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Providing Internet Connection to the Rural Areas in India through Satellite Backhaul via VSAT and Frame Relay Node.

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Abstract: The primary aim of this study is to provide internet connectivity to rural areas in India. By investigation we found that approximately 3.8 billion people (half of the world's population) does not have access to the internet. In developing countries, the lack of awareness of internet connection and the high costs of service acquisition and the development have left a significant percentage in rural areas population without the benefits of connectivity. This paper is to provide a seamless wireless coverage with the help of Relay.We also discuss the role of VSAT access for remote users to integrated Broadband communication network through satellite back haul connection. It is one of the methods is to reduce the number of towers byincreasing capacity and rest spectrum in the rural areas.

Index Terms-VSAT1, Relay node2, Frame Relay3

1. INTRODUCTION

Providing mobile and internet connectivity to unconnected indoor and outdoor users especially in rural and remote areas[1]. In recent years the development of telecommunication network and service have led not only to more connected and service communication but also to addition of new service and application that have a direct effort on welfare of users and communication as a whole.

However,there are still segments of world population that have not experienced the benefits of connectivity and accessto network. In developing countries, the lack of digital awareness and the high cost of service acquisition and infrastructure development have left a significant percentage of rural population without the benefits of the connectivity.

2. VSAT

VSAT now a well-established acronym for Very Small Aperture Terminal[1], that can be used for two-way communication by connecting it to a central Hub via satellite initially it was marketed in the 1980's by telecom general in the USA. VSAT can be used for bi-directional operation only and this can be of two modules viz. indoor and outdoor units. Outdoor unit mainly house antenna, feed horn RF Transceiver LAN and indoor unit function as PC'S, telephones. it is mainly helpful to provide a communication in rural areas, schools, hospitals, banks.

2.1. VSAT Indoor Unit

An indoor unit is a telecommunication device that is used in satellite telecommunicationand internet serves for MUX AND DMUX the signal.

Where MUX will multiplex all the channels with it used TDM .On receiver side DEMUX is used to de-multiplex the channel and passed on to respective end users equipment to the specific area on the earth surface where satellite dish is setup to convert the transmitted frequency into electrical impulse that is send to the user IDU and then converts into digital data and gives the internet access to the user modem (or) router [2].

2.2 VSAT Outdoor Unit

ODU are usually mounted near the antenna system outside hence the name .it is typically including a satellite dish, LNB (low noise block) in bi-directional satellite system,power amplifier,feed horn.

Where the outdoor unit is connected to the indoor unit with the help of the help interface facility link. Here the satellite dish receives the signals and the signal is amplified with the power amplifier before sending it to the feed horn.The feed horn is made of array of microwave passive components, then the feed horn delivers the signal to LNB [2]. The LNB converts the satellite frequency to the intermediate frequency and it is connected to the indoor unit through coaxial cable. This is situated inside the building.

2.3 Up Convertor

An uplink is a link that receives the signal from the ground station from the satellite. Basically, it uses a frequency band of C-band, Ka-band and Ku-band[2].

Ku-band and Ka-band are mostly used for satellite communication.

2.4 Down Converter

A down link is the link where the communication is done from satellite to the ground receivers. It contains lower band in order to avoid possible input output interface Uplinkand Down link communication is called as two way communication and this communication is done by DSN (Deep Space Network).

2.5 DSN

Deep Space Network allows huge antenna on the ground to communicate with satellite these are 120 degrees apart from the antenna ensuring that there is always a satellite to send or receive signal facing at any point in the space.

3.VSAT NETWORK

VSAT Network consists of 3 components:

- A central Hub
- A satellite
- A virtually unlimited number of VSAT user terminals.

Where Hub station and VSAT terminal is caring out using RF frequency in different bands.

3.1VSAT Network Topology

Vsat network is the division of two- way implementation is star and mesh network architecture

3.1.1VSAT Star Network

3.1.2VSAT Mesh Network

3.1.1Star: In star network architecture all traffic is routed via the main hub station and this is done with multiple hops communication. Star is the most common VSAT configuration. This is divided into shared hub and distributed hub.

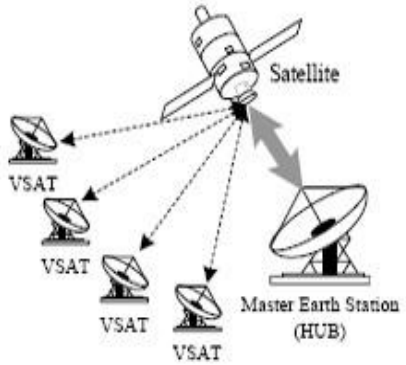

Figure (1): star vsat topology

(i) Shared Hub Network

In Shared Hub Network type, we have only one Hub and many VSAT antennas these all VSAT are divided into sub-networks. these are very high bit rate outbound carrier from hub to the remote earth stations and one (or) more low (or) medium bit rate inbound carrier. All the VSAT uses the same hub.

(ii) Distributed Hub Network

Distributed Hub Network type each network has its own hub station known as 'min-hub' in this all clients will have their own hub station.

3.2. MESH Network

Mesh Network provides a way to switch between point to point communications [3]. Here we won't use any central hub. This network is configured to operate without a large central earth station and carry a mix of data traffic and telephony traffic. It has only network controlling station which monitors the operation of the network.

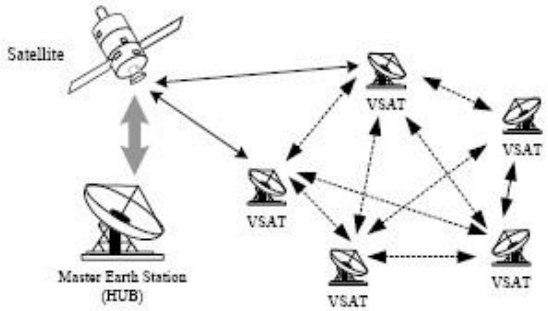

Figure (2): mesh VSAT topology.

4.RELAYNODE

Wireless Relay networks have become very important technologies in mobile communications. It ensures high throughput and coverage extension with a low cost. The poor capacity at cell edges is not enough to meet with growing demand of high capacity and throughput irrespective of user's placement in the cellular network. In this paper we propose optimal placement of frame relay node that provides maximum achievable rate at users and boost the throughput and coverage at cell edge region. The proposed method is based on the outage probability of frame relay at users which account the interference between nodes.

LTE relaying full & half duplex

4.1Half-Duplex: It is a Bi-directional communication system based on time multiplexed. It requires careful scheduling for LTE relay. It requires that the RN coordinates its resource allocation with the UEs in the uplink and the assigned donor eNB in the downlink. Static preassigned solutions is used to achieve this, For greater flexibility and optimisation we require more intelligence and communication

4.2Full Duplex: It can transfer and receive the data at the same time. Same frequency is used in LTE relay nodes. The received signal gets processed and then it is transmitted on the same frequency with a small delay, although the small delay will be when compared with that of the frame duration. It can be achieved with the help of isolation between the transmit and receive antennas.

If we consider full or half duplex systems for LTE relay nodes, there is a difference between performance and the relay node cost. when only one channel is used the received performance get critical and the antenna isolation becomes high to allow the transmission.

4.3Inband: If the link between the base station and the relay node are on the same carrier frequency as the link between the LTE relay node and the user equipment, UE, i.e. the BS-RN link and the BS-UE link are on the same carrier frequency then it is called Inband.

4.4Outband: For Out band LTE relay nodes, RNs, the BS-RN link operates of a different carrier frequency to that of the RN-UE link.

There are two basic types of LTE relay node[10]

- Type1 LTE relay node and
- Type 2 LTE relay node

4.5Type 1 LTE relay nodes*:* These LTE relays node cells are controlled by their own identity along with the transmission of their own synchronisation channels and reference symbols. Type 1 relays appear as if they are a Release 8 eNB to Release 8 UEs. This ensures backwards compatibility. It provides half duplex with In band transmissions.

There are two further sub-types within this category:

***4.5.1 Type 1.a*:** It is a Full Duplex which have the same property as the basic type 1 relay node and it is also an Outband RN.

***4.5.2Type 1.b*:** It is also an Inband form. It has a sufficient isolation between the antennas used for the BS-RN and the RN-UE links. It can be achieved by antenna spacing and directivity as well as specialised digital signal processing techniques. The performance of these RNs is similar to that of femtocells.

4.6 Type 2 LTE relay nodes: They look like a main. They do not have their own cell identity. Any UE in range is not able to distinguish a relay from the main eNB within the cell. The information which is controlled can be transmitted from the eNB and user data from the LTE relay.

5.CONNECTIVITY OF VSAT AND FRAME RELAY NODE

Frame Relay node by its nature was designed to work in an environment where the link between the first frame relay node to another frame relay node are totally using fiber link. Thee type of stimulation is not available in small city so the idea is to provide this service in remote areas by utilizing VSAT solution, here Frame Relay node will support 10w RF power and antenna deployment starting with 2.4m dish and speed is 64kbps to 512kbps. This is adequate to handle LAN to LAN traffic with modulate traffic.

If we select an antenna of 4.5m then it will provide ample capacity to anticipate customer growth. This flexibility that eventually will support the idea to provide service to remote areas and provide alternate route for 2M filter link.

So here VSAT will be interconnected with frame relay that is collected at the HUB site and the signal is spread to the remote areas.

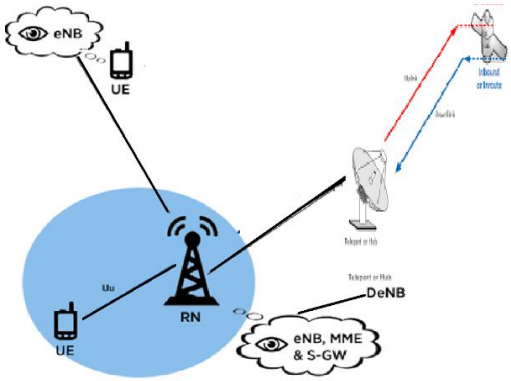

Figure (3): Connectivity of VSAT and Frame Relay Node

6. CONCLUSION

In this paper author has emphasized on VSAT and frame relay node to provide internet connectivity in the remote areas with the satellite backhaul connection. The advantage are that the equipment is not to large, easy to fit anywhere, less in cost, high quality of network access. A complete over view has been presented in this paper on VSAT, VSAT indoor unit, outdoor unit , up convertor ,down convertor, DSN, Vsat network, relay , frame relay node, half duplex, full duplex. Here relay node is used to improve the coverage area.

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