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STUDY OF COMCACH TO ENABLE IOT DEVICES IN RURAL INDIA

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ABSTRACT
The Internet of Things (IoT) delivers endless opportunities and challenges and has rendered its essence in every area by providing us with a remarkable measure of comfort through smarter living. In developing countries like India, very little has been done for the rural areas and people dwelling in these areas face a lot of challenges. IoT can play a crucial role in empowering millions of people in these areas and connecting them to the mainstream. This paper illustrates the problem of rural connectivity and proposes a solution to connect rural India in a visible horizon. With a well-established technology, VSAT, every corner of the country can be connected. Small cells in combination with satellite backhaul provide a cost- effective and fresh approach to meet the demand in real time. The author has also made an attempt to consider the techniques of compression and caching (COMCACH) so as to provide rapid network connectivity to rural areas.

Keywords:
Very small aperture terminal, small cell, compression, caching

INTRODUCTION

The term IoT refers to data, devices, networks and incorporates everything that is connected to the internet. At the point when the devices are connected to the internet, it becomes possible to gather information, analyze the data and create an action with least human exertion. IOT generates opportunities for an effective correspondence between the devices not just inside a room but across different networks thereby creating a more connected world.

In this fast-moving world, although India aspires for faster and reliable communication, the mobile network is as good as dead in thousands of villages. Around 27,721 villages in India have no mobile network connections and scarce availability of services. This restricts communication and hinders their development. Thus, there is a requirement for improvement in connectivity to these under-served, rural areas.

But sadly, this is certainly not an easy process. Rural areas are often tough to access and have high cost of deployments in the light of the fact that profitability is a challenge for the operators in these areas. The major challenge is the expense of building a backhaul to provide connectivity.

While fiber is usually the best solution for providing backhauls, but it is not a viable choice for the rural areas. Likewise, microwave towers are huge, expensive to deploy and providing them with a reliable power, again is an issue. In order to make these deployments cost-effective, a VSAT satellite network becomes an only option when the other technologies fail. Together with satellite backhaul, small cells offer an efficient solution which can satisfy the demand in real time.

A VSAT network, however, has its own limitations such as high latency and low bandwidth. As more time is needed by the signal to propagate, there occurs high transmission delays in satellite communication.

Therefore, compression and caching (COMCACH) may be employed to reduce the network traffic and leads to a better user experience by eliminating the redundancies in transmitting data.

METHODOLOGY

There is a prominent need of connectivity solutions intended to serve the increasing number of connected devices. While the cellular communication fulfills the overwhelming demand in the city, the advancement of satellite communication is a cost-effective solution that can be directed towards the rural and remote areas.

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Very Small Aperture Terminal

The satellite communication system, VSAT, has increased in prominence because of its vast coverage and its ability to effectively transmit and receive data. It stands for "Very Small Aperture Terminal" which comprises of a dish antenna and requires no additional technology to operate it. As a system that can be easily deployable and affordable, VSAT becomes enormously valuable for many applications in rural areas for the purpose of communication.
Besides providing a fast and reliable communication link, VSAT is also critical for improving the socio-economic aspects of these areas and an effective alternative to the standard satellite communication systems. Hence, the reliability on this system increases for real-time applications which has resulted in the increased demand for bandwidth utilization and a boosted data transmission in the system.

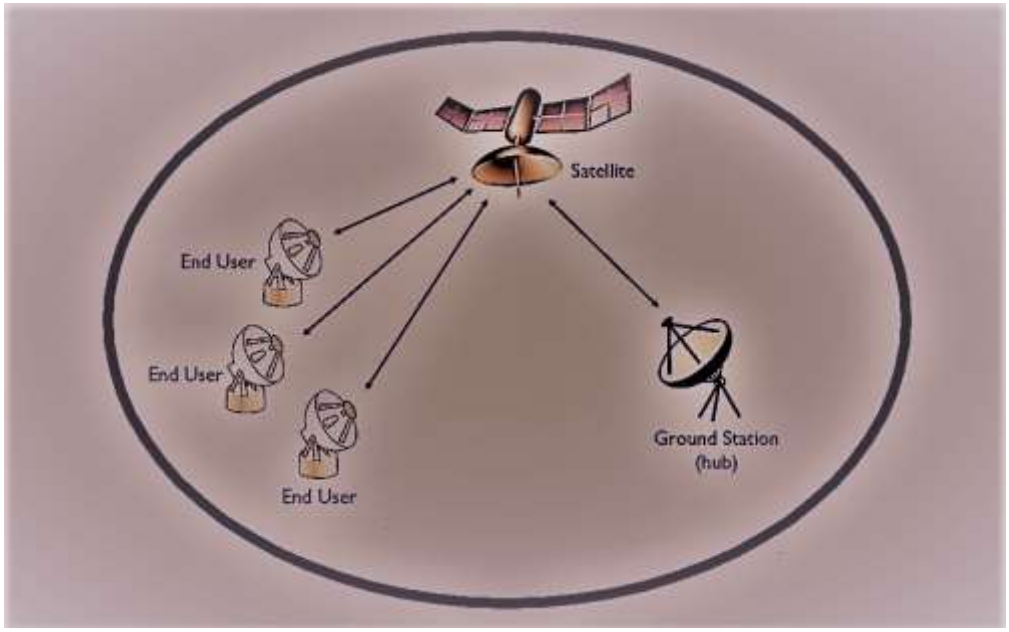

Fig. 1: VSAT communication system

But VSAT is a high latency network and provides a limited bandwidth. This adds to congestion across the network which causes a considerable lag in the transmission of packets. Latency is largely determined by how rapid the network is and the distance that the responses or the requests commute, to reach the destination. In applications which require series of data transmissions, even a barely noticeable lag per transmission adds to the overall substantial delay in the entire system.
In order to meet the deadlines of the user's requirements, the system with high latency causes traffic congestion and it may result in loss of data packets. Moreover, the size of the packets also contributes largely to latency. Large packets take a longer time for transmission compared to the smaller packets.
Numerous techniques have been proposed to enhance the utilization of the bandwidth and to minimize the overall traffic of the network.

Compression and Caching techniques

Compression is one such method, that is used in reducing the size of the packet. With this technique, a greater number of packets can be transmitted rapidly over the network, and it leads to an effective bandwidth utilization. Due to its easy implementation and no hardware requirements, data compression is an effective approach. It represents data in a compact way thus eliminating redundancies in data transmission.

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Furthermore, for the data that is utilized more frequently, we use the cache memory to store it locally and the next time, the same request gets delivered from the local copy and not through the satellite link. Each node can cache data to serve future requests to minimize latency and bandwidth requirement.

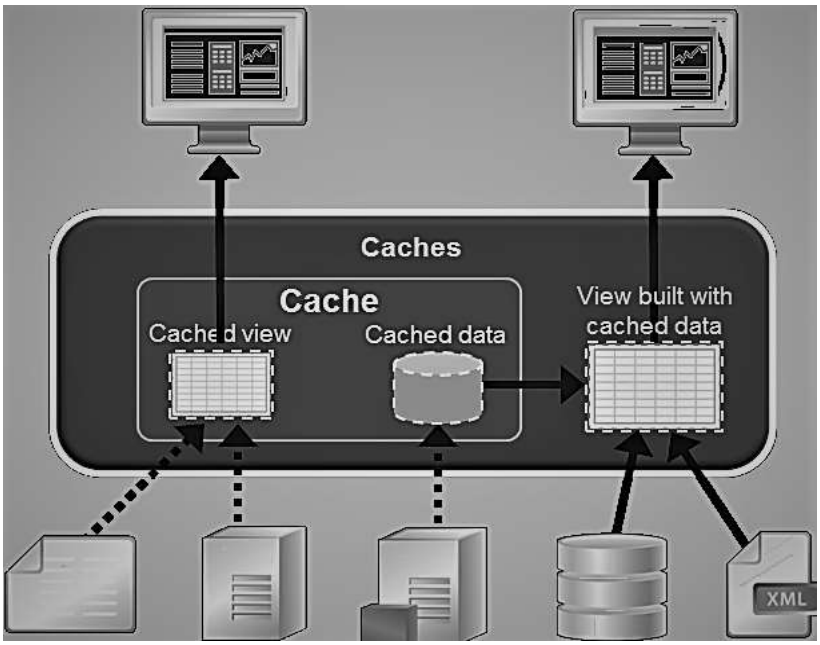

Fig. 2: Caching mechanism of data

Hence, compression and caching (COMCACH) maybe employed for a better user experience where in, the data is compressed to an extent along with caching of a certain amount of data. When the data is generated by the sensor nodes, the data is compressed, and the processed data is collected by the sink node to serve the data requests. The intermediate nodes along the path will cache the data and the data requests will not have to reach the nodes that generate data. The requests can be served from the data of the cache. If the data is not already cached along the path, it then goes to the sensor node to serve the request.
This technique overcomes the latency and the bandwidth utilization issue that arises in VSAT satellite communication network.

VSAT and Small Cell integration

The use of satellite backhaul, is more often the only choice in rural areas. An integration of the backhaul with a small cell may be implemented for a quality experience and is an important tool to provide coverage in remote/rural areas. Small cells, also referred to as “mini base station”, is an aid to the rural areas where deployment of macro cells is a matter of concern and requires just a fraction of the total cost that would otherwise be required by a macro cell.

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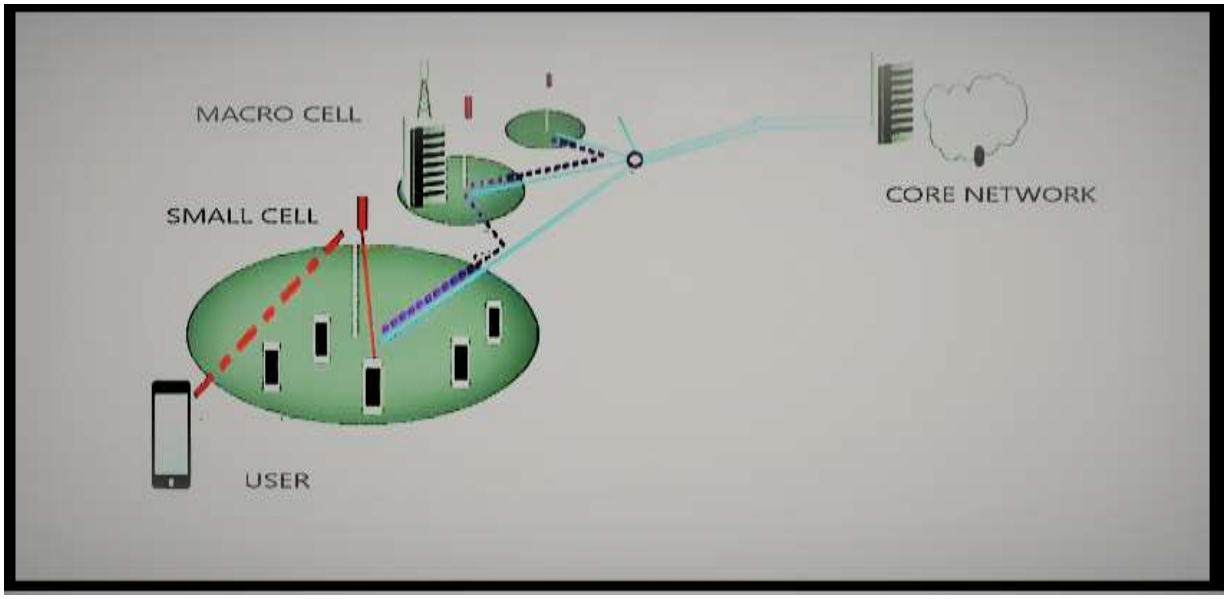

Fig. 3: Representation of communication system via small cell

Another feature that adds to the cost-effective feature is that they are solar powered and address well to the concerns of the operators requiring no maintenance. The VSAT when mounted in a close vicinity of the small cell transmits data to the core network through the satellite backhaul.
Thus, the integration of VSAT with small cell is a cost-effective solution for the people in rural areas. The following diagram illustrates the methodology.

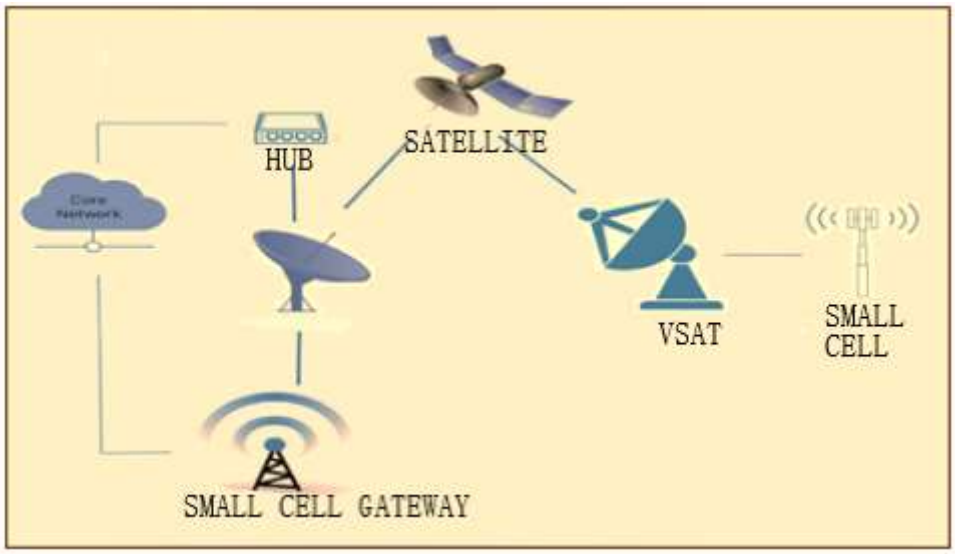

Fig. 4: VSAT-Small cell integration to provide a satellite backhaul

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CONCLUSION

The internet of things (IoT) has seen a rapid growth over the last few years. Among various challenges associated with IoT, communication is one of the key challenges. The paper has focused on the need to connect the rural India to the mainstream and to reduce the network congestion and enhance the quality of service. It aimed at providing an overview of the latency issue and proposed a solution to overcome the problem. To boost the transmission of data and to eliminate all the sources of delay, there is a need to integrate the techniques. We presented the technique of compression and caching (COMCACH), proposing a system to establish a reliable communication across the satellite network.

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