum analyzer at IF OUT of LNB and check for good signal, tighten the antenna in that position.

Step 5: Run the IF cables from LNB and BUC to indoor unit (satellite modem).Connect LNB cable to IF IN of modem & BUC to IF OUT of modem.

Step 6: Do necessary connections between MUX and Satellite modem for the Data (or voice or voice +Data) to be transmitted using satellite link.

Step 7: Connect MUX with EPABX for voice connection and with PC for data connection depending on the system designed for.

Step 7: Do setting for Frequency and power in RF equipments (RF Transceiver unit) and modem.

Following settings need to be done in IF Modem for VSAT 1 and VSAT 2 to be communicated via satellite. Need to take care of Bandwidth so that one spectrum does not overlap the other.

FREQUENCY SETTINGS:

(VSAT1)	**(VSAT2)**
Mod: 71.1MHz	**Demod: 71.1MHz**
Demod: 71.2MHz	**Mod: 71.2MHz**
UC: 6176.1MHz	**UC: 6176.2MHz**

DC: 3951.1MHz **DC: 3951.2MHz**

Typical VSAT system specification:

1. Access is TDM-QPSK-FDMA

2. Information rate 128kbps

3. Hub station antenna 11 meter or 7.5 meter

4. VSAT antenna 2.4 meter, 5 watt PA, 65 deg K LNA

5. Rate ½ Convolution FEC, Viterbi soft decision decoder and outer Reed Solomon encoder-decoder

6. Support for 5-7 voice channels, Data channel for Network Management

7. Frequency of operation -C band

References:

http://www.groundcontrol.com/

http://www.wirelessconnections.net/calcs/calculations.asp

http://www.satsig.net/linkbugt.htm

http://www.satcoms.org.uk/budget.asp