

Designing maps for LBS

Responsible persons:

Alistair Edwardes

(Overall)

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1. Designing maps for LBS

Learning Objectives

- With an emphasis on cartographic portrayal, you will be able to analyse scenarios for location-based information use, and describe the construction of map-based services to meet these needs in terms of the data contents, interaction and presentation of information needed.

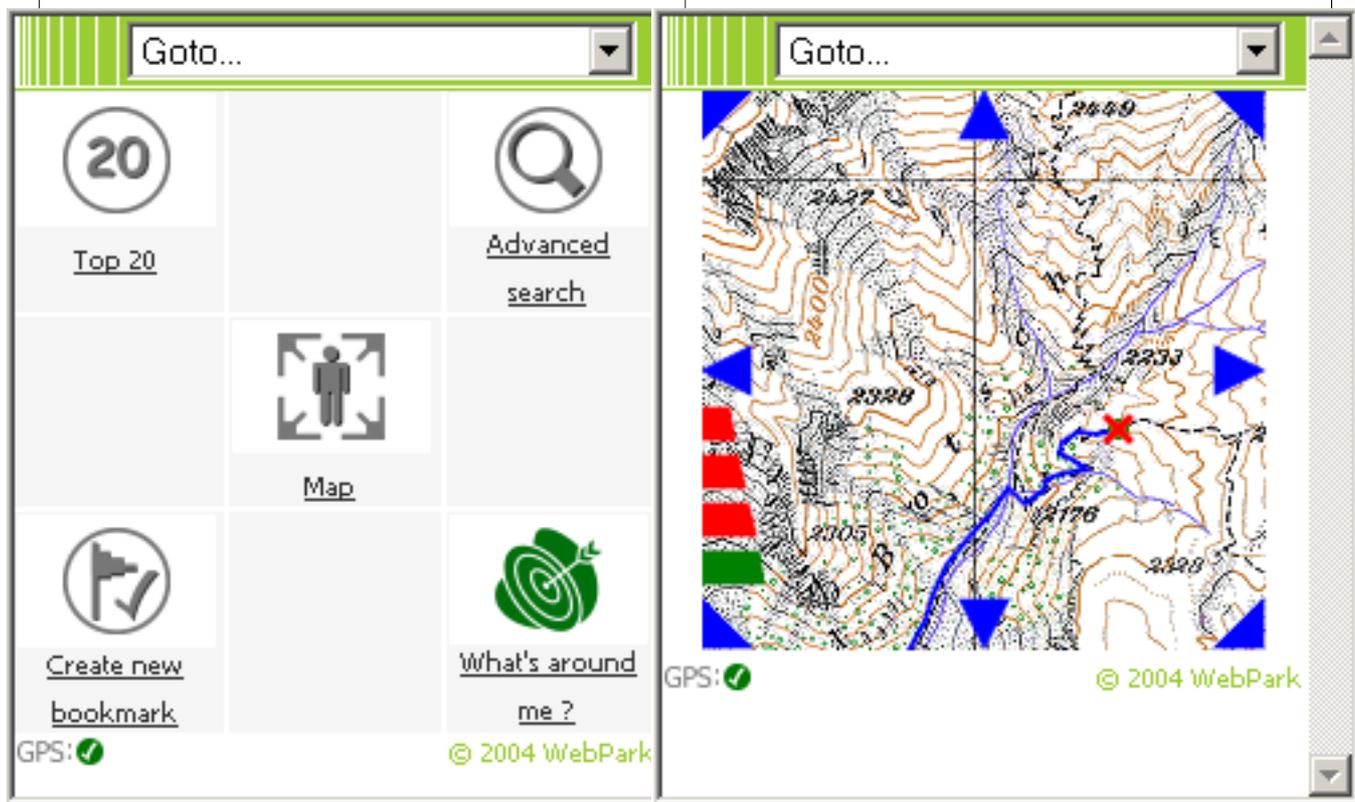
Introduction

Maps play the main role for communicating information and allowing users to interact with a location-based service. As such, maps not only present visualisations but also provide an interface into data holdings, allowing users to select particular views of the information relevant to their tasks and context. Maps resulting from this process are different from more conventional paper maps because they are compiled dynamically. The information they contain is ephemeral and relevant only to the moment at which they are needed. These aspects to map use in an LBS require special considerations for their design. It needs to be possible to define which data items are relevant to a user at a particular time and how they should be visualised to enhance their relevance. In addition, how the user can interact with the map interface needs to be considered as well as how different types of media related to the data, e.g. textual descriptions, photographs etc. can be integrated with it.

In this lesson you will learn about the differences between conventional maps and maps for location-based services. Based on these considerations you will look at different issues related to the compilation and design of a map and the map interface. These include the data required and aspects related to its relevance and use, the functionality that it needs to provided and the graphical design of the map itself. These different aspects are described within the integrated concepts of the model (data), the view (map) and the controls (functionality).

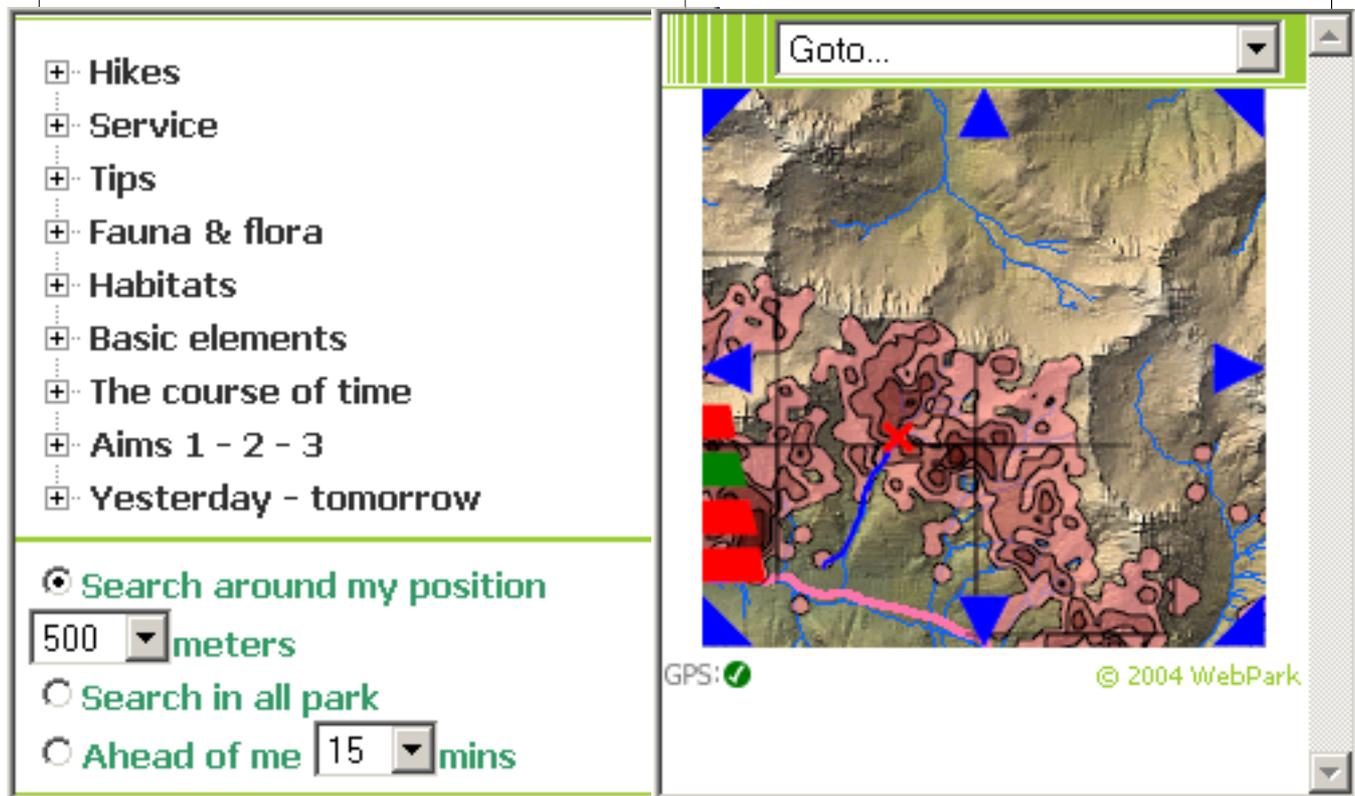
Designing maps for LBS

Interfaces from the Webpark project



Service selection interface

Main map interface



Advanced Search

Density surface of animal observations

1.1. Map-based Services

Learning Objectives

You will be able to ...

- describe the difference between a service and product, and provide examples of each in terms of geographic technologies.
- discuss how the (SHIP) characteristics of a service relate to the design of an LBS.
- differentiate the three components; Model, View, Controller, in relation to the architecture of a map-based LBS.

Introduction

Many people have noted that location-based services possess a special property. They allow using spatial information to be integrated with direct experience of the world. For example, Longley (2004) comments: "direct and indirect experience blurs when handheld devices are used as an adjunct to reality in the field. Spatial knowledge acquired through interaction with 2D maps ('map reading'), is usually taken to be the most advanced level of spatial knowledge." Similarly, (Armstrong et al. 2005) note: "Contextually aware in situ learning environments will enhance learning by coupling direct interaction with real-world phenomena and immediate access to associated knowledge repositories." Arguably, such comments could equally be made of any geographic information repository used 'in the field', for example paper maps, a printed out route plan, or a mobile GIS. So, what makes location-based services different from these substitutes? In this unit we consider this issue in terms of the S in LBS; Services. What is a service? And, how does being a service differentiate LBS from other media for geographic information? Based on these observations, we will then consider how being a service effects the design of maps.

1.1.1. Products and Services

In economics there are two types of item that can be paid for; products and services. When you buy a product (sometimes called a good), you become the owner of something physical. When you buy a service, you don't own anything. Instead what you obtain might be an experience, an idea, a piece of knowledge or advice. The definition of a service in economics terms is very broad. It includes getting a hair-cut, watching a film or even learning about LBS as you are doing now.

Tick whether the following are products or services

The SHIP Acronym

den Hengst et al. (2004) use the economics definition of a service to describe mobile information services. They define four characteristics of a service using the SHIP Acronym:

- Simultaneously produced and consumed. The user and producer of the service are both assumed to be present during a transaction. Hence, they co-produce the service.
- Heterogeneous. Every service produced through interaction is unique to a certain degree.
- Intangible, purchase of a service does not result in a physical object
- Perishable, The value provided by a service is gone when it is consumed. For example, it the service cannot be resold.

We can consider these characteristics in relation to user accessing a map with an LBS and using a paper map.

SHIP Characteristic	LBS Map (Service)	Paper Map (Product)
<u>S</u> imultaneously produced and consumed	The map is defined by the user at the moment when they need information.	The map is predefined by a cartographic agency.
<u>H</u> eterogeneous	Different maps are produced according to the nature of interaction (e.g. showing search results), the interests and context of the user (e.g. activity).	The map is generic (supporting a broad range of different users and activities) and static (independent of location and time of use).
<u>I</u> ntangible	An LBS map is virtual, it is an electronic medium.	The paper map is physical it can be held, folded, written on etc.
<u>P</u> erishable	LBS maps are relevant to a particular interaction and situation and after that their usefulness is gone.	The map continues to exist after it has been referred to. It can be re-used and re-sold if desired.

The Product-Service Continuum

Most things are not purely a product or a service, but exist somewhere in between, having both service and product components. For example, going for a meal at a restaurant involves both a product; the food, and a service; the ambiance, the waiting, the creativity of the chef etc. Goods can therefore be seen along a continuum ranging to pure service to pure product. Explore the continuum for a variety of geographic technologies using the animation below. Move the slider to look at different technologies along the continuum. Moving your mouse over the graphics that appear gives more information about the technology.

Location-based services are not pure services in several ways. Can you suggest some of these based on the SHIP characteristics?

- *LBS maps and services may be stored on the device and used at a later time (e.g. a guided tour of a city). So they are not always simultaneously produced and consumed.*
- *Parts of the information may be quite generic, static, and relevant to many users and activities, for example a series of topographic base maps used for orientation, in this sense they are not completely heterogeneous.*
- *LBS requires a physical device to be accessed so, to some extent, services are not intangible.*
- *The information produced by a service can be current for an extended period of time, for example the plan of a journey, so to a degree they are not perishable*

1.1.2. Service Design

Model-View-Controller

The service aspects of LBS mean that maps cannot generally be prepared in advance. They must be created at the moment they are needed. Producing maps in this way is termed 'on-demand' or 'just-in-time' mapping.

Service Components

In a location-based service, a provider allows user`s to access information resources, according to their interests and needs at a particular time and place. Information relevant to a user is then presented visually in ways that are adapted to suit the context of use. This description emphasizes three of the important aspects that need to be considered in an LBS design; the information itself (the map content), the interaction, and the visualization. Components realizing these aspects are commonly referred to as; the model, the controller, and the view.

Collectively these components can be described in relation to the model-view-controller (MVC) design pattern (Gamma et al.). MVC is used in almost all interactive computer systems, be they software products or Internet services. MVC will be used as a conceptual design model to organize the remaining units of this lesson.

Model

The model relates to the to the information sources that will be used to create an LBS map. It consists of the data itself as well as filters and functions that operate on the data. Because information sources are largely developed to suit a broad range of uses and situation, the model is the part of the service that is most similar to a product. The model includes:

Spatial data	Base maps, routes, and locations of places and objects of special interest, real-time data (e.g. traffic incidents)
Descriptive data	Descriptive text, photographs, video, and sounds related to the spatial data
Operations	Filter, search and update the information resource, perform processing on it (e.g. find the nearest, find the shortest route)

Controller

The functions of the controller are what makes the service heterogeneous and simultaneously produced and consumed. It interprets the user interactions with the device and the changes in their situation (e.g. location) and based on this specifies the contents that are relevant for display on the map. Essentially it provides the logic of the system. It includes:

Map Controls	Control map navigation (Zoom, Pan etc.)
Spatio-temporal Filters	Filter information according to the current location of the user and the time of use
Semantic Filters	Filter information according to themes relevant to the user's interests and activities(e.g. Italian restaurants)
Search	Allows the user to interactively look for descriptive and address based information

Designing maps for LBS

View

The view handles how the relevant information is presented to the user, e.g. graphically with a map or a text based or audio route description. It relates most closely to the intangible and perishable aspects of the service.

The view includes:

Cartographic Display	Maps, Geographical descriptions e.g. routes
Textual Display	Web pages containing descriptive text and multimedia
Presentation rules	Map styling rules (e.g. which symbols to use for points-of-interest), style-sheets (e.g. for styling and laying out web pages)

MVC Interaction

The interactive animation describes how the MVC model works together. Use the four controls in the middle to see how the map is changed. The checkboxes in the middle marked 'Hotels' and 'Cafes' change the map theme.

The plus and minus buttons below these change the scale.

1.1.3. Summary

In this unit you learned why map-based LBS are different from other map media. In particular you saw how the need to support the dynamic generation of maps requires a separation of a service into data, interaction and presentation based components.

1.2. Model content

Learning Objectives

You will be able to ...

- distinguish between background and foreground information and provide examples of each.
- list criteria to evaluate data for use in an LBS and describe how it can be transformed to meet needs for information.
- describe issues involved in evaluating data for use in an LBS, and highlight the relevance of data items to different activities.

Content for Location-Based Services

"Content is king" in location-based services. Fortunately, there is a wide variety of data available that can be combined to provide content-rich services. However, to create useful services we need to be able to decide which data is appropriate for us. In this unit we shall look at the different types of data available and learn how to evaluate them with respect to our own needs.

1.2.1. Types of Geographic Information

Background and Foreground

Most location based services will consist of a mixture of two general types of information; Background and Foreground Information.

Background

Background information describes the geographical setting for users' activities. It is used for orientation and provide a framework for integrating the special purpose, foreground, information. Generally, background information is static, appropriate to many different activities and ready to use without much alteration. It is usually obtained from map product agencies (e.g. National Mapping Agencies). Typical background information includes; topographic base maps, land-cover, satellite imagery and aerial photographs.

Foreground

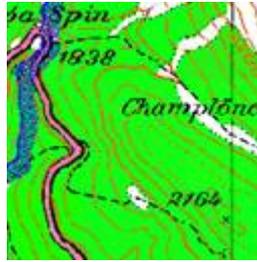
Foreground information is more special purpose information that will be dynamically filtered and adapted to suit a users' interests and context. Generally, it is provided by information service providers as feeds of raw data, for example 'yellow-pages' providers. As such, it needs to be processed to integrate it within an application, for example, so that it can be displayed on a background map. Typical foreground information includes; points-of-interest, services of interest and driving restrictions information. The animation shows examples of different types of foreground and background data used in LBS.

Only pictures can be viewed in the PDF version! For Flash etc. see online version. Only screenshots of animations will be displayed. [\[link\]](#)

Examples of Content

Background Data

Base mapping – topographic vector and raster data sets over a range of scales. They include; road networks, railways, building outlines, elevation data and administrative boundaries.



Imagery - satellite, aerial and terrestrial imagery for visualisation.



Designing maps for LBS

Foreground Data

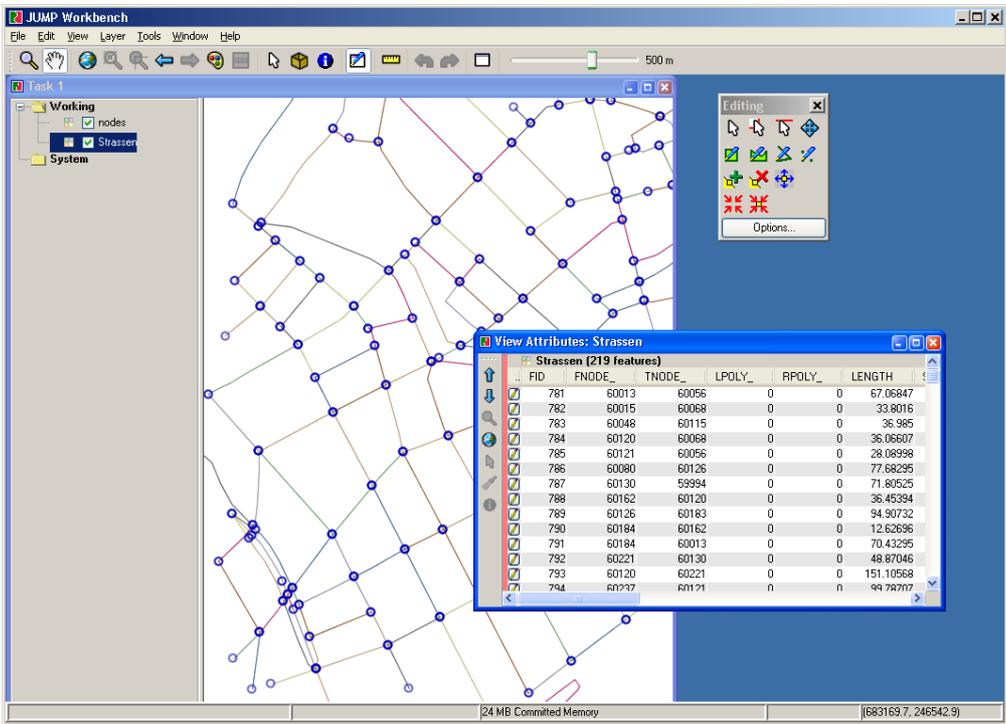
Points-of-interest - various categories of prominent places and landmarks (with attributes)

	<p>In the depths of the countryside Service - Accommodation - Chamanna Cluozza</p> <p>The Cluozza hut is in the midst of the Cluozza valley, where the National Park began.</p> 
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Services-of-interest - geocoded electronic yellow pages / business directory with detailed attributes of each service including URL links to Web pages.

	<p>Medische Post Logistiek voor uw bedrijf - Gezondheid - Artsen</p> <p>adres : Nkadel nr. : 17 Postal Code : 1796 BP Stad : De Koog Tel : 0222-327270 url : n/a</p> <p>Extra info : In het hoogzeiben: Vakantiegangers die medische hulp nodig hebben kunnen in de zonnemansuren van 8 tot 17 uur</p>
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Navigation data - public transport routes, street-level routing data including one-way systems, driving restrictions (e.g. no entry), key signs and other road furniture such as traffic lights and bus stops.



The screenshot shows the JUMP Workbench interface with a network of roads. A 'View Attributes: Strassen' window is open, displaying a table of road features.

FID	FNODE_	TNODE_	LPOLY_	RPOLY_	LENGTH
781	60013	60056	0	0	67.06847
782	60015	60068	0	0	33.80016
783	60048	60115	0	0	36.985
784	60120	60068	0	0	36.06697
785	60121	60056	0	0	28.08998
786	60080	60126	0	0	77.68226
787	60130	59994	0	0	71.80525
788	60162	60120	0	0	36.45394
789	60126	60183	0	0	94.90732
790	60184	60162	0	0	12.62636
791	60184	60013	0	0	70.43295
792	60221	60130	0	0	48.87046
793	60120	60221	0	0	151.10568
794	60232	60121	n	n	99.78707

Sound clips - such as commentaries on features of interest and prerecorded navigation instructions.



Moving image clips - for example from Web-cams

<http://www.e-cartouche.ch/convrighth.nhn> - Version from: 6.8.2008



1.2.2. Fitness for purpose

Making sense of all this data requires us to consider what is important to the user of a service and what is irrelevant. (Brodersen 2001) list 4 aspects that must be initially considered to create a useful map product. These are equally important to define a service:

- Purpose – Why is the service being created? What is the value for the consumer and producer? For example, to make road travel more efficient and less stressful, or to provide education and information.
- Target Group – Who will use the service? For example, car drivers, business people, tourists, teenagers.
- Aim – How will the map service look? For example, "The service will run on a PDA. It will show a map of central Zurich, allow visitors to find places and services of particular interest and navigate to these using landmarks"
- Context-of-use – How is the service to be used? For example, in the hand of a user while they are walking around, secured in a cradle inside a car or on a bicycle.

Having created such a specification, you should be able to come up with a list of questions that the user is likely to pose using the service. For example; Where am I? Where can I find an Italian Restaurant? Where is the post office? How can I get to the post office by bus? etc.

Look at the picture below, develop a scenario for usage based on the 4 criteria previously discussed. Suggest 5 questions that a user might ask of such a service.



1.2.3. Evaluating data for LBS

Evaluation Framework

Having determined the pragmatic aspects of a service, different resources of available foreground and background data can be assess in terms of their usefulness. (Raper et al.) describe a framework with which geographic information (GI) can be evaluated. It consists of two main components; the representational and the communicative.

Representational component of GI

The representational component of GI relates to the structure of the data. This consists of 3 levels at which it can be evaluated: *List contents to go in an animation*

- Ontology – How is the data organised as concepts (entities and their inter-relationships). Are these appropriate to the context of use? Can they be translated easily into other terms?
- Modelling – Spatial data can be modelled in many different ways. For examples, roads can be modelled as centre-lines or as areas, points of interest might be described by a coordinate or an address. The issue is then to consider if the data model is appropriate for use in the service or if it can it be satisfactorily transformed. Data will also have been collected at a particular scales or resolution. This can result in problems when combined. For example, a point-of-interest surveyed at 1:50,000 might fall on the wrong side of the street when used with road data at 1:25,000.
- System – Data can be found in many different formats (e.g. AutoCAD DXF, ESRI Shape, comma separated values) and media (e.g. spatial and non-spatial databases, CDROMS, text files). Some formats are relatively open to integrate in a service, e.g. text files, others are more proprietary and require special readers or software to use.

Use the animation to explore different types of models and ontologies. Here, two ontologies are defined based on a single dataset, one for drivers and one for pedestrians. On the map these are visualised using different color schemes. Two different types of model for spatial data are also shown. One is based on a linear network the other models all features as areas.

Which model do you think is more useful for pedestrians and drivers respectively?

Pedestrians move in spaces that are relatively unconstrained, hence a model of space that is based on areal objects is often more appropriate. Drivers, on the other hand are constrained to move along roads, with driving decisions need to be made at junctions between roads. Thus a spatial abstraction that is based on a network is often more useful.

Communicative component of GI

The communicative component of GI relates to how it can be explored by users and how it can provide a basis for deriving knowledge. It comprises four levels for evaluation:

List contents to go in an animation

- Utility – How well does the information relate to the tasks of a user? Does it fill gaps in the knowledge they require to undertake their tasks? Is it current?. For example, an in-car navigation system may benefit from information about traffic incidents, but only if this information describes road conditions at the time they are required.

- Exploration – Can the information be visualised? Can it be integrated with other information? Can it be related to the user's context? Can it be searched? For example, a scanned image of topographic map can be explored visually, but the map features cannot be integrated easily with other information and cannot be searched for.
- Commodification – Because services are intangible, it is difficult to describe to consumers what they are paying for. Commodification relates to how the information can be package as units that can be priced and offered. The user can then weigh up the value they are obtaining and decide if it is worth paying for.
- Management – Information decays over time if it is not properly managed. It must be kept up-to-date if it is to remain useful. For example, if a new road is built, it needs to be added to the database. Management deals with the on-going process of database maintenance. Data that is collected in a one-off survey or added manually based on an individual's own knowledge is very difficult to manage because an update process cannot easily be defined.

1.2.4. Summary

In this unit you learned about some of the many sources of information that can be used in LBS and saw how these are employed in different ways within an application. You then learned how to specify an LBS in terms of the needs of users and how to evaluate different information sources in respect to this specification.

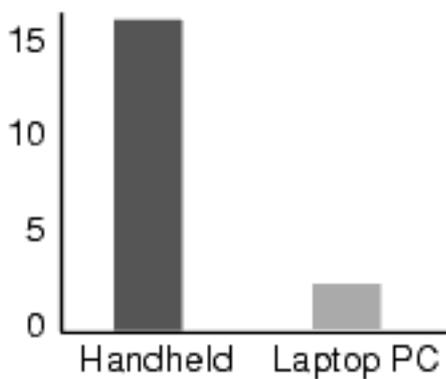
1.3. View design

Learning Objectives

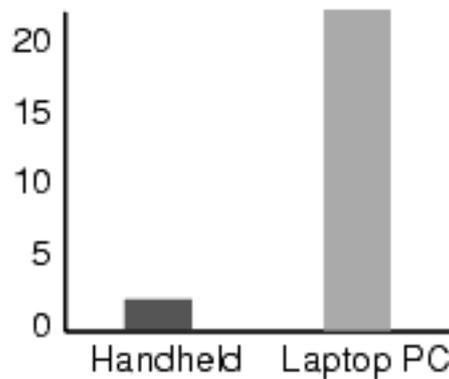
You will be able to ...

- describe different forms of point based information and issues related to their presentation.
- list different ways in which such information are relevant to the users at different moments.
- suggest how relevance can be communicated graphically so that it can be described dynamically during the course of an activity.

Introduction



Accesses per day



Average session time (minutes)

(Ostrem 2003)

LBS usage tends to be based around short and frequent interactions with a device rather than the browsing behaviour that is employed for other types of computer access. This means that relevant aspects of information must be communicated to users rapidly and effectively. As we have seen in the previous unit, LBS data have many attributes that can be described. The problem is then to decide which are relevant and how they can be communicated visually. In this unit, we will focus more on design issues involved presenting information to users in appropriate ways.

1.3.1. Points-of-Interest

Types of POI

Users of location-based services need to be able to tap into diverse sources of data and visualise these dynamically with maps. In the previous unit, we described this type of information as 'foreground'. The most common type of foreground geographic information are items of data that have been associated with points. Such data are often described as "Points-of-Interest" or POIs. This term highlights the main cartographic aspects of the information, i.e. as points containing special purpose information, but hides the differences amongst the various sorts of POIs. We can distinguish a number of types of POI relevant to LBS

1.3.2. Dynamic Portrayal

Adaption

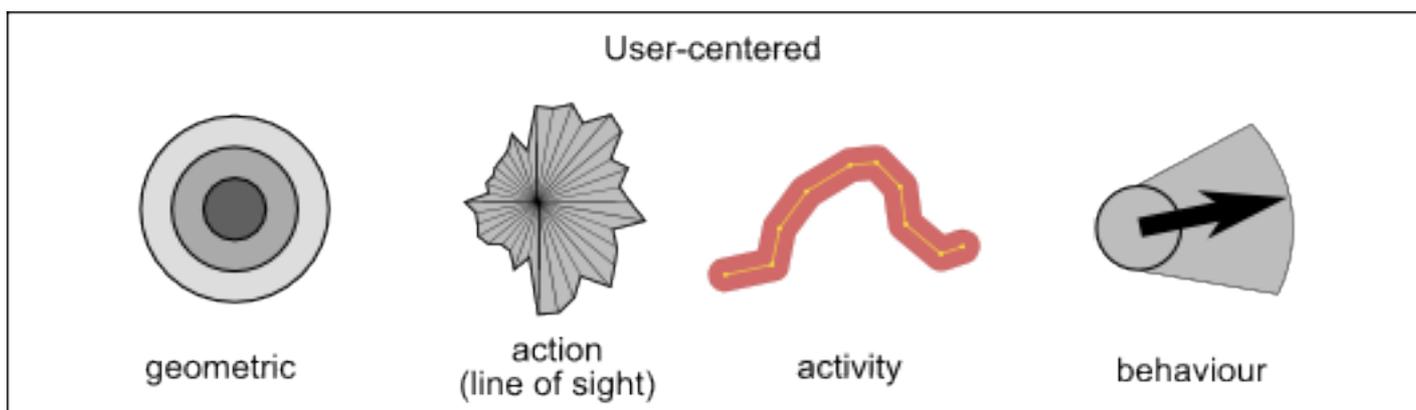
Different POIs will be of more or less interest to a user at different times and locations. A goal of LBS map design is to portray information in a way that is most useful to their needs at a given moment. Previously in Lesson [LBS Basics Unit3](#) this was touched on in terms of adaption. There it was illustrated what adaption was and how it related to context. Here we will explore this idea more in relation to how adaption can be related to importance.

Scope

In the last unit we considered the different types of relevance: activity, spatial, temporal, and thematic. At a given moment of time each of these will have a different range over which they are relevant. This range is called the scope (Edwardes et al. 2003). The simplest example of this might be the distance a POI is from the user.

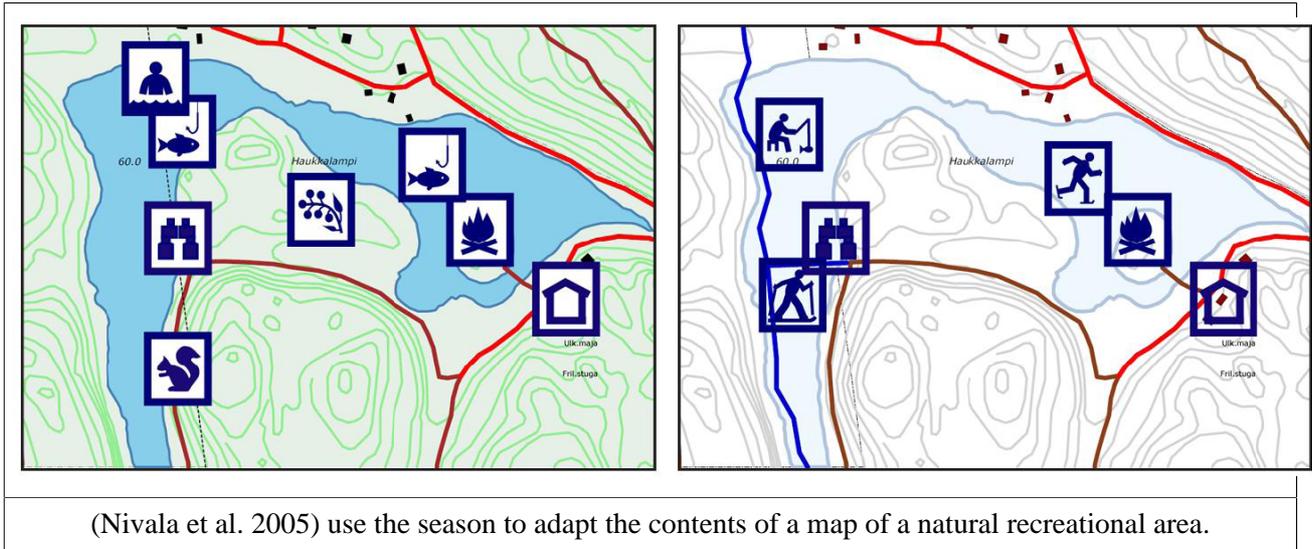
Spatial Scope

The spatial scope describes the relevance to *where* you are. The scope can be modelled in different ways. The simplest is based on the geometric distance from a users location. More complex methods involve considering what the area visible to a user at a particular moment (this is important in applications such as tour guides), the space over which their activities will take place (e.g. a route they will drive along), or a distance that also takes into account where their behaviour and the direction they are headed, if they are moving. Spatial scopes can also relate directly to a place or region where the user is located. For example, "at the office" or "downtown".



Temporal scope

The temporal scope describes *when* information is relevant. The most obvious range is the time of day, for example the opening hours of a shop. The day of the week is often also important. For example museums are usually closed on Mondays. The season of the year will also define a relevant interval. For example in an alpine recreation area skiing might take place in winter and hiking in summer. Some types of information will have an age. In an LBS describing animal observations, the observation will have taken place at some time in the past and the age will be important.



Activity Scope

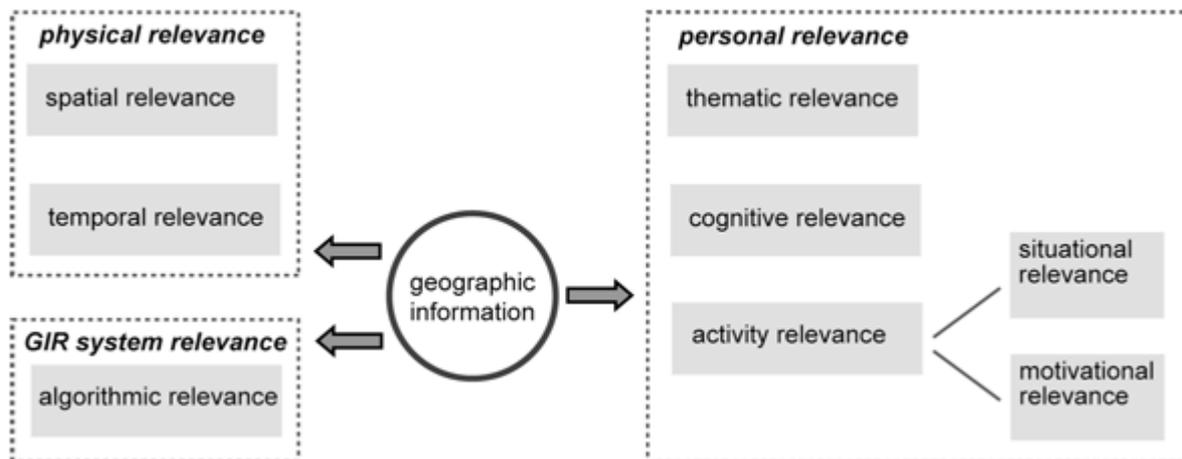
The scope of an activity relates to the resources and places that are relevant to the tasks involved in performing it. For example, in an LBS for car navigation resources might include petrol stations and rest areas, and places include junctions where navigation decisions must be made. The scope of an activity changes depending on the current task of a user. For example when planning a journey the start, destination and major intermediate landmarks are the most important, whereas when actually driving the junctions and turning actions that need to be performed there are more relevant.

Thematic scope

The thematic scope relates to the identity and personal preferences of the user. As such it can be quite broad. Important types are the user's age, their social situation and personal preferences. A thematic scope based on age for instance might filter bars and nightclubs from very young people. A social scope might filter out people not known to a user in a friend finder application. Thematic scopes including personal preferences might cover aspects such as the types of ATM they can use, how expensive a service of interest is, or their likes and dislikes (e.g. never showing fast-food restaurants).

1.3.3. Assessing relevance

Petrol finder



(Reichenbacher 2005) identifies different types of relevance, here we focus on his four main types:

- Activity relevance – how is the information relevant to what the user wants to do?
- Spatial relevance – does the information vary spatially, so that it is relevant to the user's changing location?
- Temporal relevance – does the information vary over time, so that it is relevant to the time when it is accessed?
- Thematic relevance – what particular aspects or properties of the information have special relevance to the user (e.g. brand of a restaurant)?

We will use these ideas about relevance to identify useful information contained in a database describing petrol stations. This is drawn from a real information service provider (Catalist). The dataset includes all manner of information about the situation, functions and services of the stations. These will be relevant in different ways for different types of service. You will need to mark each data item as either irrelevant or; activity, temporally, spatially or thematically relevant, in relation to one of three car journey tasks. The activities that you can choose from are:

- Finding fuel
- Stopping for a rest break
- Last minute shopping.

The aim of this exercise is to analyse a real data resource and identify which data items are most relevant to the activity chosen, in relation to four main types listed above. Selecting an item from the list in the left hand box allows you to mark whether you think the item is relevant spatially, temporally, thematically or with respect to the theme. Mainly an item will only satisfy one of these criteria, but you may have reason for selecting more than one relevance type. Your selections for each item will be shown together in the lower box. Discuss your choices with your fellow students and have your tutor review your analysis (if required, you can select the text of the lower box and save your final analysis).

Only pictures can be viewed in the PDF version! For Flash etc. see online version. Only screenshots of animations will be displayed. [\[link\]](#)

Questions to consider

How might the different types of situation information be used in different forms of information portrayal of your services (e.g a map or a set of text-based route instructions)?

Latitude and longitude data is most useful when you are portraying information as points on a map. However for route descriptions knowing the address and the main roads served is often more useful information.

In deciding how to define a symbol style for a petrol station on a map you will be limited in how much information you can present in the graphic. Hence you should only show what you consider to be the most important data items. What type of relevance and which data items would you use as the main criteria for defining a symbol graphic?

You will most likely use the activity relevance to decide whether to show a petrol station or not. Mainly, you would then want to use one of the data items that is thematically relevant to define the style of the graphical symbol itself. In the next unit you will see how you can apply subtle changes to the graphic to then communicate further information about relevance.

How would you present the remaining data items to the user?

You will want to provide links to more detailed descriptions about a particular petrol station. On an interactive map you might link to a web page when the petrol station is clicked or a pop up a box containing more details when the user moves their stylus over the POI.

1.3.4. Portraying relevance

Classes and graphical variables

Relevance classes

On a map we want to show the differences amongst points of interest items in relation to how important they are to a user. We can define 3 classes of measurement for relevance.

Relevance class	Meaning	Example
Binary relevance	An POI is either relevant or not	A museum is closed or open
Ordered relevance	An POI is more or less relevant	The distance a POI is from a person
Highly important	A POI is of immediate concern	An road accident on a route

Graphical variables

Based on the classes, different methods of to change the presentation of the POI and communicate its relevance.

Only pictures can be viewed in the PDF version! For Flash etc. see online version. Only screenshots of animations will be displayed. [\[link\]](#)

1.3.5. Summary

In this unit you learned about how different types of foreground information are presented in LBS as points of interest. In particular, you learned about how to adapt the portrayal of these to communicate additional information about relevance.

1.4. Control and interaction

The main way in which LBS become services is by allowing the selection and presentation of information to be performed dynamically as and when it is needed. The controller component of the MVC model is responsible for triggering this. It can be performed in one of two modes: automatically where there is low user interaction and instead a knowledge of their context and activity allow the system to interpret their needs for information or, actively where the user controls the information that is shown through their interactions. In this unit we look at how dynamic control can be structured within an LBS through this two modes of user and how it provides the glue between the model of information and its visualisation.

Learning Objectives

You will be able to ...

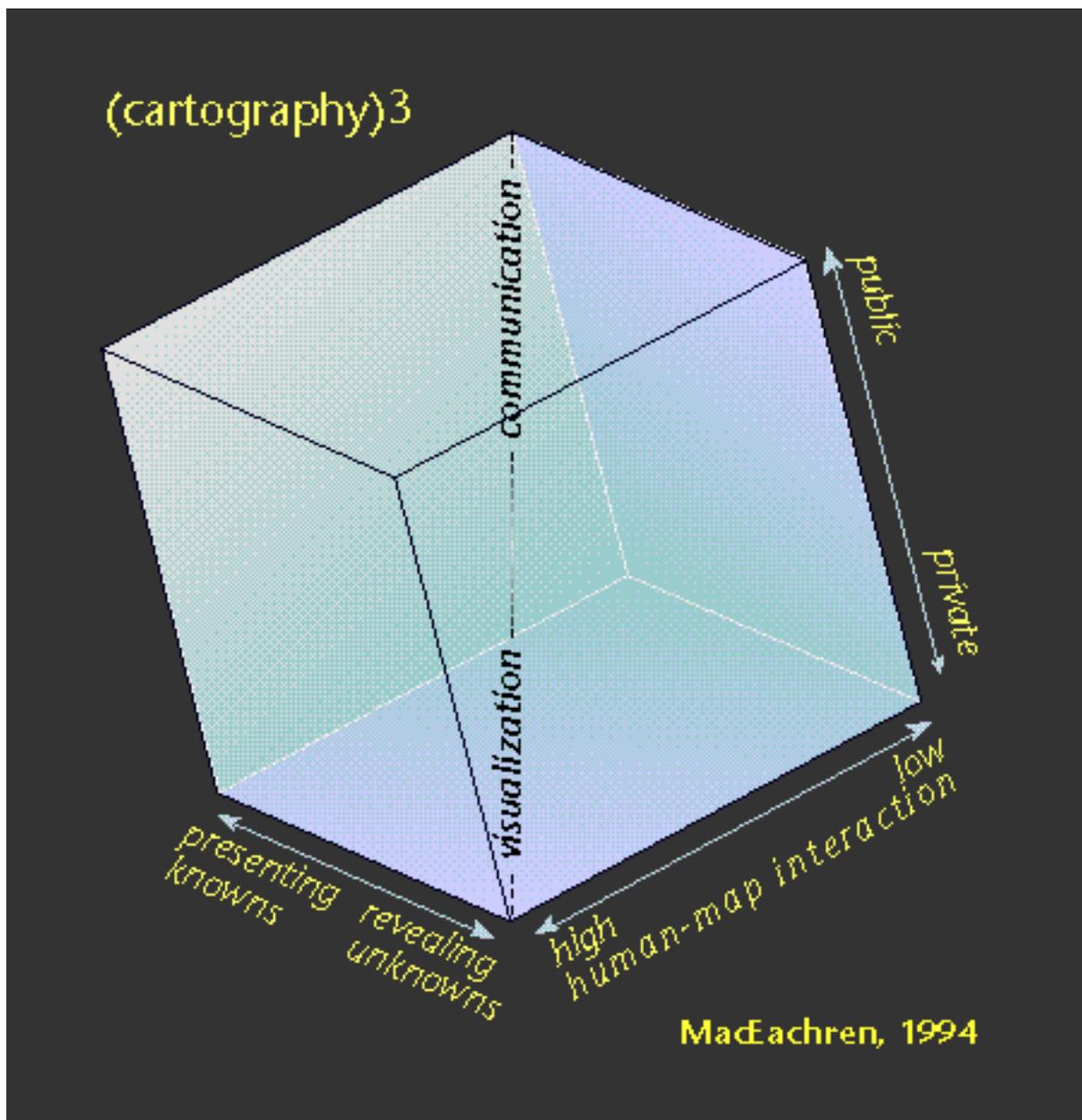
- list different patterns of interaction and relate these to user's actions. For particular LBS scenarios you will be able to describe users needs for accessing information in terms of these patterns.
- describe different interaction modalities
- list a set of interface components for LBS

1.4.1. Levels of Interactivity

The map cube model

In the field of geo-visualisation, (MacEachren 1994) has presented a conceptual model (the map cube or (cartography)³ model) for categorising different types of maps along three dimensions. In describing the model he says:

"The fundamental idea is that map use can be conceptualized as a three-dimensional space. This space is defined by three continua: (1) from map use that is private (where an individual generates a map for his or her own needs) to public (where previously prepared maps are made available to a wider audience); (2) map use that is directed toward revealing unknowns (where the user may begin with only the general goal of looking for something "interesting") versus presenting knowns (where the user is attempting to access particular spatial information); and (3) map use that has high human-map interaction (where the user can manipulate the map(s) in substantive ways - such as effecting a change in a particular map being viewed, quickly switching among many available maps, superimposing maps, merging maps) versus low interaction (where the user has limited ability to change the presentation)." (MacEachren 1994, p. 6-7)



(MacEachren 1994)

In LBS the model has particular relevance when we think about the goals of interactivity. Highly interactive maps allow the user to pose questions about their surroundings. In maps with low interaction information is updated automatically in response changes in the user's context. We can place different types of LBS application in the model accordingly.

	High Interaction		Low Interaction	
	Revealing Unknowns	Presenting Knowns	Revealing Unknowns	Presenting Knowns
Private Thinking	Social Navigation, exploring where others have been	Searching and browsing through points of interest or web-based data	Following a journey with an in-car navigation system	Orientation using topographic information, for example contours
Public Communication	Exploring distributions of phenomena, for example wildlife sightings	Browsing public service information, for example bus stops with links to timetables	Receiving 'Pushed' information as a user moves through an area	Following a guided tour, for example about architecture

1.4.2. Interactive LBS

Questions and Answers

The purpose of highly interactive LBS are to allow users to ask questions related to themselves and their environment and obtain answers to these from an information resource. Such questions might be "Where am I?", "Where can I find something to eat?", "What is this building?", "What hotels are near me?", "How do I get to the train station?" etc. Answering such questions might be done using a map, text and multimedia descriptions e.g. a web page about a hotel, with a list of items that are of interest or through the description of a route (graphically, text or audio based).

Actions and questions

There is of course a limitless range of possible questions that users might ask an LBS. Whilst on first consideration this may seem a daunting prospect to designing a service, most questions can be categorised into a few basic actions that the user is aiming to achieve. We can identify 5 main types of actions that are performed by users when using an LBS (Reichenbacher 2004).

Use the interaction below to organise the different questions by dragging them underneath the action they represent. The question will change colour to green with the right answer.

Only pictures can be viewed in the PDF version! For Flash etc. see online version. Only screenshots of animations will be displayed. [\[link\]](#)

Action characteristics

Actions can be characterised according to the information that needs to be inputted to them and what will result. Different types of action will have different characteristics depending on the focus of interest and any constraints on the action. For example, in the question "Which hotels are near me?", the action is searching, the focus of interest is hotels and the constraint on the search is the hotels should be "near me".

Action	Input	Constraints	Output
Identify	An individual object to be identified (e.g. a POI on a map)	None	A detailed object description or category
Browse	A detailed object description or category (e.g. a web page about a hotel)	None	A detailed object description or category
Search	A category (e.g. 'Birds')	A spatial and temporal scope	The set of individual objects in a list or object locations on a map
Locate	An individual object or set of objects (e.g. entries in a list of hotels, or the user them self)	A spatial and temporal scope	Locations of objects
Navigate	A pair of locations (e.g. the users current location and the location of a restaurant)	Type of route calculation (e.g. fastest, easiest, most interesting)	Sequence of objects (path segments or landmarks)

Chaining actions

By taking the output of one action and feeding it into another, actions can be chained into a sequence of interactions. For example, the user might locate an object on a map, giving them a location and then navigate to it from their current location.

Consider the following scenario. *You have just arrived in a new city and want to find a hotel to stay the night in. You lookup "Hotels in downtown" on your LBS and receive a list of hotels. You go through the list of hotels one by one until you find the Metropole Hotel, which you like. You look at where the hotel is on the map and see that it is well situated for you. You then ask the LBS for the most direct route to get there.*

Can you identify the sequence of actions in this example?

- Search - you search using the category hotels and get back a list of hotel items
- Identify - from the list of hotels you identify one you like from its description
- Locate - you locate the selected hotel on the map
- Navigate - you compute a route to the hotel from where you are

1.4.3. Controls and Interfaces

Controls

Actions are implemented using controls. The characteristics of an action also mean that we must be able to define the input to the action and the constraints on it.

Interfaces

Controls are organised components within interfaces. Interfaces organisation information and therefore relate to both asking question and presenting answers. They include the map, screens for searching for information, a browser to look at detailed descriptions.

Examples of controls

Search	
<div style="border: 1px solid red; padding: 5px; background-color: #f0f0f0;"> <p>Only pictures can be viewed in the PDF version! For Flash etc. see online version. Only screenshots of animations will be displayed. [link]</p> </div>	<div style="border: 1px solid red; padding: 5px; background-color: #f0f0f0;"> <p>Only pictures can be viewed in the PDF version! For Flash etc. see online version. Only screenshots of animations will be displayed. [link]</p> </div>
Free text search	
<p>Food Movies Life Fun Musica Parties Sports Design Daily Popular Home Photos Graffiti Wellness Culture Escape Happiness Nature</p>	
Search tree	Search by Tags
<div style="border: 1px solid red; padding: 5px; background-color: #f0f0f0;"> <p>Only pictures can be viewed in the PDF version! For Flash etc. see online version. Only screenshots of animations will be displayed. [link]</p> </div>	
Spatial search	

Searching for relevant information requires controls that allow both semantics to be defined and a spatial region of interest to be described. The semantics can be controlled through different methods including by search term, by a hierarchical tree of selectable concepts or by *folksonomic* tags. The latter are open-ended expressions that users label particular pieces of information with. As more and more people collaborate in labelling information in this way some labels are encountered more frequently which captures the semantics of information in ways closer to peoples experience of the places tagged. The spatial scope of a search is often defined using a menu of spatial regions that are relevant to a user, such as "Around me", or "Within 5 minutes walk".

Identify

Only pictures can be viewed in the PDF version! For Flash etc. see online v

Interactive Select

(click on a restaurant poi on the map, or click and drag open a select box to select a group of objects. Then select a restaurant from the results list)

In identifying information the user needs to relate what they are seeing on the map or directly around them with more detailed descriptions. One method is to allow the user to select items interactively and create a list of results from this. The animation above show an example of three controls to achieve this action.

What are the three controls being used to identify restaurants in the animation above?

- Selection control - allows the user to click on a point or use a "rubber band" selection box to select an number of points
- Results list - allows the user to review a set of different features based on a concise label, in this case describing the name of the restaurant, the quality (number of stars), and the price (number of Euro signs).
- Description - a webpage giving a more detailed description about item. Here, this includes a name, price and quality, a photo and a brief review

1.4.4. Low interactivity

Automatic control

In many LBS applications users do not want to manually select information, but rather want the service to choose what information is relevant to them in given context. Different methods exist to decide when to inform an user about information and how to present the information in appropriate manners. Usually automated control is configured through specific events occurring. These include, changes in the user's location, changes in the location of an asset that a user is interested in, receipt of new information, or the discovery of information that might be relevant and interesting to an user.

Geofencing

Geofencing involves defining boundaries that are important to the user or service provider. When the user enters or leaves a boundary they are alerted.



The image shows a set of geofences marked on a city map that might be used to inform a user who is a tourist about the particular characteristics of the neighbourhoods they define.

Geofences are often used to define hazardous regions or restricted area. For example, an area with a risk of avalanches or an natural area that is especially sensitive to disturbance by people walking in it. A further use is for managing assets and people. A parent might define a geofence around themselves so that if their child move outside it they are alerted. A vehicle carrying hazardous materials might use geofences to avoid areas that would be the worst affected if they had an accident.

Geofencing is increasingly being used in workplaces to locations of employees, such as in warehouses and supply centers. On the one hand these can allow employees to be more effective, making their working lives easier and safer. For example, a geofence around a ship might alert the crew if someone is washed overboard. However, the technology can also be used to monitor staff in more sinister ways, for example recording how often they have been to the toilet or restricting their movement to a few designated zones. (Blakemore 2005) and (Dobson et al. 2003) provide informing discussions of such pitfalls of geofencing and its related technologies.

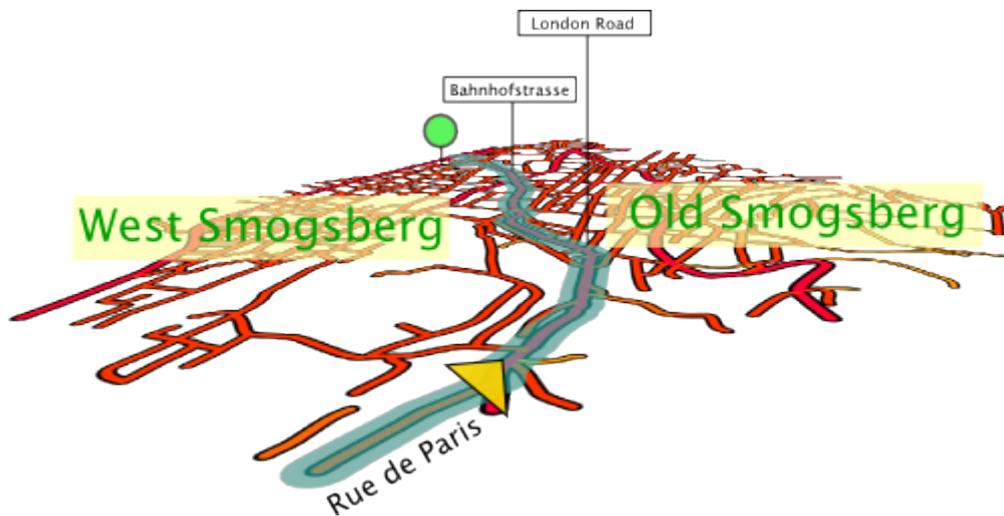
Automatated levels of detail

In location based service for car navigation the driver requires different views of information at different times. (Timpf et al. 2003) suggest there are 3 levels at which the task is carried out.

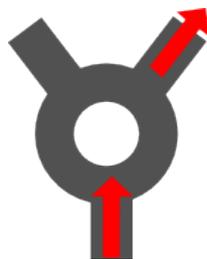
Designing maps for LBS

- The planning level - planning a journey requires information about where the driver is and where they want to get to, what are the main places they will pass through and what are the main roads they will transit.
- The instructional level - during the journey the driver needs information about the locations of decision points and the roads between these.
- The driving level - At decision points the driver needs detailed information about the actions they must take, for example which exit to leave and which lane they need to be in.

Services can assist the driver in these tasks by selecting the most appropriate spatial scope and visualisation automatically according to the driver's location within their journey. At the planning stage a conventional north-up topographic map might be most appropriate. At the instructional stage a view taking in the perspective of the driver is often employed. This will highlight their remaining route and destination, and the major places and roads relevant to the driver that are nearby. As well as being oriented in the direction the driver is headed, the view might also be tilted planimetrically to give a more intuitive feel of distances. Alternatively, instructions can be instead described through speech. Here, each description chunks information together along the journey legs. This has the advantage of not being a distraction to the driver.



At decision points, often highly schematised information is most appropriate, that describes simply the structure of the junction and the manoeuvre that needs to be made there. For example, a roundabout shown with arrows indicating the entry and exit points.



1.4.5. Summary

In this unit you learned about different ways of interacting with a location based service. In highly interactive services the need is to relate the questions of a user to actions that they are trying to perform. These can then be implemented through various controls. In low interaction services, information and its presentation must be made available to the user dynamically, in responses to changes in their context and location.

1.5. Summary

In this lesson you learned about the difference between conventional map products and maps for location based services. These were investigated through the SHIP characteristics of a service:

- Simultaneously produced and consumed
- Heterogeneous
- Intangible
- Perishable

Based on these characteristics you learned about designing mobile information services from three integrated perspectives,

- The model - the data resources
- The control - the functionality
- The view - the visualisation of information with a map.

From the perspective of the model you learned about different types of data used in LBS and how to evaluate these in terms of pragmatics (fitness-for-purpose), their representation (data model, ontology and data format) and ability to communicate information.

From the perspective of the view you learned about portraying dynamic information such as points of interest according to context and its relevance to a task.

Finally, you learned about making map based services dynamic. One way of achieving this was through interactivity. Here controls were provided that linked questions to actions. Five types of action were described:

- Locate
- Search
- Identify
- Navigate
- Browse

The other way of achieving this was through events triggered by changes in context. The response to these was to changed the visualisation or alert the user. Examples described where geofencing and car navigation.

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