



An Android Application for Bluetooth Multicasting in a Piconet

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Abstract: Bluetooth is a wireless Personal Area Network (PAN) that provides the means to connect mobile computing devices with each other. It is a low-cost cable replacement technology that connects one device to another with a universal short-range radio link. The current Bluetooth implementations facilitate one-to-one transfer of data for cellular phones i.e. unicasting. The Bluetooth specification provides support for a Bluetooth-enabled device to manage multiple connections. The goal is to develop an application that utilizes this facility for transferring data from a single Android-based mobile phone to multiple mobile devices.

Keywords: Android, Application Programming Interface, MAC Address, master, multicasting, Personal Area Network, piconet, slave, unicasting, UUID

I. INTRODUCTION

Bluetooth wireless technology is a short-range radio technology that is designed to fulfill the particular needs of wireless interconnections between different personal devices. The majority of the mobile phones currently in production have in-built Bluetooth. A piconet is the usual form of a Bluetooth network and is made up of one master and one or more slaves. The device initiating a Bluetooth connection automatically becomes the master and the devices accepting the connection for receiving data from the master become slaves. A piconet can consist of one master and up to seven active slaves. Multipoint operation is supported via piconets. The proposed application aims to set up a piconet of five active slaves. Before actual data transfer can take place between two Bluetooth-enabled devices, the devices need to be paired. Pairing is a bonding procedure that allows you to avoid entering access information each time two devices establish a connection. The Android application framework provides access to the Bluetooth functionality through the Android Bluetooth APIs (Application Programming Interfaces). These APIs allow for pairing and connecting Bluetooth devices for point-to-point or point-to-multipoint communication. These APIs require that two devices must be paired before a connection can be established between them. A connection between two devices implies that they share an RFCOMM (Radio Frequency Communication) channel for transmitting data. The proposed application will utilize the Android Bluetooth APIs for establishing point-to-multipoint communication between a master (running on Android platform) and five slaves.

II. RELATED WORK

The most common usage of Bluetooth networks in mobile phones is to connect one device to another. However, its usage can be extended for other applications such as broadcasting or multicasting of data. [1] explains an optimal algorithm for multicasting in a piconet where one node desires to share content with rest of the seven nodes. It also presents a number of simpler practical algorithms that are compared with the optimal case.

Some specific implementations [2,3] have been developed that use Bluetooth for broadcasting purpose. These implementations also investigate the practical concerns of broadcasting and multicasting using Bluetooth. The following section describes two such implementations:

A. The Baloo Bluecasting Server:

The goal of the bluecasting (Bluetooth broadcasting) server, Baloo, was to provide a flexible server via Microsoft's Bluetooth stack for broadcasting [2]. It could be used to broadcast any type of information to any Bluetooth device. This Bluecast system is especially useful for spreading information to temporary recipients via a server. It provides users with the facility of collaborative information sharing by sending a text message to the server for receiving the relevant information via the Baloo Bluecasting Server.

B. RugBlue:

The RuGBlue broadcasting server uses Ubuntu 8.04 BlueZ stack as it provides stable Bluetooth implementation [3]. The implementation of the RuGBlue server proves that Bluetooth can be used for broadcasting to unknown devices based on their location. The RuGBlue architecture consisting of internal databases for login and synchronization and external databases for content distribution was used to broadcast course-related information to the university students.

III. SYSTEM OVERVIEW

The system will be developed on Android platform. It will implement the Android Bluetooth APIs for data transfer. The APIs provide a mechanism for secure connection establishment, pairing between devices and for managing multiple connections [4]. The system will consist of one master operating on Android and five slaves. The functionality provided by the system is:

- Manage the Bluetooth settings for the phone.
- Discover other Bluetooth devices within the range of the master.
- Pair with the remote devices to establish a secure connection. Use the UUID (Universally Unique

- Identifier) to uniquely identify the application’s Bluetooth services.
 - d. Connect to at most five devices using multithreading for data transfer.
 - e. Display estimated file size and progress of file transfer.
- Fig. 1 shows the activity diagram for Bluetooth Multicast system.

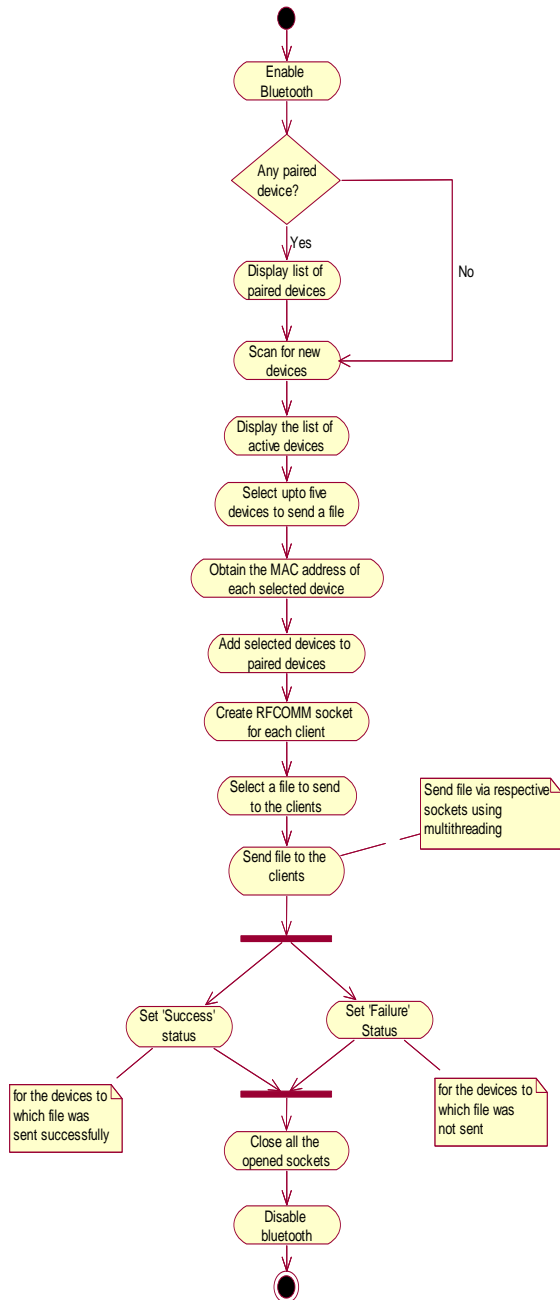


Figure 1. Activity Diagram for Bluetooth Multicast system

IV. SYSYTEM DESIGN

A data flow diagram (DFD) is a graphical representation of the "flow" of data through an information system, modeling its process aspects. A DFD shows what kind of information will be input to and output from the system, where the data will come from and go to, and where the data

will be stored. Fig. 2 shows Level 0 DFD and Fig. 3 shows the system in greater detail.

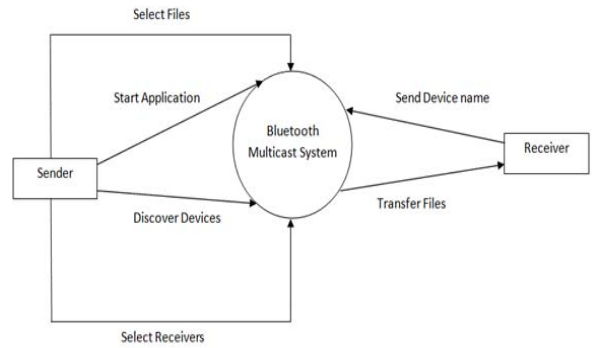


Figure 2. Level 0 DFD for Bluetooth Multicast System

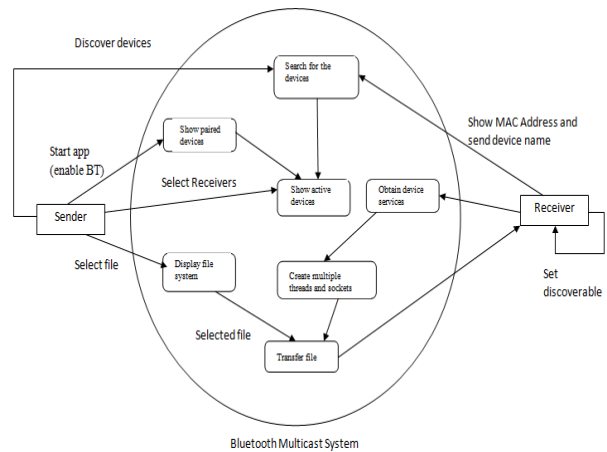


Figure 3. Level 1 DFD for Bluetooth Multicast System

V. USECASE SCENARIO

Bluetooth Multicasting is the enhancement of the current Bluetooth implementation. Bluetooth Multicast system will be able to transfer data such as images, text and video to multiple receivers at a time. It can be used in a university or a company to transfer important data such as notes or timetables to an intended group of people.

VI. MATHEMATICAL MODEL

Let, S be the system, then

$$S = \{I, O, F, F_c, S_c\}$$

Where,

‘I’ is a set of all inputs,

$$I = \{\{I_1\}, \{I_2\}, I_3\}$$

$$I_1 = \{I_{11}, I_{12}, I_{13}, I_{14}, I_{15}\}$$

Where each I_{ii} = MAC address of remote device i.

$$I_2 = \{I_{21}, I_{22}, I_{23}, I_{24}, I_{25}\}$$

Where each I_{ij} = Created socket for each remote device i.

$$I_3 = \text{File to be transferred}$$

‘O’ is a set of all outputs,

$$O = \{\{O_1\}, \{O_2\}\}$$

$$O_1 = \{O_{11}, O_{12}, O_{13}, O_{14}, O_{15}\}$$

Where each O_{ij} = Socket for each connected remote device j.

$$O_2 = \{O_{21}, O_{22}, O_{23}, O_{24}, O_{25}\}$$

Where each O_{ij} = Status of file transfer for each connected remote device j .

'F' is a set of all functions.

$F = \{f_1, f_2, f_3\}$

$f_1: I_1 \rightarrow O_1$

f_1 will search for active devices to get their MAC address for pairing with them and give output as O_{1j} .

$f_2: I_2, I_3 \rightarrow O_2$

f_2 will select files and transfer them using the created socket and give output as O_{ij} .

A. Success case :

- a. For I_1, I_2, I_3 system produces output O_1

B. Failure cases:

- a. For I_1, O_1 fails as the remote device goes out of the range or could not be discovered.
- b. For I_3, O_2 fails if the file size is greater than the available memory of the receiving device.

VII. CONCLUSION

Bluetooth is a low-cost technology present in virtually every mobile phone. Using a multicast system can enable a device to send data to multiple clients, thus eliminating the need to send the same file separately to each client. This system can be implemented in a business scenario or a university for transferring important data to a selected group of people. On successful implementation for a piconet, the system can be extended to a scatternet.

VIII. ACKNOWLEDGMENT

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