LOCATION-BASED SERVICES WITH RESPECT TO LEGAL AND PUBLIC ORDER AND E112 CALLS

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ABSTRACT

Geo-information is regarded as a necessary asset with respect to the enforcement and preservation of legal and public order, the observation of security issues, and the assistance of those who need aid by calling the Emergency 112 (E112) number. Therefore, police forces, fire brigades, and ambulance services demand the access to up-to-date, real-time, and secure geo-services to obtain the information they require at the location of the event. The geo-information should be supplied in a way such that the essential action is supported right away: not maps to read, but maps to act.

The Dutch 'Space for Geo-information' program aims to exploit the currently available geo-information and geo-services within the Netherlands. To this end a five-year program of financially supporting innovative geo information projects is set up. An amount of in total 20 Million Euro is available to support the development of the geoinformation infrastructure itself, the use of GIS by a broad public, and for monitoring and forecasting applications. One of the projects undertaken so far is a requirement study and information analysis on location-based services with respect to public order and security.

In this LBS 24/7 project the main actors are addressed, the geo-information needs are identified, and the limitations and possibilities of the used devices, the communication, and the location determination with respect to public order and security and E112 calls are studied. In a workshop with officials in the field of public order and security and with LBS experts a detailed user consultation took place. From that workshop and through personal interviews the requirements and wishes of LBS with respect to public and legal order and security issues were classified by the following topics: availability (i.e. do the data exist), accessibility (i.e. are the data accessible), affordability (i.e. are the data cost effective), timeliness (i.e. are the data ready in a timely manner and updated regularly), and reliability (i.e. do the data have the required accuracy).

From these requirements it is derived that two concepts of LBS as applied to public order and security are feasible. The first concept is more ore less a synonym to the GIS as used in the central crisis centre of the police forces and fire brigades. If all available resources are pulled and communicated in real-time to the central GIS and mapped properly, reliable decisions on the necessary actions can be made faster and more – literally – to the point. The second concept deals with the actions that are to be performed by the operational police officers, fireguards, and ambulances in the field, the information should be adapted to them. There is no time for interaction compared to standard 'pull-

services' were the user can pan, zoom and identify the geo-databases through a map-interface until he has found the requested information. Within this second type of LBS unambiguous and localized maps are thus to be pushed to the operational forces through special designed – location-aware – devices.

REQUIREMENT STUDY AND INFORMATION ANALYSIS

To study the need and potential of location-based services with respect to public order and security the project was dispersed over the following issues:

- Investigation of the end user demands and requirements. A survey of existing projects, initiatives, and other activities currently issued to assist the police and other organizations in law enforcement, assistance support and disaster management with location-based services.
- Availability of geoinformation data and -services. A survey of available and requested geoinformation, and –services as needed by this particular group of identified end users.
- Special requirements of 3D-positioning within Location Services (OpenLS) of the OGC as currently available and required for E112 location-based services.
- A workshop, to discus into detail the potential of this kind location-based service that should be available, accessible, affordable, timeliness, and reliable to be operational for the enforcement of public order and security and E112 calls.

INVESTIGATION OF END USER DEMANDS AND REQUIREMENTS

As a first exploration an inventory on all kinds of projects and initiatives has been performed. This non exhausting list shows an extensive amount of activities where geoinformation is used to assist the police, fire brigades and ambulance services in their duties. Some to mention are:

- Neighborhood vision (Dutch: Buurtbeeld). This is a concept for the tuning of neighborhood safety related issues between the various (governmental) organizations. This tool is developed by the Dutch Security Association (Nederlands Veiligheids Net);
- The National Location Server Initiative. According to a fixed specification, location related administrative data are stored in an Oracle Spatial Database. The fixed format should ensure easy data transfer between different databases which make the National Location Server a number of coupled databases and not just one.
- Sherpa, a common geoinformation infrastructure as used by several Dutch Police Districts. In short, Sherpa provides a standardization concept of communication protocols and file formats between regional police departments.
- An initiative by the National Fire Brigades to come to a GIS to be used by all E112 services that has lead to a list of requirements.
- P-Info, a portal for mobile access to the police-database; and 112 alarm assistance services that demands the position of the people in distress.
- IMC: Integrated Environmental Control. With this IMC-application, various (governmental) agencies involved in environmental control can access data when working in the field as well as register environmental offences.

In the next step respondents involved to these E112 projects are interviewed to pin point their opinion on the specific issues of these developments. These meetings where composed by the following topics: availability (24 hours, 7 days a week?), accessibility (to whom and how?), affordability (cost effective?), timeliness (current and updated?), and reliability (positioning?).

From this desktop research and interviews some first conclusions on the user demands and requirements could be composed:

Availability:
- Location-based services used for the enforcement of legal order and security should be up and running 24 hours, 7 days a week.
- These kinds of services are not only to be used inside the office, or through mobile but car-mounted devices, but the added value has to be found within wearable, personal based systems.
- The services should have access to current and frequently (regularly updated?) data, as in most cases the data should be used here and now, and is mostly dynamic of nature.

Accessibility:
- The information flow to the manpower in the field should be controlled (pushed) by the central control room. The content and the amount of information is thus protected and limited to what is really needed for a certain task.
- The access to the position-information of the co-workers in the field (all available manpower) and their kind of activity is of most importance for both the executive in control as for the manpower in the field themselves.

Affordability:
- As the costs of these kinds of location-based services are not restricted to the direct costs of the devices (PDA's), the positioning (i.e. GPS-devices), the needed communication portals, and the geoinformation itself, but depends more on the introduction and maintenance of the involved (geoinformation) infrastructure, these costs should be taken into account.

Timeliness
- As within the assistance of those who need help, time is the key-factor to deal with. These kind of location-based services need to provide the requested information (in real-time?) as soon as possible. But, even more important, this information should be valid and up-to-date..

Reliability
- Not only the precision of the positioning should suit the application, but also the reliability is an issue to deal with as one has to be sure the manpower in the field is at the position the system claims. As security and assistance is not restricted to rural areas, the position determination should cover also urban and in-house areas. The current single positioning methods like GPS are neither reliable nor precise enough to depend on in build-up areas. A combination of various outdoor (e.g. GPS, Galileo) and in-house positioning (e.g. RFID, WLAN) systems may be reliable enough.
- The quality of the necessary geoinformation is as important as the geoinformation itself.

AVAILABILITY OF GEOINFORMATION DATA AND -SERVICES

Simply and solely availability of geoinformation through all kinds of services is not appropriate with respect to LBS to be used by police, fire brigades and ambulance services. The available information should be adapted to the specific goal of to the enforcement and preservation of legal and public order, fire fighting, and first aid and conveying casualties to

the hospital. The advisory committee on the coordination of disaster management (*Dutch: Adviescommissie Coördinatie ICT Rampenbestrijding)* distinguish the following types of information: static, dynamic, and model. Static information is valid for a longer period; most common described as geo-information like topography and population data. Dynamic information is only valid for a shorter period, like traffic information. The last kind of information is used as input or achieved by certain spatial models.

Each of these data sources could be judged by the same quality topics as used by the investigation of end user demands: availability, accessibility, affordability, timeliness, and reliability. It is shown that the 'static information', although regarded as the core of these kind of location-based services, has been evaluated as expensive, limited available and poorly accessible. The quality (an important part of the reliability) of dynamic information is often not known, as this kind of information 'pops-up' without a clearly understood information chain. At last, the information needed to run the required spatial models, like meteorology or the dispersion of pollutants, should fit the parameters of the model itself.

This survey on which kind, and to what extent, geoinformation is available for location-based services with respect to public order and security shows the need for more or less freely available topographic information, in the sense that this information could be accessed by open geo-services.

SPECIAL REQUIREMENTS OF 3D-POSITIONING WITHIN LOCATION SERVICES

As soon as E112 actions in buildings or underground tunnels are involved, the 3D situation becomes important. As the user can be anywhere, the position fix should not be limited; but be available anytime, everywhere. The position determination should then be performed in full 3D space, thus not restricted to outdoors and ground level applications only. In this context the possibilities and limitations in 3D positioning with respect to the Location Services (OpenLS) of the Open Geospatial Consortium (OGC) should be mentioned. The OpenLS of the OGC comprise an open platform for position access and location-based applications targeting mobile terminals. The OpenLS feature set is defined by the "Core Services and Abstract Data Types (ADT)". The most important aspect in these specifications is the 'GeoMobility Server', which role is to provide requested information considering the position of the user. A Location Service Client sends a request for a position determination to the Gateway. The Gateway determines the position of the subscriber's mobile terminal and forwards this to the Location Service Client.

The minimum number of OpenLS services is currently defined as directory, route, location utility (geocoding and reverse geocoding), gateway and presentation (see

Figure *1*). These five core services are considered sufficient (Togt et al, 2005) for a variety of use cases such as:

- Proximity: find something in a given area;
- Fencing: restrict the position of a user to within (our just outside) a given area;
- Navigation (compute route);
- Tracking ('record' the way of a user).

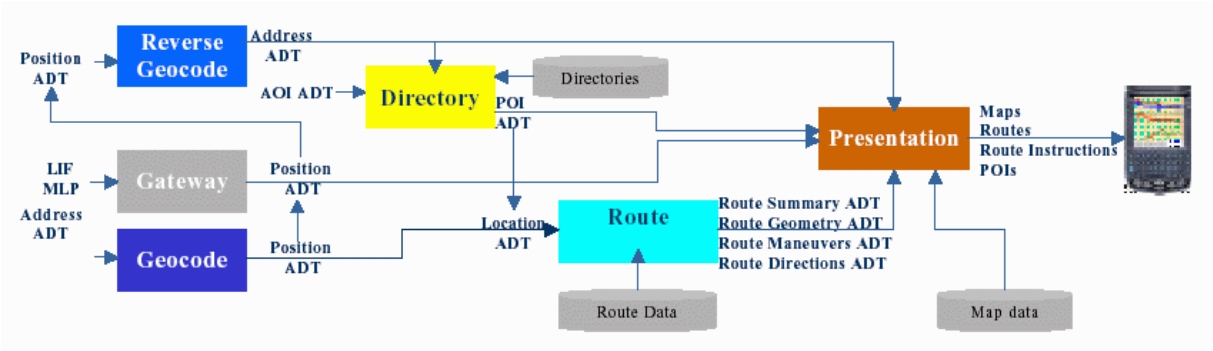

Figure 1: GeoMobilty Server (according to OpenLS).

These services are however, limited to 2D, as the position ADT is restricted to latitude and longitude only.

3D LBS have to be able to ensure the same set of services, i.e. proximity, fencing, routing and tracking but in 3D (Zlatanova et al, 2005). Example of 3D requests would be:
- Proximity: 'show to me all the electrical switches at all floors in a building';
- Fencing: 'tell me when I am not at a dangerous floor of a building '
- Routing: 'compute a route from this floor to the ground level';
- Tracking: 'track this visitor all the way on his route from this floor to the ground level'.

In terms of core services as specified in OpenLS, 3D LBS have to provide:
- 3D location utility service, i.e. 3D geo-coding and 3D reverse geo-coding to transform a 3D position to a descriptive location and visa-versa;
- 3D gateway service: to fetch a 3D position;
- 3D route service, i.e. give the route in multilevel constructions (buildings, viaducts, bridges, etc.);
- 3D directory, access to an online directory to find the nearest or a specific 3D place, product or service;
- 3D presentation, i.e. 3D visualization on mobile, hand-held devices and the appropriate interface for this

To be operational, these core services should have to work with a 3D position ADT, thus latitude, longitude, and height (related to some reference system). However, with respect to Location-based Services within the built environment, 3D positioning of location-sensitive devices anytime, everywhere, is still an issue (Zlatanova et al, 2003). This issue is part of the developments of the OGC Web Services, phase 3 (OGC, 2006). Herein it is concluded that: "The present OpenLS services and information model are limited to outdoor navigation (i.e. the concepts of 'location' and 'navigation' are confined to outdoor activities.) An enhancement to the OpenLS services and information model is to support seamless indoor-outdoor navigation. The OpenLS services and information model will have to be modified to accommodate indoor location and navigation constructs". Therefore it is suggested to: "add a tracking service that supplies a position management and access capability and make first steps toward path-planning and navigation in buildings and other environments beyond the limits of road networks". By this kind of indoor-outdoor navigation is should be made possible for "clients with mobile terminals to receive location and navigation guidance indoors or outdoors, as well as receive navigation guidance across indoor-outdoor and indoor-

indoor transition points (e.g. doorways). Indoor location concepts must be supported for how people identify location for indoor environments, e.g. building, floor, room, etc. Indoor navigation concepts must also be supported for how people negotiate their way around indoor environments, e.g. park on level P1-P4, elevator to 3rd floor, right hall to room 310".

It should be noted, however, that the OpenLS specifications suggest a Gateway service that uses telecommunication networks for localization of the mobile user. Positioning with mobile communication networks is widely used for commercial, push LBS applications as it is quite easy to reach a group of cellular phone users within the area of a certain base station (Cell of Origin) and send them an advertisement SMS. It is also possible to position the users within a certain sector and range of the base station by Uplink Time Difference of Arrival. If that information is monitored over time and combined with a road network, the position of the cellular phone user can be detected in a more precise manner. For example, LogicaCMG has introduced the so-called Mobile Traffic Service where these locations are aggregated to real-time traffic information for the Dutch Province of Brabant (LogicaCMG, 2005).

However, positioning with telecommunication networks based on just cell-id identification is inaccurate. Precise Mobile Network positioning requires considerable modifications to the current GSM network setup, or the use of next generation networks like UMTS. Due to the more or less planar arrangement of the GSM/UMTS beacons, accurate and reliable 3D positioning by mobile networks is not possible. Most of the LBS devices rely with respect to 3D positioning on one particular positioning technology, like a Global Navigation Satellite System (GNSS) as GPS, that is known to operate not at all or unreliable near buildings or within indoor situations. People can be positioned by a variety of other means such as telecom-based location, location fingerprinting based on Wireless Local Area Network (WLAN), tags based on RFID, and other tracking approaches (Zlatanova et al, 2004). The location can be also given by using other non-coordinate related approaches such as address, floor, room, or a description of the environment. This location can be given (supposed the end-user posses the device/tool that would allow him to position himself) or requested (obtained by the system) by a user or by a control facility, for instance to locate a person in a building. The localization is the most important but only the first part of the service.

Sufficient technological possibilities for 3D positioning exist but all of them do have their drawbacks with respect to Location-based Services, i.e. coverage (indoor/outdoor), availability (not anytime up and running), precision, reliability and integrity.

Most position systems are presented as 'stand alone' solutions, due to commercial interests. As no system operates best under all circumstances, the reliability will be improved and ensured when the systems become more integrated.

The OpenLS specification has to be extended further to provide 3D core services:
- 3D location utility service, i.e. 3D geo-coding and 3D reverse geo-coding to transform a 3D position to a descriptive location and visa-versa;
- 3D gateway service: to fetch a 3D position;
- 3D route service, i.e. give the route in multilevel constructions (buildings, viaducts, bridges, etc.);
- 3D directory, access to an online directory to find the nearest or a specific 3D place, product or service;
- 3D presentation, i.e. 3D visualization on mobile, hand-held devices and the appropriate interface for this.

In this respect, these core services should have to work with a 3D position ADT, thus latitude, longitude, and height (related to some reference system).

CONCLUSIONS

Some conclusions of this LBS-24/7 definition study are:

- In this kind of public order and security LBS the availability of geo information is of most importance. In both, the central crisis centre and the operational forces in the field should have confidence in the accessibility of all required geo-information, the location-determination of the operational forces, and the used devices and communication means.
- Although maps are a well accepted mode to communicate geo-information, oral contact is an important possibility in directing (sic) the operational forces.
- The location determination is still an issue within the built environment. One can not trust positioning by GPS in urban 'canyons' and it will not work at all within buildings. Special three dimensional positioning methods and techniques for this kind of environment should be developed or a combination of already existing techniques should be used.
- In the field of public order and security static information is useful for developing scenarios and for monitoring purposes. However, during crisis times, dynamic information is top priority. These demands put enormous operational constraints to the used geo information infrastructure, databases and geo information production.

FUTURE RESEARCH

This definition study will be succeeded by two new RGI-projects. The first one, "Geo-info to-go" had a specific focus on push-oriented location-based services. The goal is to study supply-driven geoinformation services by answering the main research question: "What kind of geoinformation, and in which representation, is needed for the enforcement and preservation of legal and public order". One of the topics to address is how to deal with the devices to use in the field. These kind of smartphones and dashboard systems are limited both in their display capacities as in their interaction possibilities.
The second project is called "3D-positioning infrastructure within build up areas and indoors". Here the limitations of positioning by Global Navigation Satellite Systems in 'urban canyons' are addressed and the possibilities and accuracy of dedicated indoor systems, like WLAN fingerprinting and RFID identification will be examined by a special equipped test site. Furthermore, the GNSS-fingerprinting will be developed to an operational tool for GNSS positioning within built environment.

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