

Chapter 13

Essential Technologies for Location-Aware Mobile, Online Map Prefetching, and Caching

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ABSTRACT

Map navigation is one of the most popular applications used by mobile users. At the same time, it is also one of the time- and resource-consuming applications. Various methods such as most-recently used and first-in, first-out algorithms are used to reduce the map transmission time and delay. One of the popular methods is online mobile map prefetching and caching. However, the mobility and location features of mobile users are usually left out by these methods. Caching and prefetching maps based on a mobile user's location would greatly reduce the transmission time and hence the battery power consumption. For example, if a user is visiting a town, prefetching the maps of nearby interesting stores and caching the maps of the visited, neighboring landmarks would help the user's visitation experience and save the transmission time. Online mobile map prefetching or caching is useful, but is not widely employed because it involves several different subjects and developers usually are not familiar with all of them. This chapter intends to relieve the problem by introducing essential technologies for online mobile map prefetching and caching so more developers can start working on this kind of project or research. It consists of four themes: (1) green handheld computing, (2) location-based services and programming, (3) map tile system, and (4) location-aware map prefetching and caching methods. A summary is given at the end of this chapter.

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INTRODUCTION

The number of smartphones shipped worldwide has surpassed the number of PCs and servers shipped in 2011 and the gap between them is expected to keep bigger. The emerging smartphones have created many kinds of applications that are not possible or inconvenient for PCs and servers, even notebooks. One of the best-seller applications is Location-Based Services (LBS) according to the following market research:

- Fleishman Hillard (2012, February 6) reports 80% of smartphone owners have location-based services and half of them use services that provide offers, promotions, and sales based on their current locations.
- The most convenient mobile shopping experience is price comparison and product research according to JiWire (2011, October 14).
- The number of location-based services users was increased from 12.3 million in 2009 to 33.2 million in 2010 (170% increase) in the US based on SNL Kagan (Cohen, 2011, January 20).

Map navigation is a critical function for most location-based services and is one of the most popular applications used by mobile users.

Despite the bright future of smartphones, they are not without problems, especially the short battery life. To save the transmission time and reduce the delay, mobile map navigation caches or prefetches maps by using various methods such as most-recently used and first-in, first-out algorithms. However, the mobility and location features of mobile users are usually left out by these methods. Caching and pre-fetching maps based on a mobile user's locations would greatly reduce the transmission time and hence the battery power consumption. For example, if a user

is visiting a town, prefetching the maps of nearby interesting stores and caching the maps of the visited, neighboring landmarks would enhance the user's visitation experience and save the transmission time. On the other hand, though map-related mobile applications are popular, the details of their design and implementation are still not known to most developers. This chapter tries to relieve the problem by explaining the map-related application design and implementation, especially map prefetching and caching, from a developer perspective. It studies the four themes of map-related application design and implementation: (1) green handheld computing, (2) location-based services and programming, (3) map tile system, and (4) location-aware map prefetching and caching methods.

This chapter studies the essential technologies for mobile, online map prefetching and caching. The rest of this chapter is organized as follows. Section 2 introduces green handheld computing, which is the foundation of map prefetching and caching. Location-based services and programming are explained in Section 3, where a simple Android application development is given. Map prefetching and caching are closely related to map structure, which is studied in Section 4. Various methods of map prefetching and caching are given in Section 5. The final section summarizes this study.

GREEN HANDHELD COMPUTING

Green computing is the practice of designing, manufacturing, using, and disposing of computers, servers, and associated subsystems for reducing the use of hazardous materials, maximizing energy efficiency, and promoting the recyclability or biodegradability of products. This section discusses the green computing using mobile handheld devices.

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