

VoIP over Mobile Wi – Fi Hotspot

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Abstract

Ever since the internet took off as a data network for sending email and browsing websites. The option of putting voice traffic on to the net has been in consideration ever since internet was able to transmit media. This is otherwise called Voice over Internet Protocol (VoIP). VoIP is implemented in Mobile Adhoc Networks (MANET) but its range is considerably small. This leads to congestion and improper Quality of Service (QoS). Current implementation of VoIP over MANET has issues like hidden and exposed terminal problems. In order for MANET to expand its connectivity, there should be at least one node within its range. As the range of MANET is a disadvantage, distant connectivity is an issue. In this paper, a method has been proposed to use mobile Wireless – Fidelity (Wi-Fi) hotspot instead of MANET for VoIP. For this, mobile nodes are connected within a range of a hotspot network (100 ft.) for audio transmission. This scenario would be simulated using both mobile hotspot and MANET and the results are compared for better understanding. Main aspects like efficient data transmission, QoS and security are taken into account.

Keywords: VoIP, MANET, Voice Traffic, Hidden Terminals, Exposed Terminals, Audio Transmission

1. Introduction

Mobile telephony has an important role in our modern world. VoIP would fail if it stayed wired. Voice over IP (VoIP) was created so as to give access to voice communication in anywhere around the globe¹. In most places, voice communication is expensive. Think about making a telephone call to an individual living on the other end of the globe. The principal issue is the expense of call. VoIP tackles this issue and numerous others. Most VoIP users are now scrutinizing the pipeline for services that will allow them to conveniently make free or cheap calls using their mobile phones, anywhere. Some of the benefits of VoIP are as follows:

Cost – effective: The most engaging characteristic of VoIP is its cost-sparing potential. When we move far from public switched telephone networks, telephone calls across countries get economical. As opposed to being transformed crosswise over ordinary business telecommunications line designs, voice traffic goes on the Internet or over private data system lines.

Better media access: The legacy phone structure prevalently gives voice and fax organization in spite of the way

that limited characteristic organization is possible. In any case, the enthusiasm of customers is much higher than that, as shown in today's rich media trades through the Internet. People take a gander at colleagues' status, (for instance, online, offline, busy), send instant messages, make voice or video calls, trade pictures, and whatnot. VoIP building makes rich media organization possible, fusing with diverse assemblies and orders.

Phone mobility: The phone gadget can utilize the same number for all intents and purpose all over the place as long as it has fitting IP connectivity. Numerous representatives today bring their IP phones or softphones when traveling, and utilize the same numbers all around.

Collaboration with other applications: VoIP protocols, (for example, Session Initiation Protocol [SIP], H.323) run on the application layer and can coordinate or team up with different applications, for example, email, web browser, instant messenger, long range informal communication applications, etc.

Boundary independent: The VoIP administration range gets virtualized without topographical breaking point. That is, the zone code or nation code is no more bound to a particular area.

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A couple of mobile VoIP administrations have risen, pioneering into a guaranteeing industry. There is an approach to still utilize VoIP benefits through GSM networks, however the GSM part remains charged at the nearby mobile rate.

Hotspots:

A hotspot, also commonly called a Wi-Fi hotspot, is a small area in which one can get connected to the Internet or a LAN without wires, through Wi-Fi. Hotspots can be found in offices, campuses, cafes, public areas, and even at home². Once you have a wireless router connected to your broadband Internet line, you have a hotspot. Mobile VoIP works with a cell phone's 3G, 4G, GSM, or other Internet service to send voice calls as digital signals over the Internet using voice over IP technology. Mobile VoIP phones can also take advantage of Wi-Fi hotspots to eliminate the calling costs of a cellular voice or data plan. By using VoIP, mobile VoIP phone users, especially smartphone users can benefit from lower costs when calling, texting, or other common smartphone activities. Digital data transmission using VoIP is also typically faster, as the data is spread out over multiple packets, each taking the fastest route to its intended destination.

2. Literature Survey

VoIP protocols:

Normally, in a VoIP system, the input voice data is converted into a digital form as voice frames. These frames are then encapsulated and relayed in RTP packets which are handled using RTCP which in turn provides stream control and statistical information³.

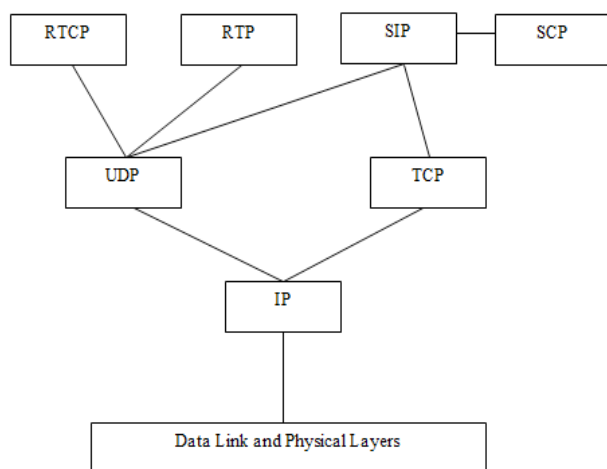


Figure 1. Hierarchy of protocols for SIP based VoIP.

Overall management of VoIP calls has been provided ever since the introduction of Signalling Protocols. Among these, Session Initiation Protocol (SIP) has become a well-known name in playing a vital role in advancing VoIP⁴.

SIP is very important in voice communication as it is responsible for connection establishing, termination and also other functionalities⁵. It can also be used for streaming videos, live conferencing, gaming etc. SIP can be implemented on TCP, UDP or even SCTP.

Issues in implementing VoIP over different networks:

VoIP is being implemented across different networks currently. But there are considerable amount of flaws mainly due to the limitations of the networks. Generally, for VoIP to function, it needs a data transfer rate of about 100 Mbits/sec. This couldn't be provided in the legacy PSTN networks. PSTN networks are the normal telephone networks which mostly relied on wired connections [6]. But, the data transfer rate in these networks was pretty slow. Voice transmission was not fast when calls were made across the globe.

Later, due to the advancement of mobile telephony, VoIP was implanted in 2G networks. 2G refers to the second generation of mobile communication. It was the first network to provide not only voice communication but also data communication [7]. But that too failed due to less data transmission speed and connectivity issues. Quality of service, which was a key characteristic in VoIP, was not satisfied in this network.

Furthermore, 3rd Generation (3G) mobile network was introduced which was revolutionary in the mobile industry⁸. It provided high data transmission speeds and better quality of service but it too had its fair set of flaws. One of the flaws was that a 3G data plan has to be activated to use its services and this is pretty much expensive. If VoIP was introduced to reduce the communication cost, then what is the point of paying for an expensive data plan? This was the concern that many raised.

Later, 4G (4th Generation) or WiMAX came into existence which was far more superior to 3G. It had blazing data transfer speeds and offered a wide range of connectivity⁹. WiMAX network could be used across cities. It uses Orthogonal Frequency Division Multiple Access (OFDMA) which greatly takes advantage from the frequency bands. The transmission frequencies of WiMAX ranged from 2.3 MHz to 3.5 MHz making it a less expensive wireless network.

Nonetheless, even WiMAX too had an equal set of flaws. They included low bitrate over long distances i.e., the bitrate is inversely proportional to the distance covered¹⁰. Even connectivity speed too was a problem i.e., when a user is closer to a tower, he can receive data at more speeds when compared to the user away from it. There is no consistency in data transfer rate.

Another issue was that bandwidth was shared in WiMAX network. This results in allocating users for individual radio sectors. But sometimes, there were more than a single user in a sector. This caused interference in communication. Most of the users have a range of 2 to 8 or 12 Mbits/sec to boost the network as necessary. One of the primary concerns of WiMAX network was its setup cost. It was tad too expensive when compared to other networks. It involved expensive infrastructure and this too was complicated to setup. In order to utilize the network, frequency license purchase was mandatory.

VoIP could also be established over Wi – Fi¹¹. But this involved the need for an internet connection. Every time, to send a message or for a voice call, the user had to connect to the internet and then perform data transfer and this too involved data charges.

Implementation requirements of VoIP:

In order to establish VoIP, a network has to abide by the following requirements:

- Better data transfer speeds.
- Provide wide range of connectivity.
- Quality of Service.
- Cost effective.
- Reduction of end to end delay.
- Consistent network speeds.
- Provide security for the mobile nodes.

In this paper, VoIP is being implemented in mobile Wi – Fi hotspot networks. These networks are currently trending across the globe. It involves a central system or domain which provides internet connectivity to the nodes connected to it free of cost. Hotspots can be said as infrastructure less networks as it only involves a central server. If two nodes need to communicate with each other they can do either directly or via server or intermediate nodes. This network provides peer to peer connectivity and therefore the data transfer speeds too are better. It also involves less overhead. Therefore, hotspots are a better solution for VoIP.

3. Proposed Work

There is a lot of scope for Wi – Fi hotspots for free communication to different nodes¹². Here we propose an initiating idea of implementing the same concept with a mobile hotspot rather than Adhoc network which is of low range. The intention behind this is that hotspot networks support peer to peer connectivity. This greatly reduces the cost of communicating across devices. The data transfer speed to is comparatively better because there need not be central server or a router. If a node wants to communicate with another node in the same network, all it needs is the IP address of the destination node. This could be very much helpful in small organizations or within the range of a small network. In a way, it could be useful in replacing the wired intercom currently present. The procedure for communication is as follows.

First a mobile hotspot should be working; the hotspot will create an instantaneous network, network will accept the connection requests from the nodes (smart devices) which want to participate in the communication. All the nodes in the network will share the same central node, which created the network. If any of the devices in the network want to transfer any data to the other node in the network. It needs to initiate the transfer by transferring the header information, such as destination address, length of the data etc. The devices which connect to the initiating device again act as mobile hotspots, this process continues until the leaf nodes. Now the communication can be done between the initiating device and leaf nodes by the dynamic routing protocols. The Wi - Fi network communication can be terminated when the need for the communication is completed.no additional cost for transferring the data except little amount of power is consumed. In hotspot, the topology is like star but which is like logical bus.

This paper is concerned about VoIP, to transmit text or voice among the devices, one device will create a Wi - Fi network and the other devices will connect to the Wi - Fi network node. The essential information of the connected nodes such as the IP address, MAC address is maintained for future communication. The connected devices create their own Wi - Fi network to transfer data within its range.

4. Results and Analysis

OPNET simulator has been used to simulate the scenario. Initially, a mobile Wi-Fi hotspot is switched on. This can host an application creating a network which can be

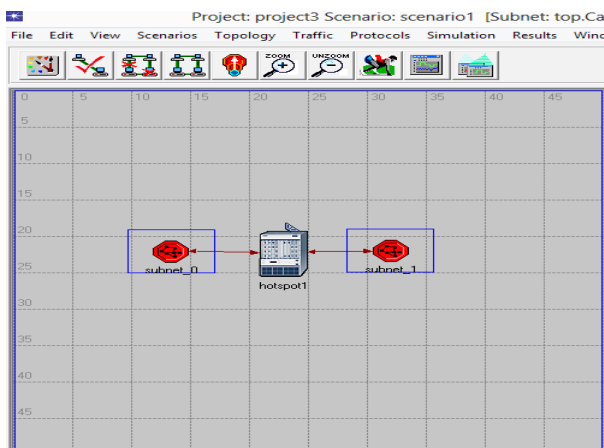


Figure 2. Proposed scenario.

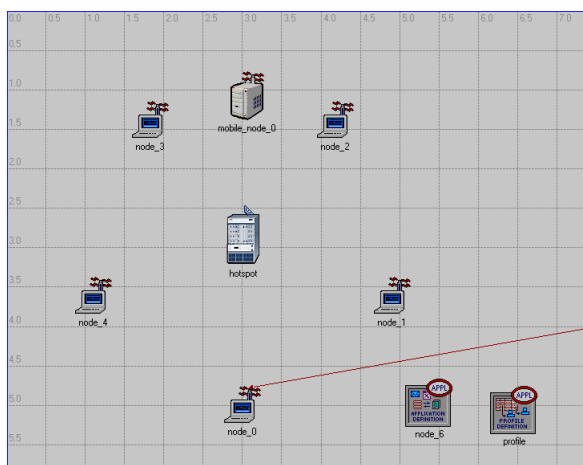


Figure 3. Network in each subnet.

Attribute	Value
name	profile
model	Profile Config
Profile Configuration	(...)
rows	1
row 0	
Profile Name	voip
Applications	(...)
Operation Mode	Serial (Ordered)
Start Time (seconds)	uniform (5, 10)
Duration (seconds)	End of Simulation
Repeatability	Once at Start Time

Figure 4. Profile configuration for VoIP.

shared by the mobile nodes which are in the Wi-Fi range. Voice can be transmitted from one to another with better QoS and high throughput than compared to other VoIP providers. This is because of low traffic and less number

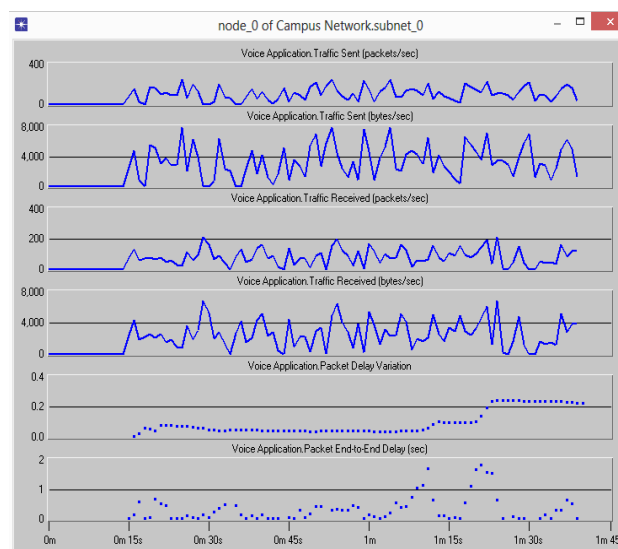


Figure 5. Statistics of a node performance.

of nodes participating in the communication. Let's take a typical Wi-Fi range as 50 meters with two subnets of 5 nodes each, an application configuration and a profile configuration for the subnets. Wi-Fi hotspot acts as a router and all the nodes connected to it in a star topology. So a router is taken for each subnet with a wlan_server which starts the VoIP communication. The scenario and the profile configuration for VoIP can be set as follows.

The 'application supported profiles' for all the nodes is set to VoIP. The application definition in configuration is set as default. Then the two subnets can be communicated by another hotspot. The server is set in a subnet and analysis of the Wi-Fi characteristics can be done by 'choose individual statistics' option of the server. The VoIP statistics can be known for any given node by selecting the 'voice application' option after selecting 'choose individual statistics' option. Run the simulation for 100 seconds with VoIP transmission starting at 10 seconds the characteristics can be as follows.

From the statistics obtained the difference between the number of packets received and number of packets sent at any given point of time is very near which shows QoS. The end to end delay is also very less as compared with the very large network VoIP applications.

Hence, from the results obtained, we can analyse that VoIP in hotspots is reliable when compared to the other networks. One more advantage is that the overhead is also much less compared to other networks. Therefore, it can be said that Wi – Fi hotspot is a better network for voice communication.

5. Conclusion

Implementation of the VoIP application in the smaller networks using the hotspots can be the better solution for high quality VoIP. But the difficulty can be that it follows star topology if any node which hosts hotspot failed then by the dynamic protocols another node can be chosen for replacement which deals with less traffic. This area can be further improved by dealing with effective communication.

Further improvements in this field includes reducing the delay in communication and also support for other media such as video, gaming, live streaming etc. It also includes support for more nodes and reducing the network conflicts. Security too could be handled by implementing certain encryption algorithms to securely transmit messages across the network.

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