Large-Storage Mobile Phones: New Devices Offering a New Application Domain

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Abstract - It is projected that mobile phones with a large storage (at least a few Giga bytes) will be widely available in the market in a few years. This kind of phone has its own characteristics and hence creates a new application domain. This article reviews some potential applications that fit into this domain and discusses the challenges involved in their implementation, thereby providing insights to developers, network operators, and end users.

Key-Words: Mobile devices, large storage, mobile application

1. Introduction

There are different types of portable devices on the market:

- Portable Media Players (PMPs)
- Personal Digital Assistant (PDAs)
- Smartphones [1]
- Basic mobile phone

Although they have overlapping functions, each of them has its own characteristics and targeted customers, so that one can hardly completely replace with another. For example, PMPs focus on the entertainment domain and provide users with a larger storage, faster processor, and bigger screen size to play their multimedia files, whereas PDAs (even though they can also be used to play multimedia files) focus on enterprise domain by providing a mobile operating system. On that operating system, programmers can design various kinds of applications for general or business use, including agendas, memos, and even the full set of office tools to work with documents, presentations, and spreadsheets. On the other hand, smartphones merge the functions of PDAs and simple mobile phones. Since the mobile network offers a channel for phones to connect to the Internet, it also allows smartphones to perform Internet-based applications, such as email, web surfing, and instant messaging. Meanwhile, simple mobile phones are desired for users who only need a basic telephone service, and so do not offer an overly exciting or sophisticated functions, which allows a smaller and lighter form factor.

There are large storage multimedia players on the market. However, when the players are integrated into a phone, there is usually 64-512MB memory built-in. For example, the Apple’s iPod [2], one of the most popular portable music player today, has a 2-40GB capacity, whereas the Motorola ROKR E1 [3], the first cell phone compatible with Apple's iTunes Music jukebox, comes bundled with a 512MB memory only. On the other hand, a few years ago, Palm launched.

Similarly, there are large-storage PDAs. For example, Palm’s LifeDrive [4], the first large-storage PDA, was launched a few years ago contains a 4GB capacity. However, when a PDA is integrated into a phone (i.e., a smartphone), it usually has only a 64-512MB memory built-in. For example, Palm’s popular smartphone, Centro [4], contains 64MB/128MB whereas the professional model, Treo Pro [4], contains 256MB/512MB.

It is projected that, in a few years, cell phones with large storage capacity, which I shall term large-storage phones, would become widely available on the market. Large-storage phones can appear in the form of smartphones or basic cell phones. This high capacity can be provided by using a small form factor hard disk or flash memory.

The above projection is based on the continuous advances in disk technology. In the first quarter of 2009, the SD Association released
the next-generation memory card format, SD eXtended Capacity (SDXC), which provides up to 2 terabytes capacity and read/write speeds of 300 megabytes per second. On the other hand, the increasing amount of personal digital content also give incentives to the development of the large-storage phones that allow users to carry part of them on the way.

Large-storage phones have the following characteristics:
1. A large storage capacity (at least a few Giga bytes)
2. Attached to a mobile network that can connect to the Internet
3. Come with built-in headphones and microphone.
4. A smaller size and lower processing power than a PDA.

These characteristics create a new application domain for large-disk phones, providing a wide range of new applications for making more productive or more fun.

Although some mobile phones in the market are already equipped with large storage, they provide no special applications other than an ordinary smartphone, the large storage are mainly for storing songs and pictures. On the other hand, although Apple’s iPhone provides large storage and an application store for users to download various kinds of new applications, the applications are mostly simple and small, which do not make best use of the large storage.

In this article, we review a few possible applications which fit into the application domain of large-storage phones. Furthermore, we also discuss the challenges and the exclusiveness of the proposed applications. In the following text, to simplify the description, we refer to large storage as a 4GB capacity because it provides a very good balance between capacity and manageability based on today’s disk technology.

2. Telephone Directories

If a telephone entry takes 100Bytes (including the phone number, name, and address, etc), a phone with a 4GB capacity can store up to 40,000,000 entries, which is sufficient to store all the telephone numbers in a small city. One surely would not need such a capacity to store the phone numbers of one’s friends. However, it would be useful and helpful if the entire Yellow Pages or other kinds of telephone directories, featuring business names and telephone numbers organized by product or the category of service, could be stored on a mobile phone. Large-storage phones can achieve this purpose.

Telephone directories can be categorized in terms of various topics. For example, if it is arranged according to cuisine, one could access the information of restaurants in a city such as name, location, and type of food. With this information, you can discover the nearby restaurants that provide the type of food you want using your large-storage phone, which is available at touch of a few buttons. And, of course, you can make a phone call to reserve a table right after the search results have been found.

2.1 Discussion

There are two issues to be considered in this application. The first is that, considering the limited processing power of mobile devices, the searching time is long if the directory is large. This can be solved by using a number of (or even many) database indexes. Database indexes take storage space and hence they are not commonly seen in ordinary portable devices.

The another issue is the synchronization problem. The regular updating of directory records requires the phone to occasionally connect to the server which maintains the directory (it can be done via a desktop computer connecting to the Internet).

This application relies on a large storage and telephone service (for making a call right after having the search result). On the other hand, it does not require a large screen as it mainly shows the textual content. These three characteristics make this application exclusive to large-storage phones (i.e., less suitable to other devices).

3. Offline Web Sites

About a decade ago, when PDAs started to become popular, people used software like AvantGo to convert ordinary web pages to text-based pages and to store these in PDAs for offline browsing purposes. People did that because the early PDAs did not provide Internet connectivity. Today, many mobile devices such as cell phones and PDAs, can connect to the Internet...
through mobile services, such as GPRS and 3G. However, the price of that is still high for many people.

With a high capacity disk, large-storage phones could store the essential content of a Web site. Users can read the off-line content any time with their phones, and connect to the origin servers when the critical links are clicked (e.g., to perform online transactions or to retrieve the latest web pages). For example, large-storage phones can store the Web content of a bookstore such as Amazon and BarnesandNoble. Users can check the information of books such as prices, descriptions, and reviewer’s comments with their large-storage phone. When they found the books they wanted to buy, they can click the link on the mobile screen or press a few buttons on the phone to connect to the origin Web site to carry on the purchase transaction. This solution provides shorter user-perceived latency and minimal mobile data fees, encouraging people to engage in more mobile commerce.

3.1 Discussion

Since mobile phones have a limited size of screen, the offline content should be different from the one shown online, with a much simpler page layout. Therefore, a software tool has to be written to convert the online content to be small-screen friendly.

Furthermore, the offline content has to be synchronized to the online web sites regularly. Therefore, it is better to offline those web sites providing information that will be valid for a longer time. Such web sites include online libraries, bookshops, and encyclopedias (offline wikipedia is feasible!).

This application exclusively applies to large-storage phones. Although hard-disk based PDAs can store offline content, it is uncommon for them to come with Internet connectivity. Likewise, smartphones provide web browser and Internet connectivity, but they do not have a large storage; it also charges a lot to use them to do online web surfing. Large-storage phones could store most of the Web content, and connect to the origin servers only when the critical links are accessed. This both shortens user-perceived latency and saves the mobile data fee.

4. Location-Based Services

Besides mobile communications, mobile networks (e.g., GSM) could also provide positioning services. Based on triangulation of the signal from cell sites (base stations) serving a mobile phone, the location of that phone can be identified with an adequate accuracy level. Hence, network operators could provide various kinds of Location Based Services (LBS) using this network-based positioning technology. For example, if users lose their way, they could use their mobile phones to send a request (possibly in the form of Short Message Service) to the server operated by the network operator asking “Where am I?” The server can then send back a Multimedia Messaging Service (MMS) image map showing their location. Similarly, the system could provide the locations of different kind of service points, such as pharmacies, gas stations, or banks. Users could request the server to send them the service points nearest them and display their locations on a map on the mobile phone screen.

As can be seen, these kinds of services rely on the mobile phone having a map feature. Although, the system can send the map to the mobile on demand via MMS, this approach is not flexible. First, a MMS only covers a small readable area. If a user wants to read outside the current viewing area, he/she has to retrieve another MMS from the server. Likewise, any zoom-in and zoom-out of the map will require another retrieval. This not only causes high latency but also a high mobile data fee.

A large-storage phone storing entire maps could solve the problem. In this case, the zoom-in, zoom-out, and shifting of the currently viewed map can be done on the phone itself. The phone and the server only focus on the passing of messages. For example, after the client sends the question “Where am I?” to the server, the server could simply reply the client with its location in term of x and y coordinates. Based on these values, the mobile phone could display the predefined map for the user. Doing this not only saves bandwidth but also allows the map application to be more versatile. For example, by simply clicking a few buttons, the map could optionally show one particular type of service point such as a pharmacy, gas station, and hospital, or all of them at the same time. Showing such information does not require contacting the
mobile system or other servers, because the information and related images are already stored in the phone.

4.1 Discussion

This application requires a number of components: 1) the calculation of the location of mobile devices (based on signal strength), 2) the communication protocol between mobile devices and the server maintained by the network operators, and 3) the software application which runs in the large-storage phones and displays the required maps with service points on the phone screen.

The high capacity of large-storage phones can store richer images to generate maps. Besides, as large-storage phones are attached to mobile networks, their locations can be identified using mobile-network-based positioning technology. These characteristics make this application exclusive to large-storage phones.

5. Peer-to-Peer File Sharing System

There are a number of peer-to-peer (P2P) file sharing networks for personal computers (PCs) connecting to the Internet. They include Napster, Gnutella, and BitTorrent. With these kinds of networks, each user (with a P2P client software installed) places the files (e.g., songs and pictures) he/she wants to share in a specified shared area or file directory maintained by the P2P client software. Then, those shared files could be found and downloaded by other people in the same P2P network (i.e., running the same P2P software).

Large-storage phones can form a new P2P network. Similarly, each large-storage phone has a shared area. Every thing inside the area can be shared. However, the network should be formed using a free or cheap connection channel, instead of using the Internet. It can be achieved by using Bluetooth, which most phones are equipped with. In this way, when the large-storage phones have detected (via Bluetooth) other phones running the same P2P software, they will connect to form a P2P network. After that, they could share files, with data transmission carried out via Bluetooth.

5.1 Discussion

Bluetooth transfers data at a rate of 721Kbps. For an average shared file of 3MB, it takes about 33sec to download the file from another phone. However, the transmission range of low-powered Bluetooth device is only 10 meters. This makes the sharing process only feasible in areas where people will meet together and will be stationary for sometime, such as in a restaurant, cafe, or on public transport. Therefore, the pool of total available shared files that can be seen at any one time is small. Nonetheless, due to the ad hoc nature of mobile users, one can always see new files in the shared pool.

Another challenge is that a new P2P communication protocol for large-storage phones has yet to be designed. This protocol should be simpler because it only needs to handle the transmission of small files, but it has to handle the mobility issues of mobile ad hoc networks (using cell phones).

This application requires a large storage to store shared files as well as a communication channel to communicate with other devices. These are two of the characteristics of large-storage phones.

6. Games

Games on mobile phones are not new, but phones with a large storage could enhance the user experience and even change the ways the games publishers sell games.

A few years ago, Nokia launched the cell phone called N-Gage [5]. The phone is actually a mobile game deck allowing users to play high quality games on it. The Nokia’s N-Gage itself provides only 4MB internal memory, which is not for storing games. The games are stored on game cards (using the MultiMediaCard standard) and have to be sold separately. Game publishers produce their game titles on game cards, and these cards are available in retail stores. One game card corresponds to one game title. Users who would like to change games ‘on the road’ have to have different game cards.

Large-storage phones, which could store many games, provide a number of advantages over the game card distribution model: 1) more convenient, 2) richer game content, and 3) cheaper games. With many games ready in the phones, users could pick any one of the games to play anytime with a few clicks on the phone, without the need to carry a number of game cards.
On the other hand, since small form factor hard disks generally provide much larger memory space than memory cards, it allows the game publishers to use richer graphics, enhanced sound, and more extensive game worlds in which to play. Finally, users could download games using a computer connecting to the server which provides the games, then upload it to their phones using fixed lines such as a USB cable. This way of game distribution could be much cheaper than that of selling game cards in retail stores.

6.1 Discussion

The large-storage phones usually use disk-based storage. One disadvantage of disks is higher access latency. To improve the gaming experience, the phones should provide more internal cache memory to store the transient and run-time data.

Although gaming can occur on other devices, such as PDAs or even PMPs, if large-storage phones (or mobile phones) have a connection to the Internet through the mobile networks, they can connect to the game server for further support (such as listing the players with highest scores).

8 Conclusion

Considering large-storage phones will be widely available in the market in a couple of years, and that a new application domain will be produced, this article proposes some potential applications that are fit for the domain. Table 1 summarizes our proposals based on feasibility, popularity and exclusiveness. The level of feasibility is based on the complexity, difficulty and components of involvement. For example, the location-based service requires the software and hardware as well as the mobile devices and mobile stations, to be cooperated together. This is definitely more complex than the application of telephone directories that merely requires a database. On the other hand, the level of popularity is based on the expected number of people using it. In general, people would prefer the center of multimedia to the peer-to-peer file sharing system. Finally, exclusiveness is based on the level the application exclusive to large-storage phones. Therefore, the application of telephone directories requiring both large storage and telephone communications has a higher exclusiveness than that of a multimedia center, which mainly requires a large storage.

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<thead>
<tr>
<th>Application</th>
<th>Feasibility</th>
<th>Popularity</th>
<th>Exclusiveness</th>
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<tbody>
<tr>
<td>Telephone Directories</td>
<td>High</td>
<td>High</td>
<td>High</td>
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<tr>
<td>Offline Text-Based Web Sites</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Location-Based Services</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
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<tr>
<td>Peer-to-Peer File Sharing System</td>
<td>Low</td>
<td>Low</td>
<td>Medium</td>
</tr>
<tr>
<td>Games</td>
<td>Medium</td>
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Table 1. Summary of potential applications for large-storage phones.

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Reference: