



## Editorial

# How do location-based services hit Google?

Location-based services (LBS) have triggered a tremendous interest in both industry and academy. The interest can be measured by the number of hits using, for instance, Google search engine. The number returned from Google indicates the amount of web documents available on the Internet. Since only about 20% of online documents are indexed by search engines, the actual number of documents related to a particular search subject should be much higher than the number of hits returned. Nevertheless, if we key “geographic information systems” and “location-based services” into Google, it reports about 834,000 and 48,200 related documents, respectively (dated on August 15, 2005). We tried to avoid using their abbreviations GIS and LBS, whose hits would be much higher, as both abbreviations could represent something else. For instance, GIS could stand for Gen Mills Inc. or LBS for London Business School.

There are many LBS related terms. The relevant terms can be grouped into two major categories: those emerged from IT and those from geospatial information science. For the first group, telematics, ubiquitous computing, pervasive computing, context aware computing and location aware computing are often used terms, whereas the second group includes location-based services and geographic information services. There has been growing convergence and intersection of IT and geospatial communities, so some terms were suggested by geospatial scientists, e.g. telegeoinformatics and ubiquitous GIS.

We used the general Google ([www.google.com](http://www.google.com)) for the number of search hits or the related documents about a certain term, and a specialised Google ([scholar.google.com](http://scholar.google.com)) for that of more scientific documents. To some extent, the documents from the two search engines could overlap, and the exact number of documents or hits may not truly reflect the situation in reality, as there are plenty of printed documents that have not been put online yet. However, our primary interest is NOT in the absolute number, but rather on how the number varies from one term to another, from one category to another, or from the Web Google to the Scholar Google search engine. The variations could be a good indicator for the current development of LBS from various perspectives.

From [Table 1](#), we can observe that LBS related topics in IT community are much more popular than in geospatial community. Among others, telematics, ubiquitous computing and pervasive computing are the most popular terms. Not to our surprise, Google hits for individual terms are much higher than Scholar hits, as scientific documents are just one specific kind of web documents. However, there seem to be a significant correlation

Table 1  
Number of hits for LBS related terms with Google

	Google	Scholar
Telematics	1,180,000	20,500
Ubiquitous computing/ubicomp	566,000	13,700
Pervasive computing	469,000	8480
Context aware computing	33,200	481
Location aware computing	8930	127
Location-based services	48,200	354
Geographic information services/GIServices	3730	84
Telegeoinformatics	718	21
Ubiquitous GIS	792	16

(Note: The data were collected around August 15, 2005, and today's hits are surely different).

between the two kinds of hits (see columns Google vs. Scholar). It implies that there is no much difference in people's use of the terms in both non-scientific and scientific communities. In other words, the level of popularity of the terms for the general public and scientists is similar. Despite the small sample, both Google and Scholar hits seem to follow a power law distribution. Taking the Scholar hits for example, telematics has an extremely high number of related scientific documents, up to 20 thousands, whereas most others just have a few hundreds and even less. The relatively small number of hits for "ubiquitous GIS" (very similar for UbiGIS) shows how new and forward reaching this specific research area is, but we expect a much higher number in the future. Furthermore the numbers show that LBS is now the much more accepted term in comparison to its equivalent "Location Aware Computing". The numbers also indicate higher general interest in LBS than in Context Aware Computing, while Context Aware Computing has now outnumbered LBS in terms of scientific hits. This indicates that researchers are now already striving to incorporate more context parameters into their applications while today's general real world applications still are primarily focussed on location as parameter for mobile applications. We consider the convergence of these two aspects—location and context—as one of the major topics in the future research on LBS and GIS.

### About the papers in the special issue

The papers that follow are related to the topic of LBS and GIS. The first paper in the issue presents an overview of current development on LBS and GIS from various modelling perspectives involving users, locations, contexts and data. The authors compared the modelling aspects to the University Consortium for Geographic Information Science research agenda on GIS, and some research themes on LBS were highlighted. The second paper takes a specific step toward the capture of users' preference and information requirements using an immersive virtual environment. The experiment was based on a conceptual model with information interaction between three related components: individuals, environments and mobile devices. Using human wayfinding tasks as a basic scenario, the study illustrates clear preferences in information requirements and how the preferences changes in response to various factors. The third paper deals with location modelling, i.e. to predict future locations of a mobile user. Both probability-based and learning-based prediction models were compared and it is found that the learning-based model is more flexible

because of embedded context information. For some LBS applications like vehicle tracking, accuracy is an important aspect for location modelling. The following paper reports an experiment for locating vehicles using the global positioning system and odometer observations. The authors of the paper developed a system to estimate and calibrate vehicles' position at a very short time interval. The fifth paper in the issue deals with real-time map labeling of line and point features in mobile maps. Finally the last paper presents results and experiences from implementing adaptive mobile GIServices for supporting pedestrian navigation. Hereby the authors present new ways of explicit modeling of relevant aspects of the context, user and situation by the means of ontologies that then are used in the task of adapting the realized GI-services to these parameters. In contrast to most other implementations of LBS the adaptation process is actually being supported by machine-learning algorithms inferring user preferences etc. Realized examples include tour-planning and adaptation of mobile maps.

The set of papers as a part special issue on LBS and GIS emerged from Geoinformatics 2004 and the post-conference workshop on ubiquitous GIS ([www.hig.se/geoinformatics/](http://www.hig.se/geoinformatics/)). All the papers were peer reviewed, and substantially revised afterwards. Based on the revised version, all the papers in the issue are cross referenced. We hope the special issue is valuable to the literature in LBS and GIS. We as guest editors would like to thank all authors for their contribution and collaboration, and more than a dozen of referees who put time aside to review papers. Special thanks go to Daniel Z. Sui for his advice in the course of the editing process.

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