Mobile Communication for Rural Development Using VSAT

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Abstract: — This paper is regarding mobile communication for rural development using vsat. mobile communication in rural areas is made possible through vsat technology. major factor is that in rural areas there are very less cell towers so we are proposing a system in which a satellite will act as a broadcast center as MSC (Mobile switching center) and BSC (Base station controller) center will act as a mobile communication center and receiving center. The access point will collect all signals from the village communities' cells and send them to the satellite system, as well as send signals from the satellite to the village communities' cells. This access point performs frequency conversion. At the transmitter, the access point converts the GSM band to the satellite band, and at the receiver terminal, the satellite band to the GSM band. The main advantages of this device are that it is customizable, extensible, and solar powered due to the low traffic in rural areas.

I. INTRODUCTION

The most appealing technology in recent years has been satellite technology, which aids in improving the rural tele-communication scenario [1]. The deployment of wire line solutions is complicated and costly due to the tele-density. VSAT offers network operators a one-of-a-kind approach as well as a cost-effective rural communications solution. Very Small Aperture Terminals (VSAT) is an acronym for Very Small Aperture Terminals. VSAT stands for Very Small Aperture Terminal, and it is a form of telecommunications technology that uses geosynchronous satellites to transmit data for point-to-point or broadcast communications. When compared to conventional land-based telecommunication systems, there are many benefits to using VSAT technology. This technology is more versatile as compared to terrestrial systems, which is the primary benefit of VSAT technology. This has been conceptualized. VSATs were first introduced in the 1970s, and large-scale production of VSAT terminals began in the late 1980s [3]. As we are using satellite communication which covers the part of the earth for communication. Vsat is reliable technology as it independently connects with satellite and transmit and receiving signal. many military applications are used on Vsat communication. due to very small aperture terminal, it is small size, low weight and portable to move from one place to another. as we can connect to mobile communication, we can also use internet communication. Vsat is also used at the disaster sites where emergency services are required. connectivity and installation are flexible and easy [2]. There are many other obstacles that must be overcome in order to provide communication services to rural areas, especially in developing countries. Geographical obstacles include rugged terrain, which makes long-distance line-of-sight difficult, as well as population demographics, such as sparse distribution in pockets along valleys and a lack of infrastructure, such as roads and a reliable commercial power supply.

II. VSAT SATELLITE COMMUNICATION

One of the problems facing thousands of businesses operating in remote or difficult-to-reach locations is the volatility and speed of communications. As a result, many businesses today prefer to integrate satellite systems into their process flow, allowing them to provide a flexible and independent communications network, as a result, there are a plethora of market-based solutions for this need, such as antennas, which provide a whole ecosystem of applications and benefits for receiving and transmitting data regardless of geographic location. As a result, you will learn more about one of them in this post, which stands out in many industries for its quality and accessibility. VSAT satellite technology is used for the antennas. The VSAT satellite technology employs a form of data-receiving and data-transmitting antenna known as a Very Small Aperture Terminal (VSAT). [2] This antenna consists of small terminals that can be mounted in several locations and linked to a central hub via satellite; the size of the dishes can range from 0.75 to 3.8 meters. Since VSAT technology is a cost-effective solution for businesses that need an independent communication network while still linking several geographically distributed locations, this antenna is being used in a growing number of sectors and applications, depending on its goal: to only receive data or to receive and send data. The VSAT-based approach to expanding mobile communication services to rural areas is very useful and cost-effective for network operators. The houses or small settlements in the village community will be grouped together in this method, and those groups of houses will be referred to as hamlet cells.

III. CISCO PACKET TRACER

In today's cooperate environment the fundamental network is computer network. This paper seeks to highlight some basic challenges of computer networks by having key features of cisco packet tracer. It has seen that cisco packet tracer has the releases of three different versions within the last two years. [4] Cisco packet has two workspaces logical and physical. user build network topologies by placing, connecting and clustering virtual network devices in logical network workspace. The physical workspace provides a graphical physical dimension of the logical network giving a sense of scale and placement in how network devices such as routers, switches and hosts would look in real network.

Cisco Workspaces with Packet Tracer The conceptual and physical work spaces in Packet Tracer are separated. By arranging, linking, and clustering virtual network devices in the logical workspace, users may build logical network topologies.[5] The physical workspace depicts the logical network in a graphical physical dimension, providing a sense of scale and location for network devices such as routers, switches, and hosts in a real-world setting. Geographic depictions of networks, including multiple towns, homes, and wiring closets, are also available in the physical view.

Cisco Packet Tracer has two modes of operation for visualizing network behavior: real-time mode and simulation mode. The network acts like real devices in real-time mode, with immediate real-time responses to all network activities.[3] The real-time mode

provides students with a viable alternative to real-world equipment while also allowing them to gain configuration experience before working with real-world equipment.

IV. NETWORK TOPOLOGIES USED IN VSAT

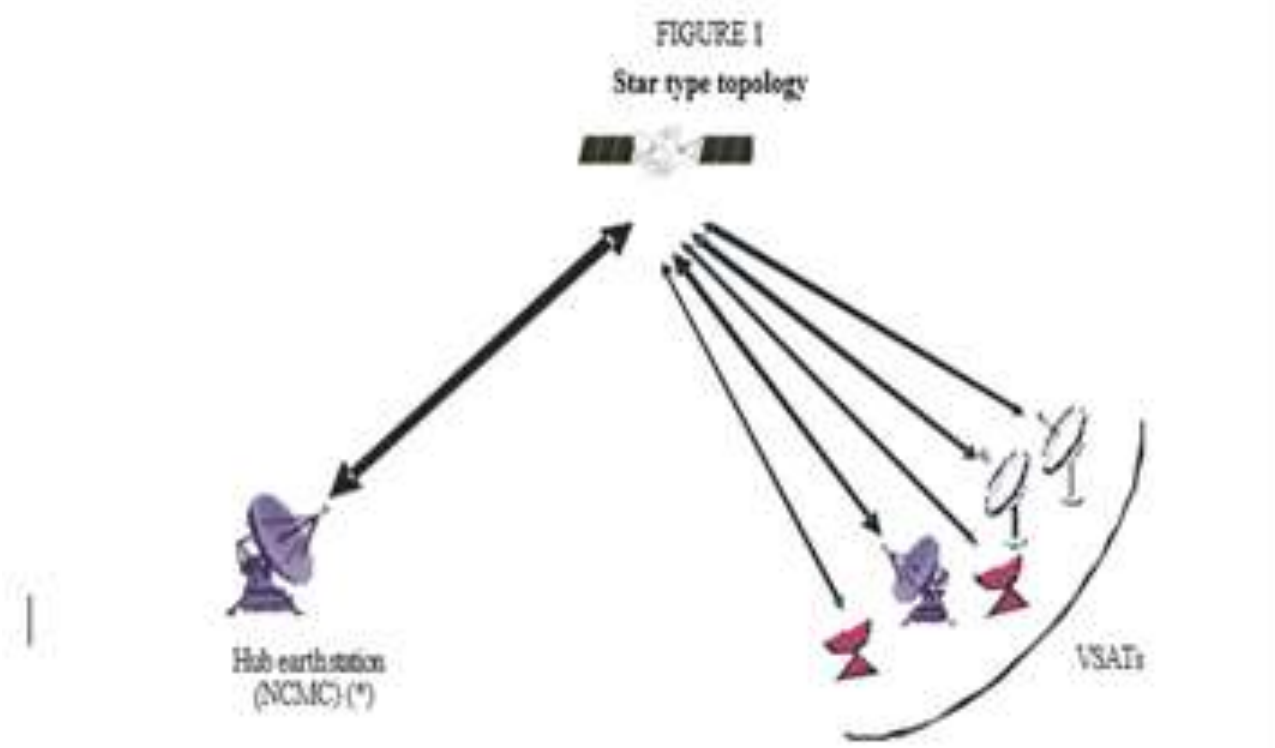
4.1 STAR TOPOLOGY NETWORK

As shown in Fig. 1, this topology includes a "hub" earth station that concentrates user traffic from a group of VSATs and assumes control of the VSATs. However, for redundancy purposes, the network can use more than one hub earth station (i.e., primary and backup hub earth station).[7] The "double hop" route must be used when interacting between VSATs.

The frequency spectrum is often shared between VSATs using a demand-driven protocol. In order to avoid bottlenecking of data traffic at the hub, outbound (i.e., hub to VSAT) and inbound (i.e., VSAT to hub) traffic transmission speeds are mostly asymmetric for such networks. It's also worth noting that VSATs with varying characteristics will coexist in the same network.

FIGURE 1

Star type topology



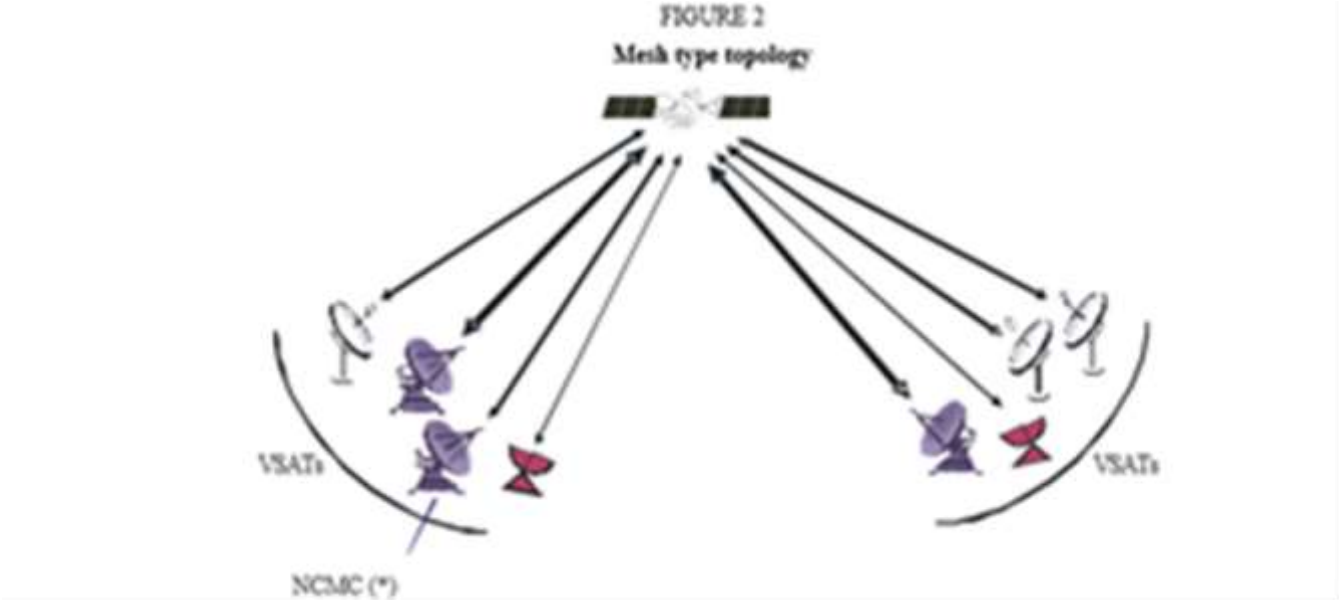
4.2 MESH TOPOLOGY NETWORK

As shown in Fig. 2, a group of VSATs can interact with each other without the use of a hub earth station (i.e., a "single hop" connection) (order N latency). For management and regulation of the community of VSATs, there is a network control and monitoring center (NCMC) earth station (or several NCMC earth stations in redundancy).

The consumer traffic, however, does not have to be directed to the NCMC earth station. The frequency spectrum is often exchanged between VSATs on a demand basis. Regardless of type, transmission speeds can vary from station to station. It's also worth noting that VSATs with varying characteristics (such as antenna diameter, transmitting capacity, and so on) will coexist in the same network.

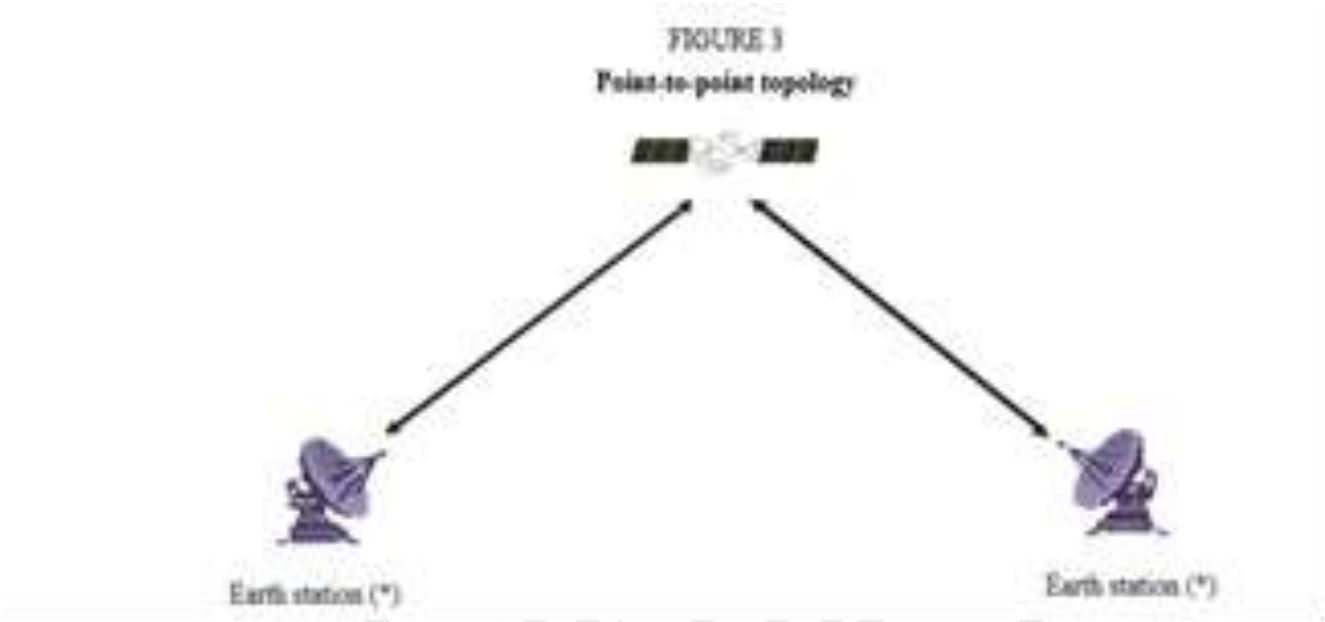
FIGURE 2

Mesh type topology



4.3 POINT TO POINT TOPOLOGY NETWORK

Only two earth stations on a point-to-point connection are connected in this topology, as shown in Fig. 3. VSATs can be found on one or both ends of the connections. In essence, the frequency spectrum is not shared but committed to the connection, and VSATs work independently of other earth stations.



V.REQUIRMENTS

IPSTAR Uplink Access Test (IUAT) [1] is a hardware and software requirement.
Packet Tracer from Cisco [2]
IPSTAR Uplink Access Test Tool (IUAT): IUAT is a free IPSTAR Uplink access test tool for Windows OS.
Things to look for include:
Assist in aligning the antenna for the highest UT received and transmitted signal output.
Calculate the UT transmission power that is most appropriate. At each installed site, check to see if the received and transmitted signal quality met the measured reference standard.

VI. MECHANISM OF VSAT

The following diagram illustrates the basic design of the VSAT satellite communication system. In the satellite communication system, several earth stations on the ground are connected to satellites in space [4]. The earthbound network would connect all endorsers to the Earth Station, and this earthbound network may be a dedicated connection or a telephone switch to the Earth Station. The earthbound network will process all of the base band signals produced by the subscribers and transmit them to the satellite from the earth station. With the satellite transponder, which receives modulated RF carrier signals in its uplink from all earth stations in the system, improves these carrier signals, and retransmits them to the earth stations in its downlink frequency range, a large number of repeaters in space are available [5].
Thaicom-4, also known as IPSTRAR 1, is a high-throughput satellite designed for Thaicom Public Company Limited by space system/Loral (SS/L). It is the first high-throughput satellite in the world, capable of serving up to two million broadband users or nearly thirty million cell phone subscribers in the Asia-Pacific region. Thaicom 4 will double as a repeater in satellite communications. Its aim is to convert the incoming frequency into downlink frequency signals that are suitable. Transponders, power amplifiers, low noise amplifiers, block converters, and other satellite components are used to perform the aforementioned operation.

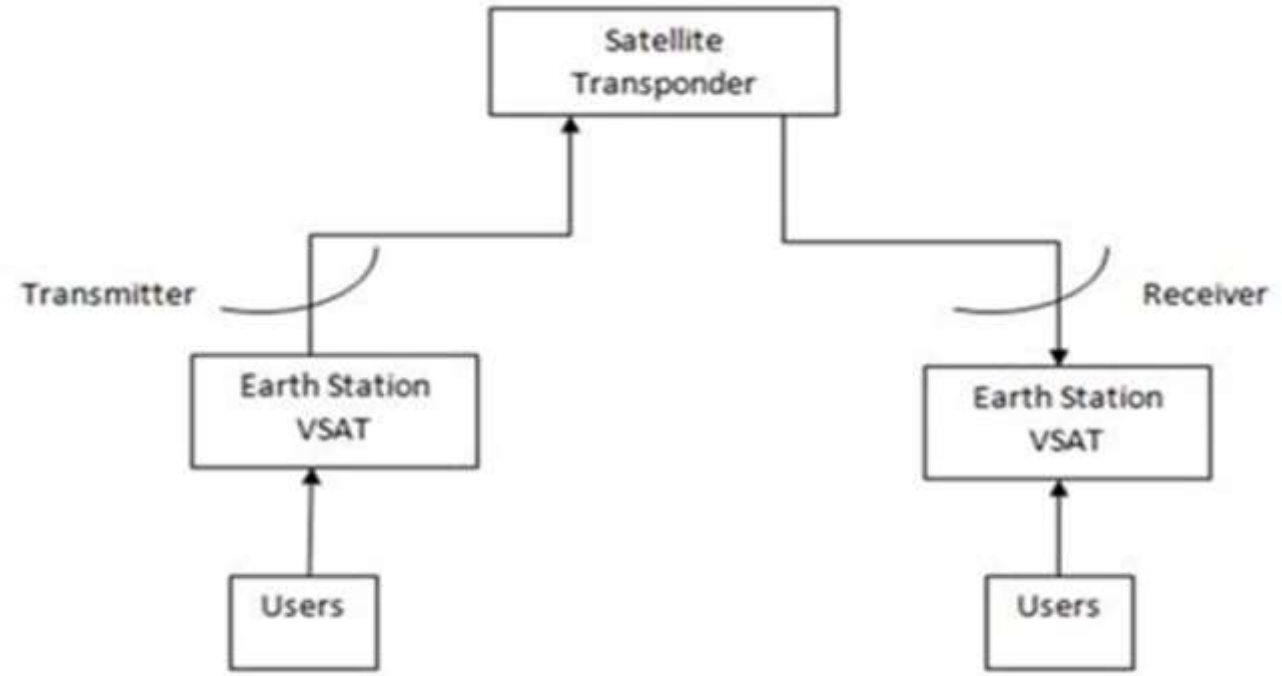


Figure 2 displays the fundamental block diagram of a VSAT earth-station Transmitter. The modulator in this transmitter processes baseband signals from the earthbound network and converts them to uplink frequency [4], [6]. Figure 3 shows the fundamental block diagram of a VSAT earth-station receiver. The signals obtained from the satellite will be processed by the Low Noise Amplifier (LNA). The signals from the low noise amplifier (LNA) are down-converted and then demodulated to obtain the initial base band signal.

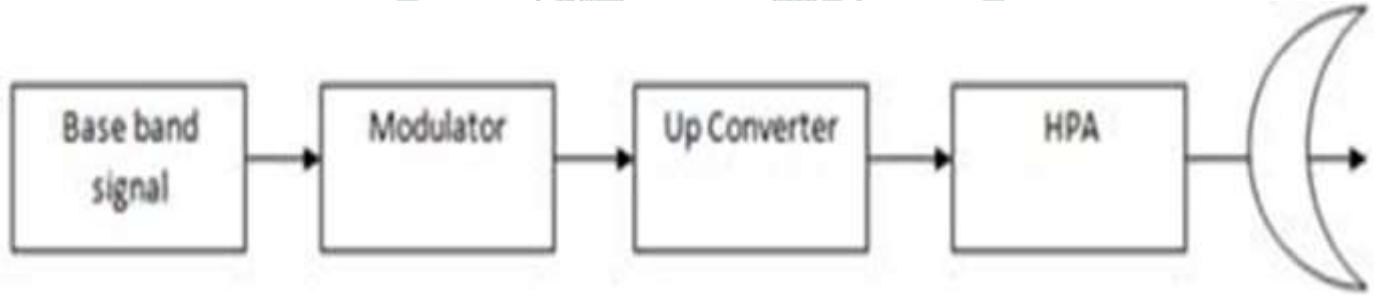


Figure 2 Block Diagram of Vsat Earth Station Transmitter

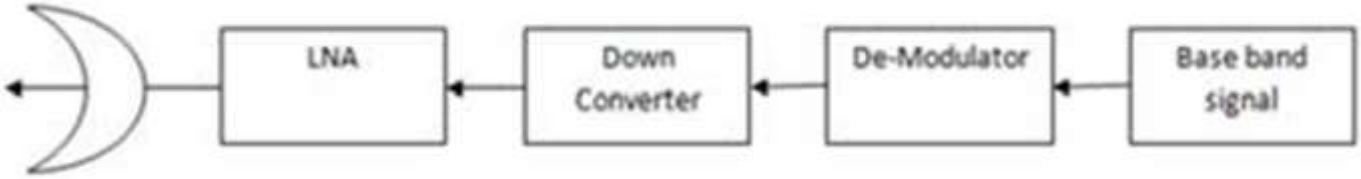


Figure 3 Block Diagram of Vsat Earth Station Receiver

VII. PROJECT OUTCOME

One of the most effective satellite communication methods for providing telephony services to rural areas is the Very Small Aperture Terminal. We have condensed the rural area into hamlet cells in this approach, and each hamlet cell is linked to low-power transceivers powered by solar panels. Calls between subscribers will be routed by the mini MSC in this network, so they will not need to go to the satellite. Both network providers and customers can save money as a result of this. This network may increase the capital expenditure, but it will lower the overall system's operating costs. This is one of the most cost-effective rural mobile communications networks.

VIII. EXPENDITURE

The total approximate cost for one voting station will be as follows:

Sr No.	Specification	Cost(in Rs.)
1	Antenna	23000/-
2	Installation	5500/-
3	Modem	35000/-
4	Rent	3000/-
5	Bandwidth(64kbps)	3000/-
	TOTAL AMOUNT	69500/-

The VSAT system can be set up in rural areas, union territories, and islands where there are no other options for contact. The VSAT antennas can be used for a number of purposes, including internet access and rural development.

IX. ACKNOWLEDGEMENT

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X. CONCLUSION

By using cisco packet tracer, the simulation is performed. VSAT, or Very Small Aperture Terminal, is one of the best ways to provide telephony services to rural areas through satellite communication. In this network, calls between subscribers will be routed through the mini MSC, removing the need for calls to be routed through the satellite. Both network providers and customers can save money as a result of this. This network may increase the capital expenditure, but it will lower the overall system's operating costs. This is one of the most cost-effective rural mobile communications systems.

REFERENCES

[1] On the Impact of Satellite Communications over Mobile Networks: An Experimental Analysis Engin Zeydan, Member, IEEE, Yekta Turk, Member, IEEE, 2019.

[2] M. Jia et al. Broadband hybrid satellite-terrestrial communication systems based on cognitive radio toward 5g. IEEE Wireless Communications, 23(6):96–106, December 2016.

[3] B. T. Jou et al. Architecture options for satellite integration into 5g networks. In 2018 European Conference on Networks and Communications, (EuCNC), pages 398–9. IEEE, 2018.

[4] L. Boero et al. Satellite networking integration in the 5g ecosystem: Research trends and open challenges. IEEE Network, 32(5):9–15, 2018.

[5] Calum Dewar and Dan Warren. Understanding 5g: Perspectives on future technological advancements in mobile. https://bit.ly/2PPli2M. [Online access; 23-April-2019].

[6] E. Zeydan et al. Big data caching for networking: Moving from cloud to edge. IEEE Communications Magazine, 54(9):36–42, 2016.

[7] Electronics Communication Committee (ECC). Satellite solutions for 5g. https://bit.ly/2shjhlm, 2018. [Online access; 23-April-2019].