Voice Calls Over Wi-Fi

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Abstract— **The use of Wi-Fi enabled cell phones to access internet away from the PC is increasing day-by-day. The use of Wi-Fi enabled phones as IP phones, and their communication within a local wireless LAN is discussed in this paper. This proposed model is a form of telecommunication that allows data and voice transmissions to be sent across a wide range of interconnected networks. The models, which are Wi-Fi enabled and have J2ME platform, can be used to communicate with each other through the free 2.4GHz communication channel. Since this is a free channel, security is a priority. In order to engender security, the packets of data may be encrypted in the header and payload by different encryption techniques. However even the security is a concern only within the specific network, the communication is completely safe from attacks external to this local network. Each mobile device connects to a WLAN router and identifies itself in the routing table. Calls can be placed by a user by sending the packets to the router, which then tries to find the destination. The destination must also be connected to the WLAN; if not the Wi-Fi server can tunnel the calls to the GSM network using UNC (Unified Mobile Access Network Converter). Since the communication channel is only capable of being affected by an inside influence (hacking), it is provided with complex cryptography techniques, which engenders high security. Our proposal allows free calls within the network with high quality voice transmission. This model will be a prototype of itinerant devices communicating through in the Wi-Fi bandwidth and will greatly reduce the communication cost in large organizations.**

***Index Terms*— IP phones – mobile phones with a logical IP addresses , J2ME- application installed on the mobile device.**

I. INTRODUCTION

Communication systems have developed steadily and new means of communications are being developed from time to time. Cell phones have evolved from being simple communication devices to a powerful portable computer. The instrument has become so commercial that it's available as a key-item in everyone's pocket, benefitting the user and serving as a lucrative business for the manufacturers. The increase in the number of service providers has made it a battle-field for each of them to gain more customers, and the cheaper one always manages to outstrip others. Service providers such as Vodafone, CSL, Star hub have already earned a name in market and are still expanding their service all over the world. The idea of having a common channel (air) for sending innumerable frequencies and use the bandwidth that's available has always been fascinating for all of us – but at what cost? It is a hectic task to design a communication system knowing how badly it is susceptible to noise.

The whole idea of modulation made it possible to neglect the low noise frequencies and making it feasible for long distance transmission at high efficiency. The concept is too deep to explore and has certainly made its mark in the field of data transmission. There is now emerging demands to have cheap communication within a fixed range, like in an office or a township. Intercom is also a similar system but in this case it has fixed phones connected by guided media. The recent advancements in the mobile phone technology have incorporated the features of accessing Wi-Fi from such a small device. The presence of Wi-Fi in the latest mobiles allows the user to access the internet with the help of a Wi-Fi router. Exploiting the entire bandwidth of 2.4GHz for making voice calls between devices, it eliminates the need of using the service provider's bandwidth. Hence voice calls can be made at zero cost.

Most of the latest models of phones come with Wi-Fi. The number of people using Wi-Fi devices has been increasing and may even rise higher this year. Our proposal shall eliminate the usage of service providers for short-distance calls and decreases the cost that gets accrued in the consumers' monthly bill. The base idea is unifying voice and data onto a single network infrastructure by digitizing the voice signals, convert them into IP packets and send them through an IP network together with the data information, instead of using a separate telephony network.

II. EXISTING TECHNOLOGY

Voice Over Internet Protocol (VOIP) provides the ideas for connecting two clients through voice over the internet. The advent of Voice over Internet Protocol (VoIP) has fundamentally been transforming the way telecommunication evolves. Driven by the ongoing deployment of broadband infrastructure and the increasing demand of telecommunication service, VoIP technologies and applications have led to the development of economical IP phone equipment based on embedded systems. IP phone application can satisfyingly provide the

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necessary interfaces between telephony signals and IP networks. Although IP phone communication over the data networks such as LAN exists but these IP phones are fixed type. We implement wireless IP phone communication using the Wi-Fi network, VOIP phones call without the use of a computer; instead they connect directly to the IP network (using technologies such as Wi-Fi or Ethernet).

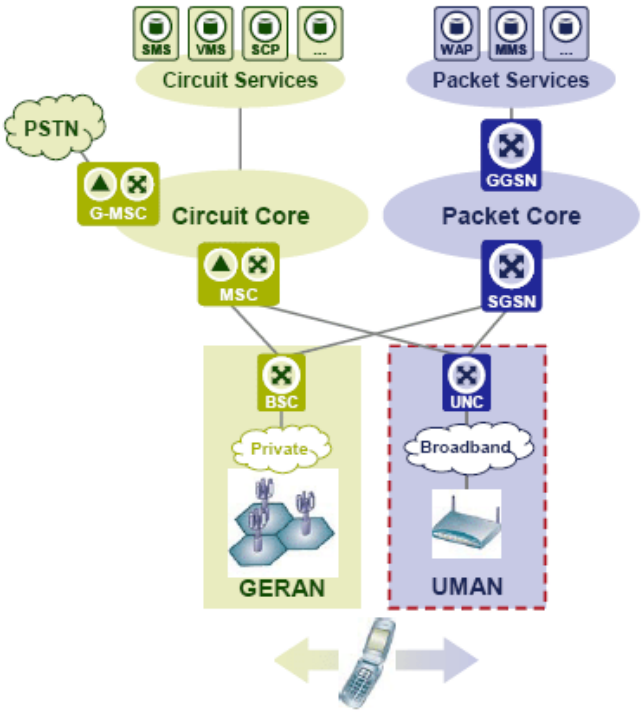

Fig 1: UMA connection methods

Unlicensed Mobile Access (UMA) is a 3rd Generation Partnership Program global specification that provides a standard for service providers to merge mobile networks and wireless LANs into a single seamless access network with one mobile device, one user interface, and a common set of network services for both voice and data. In fact, the UMA solution converge cellular networks with any IP-based access networks, including wired and wireless technologies such as IEEE 802.16 WiMAX networks, IEEE 802.20 Mobile Broadband Wireless Access, and Ultra Wideband (UWB)-based networks *(Fig. 1)*.

With UMA, subscribers can move between mobile networks and WLANs with seamless voice and data session continuity as effortlessly and transparently as they move between cells within the mobile network. The UMA solution effectively creates a parallel radio access network, the UMA Network (UMAN), which interfaces to the mobile core network using existing mobility-enabled, standards-defined interfaces. The existing service provider Business Support Systems (BSS), service delivery systems, content services, regulatory compliance systems, and Operation Support Systems (OSS) will support the UMA network without change. Service enhancements and technology evolution of the mobile core network apply transparently to both the GSM access network and the UMA network.

III. CALLING WITHIN THE LAN

The use of J2ME-

For a mobile device to communicate with a router it needs a platform. A J2ME application can be used in a mobile device that is Wi-Fi enabled to communicate with a router. This is a very useful tool because by communicating with the router directly, many processes of networking can be simplified. J2ME provides a robust, flexible environment for applications running on mobile. It includes flexible user interfaces, robust security, built-in network protocols, and support for networked and offline applications that can be downloaded dynamically.

So this platform is what connects the user and his device to the router. The developed software will perform the payload encryption on the transmission side and payload decryption of packets in the receiver side through software manipulations of digital format of data.

When placing a call to a phone within the network, the number is dialed and passed through the J2ME to the router. The application then sends the number in 128 bit encrypted form to the router, requesting a call to be placed. The J2ME application at destination intimates the user of the incoming call; if the call is accepted, the router changes both phones status to busy. When busy no further calls can from be made or received by the phones. This is because, we are using the limited free bandwidth of the Wi-Fi, so conference calls and similar features are not supported easily. After a call is made and connection is established router routes the packets to the destination number.

If the sender or receiver goes out of the Wi-Fi range then the message is tunneled through to GSM. However if the receiver is initially not within the Wi-Fi range, then the sender needs to dial '*'. This tells J2ME that the call is to the outside world, so directly GSM connection is activated. When a call is transferred from Wi-Fi to GSM, the talk time charged by the service provider is only that amount of time which the phone went out of range. So this is a very cost effective solution.

SEQUENCE OF STEPS-

- On the Wi-Fi route IP phones registers its fixed IP, where the router will update its routing table with this IP phone being active
- IP addressing and sub-netting is available in the same way as in any computer system
- Each phone is identified by a user name. So the routing table updates its IP with a corresponding user name
- Calls can be made to any user in the routing table identified by user name and this information is made available to all users logged into the network.
- When '*' is used before a number, the call is tunneled to GSM.
  - When the phone goes out of Wi-Fi range, then hand off.

IV. HAND OFF

Hand off is a process where one network hands over the connection responsibilities to another network. This happens when the device goes out of range of the one system. This is very common in mobile communications with towers, where one tower hands over the carrier and communications links to another tower when the device moves from one region to another region.
Any handoff operation is a three-stage process that includes handoff decision, radio link transfer and channel assignment. The hand off is only initiated when the signal strength goes below a certain predefined standard. The base station usually measures the quality of the radio link channels being used by mobile nodes in its service area. This is done periodically so that degradations in signal strength below a prescribed threshold can be detected and handoff to another radio channel or cell can be initiated. Hand off can be implemented in two ways -

Make before break -The mobile node's connection may be created at the target base station before the old base station connection is released.
Break before make - The new connection may be set up after the old connection has been torn down.

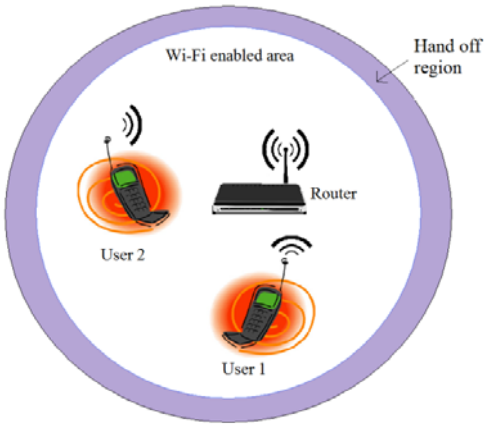

Fig 2: WLAN and logged IP phones

It is preferable to have the make before break hand off to ensure smooth transition from one station to next. In our case the hand off is from a Wi-Fi stage to GSM. But in our Wi-Fi communication we use a few encryption methods and techniques which are irrelevant to GSM communication standards, so before hand off, all the messages must be decrypted.

First the mobile unit has to detect that the Wi-Fi signal has completely faded out. Also now the Wi-Fi service is no longer acceptable. At this stage the mobile unit sends a handover request to a neighboring GSM cell. The selection of mobile cell depends upon the SIM card present in the mobile unit at that time. Then the core network of the service provider has to handle the resource allocation procedure with the base station controller (BSC) for the GSM calls. Once the allocation is complete a signal is sent to the mobile unit indicating the handover has taken place.

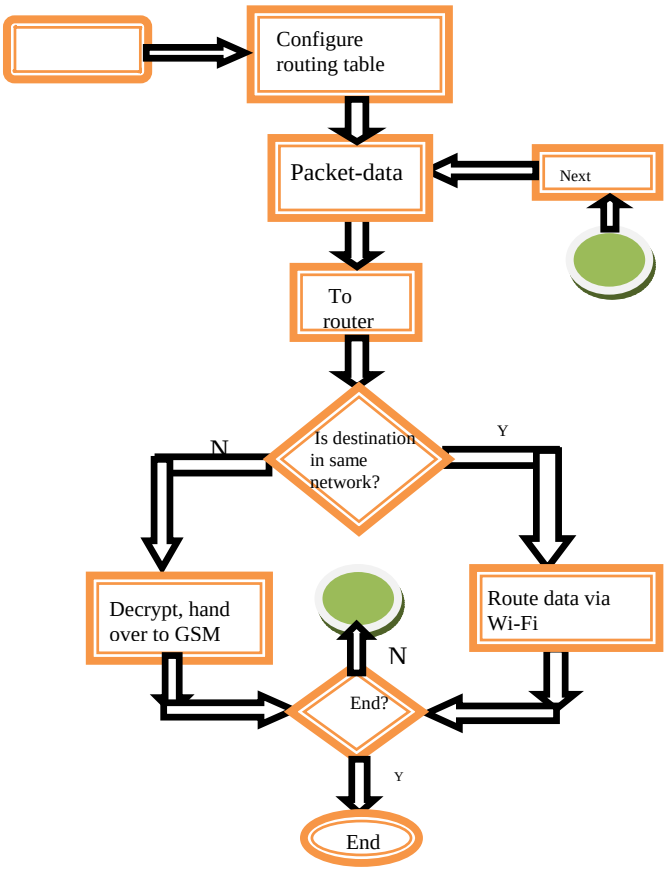

Fig 3: Flow Chart

V. PROPOSED MODEL

Voice communications are more delay sensitive than error sensitive. UDP provides less efficient communication but at rates faster than TCP and also UDP is used for wireless systems. So in transport layer we use the UDP protocols for communication. Several signaling protocols have been proposed for IP phone applications. SIP is peer to- peer protocols. Being simple and similar to HTTP, SIP will bring the benefits of WWW architecture into IP telephony and readily run wherever HTTP runs. It is a gradual evolution from existing circuit-switched networks to IP packet-switched network.
In this model of communication voice to be transmitted by one user is encrypted by the device and J2ME by software modifications of digital form of the signal. Then this is packetized and communicated to router through Wi-Fi channel in the same way data is communicated. The router performs header decryption and finds the destination phone from it routing table. The encrypted voice is sent by same means as communication of data by Wi-Fi.

VI. WORKING

Figure 3 gives the basic flowchart of the algorithm for Wi-Fi based communication. Algorithm has to be defined for the J2ME software and the router. The regular 802.11 standards of communication are used for the data transmission.

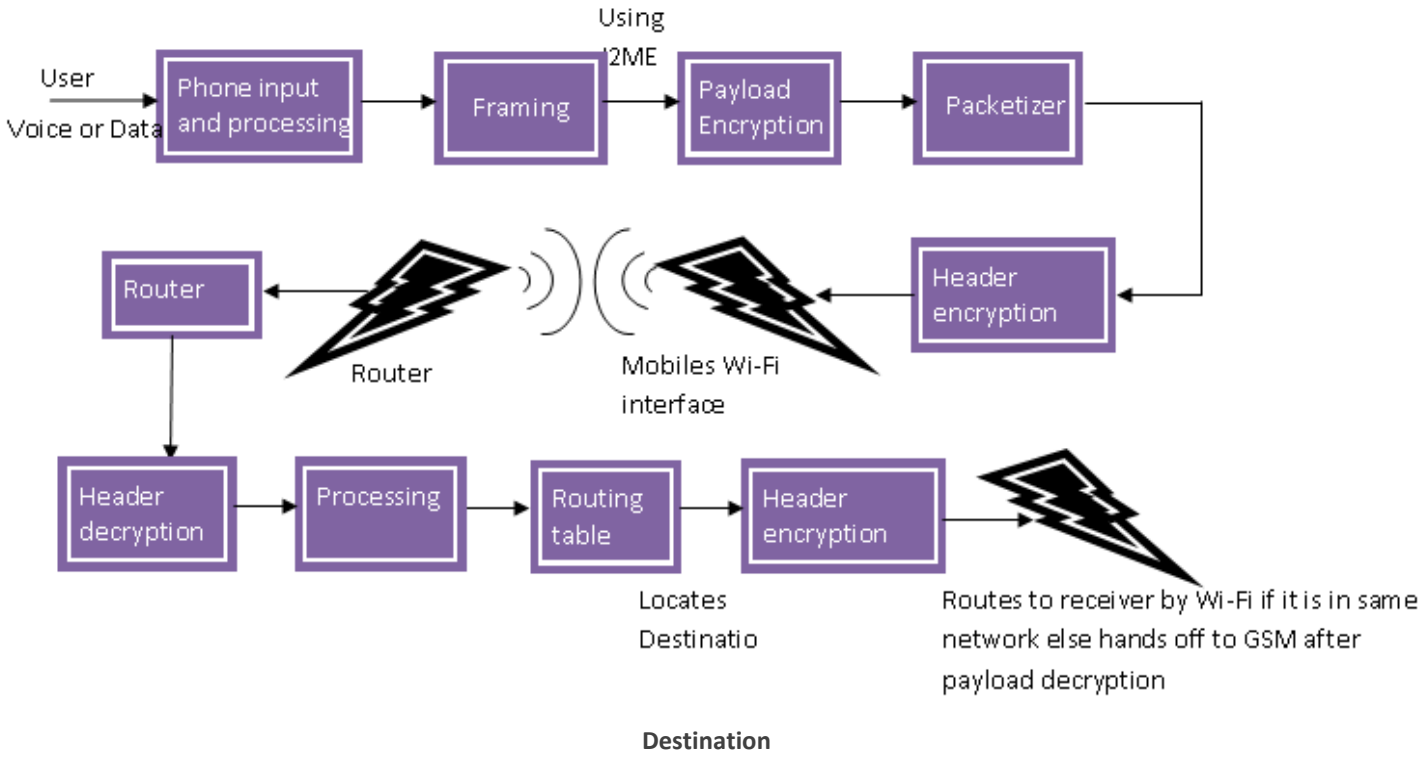

Fig 4: Block diagram.

However for the routing table we suggest these parameters: IP, masking, user name, busy, next, mode and strength. When one phone connects to another, their busy flags are marked. Once the busy flag is set, more data transfer through the Wi-Fi layers is not permitted. So this restricts communication to be one to one. When the call is cut, the busy flags are reset again.

This method of communication is an indirect approach. We know that any number of Wi-Fi enabled phones can access the network. So this ensures that there is no limit to the number of users in the WLAN. So to make it possible for so many users to communicate with each other, we transfer the voice as data to the router, similar to uploading something to a network. But now this message is cannot be accessed by all the phones because of encryption. Then the receiver phone can download this data from the router and hence then acquire the voice from that data. So in effect the mobile devices do not communicate directly with each other; data is uploaded to the network by the sender and then it is downloaded only by one other device; the intended receiver. So communication is indirectly done through uploads and downloads.

Note: Upload and download speeds and hence communication time depends on the traffic and the speed of the Wi-Fi.

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So a fast LAN with moderate traffic shows good communication performance. To make the communication continuous and transparent to the users, uploads and downloads must be fast. The block diagram shows the basic working of the communication process of upload by the user 1. Now only depending on the presence of receivers ID in the routing table the type of communication is determined.

Accordingly we have two results:

(i.) If the destination is also logged in to the Wi-Fi network, it establishes connection through the free communication bandwidth of WLAN.

(ii.) If the destination is not logged in to the same WLAN, it hands off control to the GSM, thereby allowing calls through the service provider.

To avoid redundant uploads and then transfer communication to GSM, we use '*' button in the J2ME software to indicate communication to the world outside the network. By this way we can save traffic caused by redundant uploads. However if the J2ME platform is not being used then calls will automatically only go through the service provider. This is because only the J2ME software communicates with the router and integrates the device to send voice over Wi-Fi channel.

Table 1. Comparison between conventional IP phones and our model

Sr. No	Attributes	Current Fixed IP Phones	Proposed Model
1.	Working	Works through PC phones connected to fixed lines	Works with itinerant devices communicating with router
2.	Range	Confined to the Local network	It is not confined and works universally with the world outside the network
3.	Software	Skype, CTK	J2ME
4.	Flexibility	Less flexible as it provides services within a fixed network	Fully flexible and allows voice as well as data communications
5.	Data rates	Higher date rates	Relatively lower data rates
6.	Cost	No cost is involved after the set up charges	No cost within local network and within Wi-Fi range
7.	Hand off	--	Hand off feature is available to ensure connectivity thorough GSM outside the Wi-Fi range
8.	Applications	Communications within the native network	Communication over entire range.

VII. ADVANTAGES

- Allows phone calls at zero cost.
- It is highly secured, because no outside device has access to the data uploaded and downloaded between routers and the device
- Easy to implement.
- Does not require any extra hardware to be installed in the device; only software (j2me) is used.

VIII. CONSTRAINTS

This model can service any number of users but it shows poor performance in a slow network and may be slowed down by problems like cross talk, delay, routing failure in high traffic situations. Hand off to GSM after being sent to the router wastes the bandwidth. Initial cost is high and it will only work on phones that are Wi-Fi enabled (which are more expensive than non-Wi-Fi enabled handsets).

IX. CONCLUSION

Communication is a field where it is highly possible for the data to get corrupted, and it's highly imperative to secure the data to be transmitted. Our proposal provides an efficient mechanism to send voice calls over the Wi-Fi bandwidth by using encryption and decryption mechanism that can render secured packet reception. This project provides a cheap, effective and secure means of communication within a specified network. The cost involved is only the initial set up cost and all calls within the network are free. This model will be very useful to solve the communication problems in large organizations, by making free voice calls through Wi-Fi.

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