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VSAT as an Alternate Source of Internet Connectivity in Remote Areas of Arunachal Pradesh, India

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Abstract: ***Satellites for communication services have evolved quite significantly in size and power since the launch of the first commercial satellites in 1965. This has permitted a consequent reduction in the size of earth stations, and hence their cost, with a consequent increase in number. Small stations, with antennas in the order of 1.2–1.8 m, have become very popular under the acronym VSAT, which stands for 'Very Small Aperture Terminals'. Such stations can easily be installed at the customer's premises and, considering the inherent capability of a satellite to collect and broadcast signals over large areas, are being widely used to support a large range of services. Examples are broadcast and distribution services for data, image, audio and video, collection and monitoring for data, image and video, two-way interactive services for computer transactions, data base inquiry, internet access and voice communications. As Arunachal Pradesh is located in highly terrain, almost places are very remote. So, VSAT is only the alternate source of internet connectivity.***

Keywords: VSAT, Networks, Computers, Antenna, Modem, Receiver, Transmitter, etc

1. Introduction

VSAT, now a well-established acronym for Very Small Aperture Terminal, was initially a trademark for a small earth station marketed in the 1980s by Telcom General in the USA. Its success as a generic name probably comes from the appealing association of its first letter V, which establishes a 'victorious' context, or may be perceived as a friendly sign of participation, and SAT which definitely establishes some reference to satellite communications.

The use of the word 'terminal' which appears in the clarification of the acronym will be replaced by '*earth station*', or station for short, which is the more common designation in the field of satellite communications for the equipment assembly allowing reception from or transmission to a satellite. The word *terminal* will be used to designate the end user equipment (telephone set, facsimile machine, television set, computer, etc.) which generates or accepts the traffic that is conveyed within VSAT networks. This complies with regulatory texts, such as those of the International Telecommunications Union (ITU), where for instance equipment generating data traffic, such as computers, are named '*Data Terminal Equipment*' (DTE).

VSATs are one of the intermediary steps of the general trend in earth station size reduction that has been observed in satellite communications since the launch of the first communication satellites in the mid 1960s. Indeed, earth stations have evolved from the large INTELSAT Standard A earth stations equipped with antennas 30 m wide, to today's receive-only stations with antennas as small as 60 cm for direct reception of television transmitted by broadcasting satellites, or hand held terminals for radiolocation such as the Global Positioning System (GPS) receivers. Present day hand held satellite phones (IRIDIUM, GLOBALSTAR) are pocket size. Therefore, VSATs are at the lower end of a product line which offers a large variety of communication services.

Advances in technology have given a new thrust to the satellite communication industry by deploying low cost very small aperture terminal (VSAT) networks for data, voice, and video communication. In this paper, we propose an architecture design of a VSAT network for multimedia on demand services. Two types of architecture are represented namely: the centralized multimedia on demand network system and the distributed system. The components of these two systems and the function of each component are investigated. A protocol for the multimedia on demand network system is also presented in this paper. The protocol defines the procedure for exchange of data between the VSATs and the MMOD server. In addition, the most common user activities and the effect of these activities are discussed. Finally, selected results of the network performance for a number of dependent VSAT network elements, obtained through analytic queuing and simulation models are presented. The paper concludes that by using a VSAT network for MMOD services, it is feasible to build low cost, easy to install and expandable MMOD systems.

VSAT terminals are used in military and naval applications to ensure communication even in remote locations. They are also used in narrowband financial applications like point-of-sale transactions, and broadband data like Voice over Internet Protocol (VoIP), and satellite internet. The base price for VSAT is estimated using average satellite capacity costs of ₹1, 00, 000/- approx. per set for C-band and ₹2, 00, 000/- approx. per set for Ku-band. The fluctuation, though, is derived from a more complex calculation. The satellite dish, parabolic in shape, is mounted on your roof facing south. It receives the Ku band RF analog signals from the geostationary satellite 23, 000 miles in the sky and passes it on to the modem. Connectivity through satellite-based communication solutions (VSAT) is a secure and reliable medium to connect geographically dispersed locations. Even in situations where other connectivity options are not feasible or are not reliable, VSAT offers two distinct advantages: quick deployment time and assured high uptime. A satellite terminal is a building detached from other airport buildings, so that aircraft can park around its entire circumference. It used an underground pedestrian tunnel to

connect the satellite to the main terminal. There are two different configurations of VSAT networks: (1) Star network configuration (2) Mesh network configuration.

2. Objectives

1) Communication links to all Primary Health Centre and Community Health Centre with MIS HQ. at NRHM, Naharlagun, Arunachal Pradesh, India.
2) To disseminate the MIS data of both state and central schemes.
3) Services of Telemedicine.

Installation Area:

1) All districts of Arunachal Pradesh, i.e. Tawang, West Kameng, East Kameng, Pakke-Kessang, Papum Pare, Lower Subansiri, Kamle, Kradaadi, Kurung Kumey, Upper Subansiri, Siang, Upper Siang, West Siang, Leparada, Shi-Yomi, Dibang Valley, Lower Dibang Valley, Lower Siang, East Siang, Anjaw, Lohit, Namsai, Changlang, Tirap, Longding.
2) List and total nos. of sites installed are:-

Total nos. of installed: 55Nos
Name of installed site:
Balijan, Mengio, Raga, Palin, Chambang, Sangram, Nyapin, Sarli, Koloriang, Puchi-Geko, Taliha, Dumporijo, Baririjo, Nacho, Siyum, District Medical Daporiji, DRCHO office Daporijo, Tirbin, Yomcha, Kaying, Pangin, Dari, Koyu, Mebo, Namsing, Mechuka, Monigong, Boleng, DRCHO Office.

Yingkiong, Tuting, Jenging, Geku, DMO Office Anini, DRCHO office Anini, Etalin, Dambukh, DMO Office Hayuling, DRCHO office Hayuliang, Hawai, Miao, Bordumsa, Nampong, Khimiyong, DRCHO Office Khonsa, Wakka, Pongchau, DMO office Longding, DCRHO office Seppa, Bameng, Chayangtajo, Pakke-kesang, Kalaktang, Lumla, Mukto.

Equipments and Tools:

1) Inclinometer
2) Compass
3) Wrench Set
4) DC to AC Converter
5) Inverter with Battery
6) 30dB Attenuator
7) Digital Voltmeter
8) Crimp Tool
9) RG6 Test Cable(2-10M)
10) Personal Computer/Laptop with LAN port
11) Cellular Phone/Walkie-Talkie
12) Cable Cutter
13) RJ-45 Connector
14) Mastic Tape

3. Materials and Methods

1) VSAT Equipment Components

The three major components are the antenna, the transceiver and the modem.

2) The VSAT Antenna

Prodelin 2.4 transmit/receive

The antenna choice depends upon the type of service that the client will provide to his clients. A cybercafé with 15 to 30computers in a location with good satellite signal will be content with a Prodelin 2.4mantenna. We choose Prodelin or Andrews because of construction strength and accuracy of manufacturer. Incidentally, they are also approved by all of the satellite operators.

Installations that require high volume connections of 1MB or greater will find savings by installing the larger3.8m or 4.5m antennas. Although these antennas cost more to purchase and more to ship, there will be savings on the re-occurring monthly bandwidth cost.

In this project, I have used 1.2m antenna of Prodelin.

3) The VSAT Transceiver

Hughes's Ku-Band Transceiver

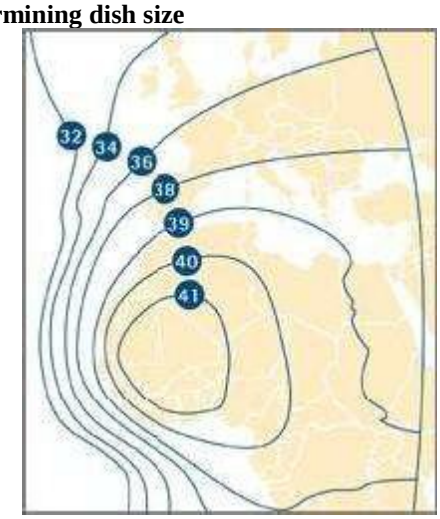
Hughes has two types of transceiver ie. Normal and Rambard model. In Rambard model, transceiver are mounted in a single unit, making it simpler to install on the antenna. Transceivers are the radios that transmit the signal from the earth station up to the satellite. Small antennas transmitting high bandwidth require powerful transceivers; larger antennas with smaller bandwidth require less power. Transceivers are sold by their power rating; our existing clients use transceivers in the range from 5watts to 60 watts. The choice is also influenced by the strength of the satellite signal at the client's location in addition to the bandwidth and antenna size.

4) The VSAT Modem

Hughes HN9260 Modem

The modem at one teleport communicates directly with the modem at our client's location. Although most modems are compatible with each other, we try to make it a rule that the modem type at our client's teleport is of the same type that we use. Often we have to instruct technicians, who are not familiar with the modem, how to set it up. It is easier to accomplish this if both sets of technicians are using identical equipment. It is important that the modem features are matched to the needs of the satellite; incorrect modem settings can lead to the client paying a premium for the monthly cost of space segment.

5) Determining dish size



The antenna size limits the amount of data that you can carry over a circuit. It is a complicated calculation based upon a client's location relative to the satellite power footprint. When we know your requirements we can guide you to your decision. Satellite bandwidth is not cheap and some companies have designed a product that seems to offer cheap bandwidth. Their solution is to sell shared bandwidth. In other words they will buy 1 Megabyte from the satellite owner and resell this same bandwidth ten times – they gamble that not all of their clients will need bandwidth at the same time. This gamble often fails at peak times and the clients are left competing for the same space. If the client is running voice, the conversation is broken up and choppy, if they are running data the download speed becomes very slow. Each satellite beam coverage pattern has power and sensitivity contours which are fundamental to the dish size required so your location is important. At the outer, lower level contours larger dish sizes are required.

In order to transmit a sufficiently powerful signal to the satellite you need a combination of transmitter power(from the Block Up Converter or BUC) measured in watts, plus a dish size with enough gain. There may be a trade off to be done, if there is the possibility of a smaller dish and high power amplifier or larger dish and low power amplifier.

6) Optimizing costs

To minimize long term monthly costs it is critical to make efficient use of the satellite capacity and power available. If you have a very small dish you will need more power from the satellite to carry the same required bit rate. Dish is the key factor. Doubling the dish area (approx 1.4 times larger diameter) will reduce your satellite power required by half. The way your digital signals are transmitted and received is also critical. Choice of the right VSAT modem is important. A wide variety of old and new modulation methods are possible. Modern modulation schemes and forward error correction (FEC) techniques allow more bits/s to be squeezed out of the available satellite capacity.

2. VSAT Installation

Installation of a VSAT system can be a challenge unless the installer has considerable experience in performing the task. An experienced installer will be able to unpack the equipment, assemble the antenna, modem and transceiver, line up the satellite and get a signal lock in 5 to 7 working days.

There are several stages involved in building a VSAT facility:

1. Inspection of the VSAT equipments
2. Preparation of the site for VSAT installation
3. VSAT equipment installation
4. VSAT antenna alignment
5. Commissioning and start of VSAT service

Step 1: Inspect the VSAT equipment

If the equipment has been purchased from several different vendors, small items like cables may not have been provided. The installer must perform a full inspection of the equipment immediately upon its arrival; any missing items

can be identified and ordered while the initial work of installation is proceeding.

1) Site preparation

Professional installer begins assembly of an Andrew 4.5m

Step 2. Preparation of the antenna site

The installer will contact the EX4U teleport & satellite operator in order to get the settings for the azimuth, which is the compass bearing from the client's location to the satellite, and the elevation, which is the angle in an upward direction that is necessary for the antenna to hit the satellite. This information will confirm that there are no trees, buildings or other obstructions that prevent the antenna from having a clear view of the satellite. The antenna site must be positioned conveniently close to the main building that will house the electronics and provide the electrical power to the antenna. Larger antennas need special concrete pads built for them, but the smaller antennas of 3.8m or less can often siton the roof of a building or on a firm flat piece of ground.

Excavating the whole for the antenna

Building the concrete pad

Installing the antenna on the support frame

Step 3. VSAT Equipment mounting

Building the antenna is time consuming, depending upon its size it may take from one day to three days. The larger antennas may need the help of a crane to position them on the mounting supports. The bolts that control the antenna position should be left loose to enable final alignment with the satellite. Typically the transceiver is mounted on the antenna support frame, with the IF cables being connected back into the building where the modem and Internet routers are housed. All items of equipment should be powered via a UPS to prevent damage in the event of power cuts.

Step 4. Antenna Alignment

Alignment of the antenna

An experienced engineer using a spectrum analyzer best performs this task. The satellites are located a few degrees apart, finding the target satellite is a very difficult task. A

professional installer will find a satellite in a matter of a few hours. Installers with less experience can take weeks of frustrating effort before getting the correct alignment. The final step in alignment is the Peak and Pole procedure with the satellite operations centre. 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.

3. Steps before VSAT Installation:

Before VSAT installation process, the following procedures and tasks must be done:

1) Submission of ISP Subscriber form with required documents to the Internet Service Provider. Details are mentioned below:-
   a) ISP Subscriber form
   b) Service Plan document
   c) CAF form
   d) ID proof
   e) Address proof
   f) Passport photo-2 copies
   g) Seal and Sign on all documents
2) When verification of the submitted documents is cleared, Site code and Job sheet are generated from ISP.
3) Then based on the Site code, IP Address is generated for the site.

4. Practical Steps during VSAT Commissioning:

Some practical steps taken during the time of VSAT installation are as follows:-

1) Lock both Tx(Transmitter) and Rx(Receiver).
2) Call to NOC Hyderabad for force download of the site by giving Site code and Modem serial number.
3) Wait till the modem restarts automatically after completion of software downloads.
4) Browse the modem using http://192.168.0.1 and note the dummy IP address (e.g. 23.6.140.1). And set satellite parameters (Degree of Satellite, Latitude/Longitude etc), VSAT Parameters (Radios, Management IP, etcs).
5) Set the LAN such a way that Computer(LAN1) IP= 23.6.140.2(plus 1 of dummy IP) and Gateway=23.6.140.1(dummy IP).
6) Then open the HSO(Hub Sign Off) web portal, filled the form, upload, IDU and ODU installed picture), call to HSO issue(TSG) team at Gurgoan and get HSO Number.
7) After getting HSO Number, call to NOC Hyderabad to avail permanent IP address for the modem in place of Dummy IP.
8) Then change the computer IP and Gateway IP (Permanent IP=10.6.200.1, then Computer IP=10.6.200.2 and Gateway IP=10.6.200.1).
9) Browse the internet.

Difficulties

1) No availability of on-grid power supply.
2) No cellular mobile tower for modem commissioning.
3) Dilapidated road condition.
4) Desktop computers not available in the premises.
5) No proper electrical earthing done in the site.
6) Blockade of antenna signal due to mountain/tree/high tower building.
7) Phone line busy in NOC Hyderabad during activation.
8) No available public transport for engineers.
9) No hotel and functional IB/Guest house available in the very remote site.

4. Analysis

1) Installation support provided from NOC even during weekends is most appreciable.
2) To install large number of VSAT in time bound project, a vehicle must be hired during entire project time.
3) Spare parts like Modem, RFT, IFL cable etc. must be carried along with during installation in remote areas.

5. Results

VSAT has been successfully installed, configured and activated in all the 55nos. of sites in the Arunachal Pradesh. Installation report has been collected from Medical Officer in-charge of all the CHC and PHC Hospitals. And photograph has been taken for both indoor and outdoor units with office staffs.

6. Conclusions

On the circuit commencement date, the duty engineers set-up a conference call between the satellite operator and the client, in order to fully activate the link. Each sides ends up a test transmission at the approved frequencies. The satellite operator measures the strength of signals and requests any power adjustments that maybe 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 EX4U teleport to the Internet routers to enable the client to begin voice or Internet services.

7. Acknowledgements

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