

Mobile Hunters

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INTRODUCTION

Growing Internet mobility due to various transmission methods such as broadband data transmission get mobile service providers interested in providing services that offer more than voice telephony. Modern cellular phones support general packet radio service (GPRS) have a color display and are usually Java-compliant. This meets the device's requirements for context-based services. As global system for mobile communications (GSM)-based cellular phones are widely used and, at least in Europe, the GSM-network is available almost everywhere, the context variable "location" seems useful for extending the relevant value-added services (Rao & Minakakis, 2003, p. 61). For example, there are services for finding friends in the vicinity (Buddy Alert by MobiloCo, www.mobilocode.de) and mobile navigation systems for cellular phones (NaviGate by T-Mobile, www.t-mobile.de/navigate). But there has not yet been a real breakthrough for location-based services (LBSs) (Lonthoff & Ortner, 2006).

Supported by T-Systems International, we developed the adventure game "Mobile Hunters." The game demonstrates what is possible with LBS and uses the currently available infrastructure mobile network providers offer for creating a virtual playing field. This playing field will be adapted to the real world. The object of the game is a hunt. Players can either be a hunter who must find a fugitive or a fugitive who has to make sure he is not getting caught. Of course, this hunt will become eventful as there are a variety of obstacles. Playing a so-called mobile location-based game (MLBG) could increase the acceptance of further LBSs.

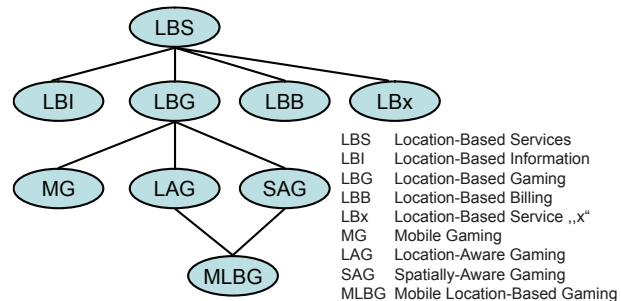
This article will first summarize the current state of research in this field and then present *mobile location-based gaming*. Then the reader will get to know the game "Mobile Hunters." After that, we will discuss the lessons learned from the game, and possible further developments will be considered. At the end of this, we draw a short conclusion.

BACKGROUND

MLBGs are a special category of location-based games, as follows:

A MLBG is a location-based game running on a mobile device. By using a communication channel the game exchanges

Figure 1. Taxonomy for location-based services



information with a game server or other players. (Lonthoff & Ortner, 2006)

Applying this definition, the fields *location-aware games* and *spatially aware games* become relevant. Figure 1 shows all terms relevant in MLBG.

Location-Based Services

The added value of mobile services opens up opportunities for service providers to address a new dimension of the user: the user's spatiotemporal position. Such services are called location-based services. LBSs are based on a variety of localization methods for determining a user's position. In the field of so-called *context-aware computing* (Schilit, Adams, & Want, 1994, p. 85), LBSs provide location information as context references (Dey, 2001). There are many possibilities of using the location reference in an application system (Unni & Harmon, 2003, p. 417; Schiller & Voisard, 2004). All of these services are based on mobile positioning. Mobile positioning comprises all technologies for determining the location of mobile devices. A position can be determined in two different ways: using network-based technology (the network provides the position) or using terminal-based technology (the device provides the position).

Network-Based Positioning Technologies

GSM-networks offer basically six different methods of network-based localization (Röttger-Gerigk, 2002). Cell of

origin (COO) is the simplest mobile positioning technique. It identifies the cell (cell ID) in which a cellular phone is logged on. The cell ID is connected with the radiation range of a mobile base station. The cellular coverage area has a certain range around the position of the mobile base station. One mobile base station can have several radiation areas (cell IDs), whereby these cells always refer to the same geographic position of the mobile base station's location (Hansmann, Merk, Nicklous, & Stober, 2001, p. 243). The positioning accuracy that can be achieved depends on the size of the cellular coverage area; it may range between 25 m and 35 km in diameter. In addition, there are more complex techniques such as angle of arrival (AOA), time of arrival (TOA), time difference of arrival (TDOA), signal attenuation (SA), and the radiocamera system.

Terminal-Based Positioning Technologies

Cell of origin can also be considered a terminal-based technique, as the desired cell ID can be read out directly from the device (terminal). To do this, however, a reference database is needed that contains the geographic coordinates stored for each cell ID. The following further terminal-based techniques are available: enhanced observed time difference (E-OTD), as well as the satellite-based systems such as the global positioning system (GPS), or assisted-GPS (A-GPS), which works without modifications to the cellular phone network infrastructure, except that the mobile device must possess a GPS receiver.

Gaming

Mobile games for cellular phones are currently experiencing a growing demand. There is a trend towards more complicated 3D games. This trend is supported by the current hardware development that is the availability of high-performance cellular phones or smart phones, respectively. Games that allow direct communication with remote participants are of great interest (multi-player games). Multi-player games on offer can be played using a wireless application protocol (WAP) portal or locally by two people (infrared) or by several players (Bluetooth).

Games for personal digital assistants (PDAs) are also very interesting. Such games are usually intended for one player. But games for several players become possible, if infrared, Bluetooth, or wireless local area network (WLAN) are used.

In location-based games the movements of a player (in the sense of a geographical change of location) influence the game. Nicklas, Pfisterer, and Mitschang (2001, pp. 61-62) suggest a classification of location-based games into mobile games, location-aware games, and spatially aware games.

Mobile games require as a location reference only one more player who is in the vicinity. The location information itself is not considered in the game. A typical example of this kind of game is Snake, a game of dexterity for two delivered with the older Nokia cellular phone models that can be played using infrared or Bluetooth. Location-aware games include information about the location of a player in the game. A typical example would be a treasure quest whereby a player must reach a particular location. Spatially aware games adapt a real-world environment to the game. This creates a connection between the real world and the virtual world. The MLB "Mobile Hunters" presented in the following belongs to this category of games.

CHARACTERISTICS AND CHALLENGES OF MLB

Important for MLB are the type of device used, the communication and network infrastructure it is based on, the way positions are determined, and the kind of game.

Devices such as cellular phones, smart phones, and PDAs can be used, possibly laptop also. In addition to this rough classification, the device properties can serve for further distinction: the operating system, client programming (Java virtual machine, Web-client/WAP-client), the types of available user interfaces, as well as battery life and processor power.

The relevant communication media are wide area networks such as WLAN, GSM, and universal mobile telecommunication system (UMTS). These technologies vary in range and bandwidth. The accuracy of a determined position depends on the technique used and on the network structure.

When looking at the type of game, two dimensions are of interest: the number of players and the type of game. There are single-player games and multi-player games. You can also play multi-player games alone, if players are simulated. Massive-multi-player games are a special type of game in which the end of the game is not defined. Players can actively participate in the game for some time and improve their ranking in the community associated with the game. Relevant genres of game would be role-playing games, scouting games, real-time strategy games, and first-person-shooter games.

Users can find a variety of game collections on the Internet that include MLBs. For example:

- www.smartmobs.com/archive/2004/12/28/location-based_.html
- www.we-make-money-not-art.com/archives/001653.php
- www.in-duce.net/archives/locationbased_mobile_phone_games.php

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