PARAMOUNT
Public Safety & Commercial Info-Mobility Applications & Services in the Mountains

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BIOGRAPHIES

Erwin Löhnert received a diploma in Aerospace Engineering in 1993 from the Munich University of Technology. In 1994 he joined the Institute of Navigation and Geodesy of the University of the Bundeswehr Munich as a Research Associate, working mainly for aerogravimetry and GPS/INS integration. In 2000 he joined IfEN GmbH as a Project Manager for integrity determination. Since 2001 he is Head of the mobile applications division, managing ASTRON/VISPA and PARAMOUNT.

Elmar Wittmann received a diploma in surveying – major subject geodesy and satellite geodesy – in 2000 from the Munich University of Technology and then joined the IfEN GmbH, where he is now working as a project engineer in the field of GPS/Galileo satellite navigation and software development for mobile applications.

Jürgen Pielmeier studied Aerospace Engineering at the University of Technology in Berlin. He worked as a research associate at the Institute of Navigation and Geodesy and was mainly concerned with research in the field of GPS RAIM Availability. Since 1999 he is Managing Director of IfEN GmbH.

Florian Sayda got a diploma for geodesy and geoinformatics in 1999 and worked as project manager in the field of GIS application for energy service providers at ENSECO GmbH. He joined AGIS in 2001 as a Research Associate and since then is the AGIS project leader of ASTRON/VISPA.

ABSTRACT

In this paper a brief overview of the project 'Public Safety & Commercial Info Mobility Applications & Services in the Mountains' (PARAMOUNT) is given.

PARAMOUNT aims at improving user-friendly info-mobility services for mountaineers by combining telecommunications (GSM/GPRS, UMTS) and satellite navigation (GNSS) with geographic information systems (GIS), based on a Mobile Client / Server architecture.

The main objectives and the concept of the corresponding core services that will be developed ('INFOTOUR', 'SAFETOUR' and 'DATATOUR') are presented in the first part of the paper.

After that a description of the main tasks that have to be performed within the PARAMOUNT project is given.

Finally another related project (ASTRON/VISPA), which aims at demonstrating the feasibility of a server-connected digital tour guide for mountaineers, is briefly presented.

INTRODUCTION

Activities in the mountains like mountaineering, skiing, mountain-biking etc. can be regarded as one of the major sporting categories today. Annually, more than 150 million people of the European Union – sportsmen, nature enthusiasts or simply tourists – are searching for recreation in the mountainous region of the Alps and this holds also for millions of people in the Pyrenees area. Since most of these people are no experts, e.g. in reading maps or in judging their own condition nor the environmental/weather conditions, every year television and print media are full with headlines of distressed or even perished people in the mountains.

Great efforts have been undertaken or are currently under way to improve information and location/navigation capabilities and the safety of outdoor people. But usually the existing concepts do only cover certain aspects of an overall solution or service, which comprises an information function, communication function, positioning/ navigation function and safety function (in case of emergency).

PARAMOUNT now targets to extend those service options, offering the user an overall solution.

Integrated on Smartphone basis, the electronic TourGuide will assist the mountaineer in the position, orientation and navigation task visualised by 3D virtual reality, delivers environmental and additional information and helps in an emergency situation or even prevents it through its safety function. But not only distressed people will profit, also Search & Rescue (SAR) teams, equipped with PARAMOUNT Pocket-PCs will benefit, since they can precisely find the point of accident, receive information from the SAR control center and coordinate themselves using the communication function.

PARAMOUNT will develop three different kinds of services: The INFOTOUR service will support the user in dangerous situations by providing information on the terrain and various useful context specific hints. The SAFETOUR service will integrate other services like forest fire warnings and weather or avalanche forecasts and provides possibilities to track a user and alarm search-and-rescue teams (SAR), if necessary. These services are anticipated to lead to a considerable reduction of mountain accidents. Finally, the DATATOUR service will automatically capture data from willing users, e.g. hiking trails or severity of trails.

OBJECTIVES

A location based service (LBS) will be developed and set up, which integrates positioning, navigation, communication, coordination and information services with new components on integrated hardware and standardized interfaces to increase emergency respond efficiency in a mountainous environment. The planned activities aim on the goal to show that state-of-the-art technology can be used to establish user-friendly services, which lead to an enormous improvement of the safety of the more than 150 million people, which are going to the mountains of the Alps and Pyrenees regularly. Besides Geographic data and methods used in Geographic Information systems play a major role in this project. This project offers the opportunity to prove that GIS data and methods can be used to contribute to protect people's health and life. Most severe accidents (66%) happen with inexperienced hikers or skiers by overestimating themselves. Immediate help from outside in or just before an emergency situation will help to lower the total number of injured persons or fatalities. In the suggested project the help from outside will be provided in different ways.

The technological objectives driving this project can be summarised as following:

Providing a mobile user device seamlessly integrating Navigation and Communication with advanced user interface (multimedia) capability, e.g. coloured 'GIS'-enabled display and interactive MMI (man machine interface)

Testing 'Off-board'/'On-board' routing trade-off depending of availability of communication link in mountainous area

Making available ubiquitous access of mobile (mountainous) users to service portals using wireless Internet access (GPRS foreseen, later UMTS) providing localized and personalized data

Demonstrating access to different services ('always-on' connection to 'INFOTOUR' and 'SAFETOUR' services) at the same time from different users for different purposes

Developing web portal services providing easy access, possessing a clear and open architecture enabling 'scalability' according to increasing number of users and easy extension or adaptation to additional user requirements

Demonstrating easy deployment of services into public 'Tourist Information Centre' (for 'INFOTOUR' service) and 'Search And Rescue Centre' (for 'SAFETOUR' service)

Providing 'INFOTOUR' service contents at different dynamic levels:

- Long term data: 3-D Geographic Data (ways, height data…), Restaurants etc.
- Medium term data: Local (cultural) events …
- Short term data: Avalanche prediction, Weather forecasts
- Instant: 'Off-Board' routing

Providing 'SAFETOUR' service contents for different user levels:

- The usual mountaineer: Sending emergency call (incl. position) in case of emergency
- Mountaineer in critical environments: Registering at SAR centre when entering critical areas, periodic tracking information to SAR, give notice to SAR centre when leaving critical areas (enables tracking and enhanced awareness of SAR in critical areas)
- SAR service people: Routing SAR service people to distressed mountaineers (position known) and/or enable cooperation between different SAR ground/air teams to efficient search of distressed people (position unknown)
- SAR centre sends warnings (critical weather, avalanche … conditions) to registered user

Providing 'DATATOUR' service:

- Tracking willing users and logging the used route for further use
- Efficiently update the available trail network in the database and derive new trails from the logged data. This allows for reducing the maintenance costs of database necessary for all other services.

SAFETOUR targets one of the main goals of PARAMOUNT, i.e. to increase the security of outdoor activities in dangerous or emergency situations. All these technical objectives shall give feasibility of these services in the very 'demanding' mountainous environment. The mountainous areas are a challenge for service providers due to very high requirements in terms of:

- Availability and accuracy of GIS data (including height, small paths…!)
- Availability of service for users due to blocking of navigation and communication capability in this height varying environment (signal shading or reflection)
- Providing adequate service contents for the many different profiles of the mountainous users (mountain walking/climbing in summer, skiing in winter)

The acceptance of this service by the user will mainly be driven by the acceptance of an additional electronic outdoor device as well as the acceptance of 'service fees' for safety or info services.

SYSTEM/SERVICE DESCRIPTION

As it is shown in Figure 1 in a very simplified manner, the PARAMOUNT system is based on the interaction of mobile client (TourGuide) and server (service provider).

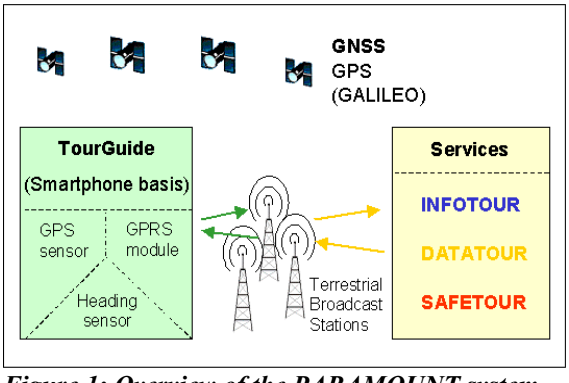

Figure 1: Overview of the PARAMOUNT system

The mobile client's position (from integrated GNSS sensor) and orientation (from integrated heading sensor) are the basic data for the navigation task. All further relevant information according to these data will be requested from the server resp. automatically provided by the server.

Basically the PARAMOUNT service can be classified into two fundamental segments :

Service Component :
The service component comprises the *Local Tourist Info Center* providing the INFOTOUR service and the *Local SAR Center* providing the SAFETOUR service. Both services access and process the GIS- and information data stored in a common database. The DATATOUR service as the third part of the service segment will provide currently updated data to this database.

User Component :
The user component is formed by the collectivity of the mobile clients.

The connection between these two components is established via Internet portals. Using the General Packet Radio Service (GPRS) for the Internet access the user can permanently stay connected to the server ('always online').

Based on the objectives as pointed out above different user communities will be connected with the PARAMOUNT service. In this project one user group are the private, leisure mountain hikers or bikers and the other group are the professional, highly skilled mountain search-and-rescue teams. Via the PARAMOUNT services, these two groups are connected more tightly and they are much more aware of each other. The user groups are not only linked between each other but also among the users within the groups. In that case help can be provided much faster and more efficient than in any other way. Figure 2 gives an overview of the user-/ service component and the relations between the different user groups.

For the establishment of the service, existing geographic databases can be integrated dynamically as long as their interfaces are based on international standards. Other data or service information can be embedded to the service by adapting their interfaces. It will be shown, that with an XML interface that uses ISO/TC 211 encoding standards and the OpenGIS Consortium (OGC) recommendation GML (Geographic Markup Language) new servers can easily be linked and used for other areas or new geodata servers of the same area of interest. In that case existing databases can be reused which increases the socio-economic value of geodata.

By integrating all kind of related information like weather forecast (automatic warning for locally severe weather

conditions like thunderstorms), avalanche warnings, environmental status (e.g. ozone concentration), forest fires, and local tourist information into the INFOTOUR and SAFETOUR services, it is not only possible to plan tours more effectively but also to give the user all the information right in the situation when he or she needs it most, i.e. on the tour, where no other way of communication is available. This will be shown during the evaluation process where experienced mountaineers are involved. With regard to this various information it also has to be investigated if these information is usable for the mountaineer. For example, the benefits of improving the existing avalanche prediction service in the Pyrenees can be demonstrated in terms of:

- the accuracy of the predictions (from regional to local level)
- the frequency of the prediction updates (from one day to a couple of hours)
- the on-line accessibility (from static Internet to mobile Internet access)

Capturing and updating geographic data in the mountains for a detailed product specification is too costly as to perform this task by single organisations.

Therefore all voluntary users who are registered to this service will provide a huge amount of data by just tracking their paths. This gives indication on rarely, frequently used (or even no more existing) trails. The possible paths can be treated by statistical methods to filter actually new paths from cross-country walkers or verify them to the existing trails in the database to perform necessary updates. The users are passive and contribute to the database just by moving in the designated area. This is a completely new way of capturing data, which can be extended for various other fields of applications. Within the project a procedure for this ambitious approach will be developed within the DATATOUR service.

Besides an interactive contribution of the users shall be realized in order to collect additional data like information on severity of trails as well as capturing points of interest (POI) resp. updating such existing information.

As this service will directly involve the users in the data acquisition and maintaining process which is a critical and security sensitive matter the DATATOUR activities will only be performed with registered PARAMOUNT users.

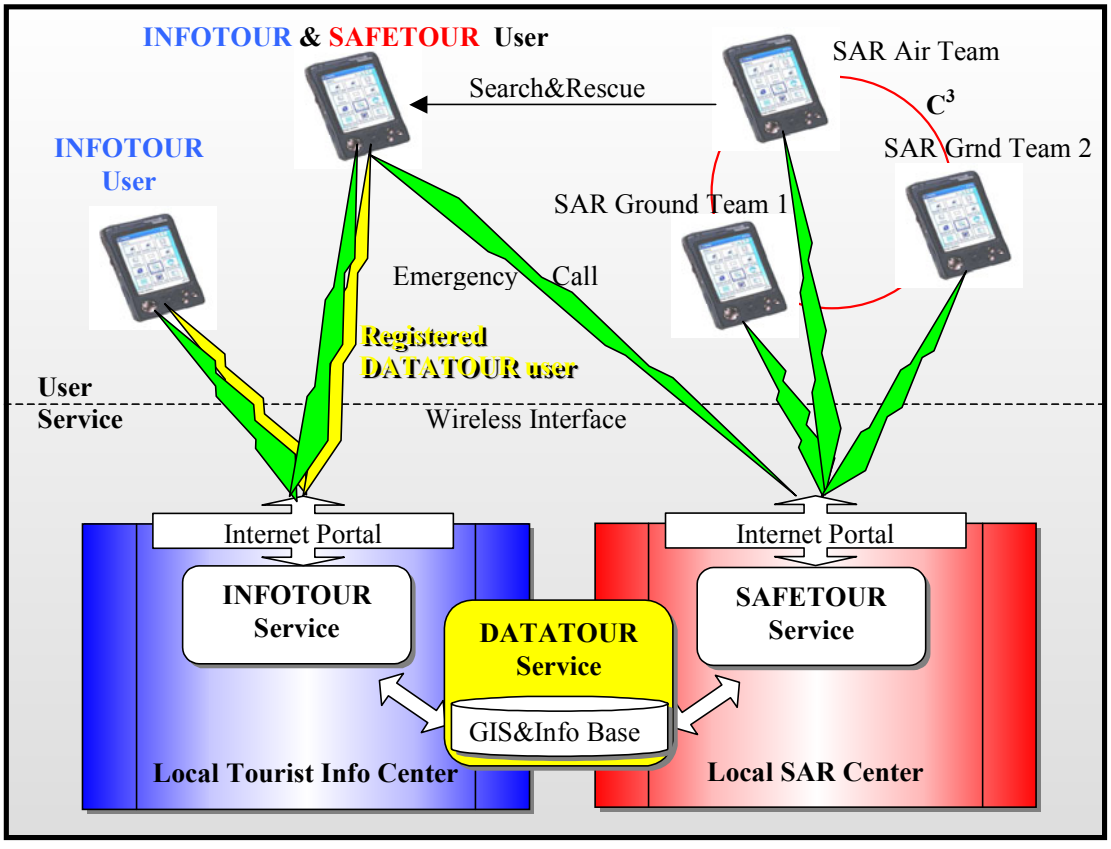

Figure 2: Operational Service Concept of PARAMOUNT

WORK SCOPE

The duration of the project will be 18 months.
The main phases of the PARAMOUNT development can be structured into the following work packages:

User Requirements & Service Feasibility
Starting point for the PARAMOUNT project will be the definition of the user requirements, which have to take into account that the project is designated for two different mountainous areas, namely the Pyrenees and Alps. The user requirements definition phase will be accompanied by investigations on the feasibility of the envisaged services and by analysing the availability of the three different components (G3), necessary to provide these services:

- GNSS (GPS, Galileo etc.) availability in the Pyrenees and Alps
- GMTS (GSM/GPRS, UMTS) availability in the Pyrenees and Alps
- GIS availability and usability in the Pyrenees and Alps.

The G3 analysis will generate various results, as for example a so-called G3 availability map (all G3 components simultaneously available), which will help to identify those regions in the mountains, where the test and demonstration of the PARAMOUNT system should be performed. These areas should be preferably used for the commercial exploitation of the services.

Service & System Design
The above-mentioned analysis will also provide information on the use cases, for which the overall service architecture has to be designed in the following service and system design phase of the project. During this phase, the three services INFOTOUR, SAFETOUR and DATATOUR will be defined and decomposed into the required components and modules. In addition, interfaces definition ISO and OGC specifications will be considered. An important task during this phase of the project is to make a trade-off between off-board and on-board navigation. Since there may be mountainous areas with no or only limited GMTS availability, a certain kind of autonomous navigation capability of the mobile client may be necessary in order to bridge GMTS service outage holes. Thus, the output of the trade-off may also affect the PARAMOUNT system architecture, which will be the final result of the service and system design phase.

System Development & Detailed Specification
The design task will be followed by the system development and detailed specification phase. This project phase undertakes the development of the INFOTOUR, SAFETOUR and DATATOUR server software and establishes the GIS database for the Pyrenees and Alps. The partners of the consortium have already data, which can be used directly or with minor extensions for the PARAMOUNT services. Those existing datasets will be integrated and related services from other providers linked. Another task to be done will be the client TourGuide hardware and software development. The phase ends with a completely integrated system, i.e. all hard- and software components required for PARAMOUNT will be integrated together, including linking of the TourGuide client to the service.

System Test & Evaluation
After the system has been integrated, it will be physically installed at the test sites in order to perform the in-depth testing and simulation.
The project will end with intensive field test and an evaluation phase, where potential users, especially search-and-rescue teams, are involved.

Dissemination & Exploitation
A successful project completion can immediately lead to a commercial exploitation of the PARAMOUNT service.

PROJECT PARTICIPANTS

The PARAMOUNT consortium includes 5 partners from Germany, Austria and Spain:

IfEN GmbH is a privately owned company, which is strongly involved in satellite navigation system studies related to GNSS including GNSS research and development. In recent time, IfEN GmbH is also engaged in mobile applications and LBS. IfEN GmbH will act as the project coordinator.

AGIS (Arbeitsgemeinschaft GIS) of the University of the Bundeswehr Munich is a study group focused on GIS.

ICC (Institut Cartografic de Catalunya, Barcelona, Spain) is an entity of public jurisdiction of the Generalitat de Catalunya and produces and distributes cartographic/geodetic data.

In order to take into account user and safety requirements, the following two organisations will also take part in the project: the **Bavarian Mountain SAR Service** and the **Austrian Mountain SAR Service**.

RELATED PROJECT 'ASTRON-VISPA'

At present a consortium of IfEN GmbH and AGIS is developing a demonstrator prototype for a mobile digital tourguide for mountaineers, named Virtual Sports Assistant (VISPA).

This Virtual Sports Assistant consists of a service provider (PINA server) and a mobile user component (client/TourGuide) on Pocket PC basis, connected with a GPRS cellular phone, GPS receiver card and digital compass. The VISPA core services offered to the user are as following:

- Navigation service: Position and heading are gained from the GPS receiver and the heading device.
- Routing service: An online tour routing is performed on the server. The guidance according to the resulting route is done on the mobile device.
- Localized Geo-information (static 3D-map) is provided to the user on request from the PINA-server.
- General information service: Additional thematic data (tourist data), e.g. names/business hours of huts, can be requested from the PINA-server.

The data communication between the server and the client is provided via the Internet on GPRS basis. Thus the user can stay constantly connected to the server ('always-online' functionality).

A user performing activities especially in mountainous regions often has the problem to locate himself properly, by looking only at a topographic map. Therefore, one of the goals in the ASTRON/VISPA project is to visualize the environment of the user in a way he is more used to and which is easier to understand for him, that is a 3D rendered view of his proximity using personalized GIS data and features. Due to the small size of that project, VISPA will only be able to demonstrate the feasibility of such a service in a dedicated Alpine test region, without having a safety function implemented. Besides it is only designed for a single-user operation and does neither provide weather/avalanche forecast functionality nor the possibility of personalized or group tracking.

This project, which is funded by the Joint Research Centre (JRC) of the European Commission within the ASTRON Programme, already is in its final state of feasibility demonstration. Its results will also have some valuable impact on the hardware and software development of the PARAMOUNT project.

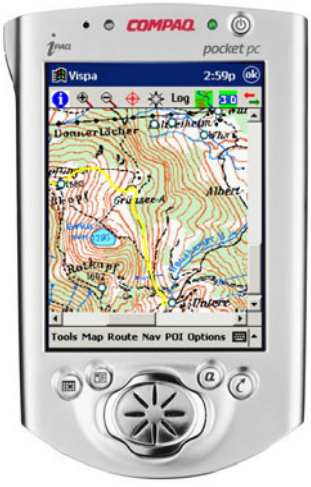

Figure 3: Core terminal with the VISPA Mobile Client software

CONCLUSION, PERSPECTIVES

The objectives and the basic functionality of the PARAMOUNT project as well as the work tasks to be done within this project have been described.

The following core services that will be established have been pointed out:

- INFOTOUR:
  Geographic data, local weather-/ avalanche forecast and other tourist relevant information will be provided to the user.

- SAFETOUR:
  The user will be able to send an emergency call (incl. position) to a SAR centre in case of emergency and to register to the SAR centre for automatic tracking while hiking in critical terrain.
  The SAR activities will be efficiently coordinated.

- DATATOUR:
  Capturing and updating geographic data will be done by tracking registered voluntary users and collecting their interactive information inputs on POIs etc.

The digital tour guide demonstrator developed within the VISPA project, which may provide some valuable experiences for the establishment of PARAMOUNT, has been briefly presented.

With a successful completion of the project leading to the establishment of a commercial service one may think of the following perspectives arising from the results of PARAMOUNT:

- PARAMOUNT outcome may be transferred to other LBS (not only for mountaineers)

- The C³ functionality (→ command control, cooperation) with SAFETOUR could be applied to other fields of public security (e.g. fire brigade, police special forces…)

ACKNOWLEDGMENTS

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