

## Mobile information systems for avalanche topics

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**ABSTRACT:** Modern mobile phones with integrated GPS and internet access offer the possibility of exchanging data at any time and everywhere. So called location-based services (LBS) can also be used in the range of avalanche prevention and information. In the context of the project mAvalanche, the WSL Institute for Snow and Avalanche Research SLF examines the possible benefits of LBS. This paper gives an overview of the different approaches to provide LBS for avalanche topics and describes the experiences the SLF has had with mobile devices so far.

**KEYWORDS:** mobile information system, avalanche education, mLearning, avalanche information

### 1 INTRODUCTION

An increasing number of modern mobile phones provide easy access to Information from the Internet. Often these phones have GPS integrated. Thus, it is possible to exchange data everywhere and anytime with respect to position.

Virrantaus et al. (2001) define so-called LBS (location-based services) as “information services accessible with mobile devices through the mobile network and utilizing the ability to make use of the location of the mobile device.” LBS lie on the interface of three technologies: Geographical Information Systems (GIS), Internet and mobile devices (Figure 1).

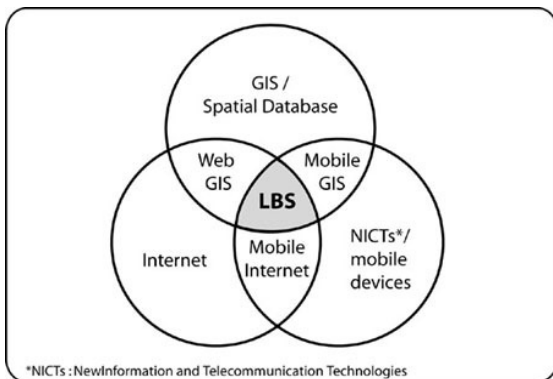


Figure 1. LBS as an intersection of technologies (Brimicombe 2002)

For mountaineers, information about current weather and snow conditions can be important for the decision making process. Thus, LBS can be a useful technology for avalanche topics. For example an avalanche LBS could provide easy access to current avalanche bulletins (Steiniger et al. 2006).

However, this new technology has a lot more potential. It is even possible to collect data in the field and send it back to the avalanche institute. For example users feed their observa-

tions into the system, plot avalanches on a map or enter feedback about the current conditions.

The WSL Institute for Snow and Avalanche Research SLF develops for several years applications for mobile devices. This paper gives an overview of the different approaches to provide LBS for avalanche topics and describes the experiences the SLF has had with mobile devices so far.

### 2 UNIDIRECTIONAL INFORMATION EXCHANGE

Traditionally, the information exchange about the current avalanche danger level is unidirectional. This means the avalanche centre provides the information through different channels, like Internet, telephone or fax. The mountaineer has to get the information by himself. Mobile devices represent a new channel for consuming avalanche bulletins and other information about current conditions. Below we list three different ways of communicating data to the user with mobile devices.

#### 2.1 SMS / MMS

Especially in Europe, the Short Message System (SMS) has become an important communication medium. Although there is a limitation of only 160 characters per message, SMS is widely spread. To put all important information about the current avalanche condition into an SMS is a major challenge (Nairz 2009). Anyhow, the technology is useful for avalanche warning because every mobile phone is capable of sending and receiving SMS. It provides another big advantage: it is possible to subscribe to SMS services. Every time a new avalanche bulletin is created, the user receives automatically a SMS with the newest information. So-called “Push-services” are provided for example by the Austrian avalanche service from Tirol and Vorarlberg (<http://www.lawinen.at>).

The successor of SMS, MMS (Multimedia Message) makes it possible to send multimedia

content such as images, sounds and longer text. Push-services are possible too. Since 2007 the SLF offers the possibility to get the danger map and the avalanche bulletin text via MMS. All you have to do is writing a keyword with an SMS to a specific number.

## 2.2 WAP

The Wireless Access Protocol (WAP) allows users since the middle of the 1990's to bring Internet content to their mobile phones. Since 2002 the SLF provides the avalanche bulletin with the danger map and some values of automatic weather and snow measurement stations in special WAP websites. The danger map is scaled down in consideration of the small screen size on mobile phones.

## 2.3 Clients for mobile phones

Neither SMS nor WAP are full LBS because they do not use the geographical position. For accessing the GPS processor, specialised programs for the different mobile phones and operating systems have to be developed. Thus, for example the Utah Avalanche Centre has developed an application for iPhones. This application doesn't work on other mobile phones. This program allows the user to read the avalanche bulletin with only two clicks on the phone, which is a very comfortable solution.

The avalanche centre Tirol, Austria, offers a Java client which is working on a large range of different mobile phones. With this client it is possible to access the avalanche bulletin and graphs and even some values from automatic measurement stations.

## 3 BIDIRECTIONAL INFORMATION EXCHANGE

LBS not only allow to retrieve information, but also to transmit information. Data are entered directly in the mobile phone and sent via Internet to a server. The SLF developed an application called mAvalanche for the winter 2008/09, with which mountain guides sent their observations from the field to the SLF (Suter et al. 2009). Other avalanche centres developed or are going to develop such projects in the near future. In the following we only report on the experiences the SLF made with mAvalanche.

### 3.1 mAvalanche for mountain guides

On-site observations from people in the field help to improve the quality of the avalanche bulletin. Up to now, the SLF used online questionnaires to get this kind of information, including characterizations of snow conditions, avalanche observations and estimations of the avalanche

danger. Mountain guides are able to collect particularly high-quality information. However, their observations reach the SLF often too late.

The SLF addresses this problem with the project mAvalanche. mAvalanche provides software for advanced mobile phones which allows mountain guides to enter their observations directly in the field and transmit it on the fly through Internet to the SLF. The integrated GPS automatically detects the current position and provides the avalanche forecasters with the exact coordinates of the observation. Furthermore, avalanche paths can be mapped on the 1:25000 map of Switzerland that is locally saved on the device (Figure 2).



Figure 2. With mAvalanche mountain guides can map avalanche paths and send their observations.

Mountain guides benefit from mAvalanche by getting access to local weather forecasts, data from automatic weather stations and the avalanche bulletin. Additionally, the integrated GPS allows them to check their current position at any time on the 1:25000 map.

During winter 2008/09 mAvalanche was successfully tested with ten mountain guides. Each guide made on average 38 observations containing useful information from the field. The mountain guides helped with a lot of feedback to continuously improve the software. At the end of the test phase, in the end of May, we collected all opinions with a questionnaire. The strongest point of criticism was the cell phone. Both the battery capacity and the usability of the Windows Mobile operating system was a big problem for the users. For tours lasting several days they had to use another cell phone because the battery was down after one day. However, the application itself was very easy to handle and all mountain guides would like to work next year with mAvalanche again. Sometimes it was not

possible to enter all the relevant data into the form. The form was too static; a general comment field was missing.

The avalanche forecasters used a special web application for accessing the data. The reports from the mountain guides were very useful to them, particularly for documenting the decrease from the danger level considerable to moderate, which is the main range for back-country and off-pistes skiers. Because the mountain guides avoided trips in areas with danger level above considerable, the avalanche forecasters did not get information on high and very high avalanche danger with mAvalanche.

For the following winter mAvalanche will be developed further and new mobile phones will be tested. With more test users we hope for a bigger observation density.

#### 4 MOBILE DEVICES FOR AVALANCHE EDUCATION

Avalanche education - in the form of books, classroom-based exercises and courses in terrain - attempts to introduce the key factors in avalanche release. Since 2006 a further possibility for self-learning in the form of the CDROM "White Risk" has been made available by the SLF (Harvey 2006). However, a key difficulty remains in translating learning from theory to practise in the real environment.

So-called "mobile Learning" (mLearning) is suggested by Okamoto et al. (2001) as being a possible means of bridging this gap between theory and practice, through the delivery of learning materials to a user who is in a realistic learning environment on a mobile phone or Personal Digital Assistant (PDA). Here we describe a location-based system for avalanche education, whose aim is to teach methods relevant to the estimation of avalanche risk in avalanche terrain.

##### 4.1 mAvalanche for avalanche education

mAvalanche for avalanche education explains some avalanche factors like slope with text, images and movies (Suter 2007). The user learns the theory and afterwards tests it with playful exercises. For example one exercise is realised for slope inclination. The learner's estimation can be compared with values retrieved from GPS-position and digital terrain model. In principle, such exercises where the learner has an opportunity to self-test, should lead to a significantly improved understanding of the underlying concepts.

Another implemented exercise is the "Pattern Analyser". It helps learners to assess the actual avalanche situation correctly and focus on the main avalanche problem. The user has to

estimate some parameters like the amount of new snow in 24 hours or recent snow drifting. The Pattern Analyser shows graphically how severe the actual avalanche problem (pattern) is. For each parameter a interactive help with multimedia content is accessible. Some parameters include a separate wizard, which helps to get the correct value by answering some questions.

The Pattern Analyser should not answer the question "is it safe to go?" Rather it should be a powerful learning tool and should sensitise the learner to collect the really important facts for estimating the risk of avalanches (Figure 4).



Figure 3. White Risk Mobile enables access to snow and weather measure stations.

#### 5 WHITE RISK MOBILE

With „White Risk Mobile“, the SLF tries to combine the different approaches for information exchange. This iPhone application is downloadable in the beginning of winter 2009/10. On the one hand it is a mobile client for "one click" access to the avalanche bulletins (see chapter 2.3). With GPS the current position of the user will be displayed on the danger map. Addition-

ally the current values of snow and wind measurement stations are accessible. On the other hand it is possible to send observations, like snow consistency, amount of new snow or the impact of the wind to the SLF (see chapter 3.1). For the mLearning part the "Pattern Analyser" is implemented and movies, text and images help to understand the complex connections between different avalanche forming factors (see chapter 4.1).



Figure 4. The Pattern Analyser helps to understand the complex connections between different avalanche forming factors.

## 6 SUMMARY AND OUTLOOK

Modern mobile phones with integrated GPS and access to Internet belong more and more to standard alpine equipment. For avalanche forecasting services this enables new possibilities for informing mountaineers about the current danger level. With SMS, Internet or mobile clients, avalanche warning products can be displayed in a user friendly way. Additionally, data can be entered by the users in the field and sent back to the avalanche centres. The project mAvalanche demonstrated that this information

is a massive surplus for avalanche forecasters. In addition, mobile devices can be used for avalanche education with mLearning.

From winter 2009/10, the iPhone application "White Risk Mobile" provides access to avalanche information, measurement station values and implements a learning environment. It allows entering field observations and sending them to the SLF. This application tries to combine all different approaches for information exchange in avalanche topics.

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