Wi-Fi Range Extension via Smart Phones (Android)

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ABSTRACT

Wi-Fi Direct is a new technology defined by the Wi-Fi Alliance aimed at enhancing direct device to device communications in Wi-Fi. Thus, given the wide base of devices with Wi-Fi capabilities, and the fact that it can be entirely implemented in software over traditional Wi-Fi radios, this technology is expected to have a significant impact. The Android platform is the product of the Open Handset Alliance, a group of organizations collaborating to build a better mobile phone. The group, led by Google, includes mobile operators, device handset manufacturers, component manufacturers, software solution and platform providers, and marketing companies. From a software development standpoint, Android sits smack in the middle of the open source world. The success in deploying services and applications based on this concept needs the development of applications that allows intermediate users the reception and forwarding of information to destination users. The user may take the maximum benefit from the technology acquired inside the mobile phone (Android) for instances, since it is possible extend the radio coverage by several hops. We make use of Wi-Fi Direct to extend the range of a Wi-Fi network

Keywords

Android, Wi-Fi Direct, range-extension

1. INTRODUCTION

1.1 Motivation

Our motivation for this project is the paper on Java Virtual Router. Java Virtual Router (JVR) [1] is intended to connect virtual networks as if gateways exist between them. JVR is made of three layers: Physical, Network Interface and Routing. These form the entire protocol stack. The Physical layer brings up the machines on a real network and passes packets to the Network Interface layer. The Network Interface layer maintains various virtual interfaces in the JVR. It passes the packets between the Physical layer and the Routing layer. The Routing layer reads in the packets from its input queue and extracts routing information embedded in the packet. It updates its own routing table using that information. The Routing layer periodically sends update packets over all the virtual network interfaces, using Poisson Reverse technique

1.2 Background

More than a decade after its initial design, the IEEE 802.11 standard, has become one of the most common ways to access the Internet. However, to continue with its striking success the Wi-Fi technology needs to evolve and embrace a larger set of use cases. Given the wide adoption of Wi-Fi in many kinds of devices, a natural way for the technology to progress is to target device to device connectivity, i.e. without requiring the presence of an Access Point (AP), traditionally provided by other technologies. This is the purpose of the Wi-Fi Direct technology that has been recently developed by the Wi-Fi Alliance. Direct device to device connectivity was already possible in the original IEEE 802.11 standard by means of the ad-hoc mode of operation. However this never became widely deployed in the market and hence presents several drawbacks when facing nowadays requirements, e.g. lack of efficient power saving support or extended QoS capabilities. Another relevant technology in the Wi-Fi device to device communications space is 802.11z, also known as Tunneled Direct Link Setup (TDLS), which enables direct device to device communication but requires stations to be associated with the same AP. Unlike the previous technologies, the Wi-Fi Direct technology takes a different approach to enhance device to device connectivity.

1.3 Need

Modern smartphones loaded with the Android OS have support for the WI-Fi Direct technology. As this technology is new and upcoming, the software application for Wi-Fi Direct features does not exist as of now. An android application is required to use the features provided by Wi-Fi Direct. Our project aims at building such an Application and enable the extension of range using this technology.

2. Literature Survey

2.1 Blue-Fi

2.1.1 Summary

Blue-Fi[2] uses bluetooth to extend the range of an existing wi-fi network.Blue-Fi proposed using bluetooth

contact-patterns as con- text identifiers for predicting Wi-Fi availability. The low range of bluetooth devices make them accurate predictors of Wi-Fi availability.To speed up the learning process, Blue-Fi uses collaborative prediction through sharing of logs and Wi-Fi connectivity details.Blue-Fi, a sytem that predicts the availability of the Wi-Fi connectivity by using a combination of bluetooth contact-patterns and cell-tower information. This allows the device to intelligently switch the Wi-Fi interface on only when there is Wi-Fi connectiv-ity available, thus avoiding the long periods in idle state and significantly reducing the the number of scans for discovery.

As Blue-Fi makes use of Bluetooth and the Wi-Fi radio simultaneously, range extension can take place without making any changes to the built in Wi-Fi application. Blue-Fi leverages bluetooths low range to its advantage to achieve high prediction accuracy of Wi-Fi network avail-ability.

Blue-Fi requires both the Bluetooth and the Wi-Fi radio to be working simultaneously. This causes increase in the use of energy and results faster battery drain. Moreover, due to the range and bandwidth limitations of Bluetooth, Blue-Fi does not seem to be a feasible soultion to range extension.

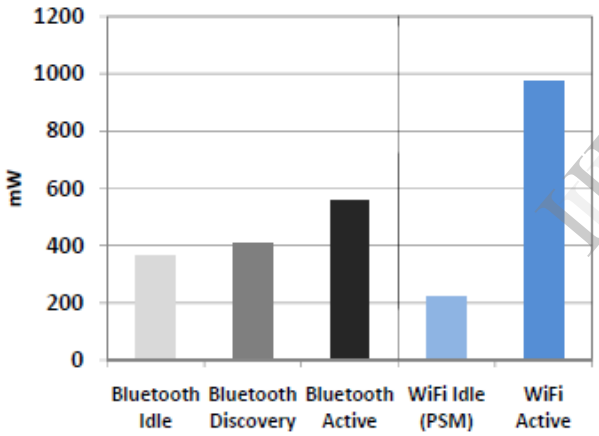

Fig. 2.1 Disadvantages of Blue-Fi

2.2 Ad-Hoc Networks

2.2.1 Summary

A mobile ad hoc network (MANET) is a self-configuring infra structureless network of mobile devices connected by wireless.Each device in a MANET is free to move independently in any direction, and will therefore change its links to other devices frequently. Each must forward traffic unrelated to its own use, and therefore be a router. The primary challenge in building a MANET is equipping each device to continuously maintain the information required to properly route traffic. Such networks may operate by themselves or may be connected to the larger Internet.

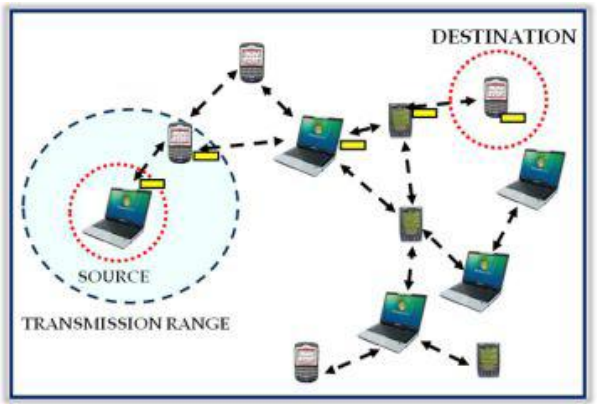

Figure 2.2: Ad-hoc Networking

There is no official support for ad-hoc networks in the Android Operating System. Android does not provide APIs for developing ad-hoc based applications.

3. Proposed Work

3.1 Objective

We intend to build an application that will create a wi-fi p2p group .The smartphone creating the group will act as group owner and allow other devices to connect to it. Wi-fi direct devices will connect to this group and traditional wi-fi devices will see and connect to it is as an access point. A member of this group can then create its own wi-fi direct group.This will enable extension of range over the different groups. This concept is show in following figure:

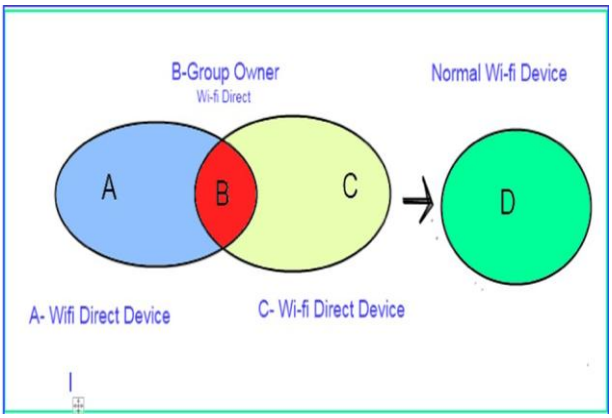

Figure 3.1: Proposed Concept

3.2 Soft-AP

In a typical Wi-Fi network, clients discover and associate to WLANs,which are created and announced by Access Points (APs). In this way, a device unambiguously behaves either as an AP or as a client, each of these roles involving a different set of functionality. A major novelty of Wi-Fi Direct is that these roles are specified as dynamic, and hence a Wi-Fi Direct device has to implement both the role of a client and the role of an AP (sometimes referred to as Soft-AP).We make use of this feature to extend wi-fi range by enabling our smartphone to act as a client to the available network and as a AP to other wi-fi devices.

3.2.2 Wi-Fi Direct Group

Wi-Fi Direct devices, formally known as P2P Devices, communicate by establishing P2P Groups, which are functionally equivalent to traditional Wi-Fi infrastructure networks. The device implementing AP-like functionality in the P2P Group is referred to as the P2P Group Owner (P2P GO), and devices acting as clients are known as P2P Clients. The logical nature of the P2P roles supports different architectural deployments, two of them illustrated in Figure 1. The upper part of the figure represents a scenario with two P2P groups. The first group is created by a mobile phone sharing its 3G connection with two laptops; for this first group, the phone is acting as P2P GO while the two laptops behave as P2P Clients. In order to extend the network, one of the laptops establishes a second P2P Group with a printer; for this second group, the laptop acts as P2P GO. In order to act both as P2P Client and as P2P GO the laptop will typically alternate between the two roles by time-sharing the Wi-Fi interface; in Section II-E we will introduce the NoA protocol that can be used for this purpose. The lower part of Figure 1 illustrates the case of a laptop accessing the Internet through a legacy infrastructure AP while at the same time streaming content to a TV set by establishing a P2P Group, where the laptop acts as P2P GO. Like a traditional AP, a P2P GO announces itself through beacons, and has to support power saving services for its associated clients. The P2P GO is also required to run a Dynamic Host Configuration Protocol (DHCP) server to provide P2P Clients with IP addresses. In addition, only the P2P GO is allowed to cross-connect the devices in its P2P Group to an external network. Finally, Wi-Fi Direct does not allow transferring the role of P2P GO within a P2P Group. In this way, if the P2P GO leaves the P2P Group then the group is torn down, and has to be re-established using some of the specified procedures.

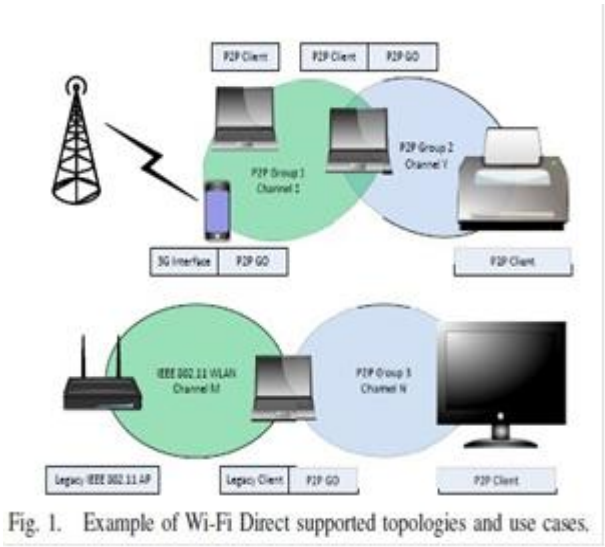

Fig. 1. Example of Wi-Fi Direct supported topologies and use cases.

Figure 3.1: Topology

3.3 Wi-Fi Direct Architecture

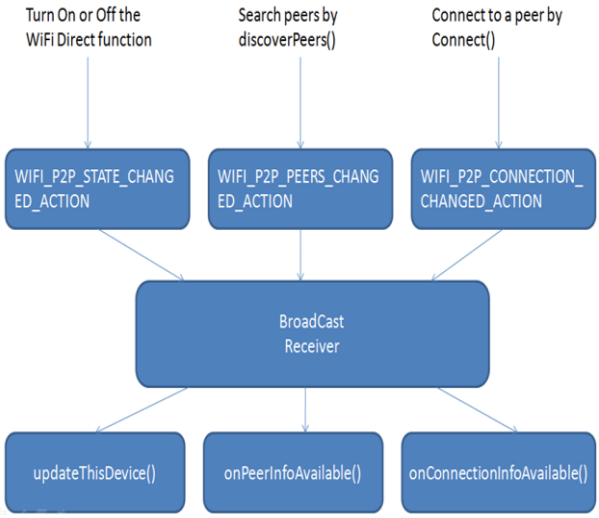

Figure 5.1: Wi-Fi Direct Architecture

3.4 Future Scope

Every project will have no scope of enhancement if unlimited resources and unlimited time is given for its development. Practically, it is not possible to provide unlimited resources and unlimited time to any project. The development of the computer based system is more likely to be affected by lack of resources and time deadlines. This project can further enhanced by considering following points 1) Application can be made available in local languages so that it is accesible to all. 2) Application can be made available on smar phones using platforms other than Android such as iOS, blackberry, etc. 3) Similar desktop applications can be built to provide wi-fi direct support.

Conclusion

The application would be a boon to the smartphone users as it provides extension of range without the use of any extra hardware.The users will derive greater benefit when they can make wi-fi direct groups. Some benefits are: 1) Wi-fi direct provides easy and high speed peer to peer communication. 2)Reliable security provisions are made to ser up secure connections. 3)Extension of wi-fi range improves the infrastructure of the network. Upcoming devices such as smart Tvs,gaming consoles,etc are making use of wi fi direct.The application will prove crucial in establishing communication among such devices. But there are some constraints with this application. In order for the user to realize the full potential of the application, they must have latest smartphones with minimum Android 4.0 and wi-fi direct support. Moreover, the current version of the application is in English, but to make it accessible to large rural domestic market, the next versions of this application would be in the local languages.

REFERENCES

[1] Java Virtual Router; Kang Yong, Marc Mosko Ramesh Balakrishnan, Saravanan Balasubramaniyan University of California, 2001
[2] Device to device communications with WiFi Direct: overview and experimentation; Daniel Camps-Mur, Andres Garcia-Saavedra and Pablo Serrano
[3] Blue-Fi: Enhancing Wi-Fi Performance using Bluetooth Signals; Ganesh Ananthanarayanan, Ion Stoica, Berkeley, California
[4] Wi-Fi CERTIFIED Wi-Fi Direct; Wi-Fi Alliance,October 25, 2010
[5] WiFi-Opp: Ad-Hoc-less Opportunistic Networking; Sacha Trifunovic, Bernhard Distl, Dominik Schatzmann, Franck Legendre,Zurich, Switzerland
[6] Off Grid communications with Android; Josh Thomas,Jeff Robble,Bedford, MA USA
[7] Android Wi-Fi P2P Networking; Sanghaar Ali Malik,Noor ul Ain Ali,Karachi, Pakistan
[8] Google Developers https://developers.google.com/android/
[9] Wi-Fi Alliance www.wi-fi.org
[10] Android Development www.developer.android.com