DESING AND DEVELOPMENT OF A HOME MEDIA SHARING APPLICATION FOR W-CDMA FEMTO CELLS

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Abstract: *Femtocell (also called Small Cell) is a small cellular base station, typically designed for use in a home or a small business. It connects to the service provider's network via broadband. In this paper; a home media sharing application design and development for W-CDMA Femtocells has been discussed. With this application, mobile devices with Android and iOS operating systems shall connect to a computer defined as server on the network. Mobile device shall connect this server with IP address. With this application, mobile devices may be able to stream media, download files, and upload files to server. Also, the mobile device will be able to automatically backup files to the server. Additionally, a user can automatically update their status on social networks (e.g. Facebook / Twitter) when he/she arrives or leaves the Femto network. The application is developed to run on Android and iOS operating systems.*

Keywords: *Femtocell, W-CDMA, iOS, Android, femtocell, media sharing.*

1. Introduction

Femtocell is also known as "home base station". It provides a better signal quality and costs much less in distances shorter than 10meters [1]. Femtocell connects end-users to the service provider via broadband. Femtocell is a more feasible solution than microcells for growing system capacity[2-3]. Femtocell is designed for home and personal use[4-5]. Femtocell may reduce the cost of service provider. It provides better signal quality so increases new service opportunities[6]. A mobile device may detect a femtocell but if connected.

We may list the basic benefits of the Femtocell as the following [7]:

- Better quality and capacity of signal.
- Increased security of macro cells.
- Cost benefits.
- Customer satisfaction.

W-CDMA Femtocells supports high throughput indoors which means users will be able to transfer large amount of data using Femtocell. Using home network local routing (HNLR) function and suggested media sharing solution, the operator guarantees traffic indoor without increasing Mobile Core or Backhaul costs.

Famtocell may also support plenty of applications except signal quality indoor. Femtocell is connected to both local and operator's network. This feature allows it to support many kinds of applications. Some of these are listed below:

•It Gathers Wireless and Mobile Technologies: Mobile devices without wireless features will be able to connect local network via Femtocell. They will be able to reach media centers by this.
•It's possible to determine if the user is at home or away. This information may be useful for many applications.
•Could connect user to local network remotely. User could connect any device in home/home from any location.
•May provide net social network integrations. Home devices may interact with each other much easily.

Many applications have been developed using this opportunities[9..11]. Some of them are listed below:

•Family Warning System: When a family member arrives or leaves home, system could automatically send an SMS to the other members of family. For example, when children leave home, system can send an SMS to the parents.
•Artificial Home Telephone: When an artificial called, femtocell automatically routes it to best available mobile phone connected to it. Thus, home telephone won't be necessary any more.

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•Media Synchronization: Music and Video files may be synchronized between mobile device and personal computer
•Picture Upload: Mobile device automatically uploads new pictures on its storage when detects femtocell connection. These pictures may have shown on digital picture frames.
•Contact/Calendar Synchronization: Mobile device automatically synchronizes contacts and calendar with other devices like PC when it's connected to the Femtocell.
•Remote Control: Mobile devices may be used as remote control for smart TV and other compatible devices.
•Mobile Video: Mobile devices may stream video files on personal computers.
•Family Table: Family member may view other members'locations, notes and voice messages using a tablet located home.
•Marketing: Femtocell detects customer's presence and sends them text messages about campaigns.
•Artificial Fax: Incoming faxes to virtual phone number may be viewed on mobile devices or printed from local printer.

It's expected Femtocell to be invested by the mobile operators and widely used by mobile users[12]. Although Increment of using femtocells may cause management and handover problems, Researchers has made many solutions to handover this problems[13..15].Purpose of this study is: Design and development of a media sharing application works on W-CDMA Femtocells. We predict that studies about Femtocell will contribute to the scientific knowledge and commercial applications.

The remainder of the paper is organized as follows. Section 2 describes the architecture of application. Section 3 describes detailed descriptions of provided services and flow charts. Section 4 includes optimization works. Section 5 concludes the paper.

2. Application Architecture

Developed application is designed with server client architecture as can be seen in Figure 1. First layer is the user interface layer. Users can reach application interface at this layer with an android or iOS mobile device. Also output of the application is presented to users in this layer. These layer devices can access a server through Femtocell 3G connectivity. Home Femtocell device is connected to GSM operator through modem at the second layer. Also server side is located at this layer and connected to Femto device by modem. At last layer called GSM operator layer manages 3G connections and Femto device directs the conversations

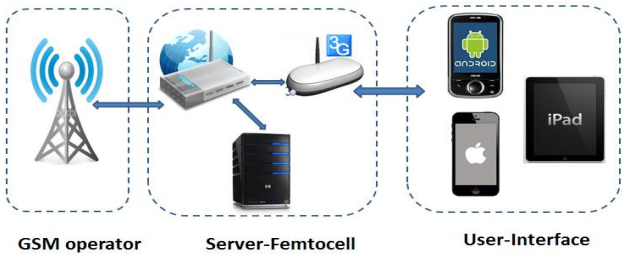


Figure 1. Application architecture

When users connects the home Femto network, they can access the application. Figure 2 shows the application's login menu screen on which the users can send request by typing server's IP address and port number.

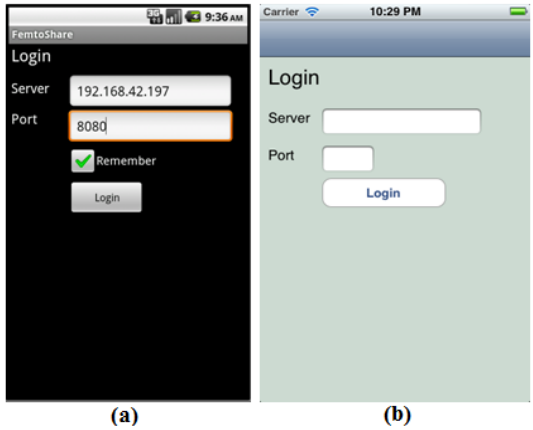


Figure 2. (a) Android login screen, (b) iOS login screen.

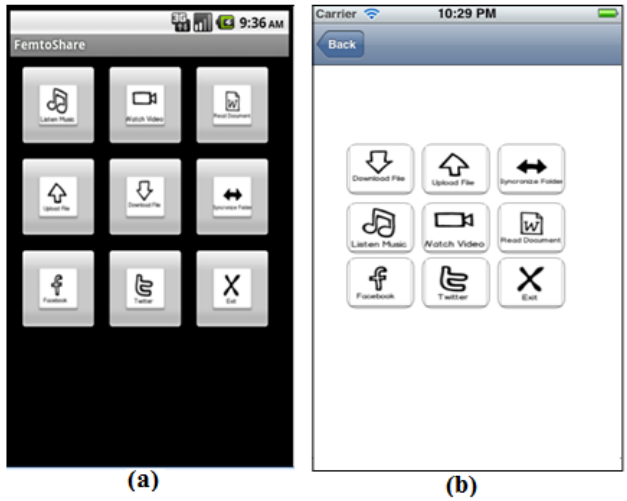


Figure 3. (a) Android menu screen, (b)iOS menu screen

Femtocell directs the connection requests to server. Server reads connection requests and analyzes the port

number. If port number is correct, server accept the connection request and as shown in figure 3, application's main menu is presented user, otherwise connection request is rejected and server sends rejection reason to user's mobile phone.

3. Provided Services

Developed application provides five different services to users.

- *Upload Service:* This service allows user to upload any mobile device file to computer.
- *Download Service:* User can download files from computer to mobile device.
- *Synchronization Service:* User can synchronize all files with the computer via this service without any complex configuration.
- *Media Streaming Service:* This service enables user to listen music or watch video from computer without download thus provide time savings.
- *Social Media Integration:* User can change their status via this service. Facebook and Twitter can be used for social media web sites.

Developed services work in two different modules which is integrated with each other. One of them works on server, the other works on mobile device on demand. For example, if users want to use upload service, they start this service on mobile device. Device send request to server and server make necessary process then stops the service.

3.1. Upload Service

A servlet waits for file transfers on the server side. At the same time, the servlet uses for synchronization. Files are transferred as binary HTTP packets which are uploaded to the computer. For this transfer we use Apache Commons File Upload library. The library makes it easy to add robust, high-performance, file upload capability [9]. Servlet contains a parameter related to the location of the file to upload information. This parameter is the full path of the directory where the file which will be uploaded on the server resides. Users can use this service by using upload button from the main menu. After this, Application will present all the mobile device's files to user as shown in figure 4. The user is able to upload the selected file to any directory of the computer.

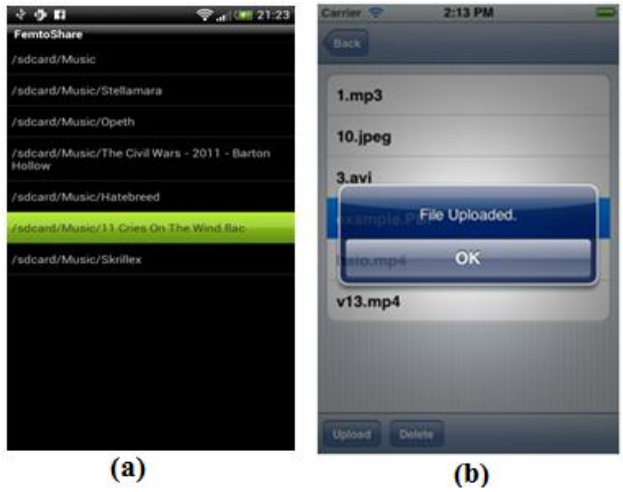


Figure 4. (a) Android upload menu screen, (b) iOS upload menu screen.

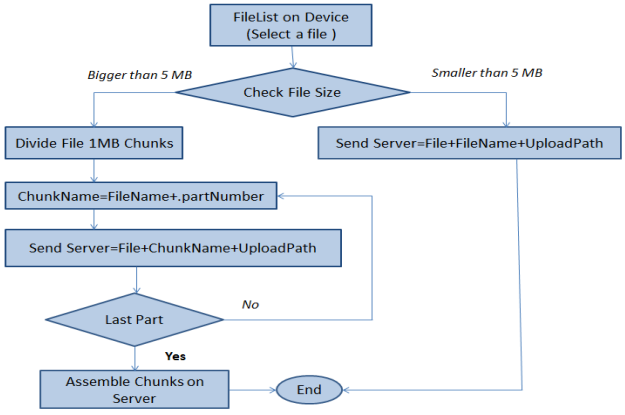


Figure 5. Upload service algorithm flow diagram

During the upload process, application is controls the selected file according to the flow chart given in Figure 5. If the selected file size is more than 5 MB, the application separates file with chunks upload chunk by chunk instead of sending just one part. The purpose of separating the parts can continue after a disconnection. Each chunk of file is sent via the upload service. After uploading the last chunk, the/an assembly service is called for combining all of the/the chunks of file. This service combines the chunks and checks the hash of the file. If hash code is different from the hash which is sent by mobile device, the service gives an error information to user. With this information user can noticethat file is changed.

3.2. Download Service

Users can download their files from the computer to their mobile devices. From the application's main menu

download button is selected and then as inFigure 6, users can access the download screen. This screen shows a list of the users' file and folders.



Figure 6. (a) Android download menu screen, (b) iOS download menu screen

In order to obtain remote file lists, browseFile service is developed. This service is written in Java Language and gets a directory for scan the files and folders. All the files and folders are transformed ina special format. Then an XML file is created with this format as seen figure 7. The XML file includes somespecial tags. <File> tag is the root directory and <Parent> tag is the root directory's parent directory. <Files> tag includes all the files of the root directory. The other tags are some special information about file like name, length, and path.

```
▼<File>
  <FileName>Videos</FileName>
  <FilePath>/home/bamasyali/Videos</FilePath>
  <FileType>Directory</FileType>
  <FileLenght>4096</FileLenght>
  <FileLastModified>1345365619000</FileLastModified>
 ▼<Parent>
    <FileName>bamasyali</FileName>
    <FilePath>/home/bamasyali</FilePath>
    <FileLenght>20480</FileLenght>
    <FileLastModified>1352458879000</FileLastModified>
  </Parent>
 ▼<Files>
    <FileName>VIDEO0004.3gp</FileName>
    <FilePath>/home/bamasyali/Videos/VIDEO0004.3gp</FilePath
    <FileType>Video</FileType>
    <FileLenght>19116307</FileLenght>
    <FileLastModified>1345365585000</FileLastModified>
  </Files>
</File>
```

Figure 7. Sample XML file is created by browseFileservice.

This XML file is sent to mobile device. Mobile device parse the XML file and obtainsthe folder and file list with extra attributes like file path, file length, last modified date etc. This list is offered to user with a special interface.This servlet gets a parameter which includes remote file's full address. Thentheservlettransfers remote file tothe mobile device as binary format. During thedownload, the statusis shown to userin with the help of astatus bar. After thefile is downloaded,the usercan open this file. The filetype can besuch asimage,word, excel, pdf extensions.

3.3. Synchronization Service

The purpose of synchronization is to automatically upload new files to the mobile device when the user arrives home or the office. For this purpose, device shall be able to detect Femtocell network when joins it. Architecture of Femtocell network does not supply any server side connection notification. Thus we shall check Femtocell connection with some other way. Femtocell may have a custom network name like wireless modems. Owner of Femtocell is able to change this network name. If mobile user enters this name to mobile application, it should recognize the network using it. A scheduled thread runs on mobile application checks network time continuously. Application proves that mobile device is in network if the network names match.

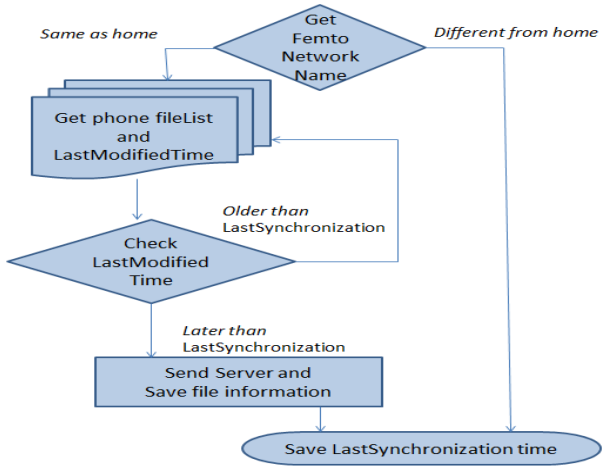


Figure 8. SynchronizationAlgorithm flow chart

The process after auto recognition is defined in figure 8. Firstly, application needs the last synchronization time. All the files are compared to this value with their modification time values. All the files changed or added after last synchronization time shall be synchronized. Successfully synchronized files are kept on a list by application for any crush or fail possibility. On a crush, connection lost or fail, these files won't be synchronized again. Thus, synchronization shall be able to continue from where it left off.

3.4. Streaming Service

User are able to stream music and video from server using this service. It takes long time to download large files. Also there might be not enough space on mobile device storage. Streaming solves these issues. By streaming, users are able to listen music and watch video without downloading them. Users shall be able to view list of media files before streaming them. This file listing function is implemented in downloading module. Only difference is, in this module application lists media files only. It's not necessary to view *.doc files before listening music. So that, only the files has extensions like "mp3", "ogg", "wav", "aac", "amr" shall be listed. For video streaming, files with extensions like "3gp", "mp4", "ts", "webm", "mkv", "avi", "wmv" shall be listed.

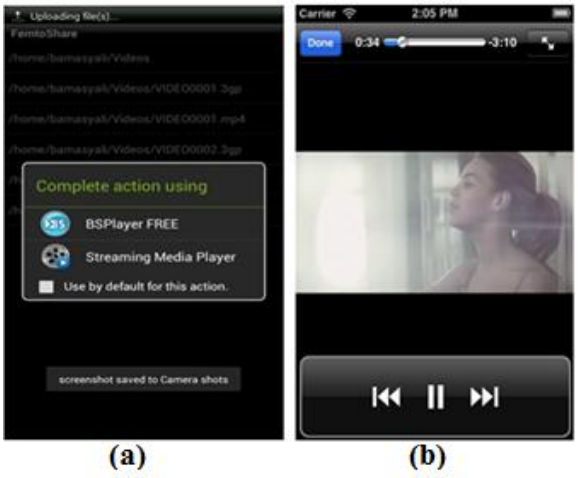


Figure 9. (a)Android video stream screen (b)iOS video stream screen

Video streaming interface is showed in Figore.9. Caching mechanism in streaming is left to android operating system. Default media player on android automatically streams media files.

3.5. Social Media Integration

The Application has a background service named "checkFemtoConnection". This service checks if device is connected to femtocell network continuously. It can determine whether connected to the network using network name. Device compares Femtocell's network name and defined network name in application to do that. If names does not match, it means that mobile device is not in home or office. Flow diagram is showed in figure 10. To be able to determine if device left home or arrived home, a status flag shall be kept in application.

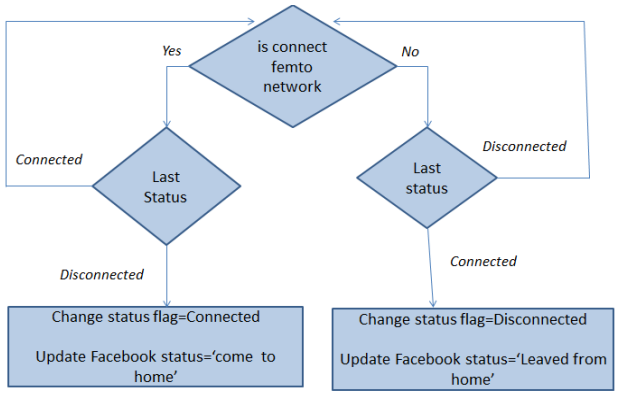


Figure 10. Social media integration algorithm's flow chart

Default value of the flag is disconnected. Every time "checkFemtoConnection" sets this flag every time it works. Any component in application checks this flag for determining connectivity status. If the value of the flag changes to connected, it means mobile device arrived home/office. With this information, application posts a status on facebook and twitter. If value flag changes to disconnected, that means mobile device left home/office. The application also may post a status on facebook and twitter about this event.

4. Optimization

At the developed application, file is transferred as chunks. While the partition off file, optimum chunk size should be selected. For optimum chunk size some tests result shown figure 11. For 100 MB file size, different sizes of chunks were calculated for transfer time. Chunks size is set 512 KB, 1 MB, 5MB, and 20 MB. As seen figure 11, Decreases the size ofparts increases transfer time. If the chunks size is very large, Transfer can be interrupted and also can exceed the memory capacity of the mobile device.

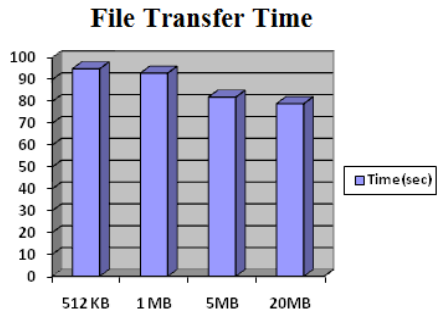


Figure 11. File Size-Time Test Results

Application get an error over 50 MB file size with the test of HTC Evo2 and Error message is " java.lang.OutOfMemoryError": (Heap Size=6627KB, Allocated=4665KB)".

5. Conclusions and Future Work

In this study, media sharing application for mobile devices and social media integration was carried out. For this media sharing application, a server application has been developed which is running at home pc. Through this implementation, mobile client devices can synchronize and share files and watch videos. Server application is tested on Windows, Mac and Linux operating systems. With the help of unit tests, all services are tested. Also testers confirmed these results.

Two client applications have been developed for the Android and iOS operating systems. Users can use this application who has Femto device and android or iOS mobile device. iOS and Android operating systems are structurally different. IOS client application does not have back ground services because of security policy of Apple. Automatic status updates on Facebook and Twitter can be made when user came home or left home. User can automatically back up files on mobile device to home server, can download files on the computer and mobile device and watch or listen multimedia files without downloading with the help of streaming.

With the help of this application, we aim to increase widespread of using Femto devices. Furthermore, actual performance and reliability data can be obtained with this work. This data can be used for which parameters can be optimized for Femto applications.

6. Acknowledgment

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