'Photogrammetric Week 01' D. Fritsch & R. Spiller, Eds. Wichmann Verlag, Heidelberg 2001.

Electronic Business and Mobile Photogrammetry: Visions for the Future

DIETER FRITSCH, Stuttgart

ABSTRACT

The paper attempts to address the issues involved in Mobile Photogrammetry (in short: m-photogrammetry) coming up very soon with the availability of broadband wireless communication services, like GPRS and UMTS. M-photogrammetry will also be part of the contents of "Location Based Services (LBS)", embedded in E-Business environments, and delivers photogrammetric data and methods within business-to-business (b2b) and business-to-consumer (b2c) solutions. According to a recent study of Strategic Alliances, a market research company, LBS is predicted with a European market share of 10 Billion € up to 2005. Photogrammetry should be prepared to make profit of the fast developments in E-Business and E-Commerce solutions.

1. INTRODUCTION

The fast developments within information (computing) and communication technologies have in common a huge impact on product deliveries and product consumption of all kinds. Daily life habits have already begun to change – products (no matter of being material or digital) can be ordered via the net. Digital data in general, like videos, games, music, etc. can be delivered right after ordering (close to real time). In future, we will use Feature Phones, Smartphones, Communicators, Personal Digital Assistants (PDAs), Palmtop and Notebook Computers, what means a great variety of "Wearable Internet Appliance (WIA) Devices" which offer us round o'clock access to the Internet,

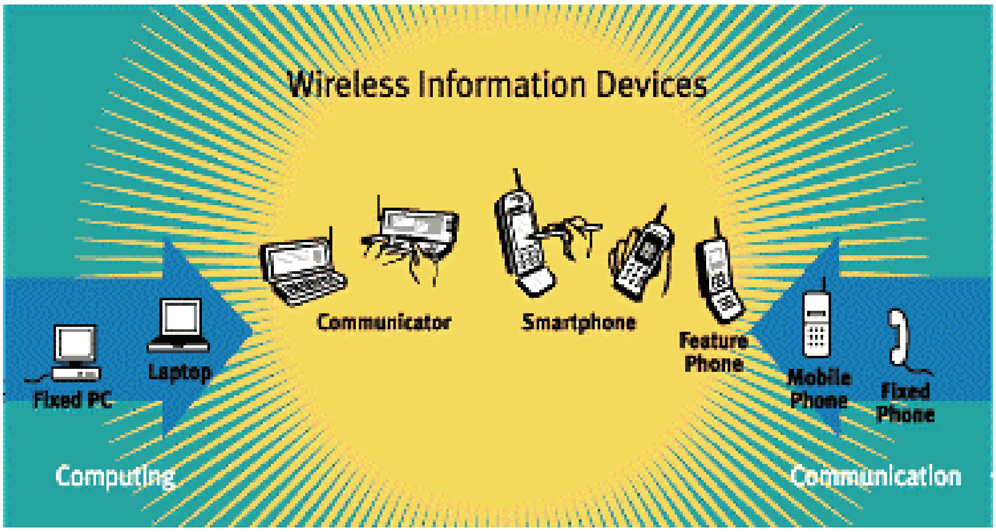


Fig. 1: Convergence of computing and communication (Copyright: Symbian Consortium)

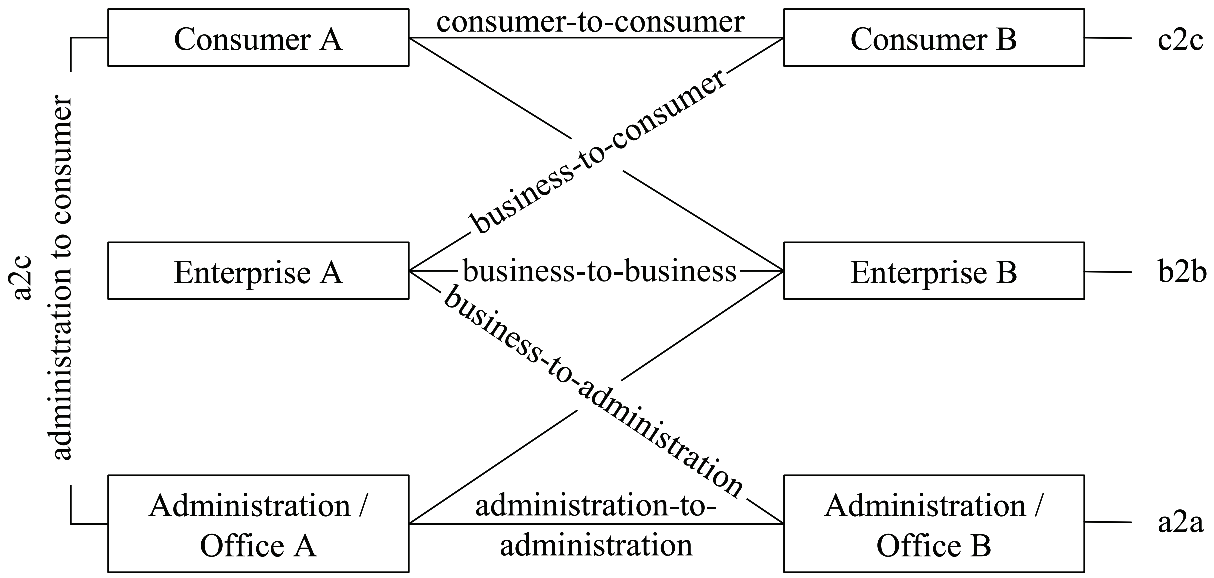
no matter where we are and at any time (see figure 1). For example, most recently Hitachi (the Japanese computer manufacturer, Tokyo) and Xybernaut Corp. (a US company manufacturing the first real wearable computers, Fairfax/Virginia) have announced a joint venture for wearable computers, a superscale Hitachi 32 Bit, 128 MHz RISC Processor with 32 Mbyte RAM, a Compact FlashT card and an USB port, weighting only 230gram and being operated by WindowsCE 3.0. This WIA computer is capable of having unlimited access to the Internet - the data is shown on a head mounted display with SVGA resolution. It is especially designed for use in cars, public

transport, offices, during shopping or simply to relax by having permanent entertainment through distance learning programs, music, video and games, GPS, voice communication, shopping and stocks. It will be shipped before Christmas 2001 and is prized less than 1000,- US$.
Using these devices information exchange and consumption will grow rapidly. To get the necessary information, the device currently in use needs to be connected to an information source, e.g. the Internet with its WEB servers and further servers. Wireless links and communications have therefore a great future. There are predictions, that very soon wireless communication will shrink the market share of wired communication infrastructures to at least 50% or even less. Some observers come to the conclusions that wired communication networks will become obsolete.
For a Wide Area Network (WAN) the wireless device can currently use the data service of a mobile telephone system like the European standard GSM (< 64Kbit/s) or of future systems, which will be more suitable for data transmissions like GPRS or the more advanced UMTS (up to 2 Mbit/s). Inside buildings a wireless Local Area Network (LAN) can be used, e.g. Bluetooth (approx. 700 Kbit/s), IrDA (IrDA2.0: approx. 56Kbit/s) and Very Fast IrDA (approx. 16 Mbit/s), according to the 802.11 standard (Eberspächer, J./Vögel, H.J. (1998), D. Fritsch et al., 2001).
In future, data and information around the current location of the user will often be requested. This location is to be determined by low-cost GPS or by the cell network topology through which he is serviced. This “Location Based Service (LBS)” or “Location Aware Application (LAA)” is predicted with a fast and enormous growth of market shares. According to Ericsson, the Swedish mobile phone manufacturer, 3/5 of all information requested by cell phone users are “location-based” – GSM Consult announced that one out of four cell phone users would pay extra charges for these new services, Airflash predicts a readiness of three out of four cell phone users to spend more than 15,- US$/month for LBS (C. Ahrens, 2001).

1.1. Electronic Business

Electronic Business – in short eBusiness or eCommerce – have got its name from the progress in information technology (IT), which is even more the driving force for the strength of this new business sphere. Although the *new economy* went into headlines last year there is and will be a huge potential in near future. The Internet is the kernel for making economy decisions of all kind via computers. The well-informed reader observes a convergence of technical infrastructures, to classify mobile business (mCommerce) and television business as a variety of eBusiness rather than being in opposition to it (M. Reiss/M. Koser, 2001).
Learning from earlier mega trends in IT, e.g. from down-sizing, Computer Integrated Manufacturing (CIM) or the introduction of Enterprise Resource Planning (ERP) software, it is real and hard fact, that digitizing and computerization of existing workflows are not the only value adding steps to improve it. A thorough assessment can be derived if the *Enabling Potential* of the existing IT and in addition the need for *Complementary Non-IT Infrastrucures* is known.
On the one hand, IT infrastructures open new perspectives for business models, enable new channels to reach the customers. A (photogrammetric) software vendor is enabled to have far more options for distributing application software via Internet than before. Besides the regular software selling business he lets his software rent or lease by unknown customers who download the software via Internet. Thus, the vendor can emerge to an *Application Service Provider,* who delivers “plug-in” applications. (By the way, the Institute for Photogrammetry, Stuttgart University, made an experiment by offering *orthoimaging software* via Internet with good success!)
On the other hand, well-advanced IT infrastructures are not the only guarantee for a successful eBusiness. Complementary infrastructures are needed which have nothing in common with classical backbone IT. Besides the informational infrastructure further segments are needed: at least a structural, personnel, cultural and technocratic infrastructure. An excellent overview is given in M. Reiss/M.Koser (2001, page 117, fig. 2).

At a more detailed view, the business channels may vary between vendors, customers and administration/municipal offices. It may happen, and this is often the case in photogrammetry, remote sensing and GIS, that a software vendor (Enterprise B) is also “customer” of a satellite data service provider (Enterprise A). Thus, a classical “business-to-business (b2b)” solution is set up. On the contrary, the end user (Consumer B) is often consumer of (photogrammetric) methods and data delivered by Enterprise A, leading to a classical “business-to-customer (b2c)” relation. Possible business scenarios are given in figure 2, which is extended by “administration-to-administration (a2a)”, “administration-to-consumer (a2c)” and “administration-to-business (a2b)” relations. In few cases the inverse is also feasible.



Figur 2: Possible eBusiness scenarios

1.2. Mobile mapping and mobile photogrammetry

It is out of question that eBusiness is one of the most challenging driving forces of the future. Also data dissemination of the mapping disciplines is heavily concerned, such as in photogrammetry, remote sensing and geographic information systems (GIS). Their methods and products will be made available besides closed system environments through open system services via the Internet, especially for mobile users. Thus, **the mapping disciplines are already or will soon become part of the eBusiness!** There are different terminals by which photogrammetric data and GIS information can be accessed “on the move”. The principle behind the transmission of any data and information content is briefed below. With the permanent development of new wearable computing devices the IT infrastructure of every individual will become more dependent from wireless than from wired services. WAP and other wireless standards enable multidimensional access to map information and photogrammetric products. Therefore, the information is made available on mobile devices like WAP phones, PDAs, pagers and even ordinary cell phones (for example: Tegaron taffic information service).
Location based services are already offered by German cell phone service providers (D1, D2, EPlus). An evaluation of the current user’s location is a *well-protected firmware feature* which enables the customer to use tailored and personalized services. This information is given in anonymous and safe formats, provided that the cell phone user has agreed to activate these extra services. But this makes also clear, that the user’s current location cannot be tracked by a GIS data

server or some photogrammetric data distributors. He moves currently within a “closed system” being controlled by his service provider, what means, there should be further sensors “on board” of the wearable device to be serviced by *Open Data Distributors* and *Open Data Services*.

2. INFRASTRUCTURES AND DEVICES

The access of digital map and photogrammetric data has become interesting for the first time by the development of *Wireless Application Protocols (WAP)* or the *Wireless Markup Language (WML)* to be used by the WAP cell phone generation. But the big disadvantage was the availability of tiny displays with very limited graphical resolutions (for example NOKIA 7110 with 96x65 pixel). In the meantime PDAs are offered with colored displays (65.000 colors) having a resolution of 240x320 pixel, besides that palmtop computers can go wireless with ordinary GSM PCMCIA cards having full XGA graphic capabilities (see figure 3)

a) b) c)

Figur 3: Wireless voice and computing devices: a) the NOKIA 7110 (Copyright: G. Gartner, 2000), b) the Hewlett Packard Journada (Copyright: HP), c) the Sony VAIO C1XD (Copyright: Sony)

2.1. Internet Protocols of several devices

A good overview on the challenges and limitations on mobile mapping is given by. U. Srinivas et al. (2001). Some parts of this overview are briefly presented below.

WAP Phones
WML can be compared with the WEB language HTML, a standard structured description language to display hypertext information on tiny displays (e.g. cell phones) independent of hardware and software. It is not directly based on HTML but on the *Extended Markup Language (XML)*. WAP is the protocol to transfer WML pages to the cell phone display. In general, WAP is used between the cell phone and a WAP Gateway Server, this server is connected with any WEB server and communicates via HTTP. A detailed description of using WML is given by the WAP Forum (1999), but see also G. Gartner (2000).

GPRS Phones
If the GPRS device user is requesting for HTML based map information then he can send directly a HTTP string to the WEB server, onto which the mapping data and applications are loaded. The response can be any HTML pages, JPEG images, JAVA routines and JAVAScripts. If the GPRS user is requesting WAP based map information than he follows the workflow of WAP Phones (see

above). The only difference here is that the wireless network is a *Packed Switched Data Network (PSDN)* instead a *Circuit Switched Data Network (CSDN)*, which needs a dial-up.
UMTS Phones
It is not yet clear how UMTS phones and data services will operate in detail. But it seems that the PSDN model of GPRS is a starting point for development. Therefore it is expected that the UMTS user can also have direct access to WEB servers via HTTP protocols.

Personal Digital Assistants (PDAs)
If the PDAs have a WAP browser installed in them, the information comes in similiar fashion as discussed under WAP phones. Some PDAs (mostly those under WindowsCE) can access Internet content directly. Alternatively, applications running on the PDAs can directly connect to remote servers, retrieve and display information without depending on any browser to display the information. The application running on the PDAs should themselves have interfaces to display the information.

PalmOS Devices
For many PDAs of the Palm family, which cannot access WEB content (HTML) directly then *WEB Clipping* comes into picture. In such devices PQA (Palm Query Applications) have to be developed on the Palm devices that clip the WEB content and receive the bare minimum to display map and image data information.

WindowsCE Devices
They can connect to the Internet directly as they have in-built soft modems. Thus these devices can directly access map and image data content from the server, as a desktop computer would do.

Windows9x Devices and WindowsME Devices
Here the same holds as given for WindowsCE devices.

3. A CLOSER LOOK AT MOBILE PHOTOGRAMMETRY

What has photogrammetry for a mobile user to offer? The answer is quite as simple as explaining photogrammetry itself. All those methods of image data collection and image data processing to come out with precise, complete and fascinating data products, such as rectified images, geocoded images, spatial resection to determine the current user's location, digital terrain models overlayed with real texture, 3D city models with and without texture, interfacing outdoor and indoor image data, etc.
A typical scenario is given in D. Fritsch (2001) for the NEXUS application. Imagine, that the first time participant of the Photogrammetric Week arrives at Stuttgart's central station right after her /his arrival at the airport. To find her/his way in the unknown environment (s)he utilizes a NEXUS station, a small mobile computer or PDA. The PDA knows the current position (through DGPS) and is able to get in touch with the NEXUS platform by wireless communication. The participant accesses the user interface provided by the system and finds a service, which gives the possibility to search for trains and to cash the fare for public transport automatically. Having specified the destination using a 3D city model, NEXUS is showing the footpath to the closest subway station, the line number and the departure time of the train, which takes the participant to the hotel. After check-in and a refresh (s)he is going to the city for a stroll. As (s)he sees a historical building (s)he just points to it with a telepointing device integrated in the PDA. Directly, all historical and architectural facts about the object are transmitted to the PDA – based on a 3D city model which is enriched with further thematic data.

3.1. Data and Methods

The mobile user will request not only photogrammetric data but also methods. For example, photographs are taken during holidays which should be rectified and mosaicked to get a panorama view of the object. That means all kinds of low level image processing could be offered for mobile environments. Another example is the use of a in-built CCD camera, by which photographs inside a room are taken. Using the CAFM data set of the building the user's location is easily to compute by spatial resection. Or the user is aware of the stereo potential of photogrammetry and takes at least two photographs of an old statue – right after transmitting these photographs to a *Virtual 3D Service Provider* the product is delivered in 3D data format (right at the time the user is still deepening the history of this statue). Many other examples could follow here.
The point is, that many providers could offer those services via Internet and make classical software vendors their market shrinking! Therefore it is recommended to our colleaques, who make their profits from photogrammetric services, to be aware of these developments – take part of it, do not consider this scenario as *playground* of the computer kids!

3.2. The NEXUS Example

As indicated by the introductory example of this section there will be several developments using photogrammetric data and methods. One of these developments is NEXUS. This research project NEXUS is carried out at the University of Stuttgart in cooperation between the Institute for Photogrammetry, the Institute of Parallel and Distributed High-Performance Computers and the Institute of Communication Networks and Computer Engineering. Its overall objective is to develop a generic platform supporting LBS for mobile users (F. Hohl et al., 1999, D. Fritsch et al., 2001, S. Volz/D. Fritsch, 2001, S. Volz, 2001).
In order to facilitate the access to LBS, distributed data sources and services have to cooperate within the NEXUS infrastructure. For that reason, a federated data management component is realized that allows an integrated view on data and services for the applications by offering standardized interfaces. Besides that, intelligent mechanisms within the platform have to allow for an efficient provision of the relevant information to the user.
Another vital aspect concerning the acceptance of NEXUS deals with the privacy of data and the protection against illegal data manipulation. The NEXUS infrastructure also has to take into account that different kinds of mobile devices like cell phones, PDAs and wearable computers being equipped with different senors to collect the current contexts of the users are accessing it and thus has to offer an adequate interface to cover the demands of all possible variations.
The users of the NEXUS system will apply different kinds of mobile communication technologies like wireless LANs (according to IEEE 802.11b) or WANs (e.g. through GPRS and in future UMTS). Therefore, the handover between these different networks have to be realized. Also the adaptivity of the communication within NEXUS has to be guaranteed, so that, for example, bandwidth changes do not cause a breakdown of applications or the system itself.
NEXUS is based on a common data model – the *Augmented World Model (AWM)* – to guarantee that the applications must be able to perceive the combination of different spatial data sets as one big single model. In order to allow for this uniform view, an object oriented model has been developed, containing a generic set of all object classes that might be of relevance for LBS. This is called *Standard Class Schema* (see figure 4).

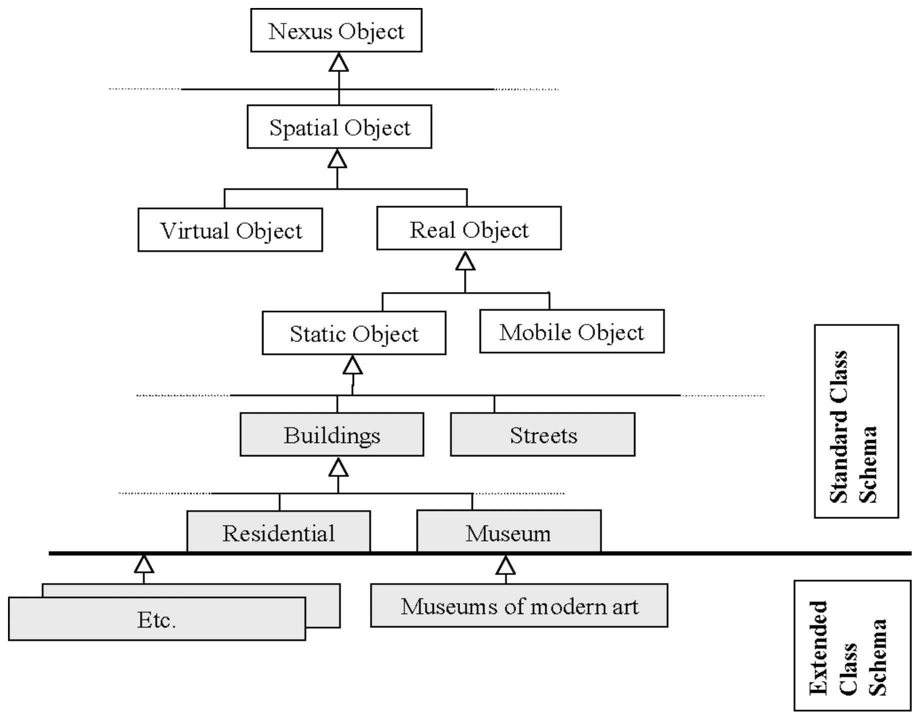


Fig. 4: The object oriented world model of NEXUS. The grey-shaded boxes represent instantiable, the white boxes abstract classes.

In case that an application needs additional object classes that further specify the existing ones, they can be inherited from the classes of he standard schema delivering an *extended class schema*. Anyone being interested in participating in NEXUS (data service providers, OGC, photogrammetric product vendors, etc.) has to obey the rules of the underlying data model and has to adjust its data according to it. Since the NEXUS system should not only include real but also virtual objects we have called it Augmented World Model.
NEXUS is able to navigate the user in outdoor and indoor environments through its navigation components (DGPS, digital compass, pedometer, Active Badges, and simple CCD cameras). It receives data of all kind like 3D city models, CAFM models, shop offers, train connections, TV programs, etc. It is a typical PDA system of the future well-prepared for m-photogrammetry applications. The interested reader can deepen its description by the list of references given below, but may even follow the invited paper of S. Volz (2001) during this conference.

4. CONCLUSIONS

The visons given in this paper are already operational or may become operational very soon. It is therefore highly recommended to prepare photogrammetric business models and value added data services for a highly mobile environment. This will help photogrammetry to become even more public, what means, to demonstrate its potential in daily life applications (such as navigating through an unknown city, to visit a virtual city while waiting for an airplane, to explore virtually the hotel of arrival on a business trip, to rectify images of all kind taken in a museum, to analyse DTM parts during a mountain bike tour, etc.).
Sure, there are remaining problems to overcome within the very near future. Above all, data safety of the individual info package has to be guaranteed at all times. In order to pay all these extra services the safety regulations should also include eMoney transfer. Digital signatures are already operational, therefore there is some optimism that these problems are really solvable problems.

As far as data standard in mapping and GIS is concerned the OGC has made a good move by offering GML 2.0 (M. Reichardt, 2001). This Geography Markup Language is an XML extension for encoding the transport and storage of geographic information, which includes geometry and properties of geographic features. It is the hope of the author, that this work will continue to adapt any map data (also photogrammetric and remote sensing data) to wireless devices of all kind.

5. REFERENCES

Ahrens, C. (2001): Virtuelle Geschäfte am realen Ort. In: Handelsblatt Veranstaltungen Newsletter 4/2001, S. 3.

Eberspächer, J., Vögel, H.-J. (1998): GSM Switching, Services and Protocol. B.G. Teubner, Stuttgart.

Fritsch, D. (2001): Geo-Informationssysteme im Spannungsfeld von Mobilität und Gesellschaft. In: Mobilität und Gesellschaft, Hrsg. M. Fromm, Stuttgart. (im Druck).

Fritsch, D., Klinec, D., Volz, S. (2001): NEXUS – Positioning and Data Management Concepts for Location Aware Applications. *Computers, Environment and Urban Systems* (in print).

Hohl, F., Kubach, U., Leonardi, A., Rothermel, K, Schwehm, M. (1999): NEXUS – an open global infrastructure for spatial-aware applications. *Proceed. 5th Int. Conf. On Mobile Computing and Networking*, Seattle.

Gartner, G. (2000): TeleKartographie. *Geo-Informations-Systeme (GIS)*, Vol. 13, 4/2000.

Handelsblatt-Veranstaltungen (2001): Telekommarkt Europa. Newsletter 4/2001. Verlagsgruppe Handelsblatt GmbH,

Maguire, D. (2001): Mobile Geographic Services. *GISdevelopment,* Vol. 5, pp. 28-32.

OpenGIS Consortium Inc. (2001): OpenGIS Consortium. http://opengis.org.

Reiss, M. (Hrsg.) (2000): Netzwerkorganisation in der Unternehmenspraxis. Lemmens, Bonn, 199 S.

Reiss, M., Koser, M. (2000): Netzwerkstrukturen für das E-Business. In: Netzwerkorganisation in der Unternehmenspraxis, Hrsg. M. Reiss, Lemmens, Bonn, S. 113-142.

Reichert, M. (2001): OGC's GML 2.0. *GeoInformatics,* Vol. 4, pp. 18-21.

Starner, T., Schiele, B., Pentland, A. (1998): Visual context awareness in wearable computing. *Proceed. 2nd Int. Symp. On Wearable Computers (ISWC'98)*, Pittsburgh, pp. 50-57.

Srinivas, U., Chagla, S.M.C., Sharma, V.N. (2001): Mobile mapping: challenges and limitations. *GISdevelopment*, Vol. 5, pp. 35-39.

Volz, S., Fritsch, D. (2001): Information management for Location Aware Applications. *White Paper*, Institute for Photogrammetry, University of Stuttgart.

Volz, S. (2001): NEXUS – information management for location aware applications. *This Proceed.*

WAP Forum (1999): Wireless Application Protocol Forum. http://www.wapforum.org