INFOAREA - AN OPEN MULTI-PURPOSE INFORMATION SYSTEM FOR THE MOBILE AGE

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InfoArea aims at becoming a comprehensive and uniform system for providing, consuming, and recording all kind of information relevant in mobile everyday life.
In this paper we motivate the development of such a system, consider feasibility and acceptance issues, present design aspects, describe the implementation of the system and give examples of use. Finally we discuss strategies to establish InfoArea as a widely-used technology.

1   On the Cusp of the Mobile Age

Mobile Computing and Multimedia have found their way into everyday life, most prominently in the form of smart phones. While intensively used for communication and entertainment, information still plays a minor role (see e.g. [1]): although most mobile phones are equipped with a web browser and dispose of a number of sophisticated capabilities and functionalities (e.g. fast internet access, large area displays, ...), mobile web browsing and mobile information (esp. context-aware) services have not yet become widely accepted.

The motivation for the InfoArea-project is to enhance the information component in the spectrum of use of smart phones. Based on the study of existing mobile services and a compilation of respective acceptance criteria (Section 2) requirements are derived and their realization is discussed (Section 3). The result is a comprehensive and uniform system for providing, consuming, and recording all kind of information relevant in mobile everyday life solely based on standard smart phone, internet and web technology. Its implementation and

use is described in Section 4, its usefulness in everyday life is demonstrated by a number of real life examples in Section 5. Finally we discuss strategies for a successful launch of InfoArea.

2   The Gap between Feasibility and Acceptance of a Personal Information System

Over the past years quite a number of (concepts for) mobile information services were suggested, prototyped, launched or commercialized. In the following we give a representative cross section with emphasis on location-based services (for a detailed overview see [7]):

- *Where Am I*: indicates the users' position on a map

- *Location Based Advertising* "... deals with strategically placing messaging near where buyer behavior can be most immediately influenced, and converted into a sale." (`www.d3magazine.com/glossary`)

- *Point Of Interest*: indicates potentially interesting or useful places in the vicinity on a map

- *where's the nearest* ...: finds the nearest ... to the users' position

- *navigation*: guides to a specified destination

- *track your* ...: displays the current position of a moving object

- *weather alert, 'meet a buddy', mobile timekeeping, ...*

Not all services were received equally well. The following criteria we consider to be crucial for the acceptance (for a sound background see [6], [8], [2]):

- *quantity, diversity, quality, up-to-dateness and situational accuracy of the information provided*

- *high added value/(initial) effort ratio*, especially the user should get started easily and experience an immediate benefit

- *embedding in familiar environment and ease of use*: the system should adapt to the user, (especially to get started) only a minimum of learning should be necessary and the use of the (core) functionalities should require only minimal interaction

- *low costs and high cost transparency*: the service should not only be "affordable" but also transparent, i.e. the user should be able to estimate/predict the costs caused

- *perceived trust*: the user has to feel confident that no sensitive data is transmitted or forwarded without her/his knowledge/approval

3 Design Considerations

Mobility is the capability of changing location readily, which normally is accompanied by a continual change in situation. To provide the right information for each situation is one of the main challenges of the mobile age.

To put it in a nutshell, InfoArea *enables to relate situation and information* by annotating information contained in web resources with tuples of parameters characterizing situations. This in turn *allows to search for information by situation* by giving parameter values and looking up the corresponding resource links. Both annotating and searching can be carried out with a mobile phone as well as from a stationary computer (see below).

Situations are characterized by . . .

- *spatial-temporal data*: the users' location, time, her/his speed

- *current areas of interest*: depending on personal preferences, whether the user is at home or abroad, . . .

- *personal data*: the languages (s)he masters, her/his age, possible disabilities

This entails the following annotations:

- *an arbitrarily shaped polygon* (the **Area** in which the respective **Info**rmation is relevant (eponymous for the project)), *a set of time intervals* (similar with time), *a speed interval*

- *a category*, e.g. tourism, transportation, warning

- *the language* of the web resource, *an age interval*, *disabilities*: hearing/visually impaired, ∼ mobility (indicates that the information contained is relevant to/suited for accordingly handicapped persons)

In due course (e.g. when novel sensors become standard in smart phones or data on the phone like calendar files become accessible by third-party applications), parameters can be added, provided they extend/refine the characterization of the notion 'situation' and can be determined automatically.

The information is given in form of a *brief description* and a(n optional) *resource link* (URL). As an alternative to specifying a (possibly dynamic, i.e. containing situation parameters) URL, a category-specific form can be completed to generate a web page (which is optimized for mobile devices).

Annotation can be carried out stationary as well as mobile by completing a web form (the polygon can be entered by click & drag on a map) (see Figure 3) or by walking along the polygon and adding a brief description (the remaining parameters and the URL can only be entered afterwards via the portal) (see Figure 2), respectively.

It goes without saying that web and internet are the natural choice for preparing and customizing information to be accessed and consumed via smart phones.

The *InfoArea*-system provides two "search" functions: *a situation-based mobile information service* and (as a by-product) yellow pages ordered by situation.

The mobile service can be used via smart phones. After downloading a mobile client the user can specify a category profile as well as languages, her/his year of birth, and possible

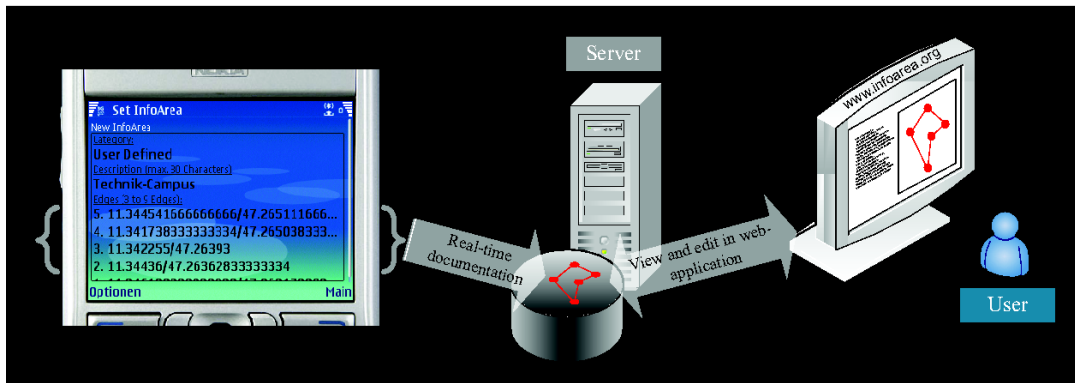Fig. 1. A click on the selected icon opens the respective web page.

Fig. 2. On-site real-time documentation (example shown: area with description annotated).

disabilities. When running, the client periodically determines the location of the phone, looks up the time, and computes the speed. This triple together with the category profile and the personal data is sent to the InfoArea-server, which returns a set of "matching" pairs, each consisting of a brief description and a URL. Each element is represented on the display of the phone by a category-specific icon. When selecting the icon the corresponding brief description is displayed, when clicking on it the respective web page is opened (see Figure 1). As soon as the linked content is not relevant anymore, the corresponding icon disappears.

The yellow pages can be accessed via desktop computers. When visiting the InfoArea-portal the user can select a map segment, set a time range, specify categories and languages, . . . the existence of matching information is marked on the map. When moving the cursor on the mark the corresponding brief description is displayed, when clicking on it the respective web page is opened.

When designing InfoArea we went further into two questions:
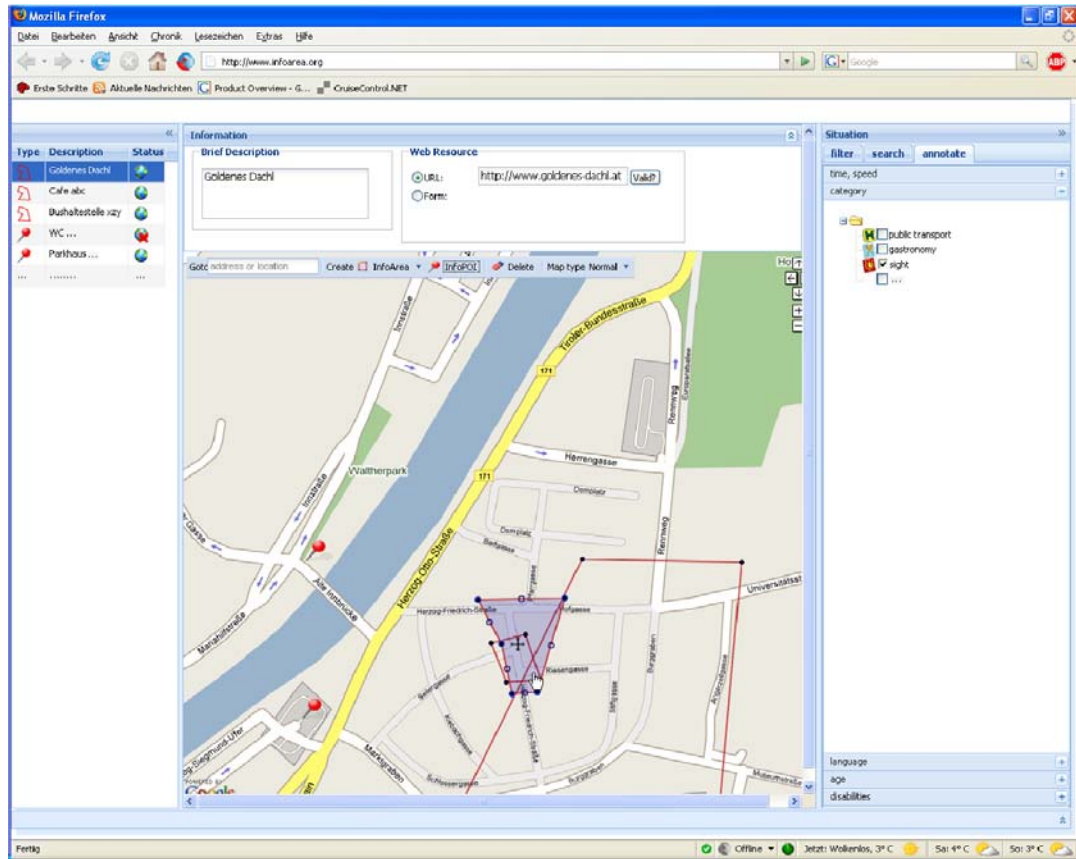
1. Are the acceptance criteria met?

Fig. 3. Annotation of web resources with situation parameters (the cursor indicates the position corresponding to Figure 1).

    2. Which additional functionalities should be provided?

Regarding the acceptance criteria (cp. Section 2, second paragraph):

- InfoArea is an open ("Web 2.0") platform (for an analysis of the huge success of 'user-generated content'-resources, see e.g. [5], [3])

- the mobile client can be installed by SMS-request and started like any other application

- the information search requires no interaction, its intrusiveness is category-specifically configurable (a standard reference on user interaction and interface design is [4])

- the service is free of charge

- all system/software components will be disclosed

Regarding additional functionalities, three facts were taken into account:

- *navigation* is an important service in mobile everyday life. In addition to standard map services, InfoArea also provides in the category 'maps' a 'point of interest'-map and a 'where is the nearest . . .'-function for each category.

- *maps* contain highly location-specific information. Therefore arbitrary (esp. local) online map services can be made available by specifying the area (entering the polygon) the map material covers and the URL template. If a user, who has selected the category 'maps', enters such an area, an icon appears (provided also the other parameters match). When clicking on it, a map segment will be displayed centered at the users' current position.

- *documentation* is the prerequisite for information. Therefore the InfoArea-client will provide documentation functionality: besides the mobile annotation function described above, which also can be used to simply virtually mark and tag a polygon, it will be possible to do the same with points and paths, the latter are recorded when activating a trace function.

4   InfoArea System Description

The basic structure and fundamental architecture of the InfoArea-system are shown in Figure 4 and 5, respectively.

The central component is a server cluster consisting of replicating peers each running a database which contains the resource links annotated with situation parameters. For the communication with clients JSON-RPC, a lightweight and fast protocol supported by most (mobile) platforms, is used. For access a Java™-API is provided, forming the basis for the web interface at the core of the portal and the mobile clients to be installed on the phones. The portal includes import/export functionality (e.g. from external sources/for offline use), an additional web interface allows to automatically create/(de)activate/delete database entries. Upon the launch of InfoArea the API will be made public to facilitate the development of further applications based on the system. Furthermore full sources will be made available under an appropriate open source license.

Mobile clients will be made available for the most popular platforms, initially for Java™ and .net™, as well as for the only recently released platform ANDROID™. In addition to an own location API an algorithm which smooths out outliers in the sequence of positions received from the GPS was developed and implemented. In order to reduce the amount of data to be transmitted for matching situation and information (drastically), each response to a request is attached the largest "spatial-temporal environment of the current situation" in which exactly the same information is relevant. As long as this "cell" has not been left (which can be checked client-sided) no further request is necessary. A detailed description of the method applied to compute (server-sided) and store (client-sided) these cells will be published separately.

5   Now, what's the use of InfoArea?

InfoArea can be used in many ways and for many purposes. Its usefulness can be demonstrated best by means of concrete examples.
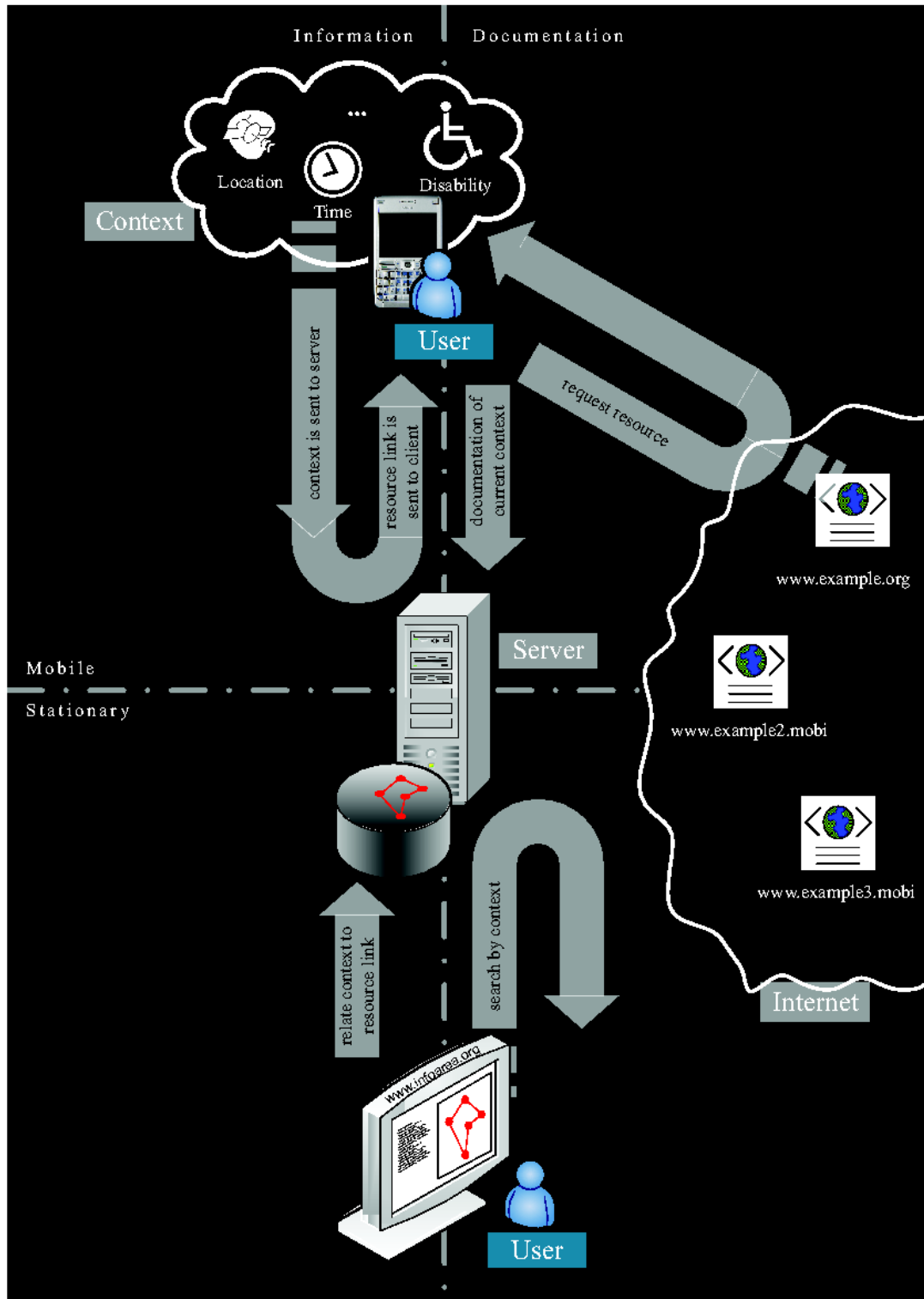
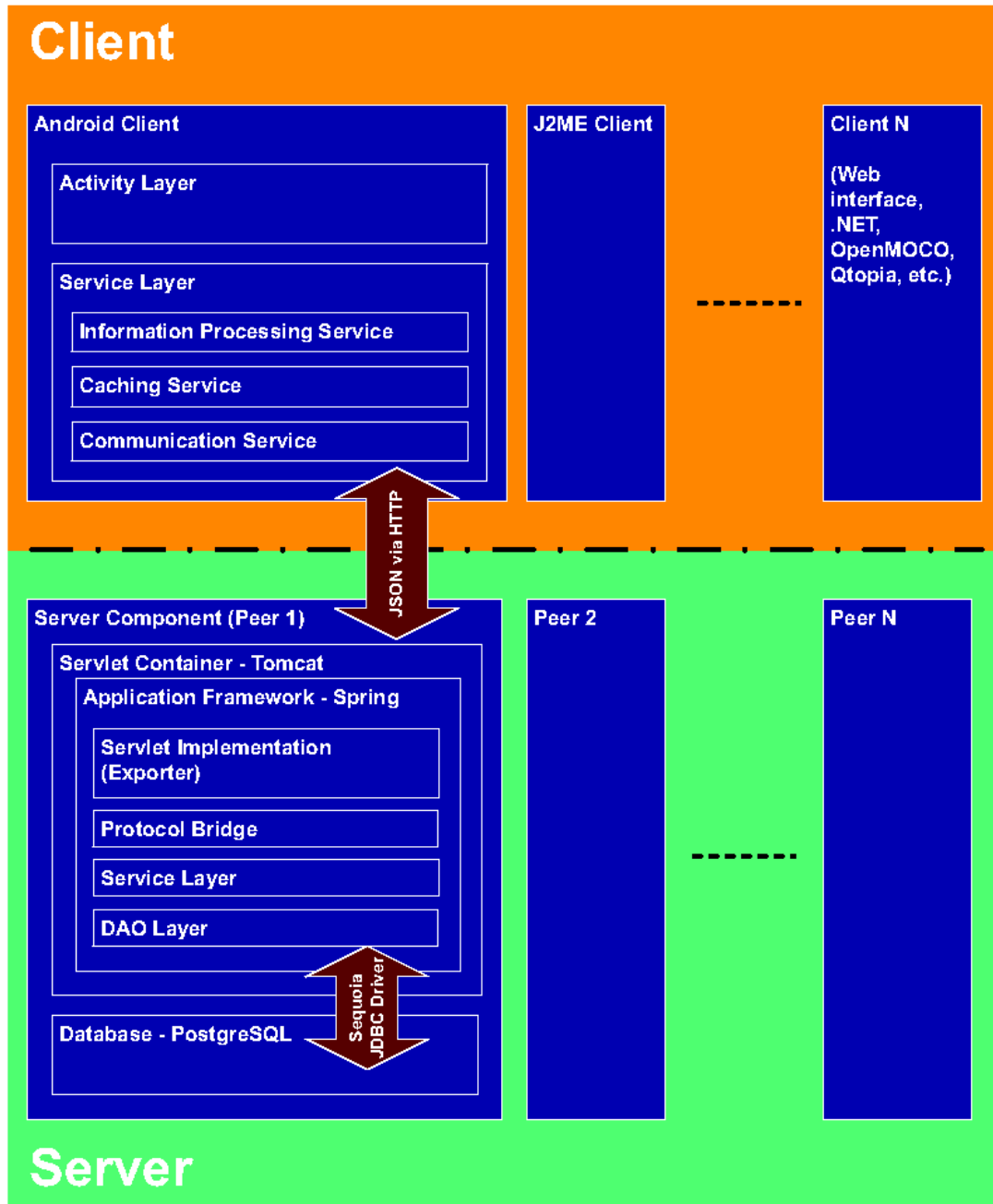Fig. 4. InfoArea system components and information flows.

Fig. 5. InfoArea software scheme.

First and foremost ... *virtual tagging of real entities*: besides countless classical applications like travel guides or walking guide books, InfoArea is ideally suited for providing information in spacious areas with permanently changing conditions, e.g. national parks or skiing areas, or in case of temporary or unexpected events like festivals or natural desasters. Also, issuing warnings (avalanches, pickpocketing, and speed traps), public art projects like Yellow Arrow (`http://www.yellowarrow.org`), and situation-based advertising can be realized easily. Furthermore, *provision of situation-based services* like virtual 'For Sale'-signs, "smart" bus stops, parking lots which indicate when a fee is required (possibly payable via smart phone), local event guides, and room reservation services for touristic areas is possible.

The *creation of situation-specific communication platforms* like virtual summit books/"odor marks" and situational blogs/chatrooms (e.g. on a campground or during an international mass event) will be made possible by providing the necessary web applications. The documentation functionality described in Section 3 allows for all kinds of *geo-related documentation*, including geological/biological/archaeological field survey, on-site mapping of isolated mountain paths and collecting data for projects like OpenStreetMap (`http://www.openstreetmap.org`), as well as real-time creation of a geo-scrapbook. Last but not least ... *outdoor games*, e.g. paper chase, geocaching, and ghost hunting can be played using InfoArea.

6   Making InfoArea part of your everyday life

The ultimate goal of the InfoArea-project is to establish a system that is useful to and used by a large number of people in everyday life.

Whether InfoArea will become widely accepted crucially depends on a number of factors, among others, the ones taken into consideration when designing it (see Section 2 and 3). In order to be able to overcome shortcomings and perform optimizations effectively it is planned to carry out acceptance studies.

Decisive for the success will be a "steep launch", i.e. the amount of information provided has to reach a "critical mass" within "half-life" in order to avoid running into a vicious circle resulting from the interdependency between the number of users and the amount of content: little content $\rightarrow$ low motivation to install mobile client $\rightarrow$ decreasing number of users ... too few users $\rightarrow$ low motivation to provide content $\rightarrow$ slowly increasing amount of content. In order to prevent such a situation there has/have to be as much content and as many users as possible right from the start. With the ever-increasing spreading of GPS-equipped mobile phones (accelerated by new technologies like incorporation of satellite positioning capability into SIM cards (see e.g. `http://www.blueskypositioning.com`) and the upcoming launch of the GALILEO-system) and the advent of data flatrates for mobile phones the two main limiting factors for the latter (many users) will disappear soon. In order to achieve the former (much content right from the start) a number of resources/services of general interest are prepared/implemented, e.g. all georeferenced WIKIPEDIA articles will be annotated and included; furthermore an extended 'where am I'-function (incl. altitude, geopolitical information, currency converter, ...) as well as a weather service will be offered.

In order to inspire the use, exemplify the possibilities and perform first on-road tests of the system/concept already now several cooperations to implement real life applications based on InfoArea are run. Amongst others at the 'Institute of Biology and its Didactics' at the University of Dortmund a complete zoo guide for the 'Dortmund Zoo' individualized by

language (German/English/Turkish) and age (children/teenagers/adults) is developed; furthermore CLOCKSTONE, an Austrian company specialized in developing game and multimedia applications (`http://www.clockstone.com`), will design an outdoor game.

The launch of InfoArea is planned for spring 2008.

Acknowledgements

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