Task-Aware Location-Based Services for Mobile Environments

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Publishable Project Summary

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Abstract

Mobile devices are a promising platform for content delivery considering the (i) variety of attached sensors, (ii) widespread availability of wireless networks, (iii) even increasing screen estate and hardware specs. TALOS proposes the concept of task computing to complement and extend location-based services as a means to enable the intuitive and efficient re-purpose, discovery, and delivery of rich content according to the user's needs. This project summary surveys that main project results towards this ambition

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Research Academic Computer Technology Institute, Greece
Fraunhofer Gesellschaft, Institute for Software and Systems Engineering, Germany
Institute for the Management of Information Systems / Athena Research and Innovation Center in Information, Communication and Knowledge Technologies, Greece
Katholieke Universiteit Leuven, Belgium
Michael Müller Verlag, Germany
Talent SA, Greece
WiGeoGIS, Austria

Task-Aware Location-Based Services for Mobile Environments

http://www.talos.cti.gr

1.Project Ambition

Despite the growth in the number of mobile users, the wide-spread adoption of ubiquitous wireless networks, and the ever increasing capabilities of mobile handsets, the **market of mobile services is still dominated by simple infotainment services**. This is especially apparent in the area of Location Based Systems, which with few exceptions (e.g. navigation) have not fulfilled its predicted commercial success in mobile environments. Some **reasons** here are that (i) content offered in typical LBS applications is still narrow and static, (ii) available methods and interfaces in mobile handsets for the discovery of available content are at best insufficient (e.g. keyword type search), (iii) mobile users still require a GPS module (integrated or autonomous) to utilize location based services and (iv) existing structured content available in several LBS applications is hard to reuse.

The goal of TALOS is to design, develop and evaluate a complete framework that will enable the **task-aware provision of content to mobile users**. We bridge the gap between traditional LBS and general Web content in that task computing will **provide purposeful, rich, geo-enabled Web content to mobile devices**. The software framework will contain all the necessary programming tools, libraries, APIs, and authoring tools, to provide modularity and simple integration with existing solutions.

The technological objectives are as follows:

- **Context aggregation** component - to derive and process the values of the contextual parameters (space, time, preferences). It will contain an **approximate positioning** sub-component for GSM and WiFi networks. The goal is to offer a device-independent context aggregation component, and estimate the user's location within 100m without the use of a GPS.
- Content aggregation and **semantic data markup** technologies will include
  - A methodology for adopting content used in print publication for e-publishing and mobile services to maximally re-use of existing content in novel services,
  - easy to use, manual task annotation tools to enable restructuring of content in a task-aware manner that can be integrated in the standard content authoring process,
  - geocoding tools that can identify the spatiotemporal attributes of a resource with a high success rate, and

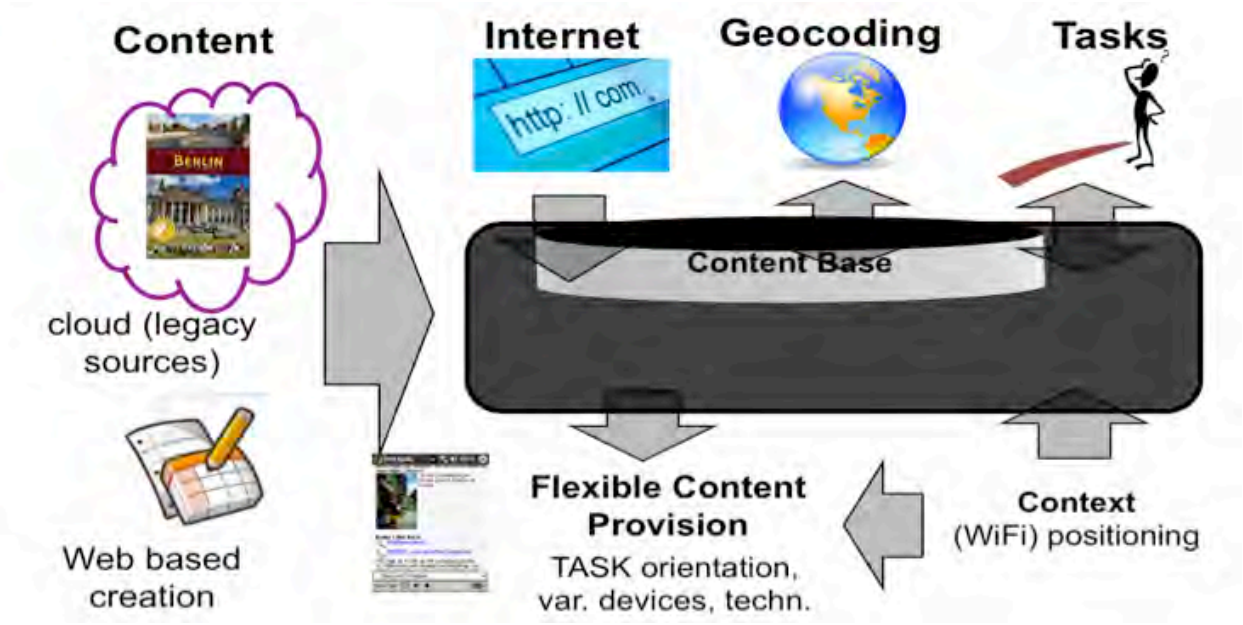
- Web scraping tools to integrate dynamic Web content with authored content

As a result, a content store containing task-aware, geo-enabled content directory is created using open-source relational database technology.

In addition TALOS will develop techniques for the collection of user-contributed geospatial information.

- Develop a generic **task model** based on standard semantic web technologies as well as a **task authoring tool** for non-experts. The authoring tool will be available as a standard Eclipse IDE plug-in. The task ontology will be easily expandable.
- A **task-aware interface** for the delivery of content & services in mobile devices. Our goals are to increase the success rate of users finding appropriate content & services in comparison to standard keyword based.

To showcase the task computing approach, two prototypes, one as an eBook and one for the iPhone have been implemented.



TALOS Overview

2.Project Results

The project has the following major achievements.

Context Aggregation

A Context aggregation module which captures the user's contextual attributes was implemented. It does so using the following components:

- An iPhone compatible "soft-GPS" Wireless Positioning component that enables the estimation of the current user's position in both indoors and outdoors environments without any need for specialized hardware (i.e. GPS), internet connectivity or intervention of third-party carriers.

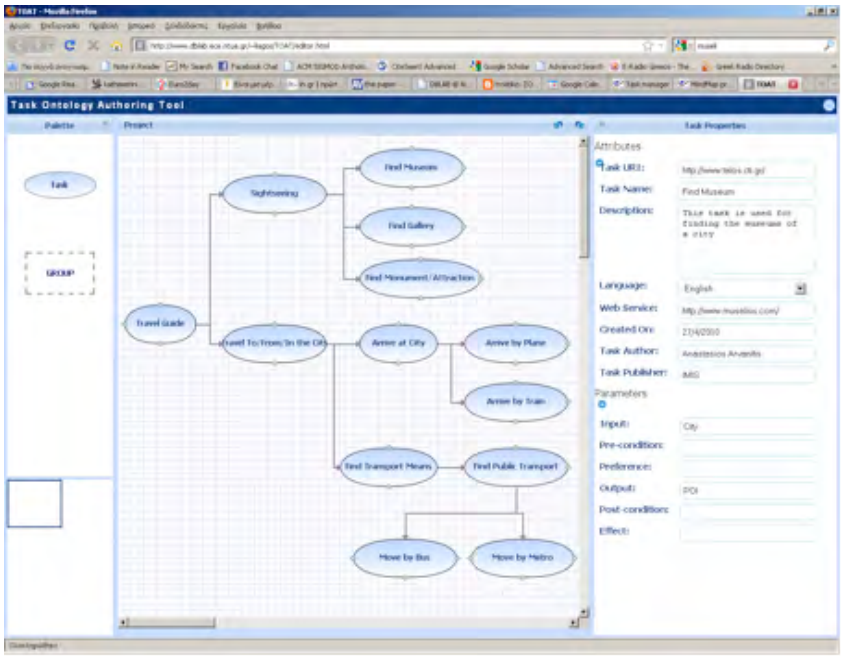
- A wardriving server that captures information about the reachable WiFi networks and the current GPS position and offers it as an XML document upon request.
- A GUI application for assisting users to create radio maps for indoors and outdoors scenarios.
- A demo iPhone application which demonstrates the use of the Context Aggregator and displays current context on the device's screen for both indoors and outdoors.

Task Computing

Task computing is a relatively novel concept in regards to the design, implementation, and operation of computing environments, aiming to fill in the gap between tasks (i.e., **what users want to do**) and services (i.e., functionalities available to the user). In contrast to the current, traditional computing paradigm, task-oriented computing environments are **ideal for non-expert users**, since they provide access to useful information in a goal-centric manner, requiring minimal user adaptation to the particularities of the user interface and device characteristics. Furthermore, task computing is ideal for pervasive and ubiquitous environments, i.e., computing applications aiming to help users in accomplishing their daily goals. In such environments, users expose high demands for minimal interaction and show limited tolerance to ineffectual content. The organization of content and services around tasks, offered in this discipline, has the potential to greatly improve the computing experience, since users receive timely and accurate information for the exact task in hand.

A task reflects what an end-user wants to do in a high-level layer of abstraction, e.g., "Visit a Museum". Each task is accompanied by a set of properties (input, output, precondition etc.) and it is instantiated by context and content in order to become an activity. Following the object-oriented paradigm, a task can be regarded as a class of activities (instances) that share common types of attributes. For example, if we assume that the task "Visit a Museum" has the attributes "Museum" and "Date" defined as inputs, then it can produce activities like "Visit the Museum of Acropolis on 26/6/10" or "Visit the Louvre on 28/7/10" and so forth.

Authoring tasks in TALOS is supported by the **Task Ontoloy Authoring Tool (TOAT)**. Examples of task scenarios regarding the use case of a mobile traveller have been created within TOAT based on actual surveys conducted by the project partners. The interface and the functionalities of TOAT are based (a) on the results of actual surveys - conducted by KU Leuven as well - involving both expert and non-expert users, and (b) on the requirements defined by the SMEs. TOAT has been implemented following the principles of the overall architecture of the TALOS system.



Task authoring tool

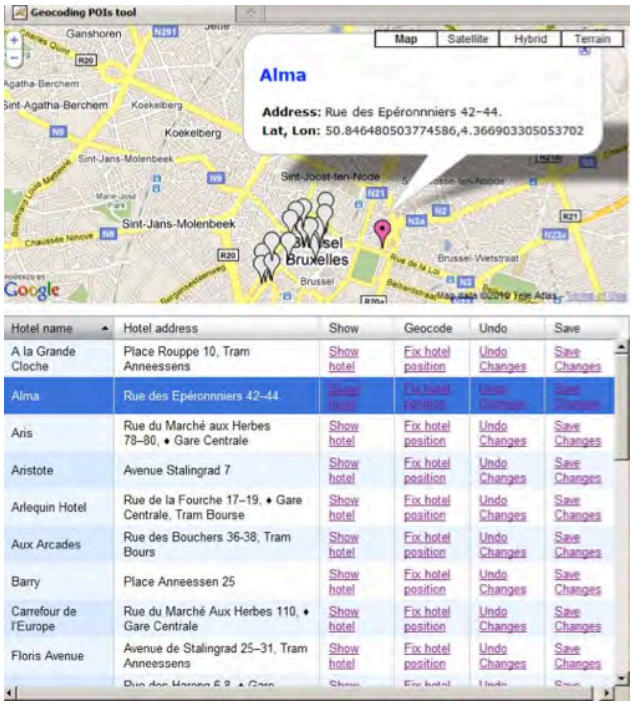
Content and Metadata

A core objective in the current effort was to make existing rich location-relevant content, in our case travel guides, readily accessible through mobile device and task-based interfaces. To do so we (i) linked such content to task metadata (task annotation), (ii) geocoded the content to provide a map-based access, and (iii) added dynamic Web content to the mix by using Web scraping, i.e., linking content from third-party sources to our content (e.g., linking the current exhibitions of a museum from the respective Web page to the POI information stored in our content management system).

The above task requires a **content management system**, which in our case comprises a database and an interface. Since content authoring is to be conducted by writers, the annotation tool had to be easy to use. To also avoid software installation task, the tool was implemented as a Web browser application, specifically using the Ruby on Rails open source web application framework and JavaScript to implement the client functionality. The following sections will give more details on the content authoring tasks mentioned above.

Geocoding

To geocode the content, we relied on existing Web services such as the Google Maps and Yahoo Maps API, Geonames, and Open- StreetMap namefinder and developed an application wrapper that provides uniform access to any or all services depending on the users needs and licensing restrictions. Advocating a semi-automatic geocoding approach, a map-based interface is in- troduced that allows the user to update the automatic geocoding results by dragging markers on the map. Fig. 6 shows the map interface.



Geocoding

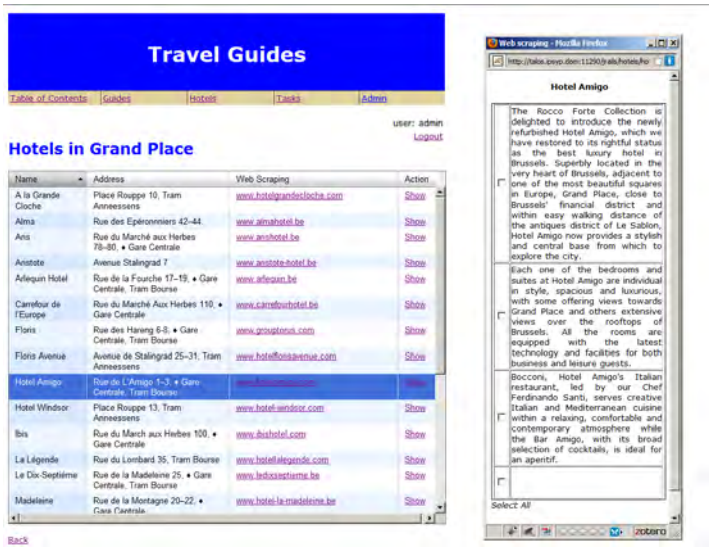
Task Metadata

Using a task ontology as input, the content annotation tool provides a simple means of linking tasks to content. The content as stored in the content management system is shown in the Web interface along with the task ontology represented in a tree structure. Clicking on a section highlights the sec- tion and shows a new pop up window with the suggested task hierarchy as a tree view and a list of already linked tasks with the specific section. After selecting a portion of the content, tasks are linked by selection to the selected content. Multiple selection is supported and the linked tasks are visualized accordingly. Fig. 7 shows the interface.

Task Annotation

Dynamic Web Content

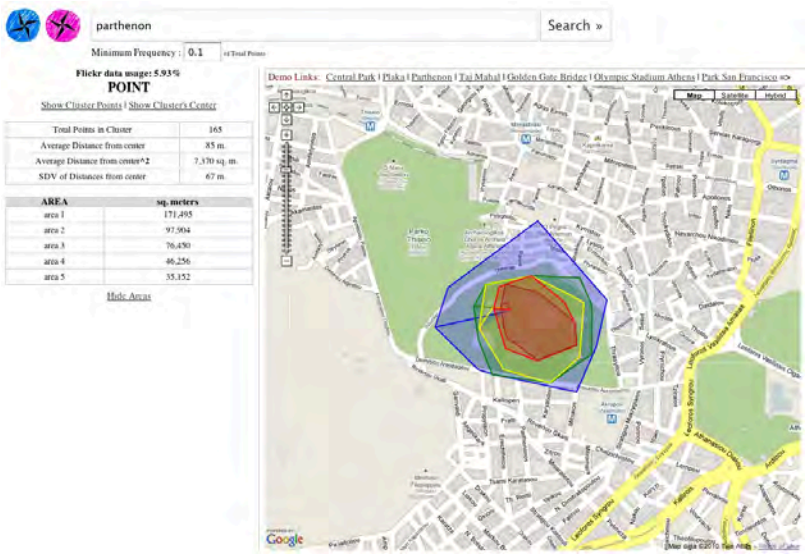
When considering electronic versions of print con- tent, an important property is the possibility of frequent (and cheap) updates. To streamline publishing such content, we link third-party Web content to our content base. Examples, here are opening hours and changing exhibitions of museums. Once such a link is established, it is simple to check if the information at the remote site has changed. We have developed Web scraping tools, specifically a Firefox Web browser extension that allows one to mark content at a remote site and so to link dynamic Web content to authored content. Fig. 8 showcases the tool with its Firefox extension.



Web scraping

Beyond this effort, various open-source geospatial data sources have been explored, e.g., Muselia, ChefMoz, dbpedia, booking.com and been integrated as metadata sources in the Web-based content authoring tool.

In addition and based on feedback collected during the project, **geospatial content creation tools** were developed. The objective is to use massive amounts of user-contributed data of low accuracy as input, fuse this data and generate geospatial data of higher quality as output. The example shown, depicts the are of Plaka in Athens as extracted from geocoded flickr images. It is worth noting that no official record of this area exists and the developed method among other things establishes the bounds of this area.

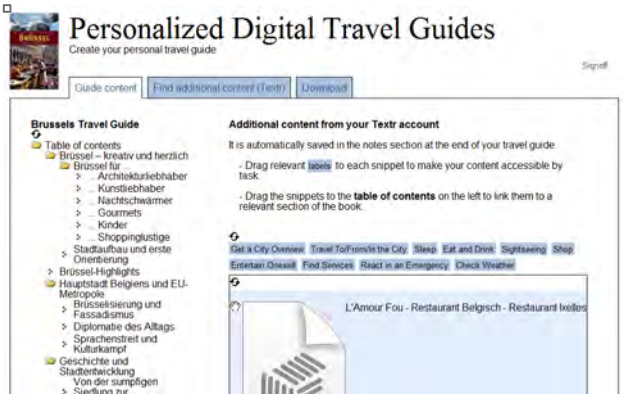


Geospatial content creation

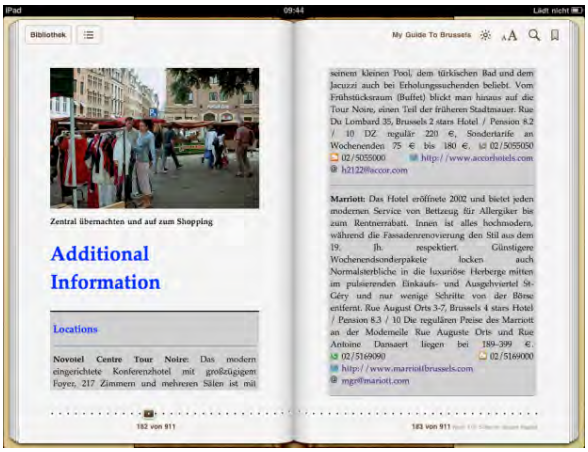
Protoypes

The above components and their outputs have been put together forming the TALOS system. The TALOS system has two output channels, which result in two **prototypes**, namely a task-aware travel guide, in an eBook form, and a mobile travel guide, designed for the Apple iPhone platform.

- The first prototype is a **portal Web site** that allows travelers to buy or select a MMV travel guide of their choice. It allows the traveler to save additional content from the Web to his or her personal space, tag the additional content with relevant tasks and add the tagged content to the travel guide. The travel guide including additional content can then be downloaded as an eBook or used in the iPhone app.

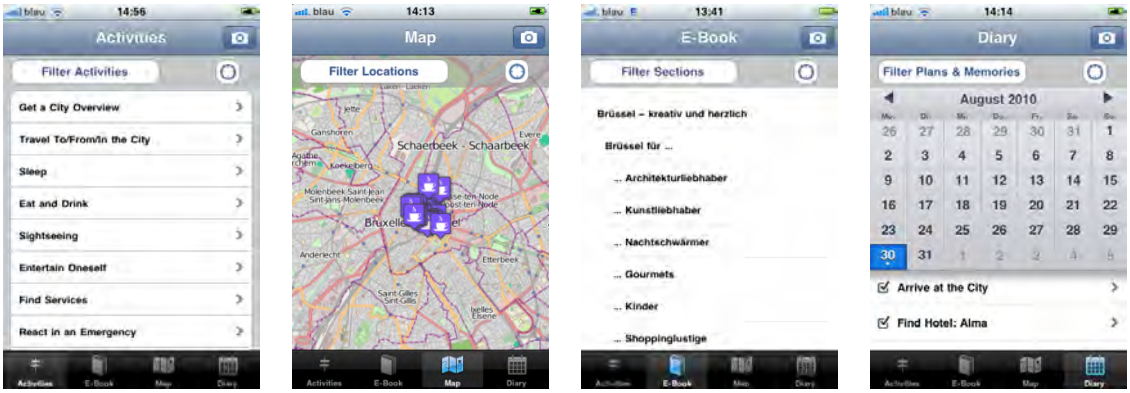


e-Book portal



e-Book

- The second prototype consists of a **mobile travel guide** for the **iPhone** platform. The mobile travel guide offers data extracted from the back-end server in various representations, through task-based interfaces. The fact that available content is organized around tasks, in combination with the exploitation of the user's context leads to efficient and personalized content provision. The mobile travel guide includes four modes of operation, namely, the activities, eBook, map, and diary mode.



iPhone application

3.Conclusions

The aim of TALOS was to make Location-based Services more user friendly by structuring content around tasks, i.e., what users want to do in a given context.

As such the project has resulted in the following four major results:

- **Wireless positioning technology** – can be used for custom deployments
- **Flexible content management technology** – Web-based content management including metadata management
- **Task computing** – tools supporting the authoring of task ontology and using tasks to structure content.
- **Protoypes** – eBook and iPhone-based prototype for mobile, task-based computting

The technology developed in TALOS can be used for a wide range of applications and potential exploitation targets. This aspect became also a necessity in the project as the SME partners have diverse business interests and thus needs with respect to the project.

The project partners have identified (i) mobile guides, (ii) mobile gaming and (iii) as geospatial data collection as initial exploitation targets.

4.Project Partners

RTD Providers

The **Data and Knowledge Engineering Group** (DKE), a research group at the **Research Academic Computer Technology Institute** (CTI), a public research institute under the supervision of the Greel ministry of eduction with offices in Patras and Athens, is the project co-ordinator of TRACK&TRADE. DKE conducts research in the area of data management, with a focus on spatial and temporal data, typically in the scope of national and European funded research projects. Recent activities include a project on telematics services for the Greek market and a European IST project on mobile computing.

"D. Maritsas" Building N. Kazantzaki str. University of Patras Campus 26500 Rion Greece.

The **Institute for the Management of Information Systems** (IMIS) in Athens is a research institute within the Research and Innovation Center in Information, Communication and Knowledge Technologies - ATHENA. The mission of IMIS is to conduct research in the area of data management and large-scale information systems.
Its research areas are management of spatial and spatiotemporal data (GIS, spatial data infrastructure), information integration and interoperability (Digital Libraries), Distributed Information Systems (sensor networks, peer-to-peer networks, grids), Web Information Systems (semantic Web), privacy preservation.

Bakou 17, Athens 11524, Greece

The **Fraunhofer Institute for Software and Systems Engineering** (ISST), with its two institute divisions in Berlin and Dortmund, is an organization of the Fraunhofer Society for the Promotion of Applied Research. Founded in 1992, the Fraunhofer ISST has been supporting computer science research within the Information and Communication Technology Cluster of the Fraunhofer Society. It provides consulting to companies and public institutions in the conception, implementation, deployment, and operation of long-term information and communications infrastructures and places emphasis on the following master themes (i)Information Logistics and (ii) Continuous Software Engineering. The "Location-based Services" department

of Fraunhofer ISST mostly focuses on personalized, situation-based services in mobile applications in two major areas, namely Early Warning Systems and Transportation Information Systems.

Steinplatz 2, D- 10623 Berlin, Germany

Founded in 1425, the **Katholieke Universiteit Leuven (K.U.Leuven)** is the oldest university of the Lower Countries and largest Belgian university. The Research Group on Document Architectures (DocArch) at the Centre for Usability Engineering was formed in 1991 and its knowledge was then based on electronic document conversion research in the 1980s. It is now active in the modeling of information (hypertext and multimedia) in structured documents, and on the applications, such as high-speed document transformations, stemming from this approach. Recently the Research Group had been focusing on navigational aspects in large information pools and on gaining information from these collections through SOAP and Topic Maps technology. European projects where these technologies were applied include OmniPaper and, more recently WalkonWeb, where the use of ontologies as a language-independent means to structure information was studied.

Oude Markt 13, Bus 5005, 3000 Leuven, Belgium

SME Partners

WIGeoGIS as European geomarketing pioneer develops innovative solutions for spatially differentiated market cultivation since 1993. This covers the areas geo-marketing, distribution/logistics and spatial media planning. Solutions of WIGeoGIS contribute to the lasting and measurable efficiency increase of marketing and selling. In addition, WIGeoGIS develops software, distributes geo-data and offers customers if required complex analyses and evaluations as services. Since 1997 WIGeoGIS develops and operates successfully IP-based map and location services for Internet and mobile Internet. These - highly specialised - applications are used particularly in information portals, in the Intranet and Internet and as location based services.

Hansalgasse 3, 1030 Wien, Austria

Michael Mueller Verlag (MMV) was founded in 1979 as a publishing house for alternative, practical travel guides, the company had early successes such as their Inter Rail compendia. Currently, 150 guides are offered covering Europe almost completely. In addition new guides have been publishing covering non-European destinations but also city guides and smaller, special interest regions. The guides have high popularity due to their focused travel tips, also allowing for budget travel professional layout and up-to-date information. MMV has become the market leader for specialized travel publications and is a three-times winner of the ITB Award for this market segment. MMV started publishing their guides as e-books. Currently 20 titles are available and new ones are added on a weekly basis.

Gerberei 19, 91054 Erlangen, Germany

Talent in Athens, Greece is a high-tech start-up company founded in 2002aimed at creating innovative products and services in the fields of education, culture, tourism, environment and commerce. The company's flagship product **Cruiser** a new medium for publishing, advertizing, searching, expressing and communicating on the web, based on maps and geographic space.

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