Development of Voice Call Transfer Service between Android Smart Phone and Tablet

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Abstract

Everyone necessitate communication technology in this information era. By use of modern technology, everyone should prefer wireless service without using bundle of wires. Colleges, shopping malls, corporate offices, coffee shops, construction buildings and restaurants provide Wi-Fi service to customers. Wi-Fi service allows data and voice transmissions over connected devices in same network. Proposed paper presents development of voice call transfer service that processes incoming telephone call which uses Wi-Fi as communication medium for voice transmission between smart phone and tablet. The proposed method allows real time communication transferred over wifi using IP between smart phone and tablet at no cost. Wi-Fi enabled smart phone and tablet are connected to the router or wifi access point to provide communication between caller and tablet user. Proposed paper develops cost effective, easy and reliable voice communication over Wi-Fi which provides good and comfort experience to user.

Key-words: Wi-Fi Service, Voice Transmission, Real Time Communication, Router, Voice Call Transfer Service.

1. Introduction

Telecommunication has more advanced in most businesses organizations which emphasizes press of simple button makes communication for developing economy. Hence, it is necessary to find solutions in cheap and affordable must be sought. Reliable communication has posses a great demand because of its secured and easy usage. Even though it is a simple and closed environment, there is a need for secured communication without complicating the system. Now wires are trending as out of style with advancement of wireless technology. Wireless technology increases solutions tremendously. The secured communication by wireless is achieved by encryption and decryption [1].

For a business organization, if higher officials needed to discuss an important issue with their teams without having to continually hold meetings. The organizing meetings would always time or cost effective. Hence, they needs an architecture with the wireless technology in the way each member of the team can communicate with one another and their superiors also instantly through a reliable link on a secure channel. But data communication network's bandwidth and quality of service are highly flexible. For several data communication applications reliability is critical issue [2]. Implementing mechanisms for error checking, acknowledgment, re-transmissions and sequencing by communication or networking protocols are needed to resolve reliability critical issue.

For real-time applications like voice communications, it is necessary to implement corrective mechanisms for transmitting lost packet and play back at the receiving end or if it is out of sequence and is considerably delayed. It is essential to design the architecture more precisely by considering all the above points. If designed correctly, it would be very fantastic experience which reaches practical needs to communicate with other devices in a secure manner without internet. This direct communication between two android devices does not rely on any infrastructures and has very low cost and very fast preparation to begin this direct wireless communication [3].

Proposed method develops voice call transfer service application to transfer voice communication between interconnected devices. Android Wi-Fi communication application programming interface (API) is used for providing connections between devices. Java in android is used for developing application [4]. Native C is used with Java for incorporating Speex encoder and decoders for real time voice processing. Network socket established through UDP is an endpoint of connection across Wi-Fi to transfer reliable voice communication. UDP provides point-to-point communication through network socket that uses client-server application for communication.

Proposed method is achieved with android application packages and APIs. Proposed design developed by android with JAVA Programming language. Android API supports telephony service, media capture and media processing and rendering. Android media API provides plug-in architecture for direct accessing media data. JAVA is a high level programming language by SUN Micro system and released in 1995. JAVA is basically developed in C and C++ and enhances features from object-oriented language. JAVA facilitates extensive libraries for multimedia, networking, multi reading, graphics and data base access. Speex encoder and decoder are used for voice processing. Voice encoding and decoding are written in the C language by using Speex API. C++ is an extension of C developed in early 1980's at Bell laboratories. Graphical user interface (GUI) was developed by android layout. It has unique design features like platform independence, high performance, multi

threading and dynamic linking. These features make programming applications complex rather than simple and straightforward [5].

2. Literature Review

Communication is very important part in our daily life. Vast improvement in technology leads convenient and efficient way of communication. Large organizations like educational institutes, corporate offices, construction sites plays fabulous role to support required communication among all employees. So it is necessitated to develop application which is easy to deploy, run, and access. Many organizations furnish Wi-Fi service for all employees to supply internet connection. By using this, one can connect laptop, tablet or smart phone to Wi-Fi router and get internet connectivity [6]. In recent surveys, Wi-Fi service was predicted as growing to 109 percent between 2011-2016 in automotive applications, 39 percent in health, fitness and medical applications, 25 percent in smart meters [7]. Hence usage of android smart phones has increased to hundreds of millions in more than 190 countries throughout world. Taking into consideration of growth in Wi-Fi as well as in android, proposed paper develops android mobile application for voice transferring through Wi-Fi network.

Proposed method in [8] facilitates connection between two remote clients via voice over internet. Mobile application for IP communication provides necessary interfaces between telephony and wireless networks. Although communication over data networks such as LAN through IP exists but these are of fixed type. Therefore violation of user's mobility occurs and VoIP phones need internet service provider which consumes more cost.

Proposed method in [9] enables two cell phones connected via blue tooth for exchanging media files. Bluetooth enabled laptops and desktops processes wireless communication are available in market. But geographical area of blue tooth range is very small causing limitations over user's mobility [10].

Another author proposes use of Wi-Fi enabled phones as IP phones and communication is developed within same Wi-Fi. Author states that each mobile device connects to WLAN router and communicates with other device. Making voice calls can be done by any device through sending packets to the router which then tries to send to destination. But security is a major issue to tackle in this environment. To resolve this issue, packets in headers can be encrypted by one encryption and payload can be encrypted by other encryption [11].

There are several use cases addressed by different smart phones for voice communication. Two-way radio transceivers allow peers in same range establishes voice communication without having any additional infrastructure [12]. This is very useful in scenarios of no cellular network coverage or when users cannot afford cost of an ongoing call for unlimited period of time [13]. Even though smart phones have great connectivity with Wi-Fi or Bluetooth, till now no research provided voice call transferring service through mobile application. Main objective of proposed application resolves this problem by transferring incoming caller voice to tablet connected in same Wi-Fi range.

3. Methodology

Proposed architecture is divided into 5 major modules: 1. Call receiving, 2. Wireless communication, 3. Transfer voice through network socket. 4. Voice encoding and 5. Voice decoding. Figure1 shows architecture of proposed application.

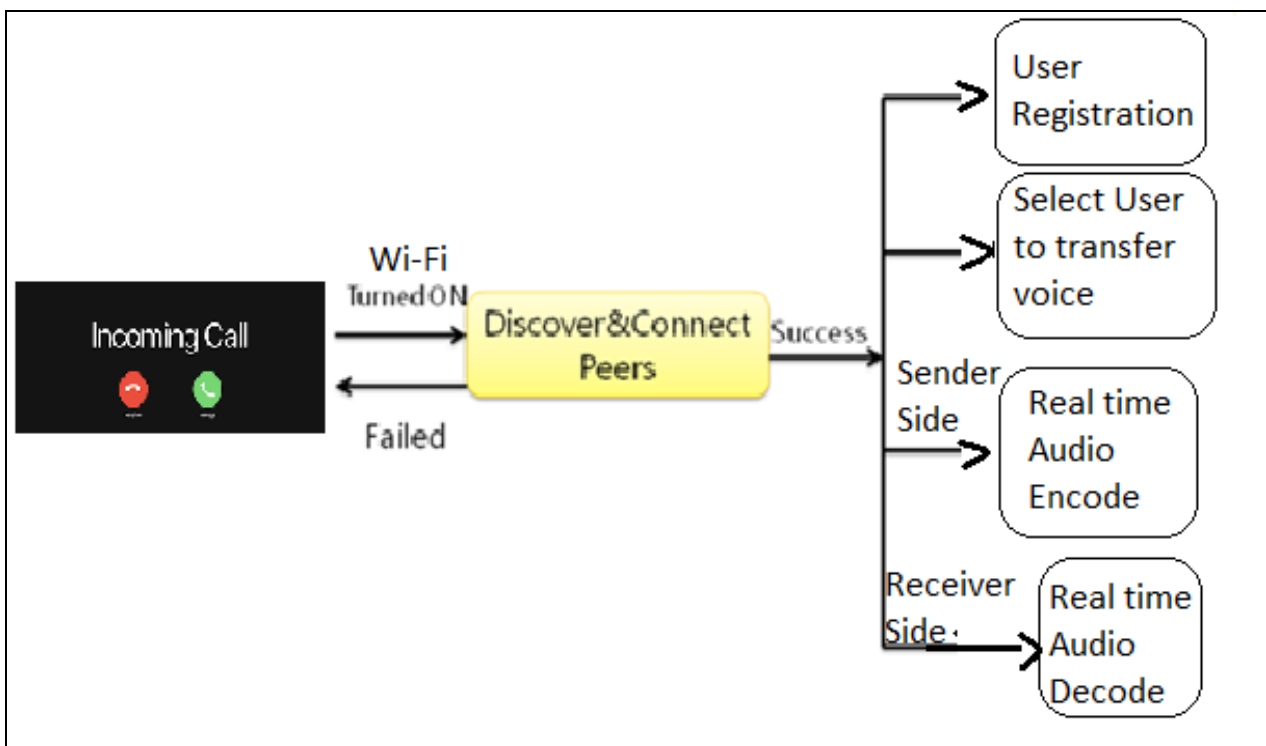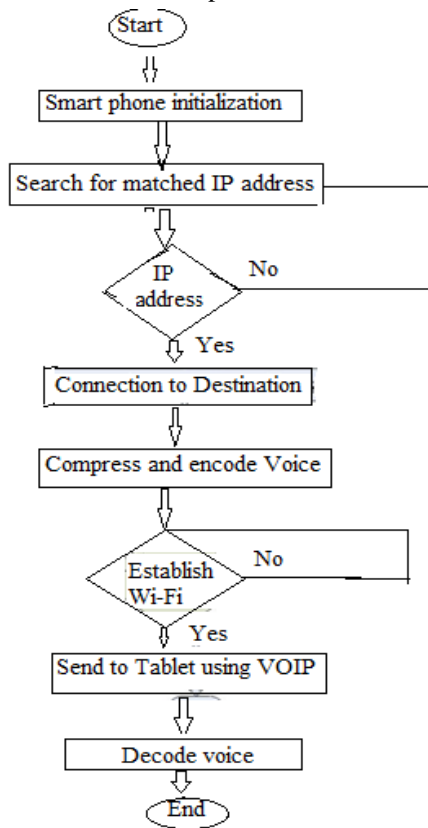Figure 1- Architecture of Voice Call Transfer Service

Figure 2 shows design flow for development of voice call transfer service.

Figure 2- Flow Chart for Development of Voice Call Transfer Service

3.1. Call Receiving

Android telephony API provides service for incoming telephony calls. Phone state listener provides listening states for incoming calls. When incoming call arrives on smart phone, it will automatically detected by the proposed application. Figure 3 shows process of telephony incoming call in android programming.

Figure 3- Process of Telephony Incoming Call in Android
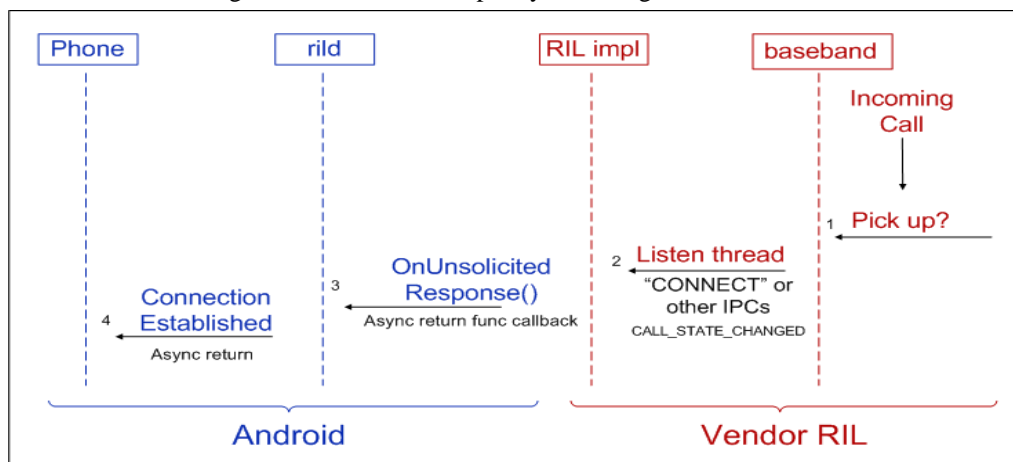
3.2. Wireless Communication

Mainly, proposed application development consists of two processes: peer discovering and connecting. Peer discovering process uses registration process for every user in Wi-Fi range. Whenever Wifi is enabled, the users need to be registered with names. After user registration, update button will update all registered users and shown below update button. Every user has been watched by other users in network. Choosing required user for voice call transfer by selecting check button of one of registered users. Broadcasting voice communication will be enabled between caller and selected user. Figure 4 shows wireless communication process in android programming.

Figure 4- Android Wireless Communication Process
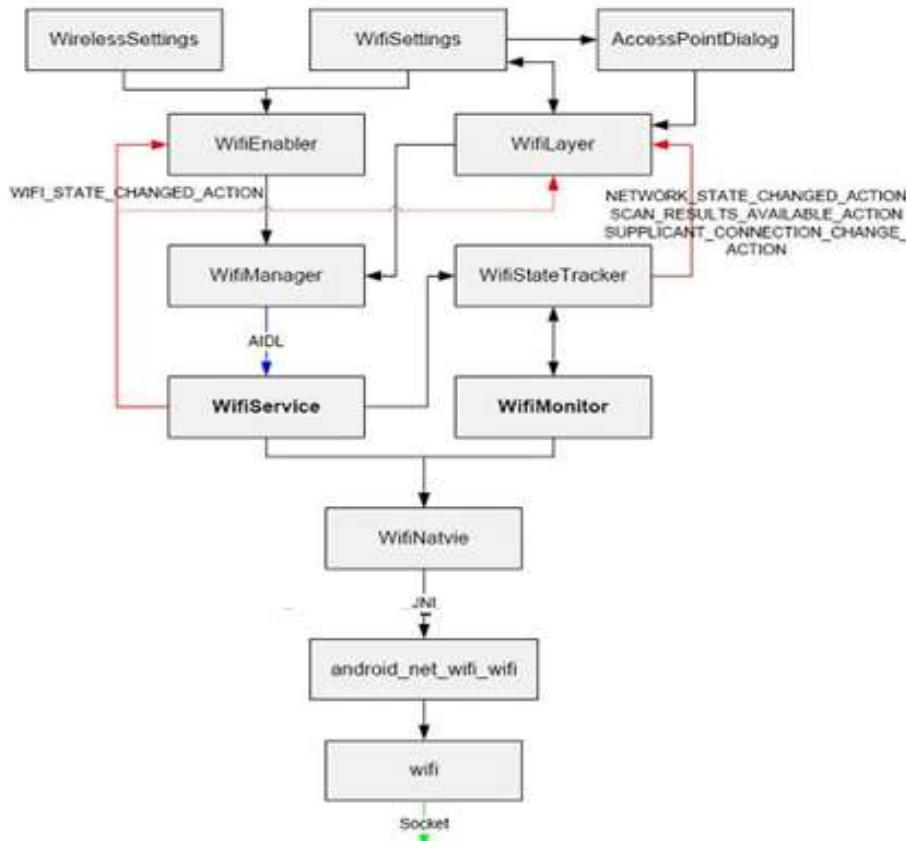
3.3. Transfer Voice through Network

Smart phone will detect the registered user with its IP address. The IP address of user is recognized by auto discovery of IP address using WiFi manager API. Whenever users are added, those are updated with their IP addresses. Android audio manager API provides read and write methods to send encoded voice and receive decoded voice respectively. Real time voice

communication is developed by running threads. Thread is used for read and write voice at pre-defined time interval. Tablet user communicates through packet based communication via Wi-Fi. For this, UDP is used to provide socket based communication through packets. As and when Android devices starts sending voice call, the voice codec compress and encode the voice call into frames and are stored into a buffer. This voice will be processed by UDP protocol and is sent over Wi-Fi.

At the receiving end, when the tablet received call through Wi-Fi, user get options like accept and end call. Communication is enabled when tablet user accept call. Every time voice is received by audio encoder, it is stored in buffer and sent as packets to destination. At destination device, received packets are given to audio decoder which decodes received voice. This decoded voice is stored in a dynamic buffer. It will be identified and played by android media API through GUI of android. In the same manner, the communication from tablet is sent to the smart phone. Figure 5 shows voice processing between two users.

Figure 5- Process of Voice Transferring
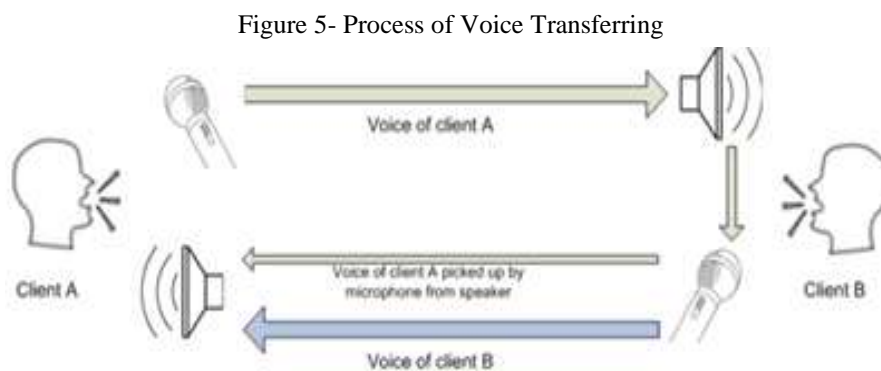
## 3.4. Voice Recording and Encoding

- **Voice Recording**

Raw voice data from microphone is encoded by android audio record API (Application Program Interface). To record and encode raw voice, 8 Kbps is used as sampling rate, 16 bit PCM (Pulse Code Modulation) is used as audio encoding format and 4096 bytes is used as buffer size.

- **Voice Encoding**

Audio record in android audio manager API is used for real time audio processing. Figure 6 shows real time audio processing for encoding and decoding in android programming. It is used for

compress raw audio data received through micro phone from incoming caller. It converts input voice data into byte frames. Server frame contains raw voice data samples. For processing raw audio 8 KHz is used as sampling frequency and frame size for voice recording is 160 samples (320 bytes). Frames are given as input to encoder (created while recording voice) which converts frames into packets. After processing, resulted data is stored in buffer. Incoming caller voice is recorded and encoded by using audio record. Resulted frames are stored in buffer. Voice encoding and recording methods are same at both smart phone and tablet application.

Figure 6- Process of Real Time Audio Encoding and Audio Decoding
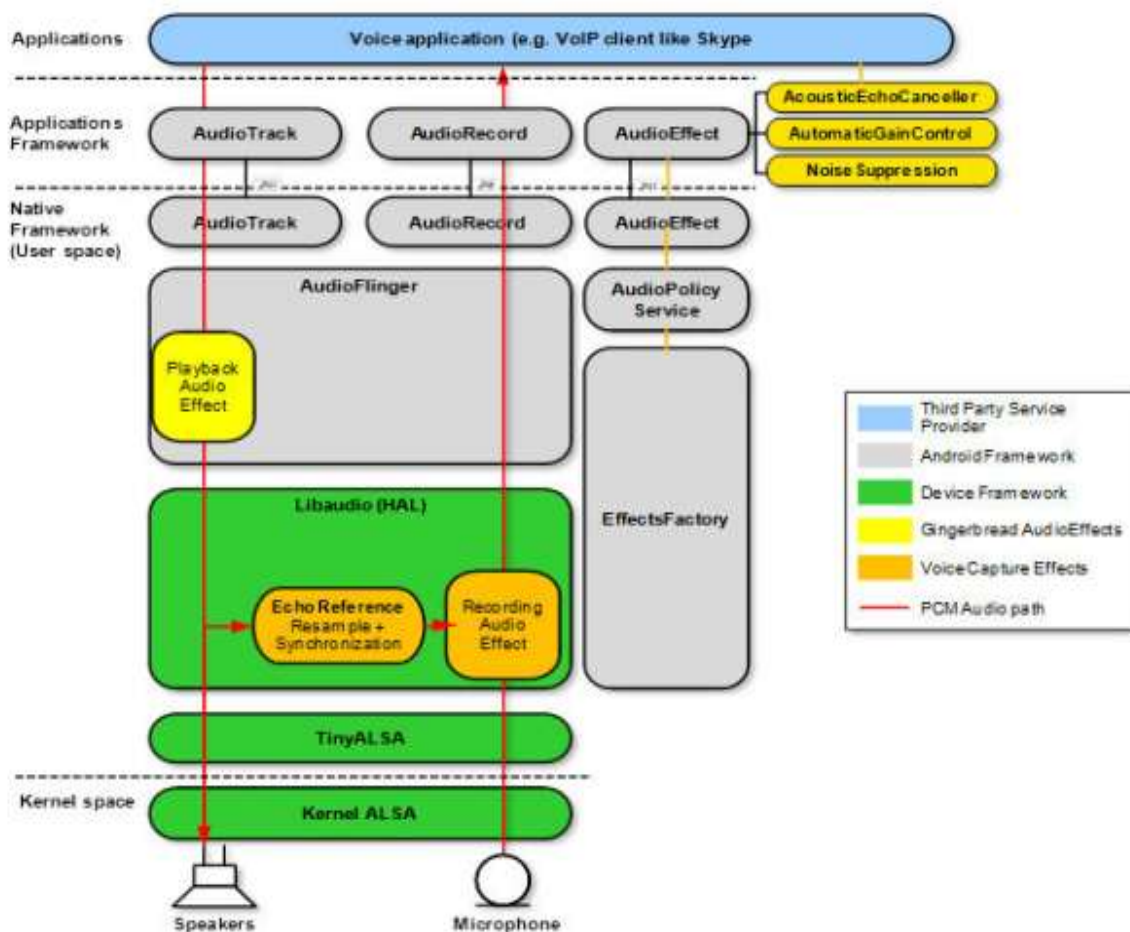

3.5. Voice Decoding

At tablet, encoded voice data is received as packets through Wi-Fi based socket programming. Received voice packets are stored in receive buffer and given to decoder which decodes buffered voice packets into 160 samples or 320 bytes of voice. Decoded data is stored in buffer and every time after decoding, write method is used for writing received data to track from buffer. Play method of

android audio track API is used to play received voice data. As buffer will be appended with new voice after pre defined time interval, real time voice played in real time at tablet until sender ends voice call. Voice decoding process is same at both smart phone tablet application.

4. Experimental Results

Proposed application was developed on android studio. Android APIs are used with android java to develop proposed application. It was compiled in android studio with build command. Build adds needed library files and standard APIs to the developed application. Following results shows step by step development process for voice call transfer service. Figure 7 illustrate screen shot of programming and compilation report for incoming phone call received through Android telephony APIs.

Figure 7- Screen Shot of Code and Build Report of Incoming Telephony Call
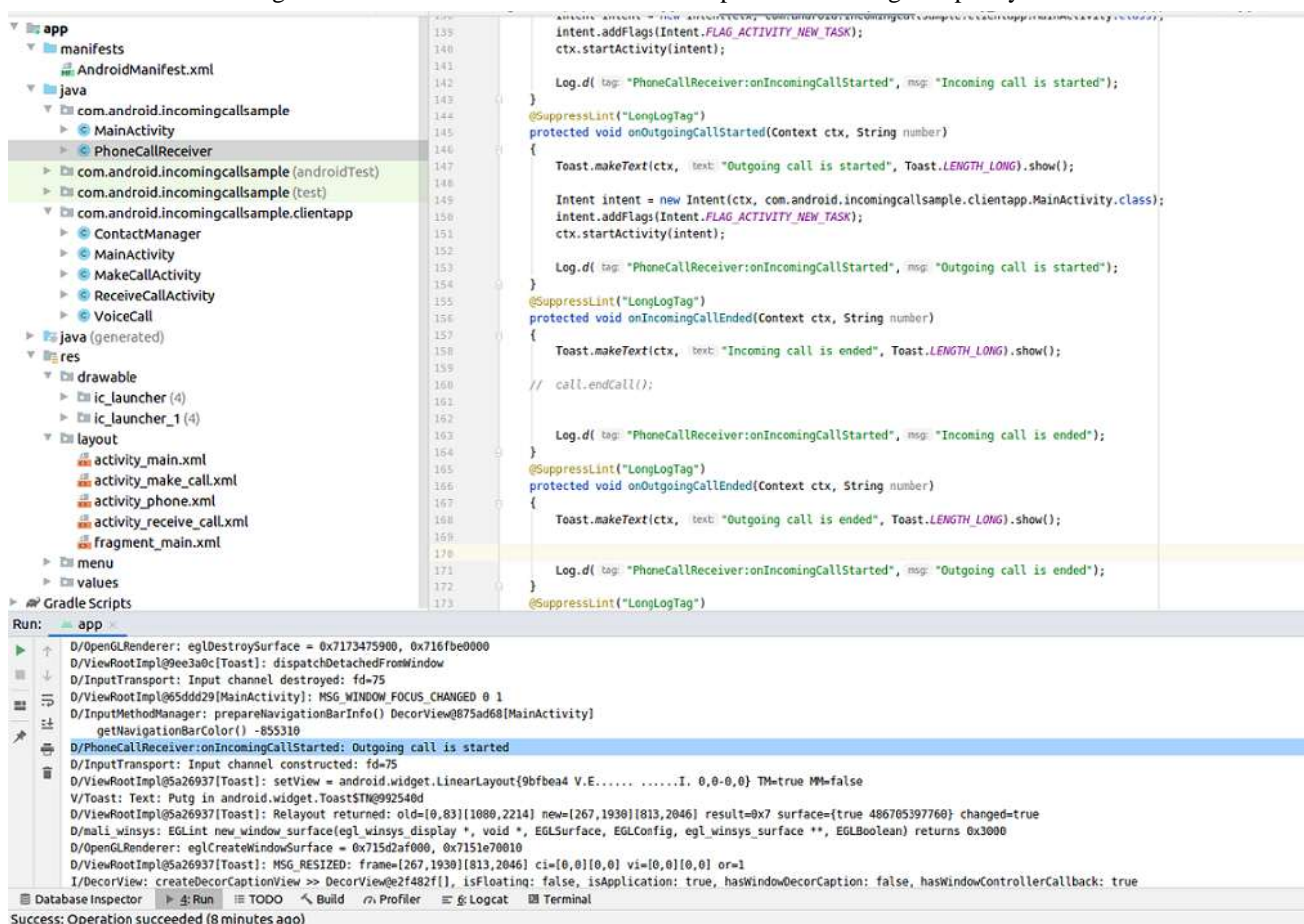
When name of user is entered, submit name button will register user with that name. Smart phone user and tablet user are registered with their names. Update button will update users. Figure 8 illustrate programming and compilation report for registration of users in same Wi-Fi network through Android Wi-Fi and Datagram socket APIs. Update user will update all users registered to same Wi-Fi network.

Figure 8- Screen Shot of Code and Build Report of User Registration and Updating Users
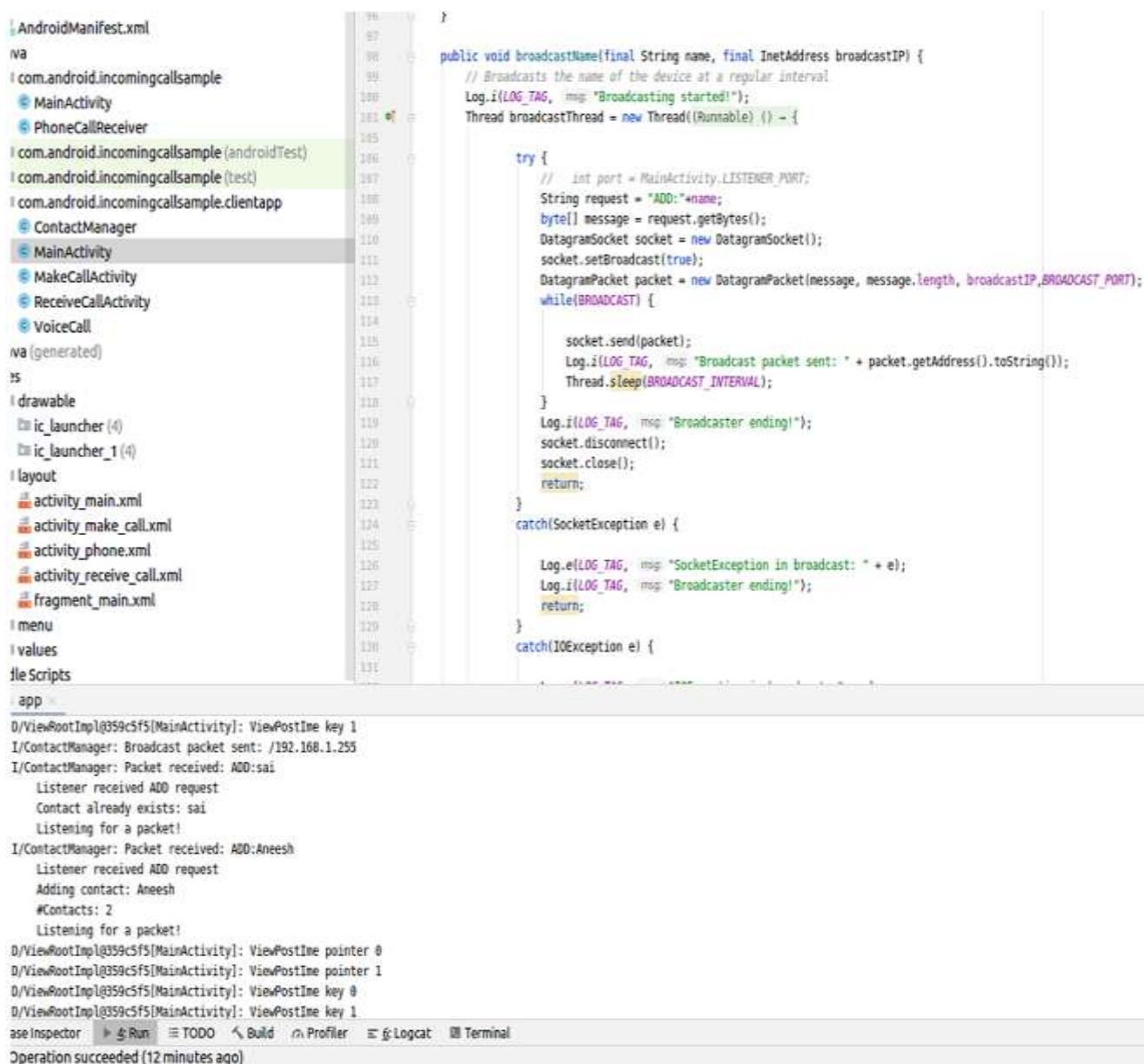
Select user by clicking on check box at registered user name. IP address of selected user is obtained through wifi manager. By click on call button, incoming caller voice is transferred to

selected user. Figure 9 illustrate programming and compilation report for getting IP address of user and started voice transferring of users in same Wi-Fi network through Android Wi-Fi and Datagram socket APIs.

Figure 9- Screen Shot of Code and Build Report of Voice Transferring
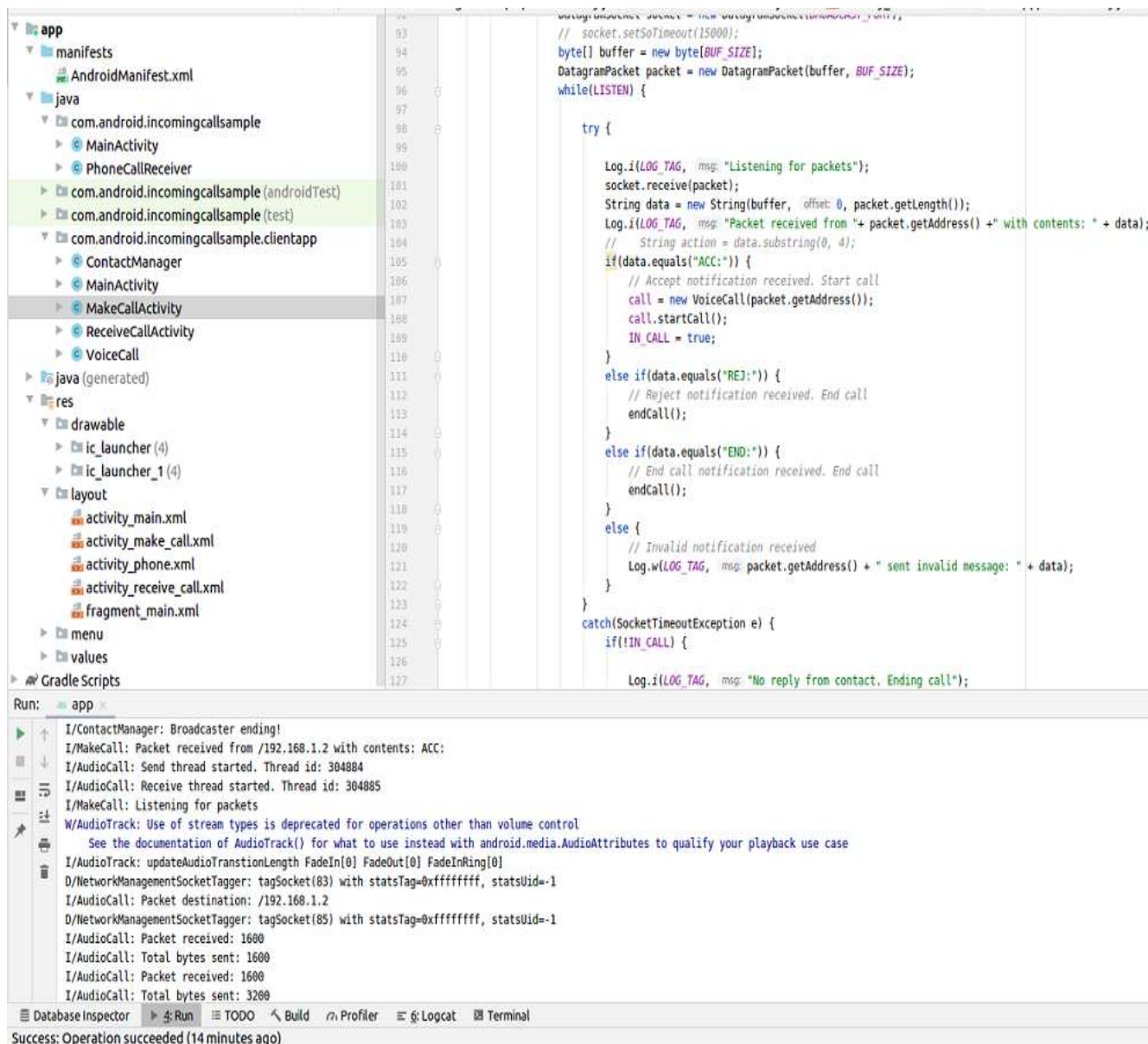
Socket based communication through UDP is used in development of transferring voice. Audio record encodes raw voice data from incoming caller into frames in smart phone. These frames stored in buffer and sent to receiving side through packets. Figure 10 illustrate programming and

compilation report for incoming caller voice recording and encoding through android audio record API.

Figure 10- Screen Shot of Code and Build Report of Voice Recording and Encoding at Smart Phone Side
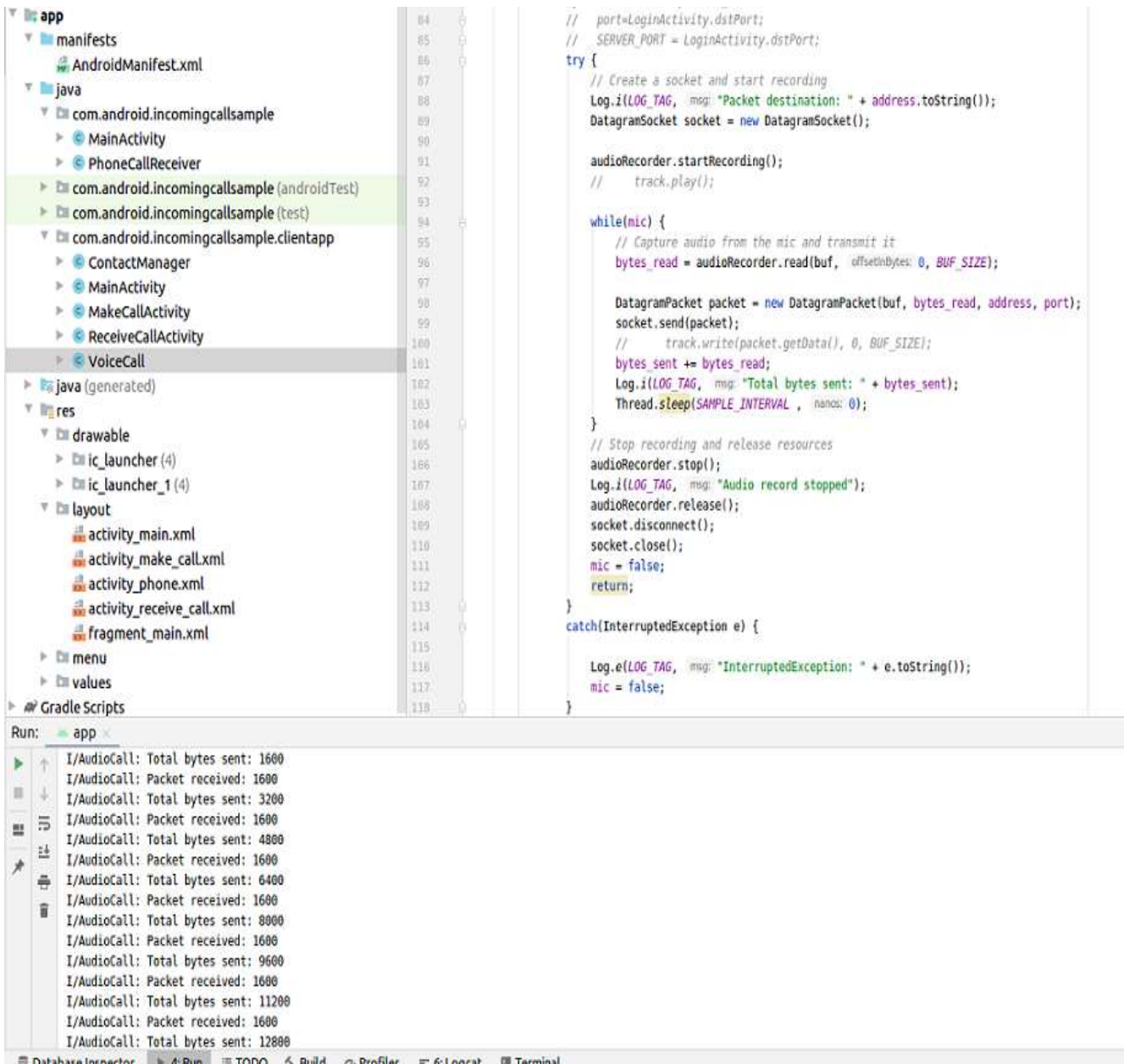
Audio track decode received packet through UDP socket into frames by android Audio track APIs. Write and play methods are developed to play received incoming caller voice in tablet. Figure 11 illustrate programming and compilation report for play method of android audio track.

Figure 11- Screen Shot of Code and Build Report of Voice Decoding and Play at Tablet Side
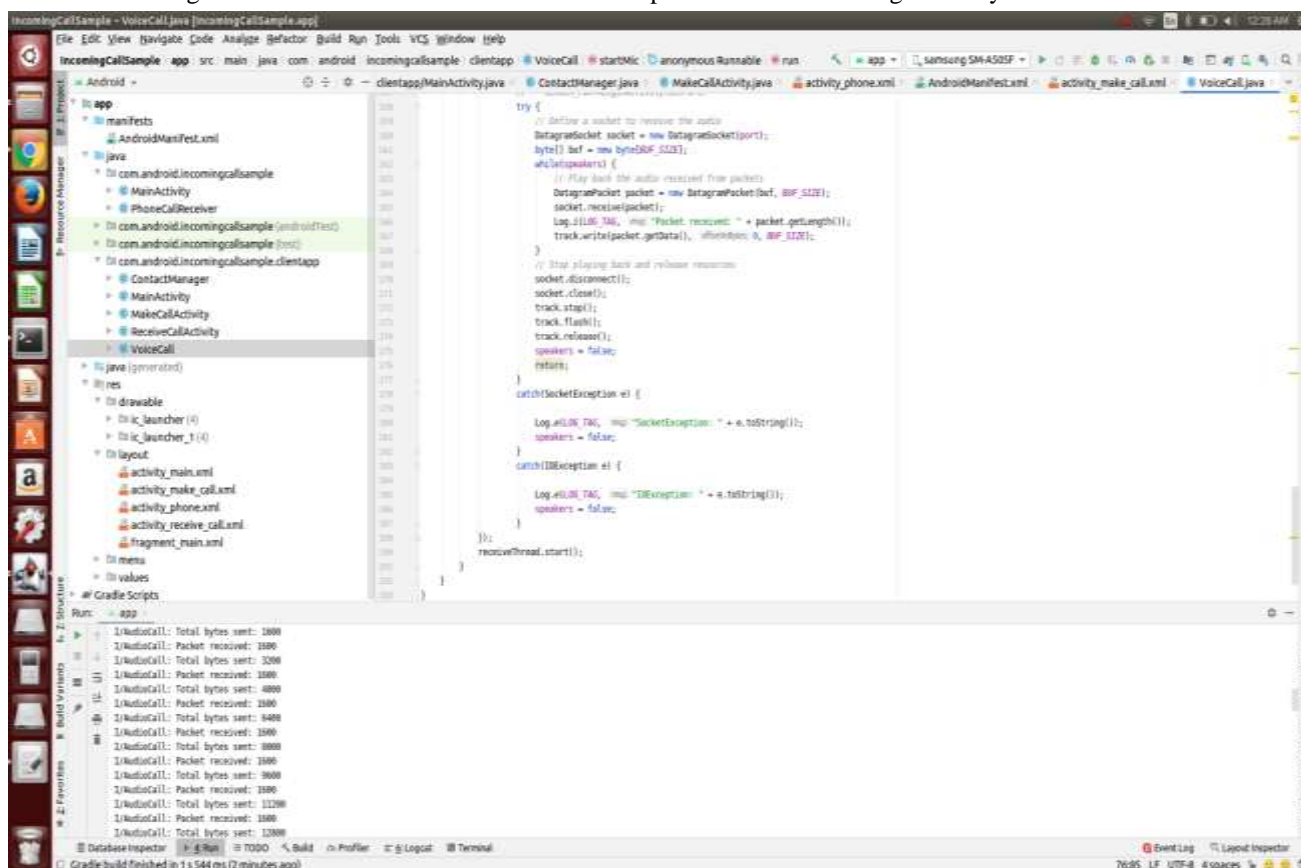
5. Conclusion

Proposed application has developed various modules involved in transferring voice call through Wi-Fi. Main work done is transferring voice in form of packets through UDP socket. Developed application is user friendly since each user can register with their names without familiar with any technical knowledge about wifi or IP address.

This free wireless voice transfer service is enabling not just free calls but also providing more advantageous and rich features and more flexible services. Although challenges stay behind, proposed application will play key role in businesses communications, small and big offices, schools, homes, construction sites etc. As per cost factor, there is no need of internet charges and telephony call charges.

Acknowledgement

Reddy, my project mentor for their patient guidance, enthusiastic encouragement and useful critiques of this research work.

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