

Independent Study Project

Let's share!

An APP synchronizing files through Wi-Fi Direct

Students : Chia-Hsuan Hsieh, Jui-Wen Hsu

Advisor : Dr. Shun-Ren Yang

CONTENTS

1. Research Motives and Goals
2. Related Technology: Wi-Fi Direct
3. System Structure
4. The Technology
5. Equipment Used in Research and Result
6. Conclusion and Future Plans

1. Research Motives and Goals

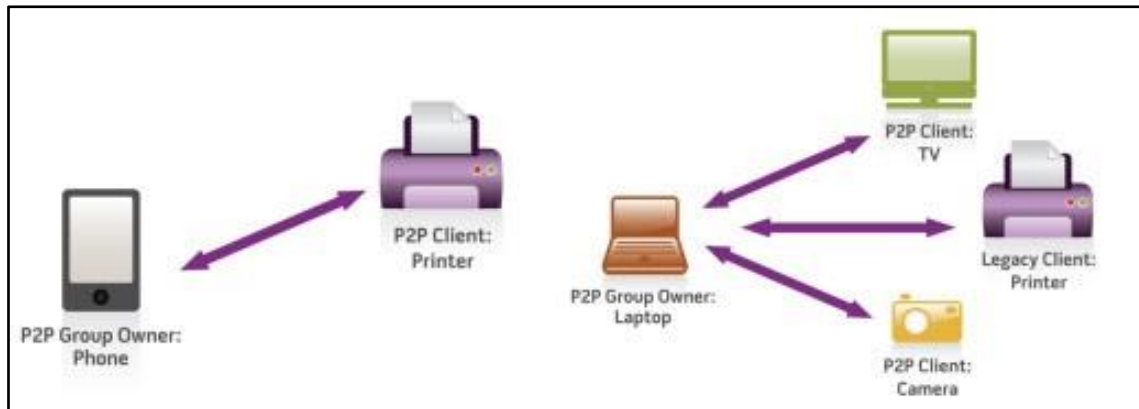
As a result of the rapid development of technology, everybody owns a smart-phone today. When a group of people goes on a trip, during the long period on the bus they may want to do something interesting such as listen to music, or share funny videos with friends, or send the beautiful photos from the trip when they return. For these reasons, we have designed an application to let people share their files immediately. When we are in a remote area with a weak signal or traveling abroad, we may not have free and available Wi-Fi to connect to. Although Bluetooth seems to be able to solve this problem, it's difficult to send many files due to its narrow bandwidth. In addition, Bluetooth only connect over a short distance. Therefore, we decided to use the new connection protocol, Wi-Fi Direct which was developed and administered by the Wi-Fi Alliance, to solve the problem.

Because Wi-Fi Direct connects each client directly without going through an access point, users can have more privacy. In order to make it easy for users to share things, we designed an application that can send files through Wi-Fi Direct. This application will construct a folder named "Let'share" in the internal storage of each phone, and users can copy or delete files in this folder through this application. Then, they can synchronize the specific folder, *Let'share*, to other phones. Because some people may want to keep their original files, the app will not delete the original files when synchronizing. Users can use the app safely without fear losing their treasured files.

2. Related Technology: Wi-Fi Direct

Wi-Fi is ubiquitous and many products include a Wi-Fi controller. There are more and more products that need to be connected. To meet the growing demand for connected products, the Wi-Fi Alliance has developed a peer-to-peer connection technology for connecting devices directly and on October 25, 2010 announced the new standard with the name, Wi-Fi Direct. That means devices can connect to each other peer-to-peer through Wi-Fi Direct.¹

¹ Wi-Fi Direct Wikipedia › <https://zh.wikipedia.org/wiki/Wi-Fi%E7%9B%B4%E8%BF%9E>



[A Typical Wi-Fi Direct Structure²]

The above picture shows the typical structure of Wi-Fi Direct. When we use Wi-Fi Direct to connect, there are two roles, a P2P Group Owner(GO) and one or more P2P Clients. The GO is similar to the access point in a typical Wi-Fi connection between clients.

The difference between the concept of Wi-Fi and Wi-Fi Direct is that Wi-Fi Direct is suitable for a single connection or a temporary connection. Therefore, Wi-Fi Direct protocol can let users easily find other Wi-Fi Direct devices, and after deciding which device to connect to and going through a certificate process, Wi-Fi Protected Setup(WPS), build a safe connection. Wi-Fi Direct doesn't need new hardware to support this protocol, so most current chips can support this technology after a firmware update.³

3. System Structure

(1) Procedure

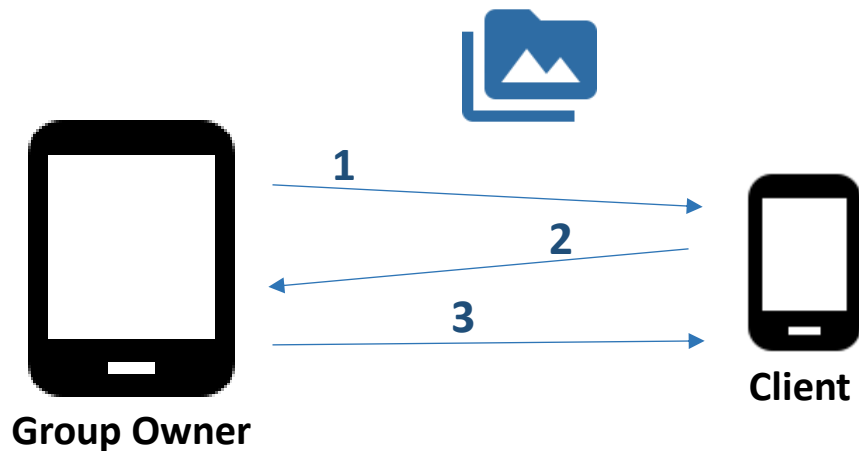
I. The app will create a folder named "Let's share" as a storage space on each device.
 II. After starting the app, there will be three buttons on the home page. The below is a brief explanation of these buttons.

- (I) Share: Sets the device as a Group Owner to synchronize files with the clients.
- (II) Receive: Sets the device as a client to receive the files from the Group Owner and synchronize with the Group Owner.
- (III) Folder: Shows the content of the shared folder to review the available space in the folder and add or delete files to this folder.

² Picture : A Typical Wi-Fi Direct Structure, engadget,
<https://www.engadget.com/2010/10/25/wi-fi-direct-certification-begins-today-device-to-device-transm/>

³ Communication Components Magazine April 2010 110th 《Advanced Technology》 ,
http://www.2cm.com.tw/technologyshow_content.asp?sn=1003240022

(2) Connection Procedure



- I. The GO confirms which files to share with clients, sets up a Group and becomes the Group Owner, and waits for the client to connect.
- II. After the clients have found the group owner, they select the Group and receive the files from the Group Owner.
- III. When the connection is successful, the GO asks the Client's permission to receive the files. After confirmation, the GO transmits the files and the Client accepts them.

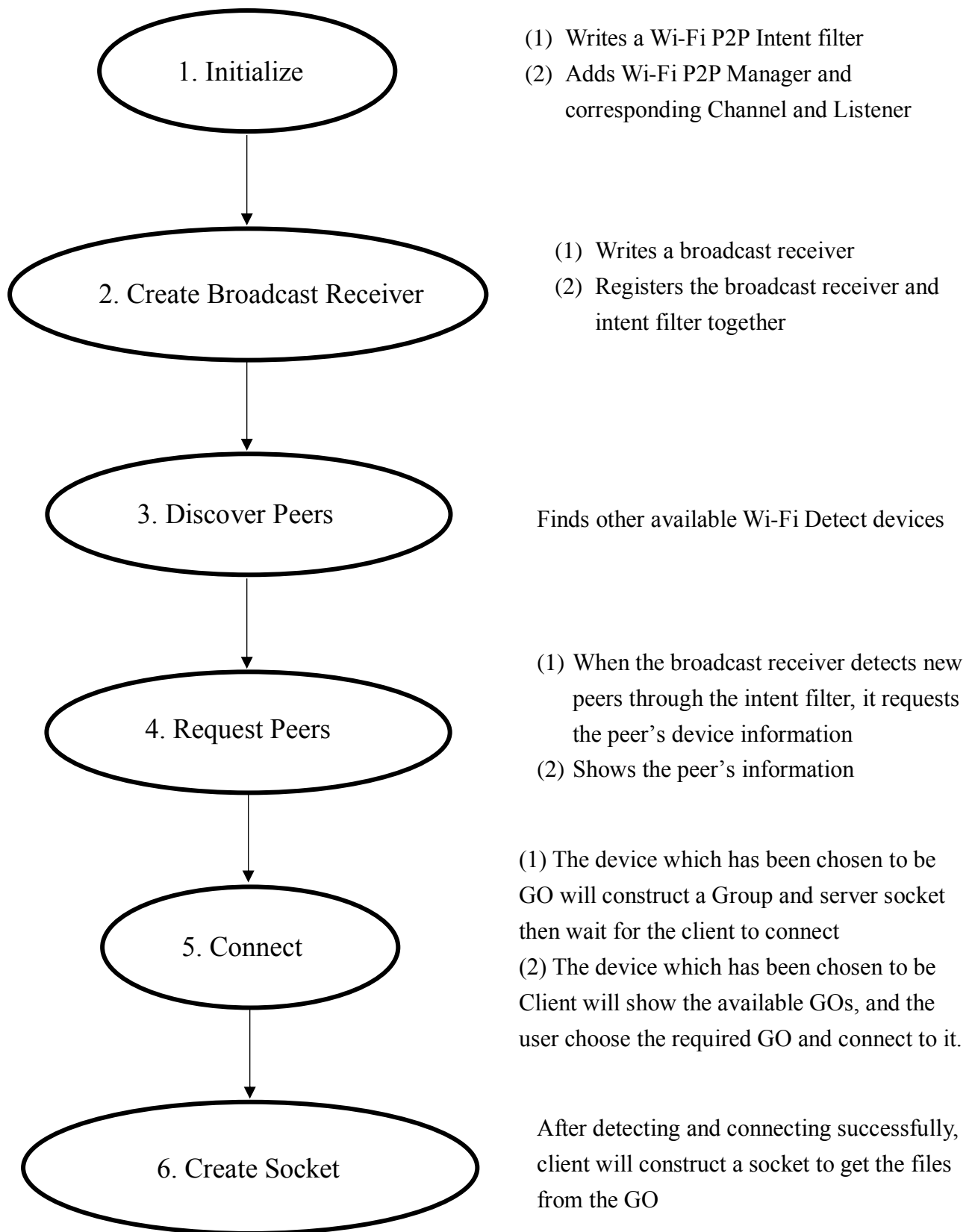
4. The Technology

(1) Wi-Fi Direct Connection

The Wi-Fi Direct connection can be simplified into six main steps:

- I. Initialize
- II. Create Broadcast Receiver
- III. Discover Peers
- IV. Request Peers
- V. Connect
- VI. Create a Socket and Send Files

Something else to note is that because the SDK version that can use Wi-Fi P2P app needs to be at least version 14, we need to request permission in `AndroidManifest.xml` first.

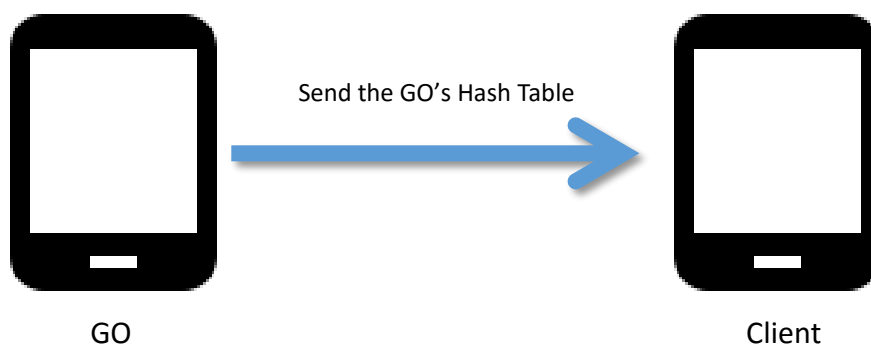


(2) Hash table synchronizes the contents of the files

We use a hash table to record the name and path of current files. We can separate the synchronization into three steps, and we will illustrate these three steps with pictures.

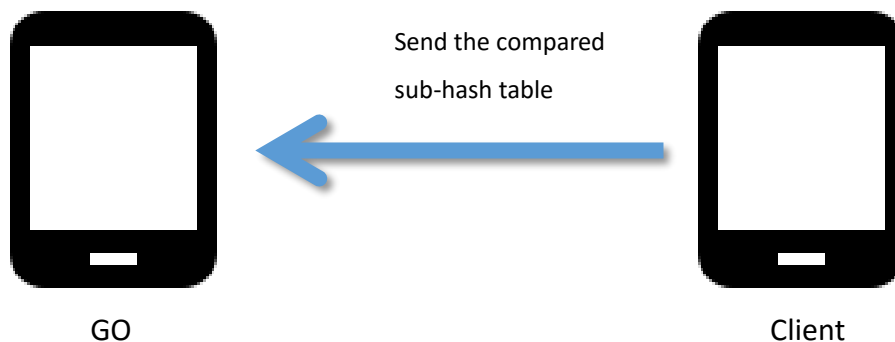
- (1) We first send the hash table from GO to the client. After the client receives it, the client will compare it with its own hash table. Then, the client will construct another sub-hash table.

Compare Hash Table



- (2) Send the sub-hash table back to GO, and client still keeps the sub-hash table.

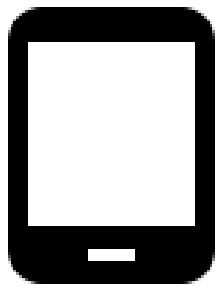
Keep sub-hash table



- (3) After receiving this sub-hash table, GO sends the files in the order listed in the sub-hash table to the client. Because we send the files in the order listed in the sub-hash table, the client names the received files in the order listed in the sub-hash table. The synchronization can thus be completed.

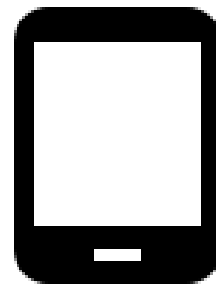
Send sub-hash table files
in the order listed to client

Receives files
and name them



GO

Send files



Client

(4) Equipment Used in the Research and Result

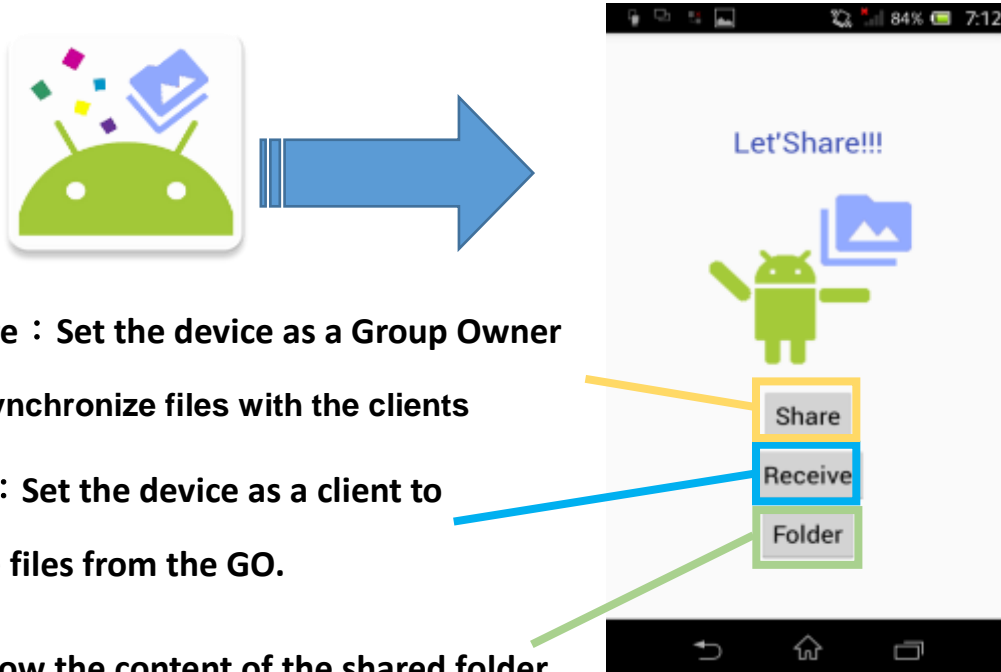
I. Equipment Used

The testing procedure needs at least two devices, one GO and at least one client. The information about the three phones used in the testing procedure is listed below

GO		
	Brand of Device	Sony D2533
	Device Model	Xperia C3_9b99
	Operating System	Android 5.0.2
	API / SDK version	21
Client		
	Brand of Device	Sony C2105
	Device Model	Xperia L_6fda
	Operating System	Android 4.2.2
	API / SDK version	17
Client		
	Brand of Device	HTC desire 600
	Device Model	Android_32f7
	Operating System	Android 4.1.2
	API / SDK version	16

II. Testing Result

When users start the app, the first screen shown is the home page. The home page contains three buttons: 1. Share 2. Receive 3. Folder. The function of these buttons is described below




1. Share : Set the device as a Group Owner to synchronize files with the clients

2. Receive : Set the device as a client to receive the files from the GO.

3. Folder : Show the content of the shared folder

1. Share : GO	2. Receive : Client
<p>The screenshot shows a dialog box titled 'Share Files?' with the text 'Do you want to share files with users connecting to you?'. There are two buttons at the bottom: 'NOT NOW' and 'YES'. The background is dark gray, and the dialog box is white with a gray border. At the bottom of the screen, there is a 'MAIN MENU' button.</p> <p>(1) After clicking “Share” button, the app asks users to confirm whether to synchronize files to the connecting</p>	<p>The screenshot shows a screen with the text 'Xperia L_6fda Discovering peers...'. Below this, there is a list of available Group Owners (GOs) with their names and MAC addresses: 'Xperia C3_9b99' and 'be:6e:64:e0:f1:f3'. At the bottom of the screen, there is a 'Main Menu' button.</p> <p>(1)After clicking the receive button, the app finds available GOs and shows them on the screen.</p>

client.



The screenshot displays a mobile application interface. At the top, there is a status bar with various icons and the time 00:03. Below the status bar, a blue header bar contains the text "Xperia C3_9b99". Underneath the header, a light blue box displays the text "Waiting for connection...". At the bottom of the screen, there is a dark blue bar with the text "MAIN MENU" in white. Below this bar is a black navigation bar with three white icons: a back arrow, a home circle, and a recent apps square.

(2)After confirmation, the app shows the connecting Client's device name and the state of their Wi-Fi Direct connection state.

Xperia C3_9b99
Waiting for connection...

Android_32f7
9a:0d:2e:6e:64:5a

All the files have been sent out

MAIN MENU



Xperia L_6fda
Connecting to Xperia C3_9b9...

Xperia C3_9b99
be:6e:64:e0:f1:f3

Main Menu

(2)After choosing the desired GO, the connection state will change, and wait for the connection.

Xperia L_6fda

Connecting to Xperia C3_9b9...

Xperia C3_9b99

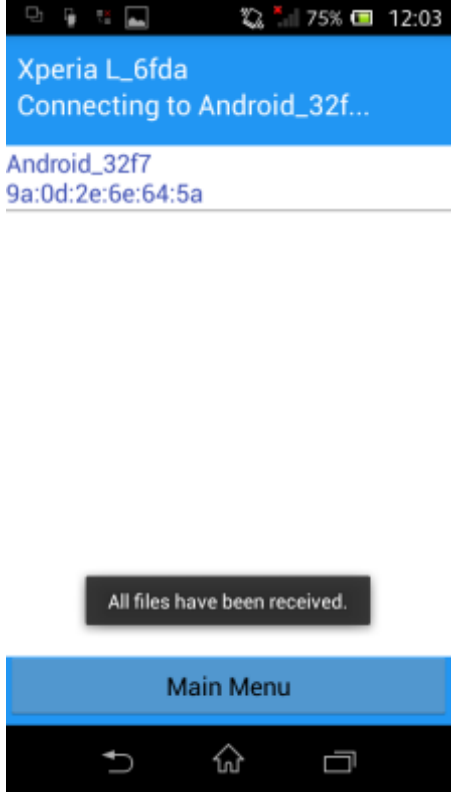
be:6e:64:e0:f1:f3

Receive Files?

Do you want to receive files from the user you chose?

Not now Yes

Main Menu

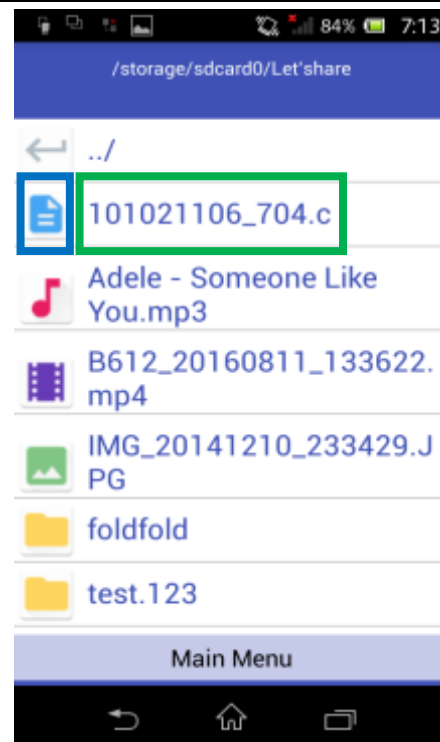
<p>(3) After the client(s) agree to receive files, the app starts to synchronize the files with client(s). After finishing sending, there will be a confirmation that all the files have been sent.</p>	<p>(3)After connecting, the app will ask the client(s) whether to receive the files from GO. After agreeing, the app will start to receive the files.</p>
	 <p>(4)After finishing receiving, a confirmation will appear below.</p>

3. Folder

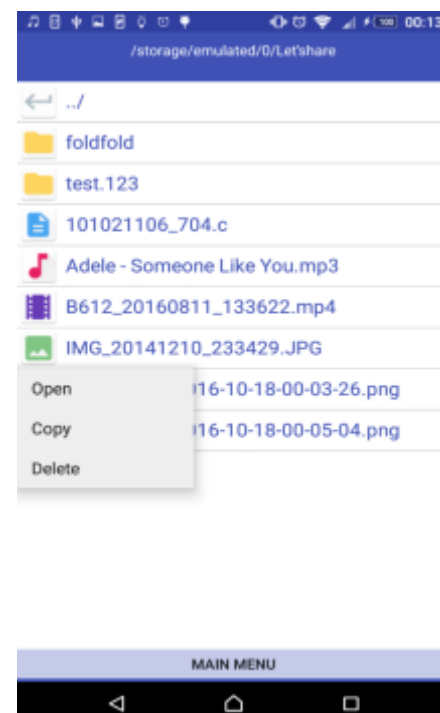
After finishing sending the files, the user can choose the “Folder” button to check the content of *Let'sshare* folder.

- (1) After entering the folder, a list will show and there will be pictures on the left side to show the file type.

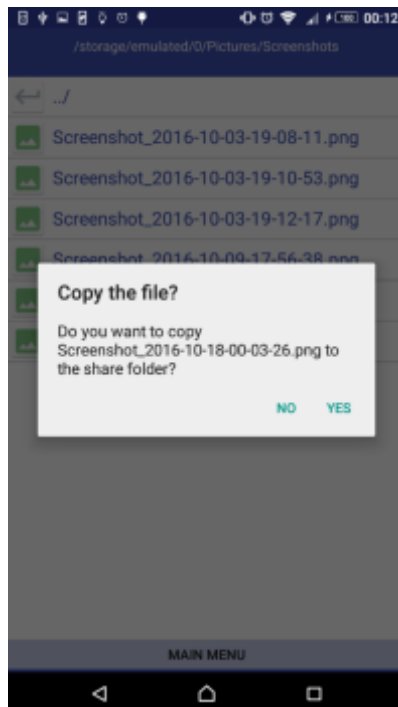
If the current folder is not the root folder, then there will be a button “../” to go to the folder level above.



- (2) If we long press the file or folder, the following choices will appear:
- Open: If a folder, that folder will open. If a file, then the selected file will open in the default application for that file type.
 - Copy: Copies the selected file or folder to the shared folder
 - Delete: Delete the selected file or folder. Warning, this will immediately delete the selected item, including all files inside if the item is a folder.



The picture below illustrate these functions.



The diagram on the left shows the screen after selecting the “Copy” command. The user will be asked whether to copy the files. The diagram after selecting the “Delete” command is similar to that of the “Copy.” The diagram on the right shows the screen after selecting the "Open" command. The file will be opened by the default application for that file type.

6. Conclusion and Future Plans

Although the app that we created, *Let's share*, can let users quickly and privately synchronize files, the app can only be used on phones which run the Android operating system. In order to extend this app to the iOS operating system, we are planning to learn the new programming language, Swift, so that everyone can use this convenient and safe app. On the iOS operating system, we will use Airdrop as the connection because Airdrop is also a peer-to-peer connection like Wi-Fi Direct.

Besides Wi-Fi Direct, there is another new and convenient communication protocol, Near Field Communication(NFC). We hope to add this into our app to let users to synchronize their files through this kind of connection.

We have mentioned that there could be a serious privacy problem when we send files through Wi-Fi or mobile internet. Despite the fact that Bluetooth can avoid this problem, the sending speed is too slow to wait. In order to deal with these two problems simultaneously, we decided to use our power to change the world. We made this app because from our enthusiasm for connection and sharing. We have never planned to take money from users, so we don't want to charge users for this app. Having a commercial interest will lessen our enthusiasm. We hope all the people in the world, whether rich or poor can have a better life through this app.