IDENTIFICATION OF TELEMATIC AND LOCATION BASED SERVICES KEY COMPONENTS AND MEANS OF THEIR UTILIZATION IN TELEMATIC SYSTEMS

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Summary: This article gives an overview of technologies used in location based services and telematic services, identifies key components of both services (which consist of wireless data and mobile technologies, location and identification technologies, mobile devices and information systems) and analyses their mutual relationship. On the basis of analysis of both services mutual relationship this article affirms convergence of location based services and telematic services and tries to examine means of utilization of location based services in telematic systems.

Key words: LBS, telematic services, GPS, WiFi, GSM, UMTS.

INTRODUCTION

Location based services (LBS) are currently dynamically expanding services which provide information and services of local character (information, navigation, monitoring etc.) in relation to actual position of users. However, the same capabilities are disponible in telematic services too, which similarly like LBS are in the role of intermediaries between the information (provided from Internet or external database) and users. The main idea of both services is the same - to provide information to questions as: Where am I? What can be found or what is happening in my surroundings?

In present time LBS find its use mainly in branch of traffic and tourism where LBS enable users to get actual traffic, touristic and commercial information related to their location and also according to the actual time or profile of users. The relation between LBS and telematic services is very significant in the area of traffic where both systems use similar concepts based on common technologies. These systems are therefore possible to classify as complementary, where LBS can support telematic systems by its flexibility and sturdiness as cited in sources (6). Common base of technologies used in both services and possible ways in which LBS can enrich the spectrum of telematic services and also their limitations will be described in the following text.

1. TECHNOLOGICAL BASE OF LBS AND TELEMATIC SERVICES AND IDENTIFICATION OF THEIR COMMON COMPONENTS

Technological base of LBS and telematic services comprises of large numbers of technologies which applications use in various mutual connection providing many different functions. Wireless technologies and mobile data technologies, mobile devices, location and

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identification technologies and information systems were identified as common components of both services. These components will be described in the following text and figure 2 will display their mutual relation.

1.1 Wireless and mobile data communication technologies

As well as in telematic services, the key component of LBS is the use of wireless and mobile data communication technologies, which usually serves there for data transmission from application running on the server to users who are in the role of a client. Realisation of these services is therefore existencially dependent on builded wireless and mobile data communication infrastructure, which is using the same technological base for telematic services and LBS alike. These technologies are usually divided to groups according to the distance of spreaded data signal, which forms wireless data network. This typology defines following groups (3):

- WPAN (Wireless Personal Area Network) - range from meters to couple of tens of meters,
- WLAN (Wireless Local Area Network) - range up to hundreds of meters,
- WMAN (Wireless Metropolitan Area Network) - range up to few kilometers,
- WWAN (Wireless Wide Area Network) - range up to tens of kilometers.

Particular wireless and mobile data technologies (available in the Czech Rep.) usable in telematic services and LBS with their detailly specified parameters and sorted by described typology are to be found in the following table:

Tab. 1 - Properties of wireless data technologies available in Czech Republic for LBS and telematic services

Name of technology (version)	**Year of release**	**Transmission frequency**	**Maximum theoretical speed of data transmission**	**Maximal theoretical distance of transmitter/receiver**
Wireless data technologies				
WPAN				
Bluetooth (2.0 - class 2)	2004	2.4 GHz	3 Mbps	10 m
Bluetooth (3.0 - class 2)	2009	2.4 GHz	24 Mbps	10 m
WLAN				
WiFi (IEEE 802.11a)	1999	5 GHz	54 Mbps	100 m
WiFi (IEEE 802.11b)	1999	2.4 GHz	11 Mbps	110 m
WiFi (IEEE 802.11g	2003	5 GHz	54 Mbps	110 m
WiFi (IEEE 802.11n)	2009	2.4/5 GHz	150 Mbps	160 m
WMAN				
WiMax (IEEE 802.16d)	2004	2-11 GHz	75 Mbps	8 km
Mobile data technologies				
WWAN				
GPRS /GSM network/	1997	900/1800 MHz	86 kbps	35 km

EDGE /GSM network/	2004	900/1800 MHz	237 kbps	30 km
CDMA 1xEV-DO /CDMA2000 network/	2004	450-2100 MHz	2.4 Mbps	54 km
UMTS /UMTS network/	2000	1920-2170 MHz	2 Mbps	2 km
HSDPA /UMTS network/	2004	873/1900 MHz	14.4 Mbps	6 km
HSUPA /UMTS network/	2005	873/1900 MHz	5.76 Mbps	5 km

Source: (4) – author, edited: author

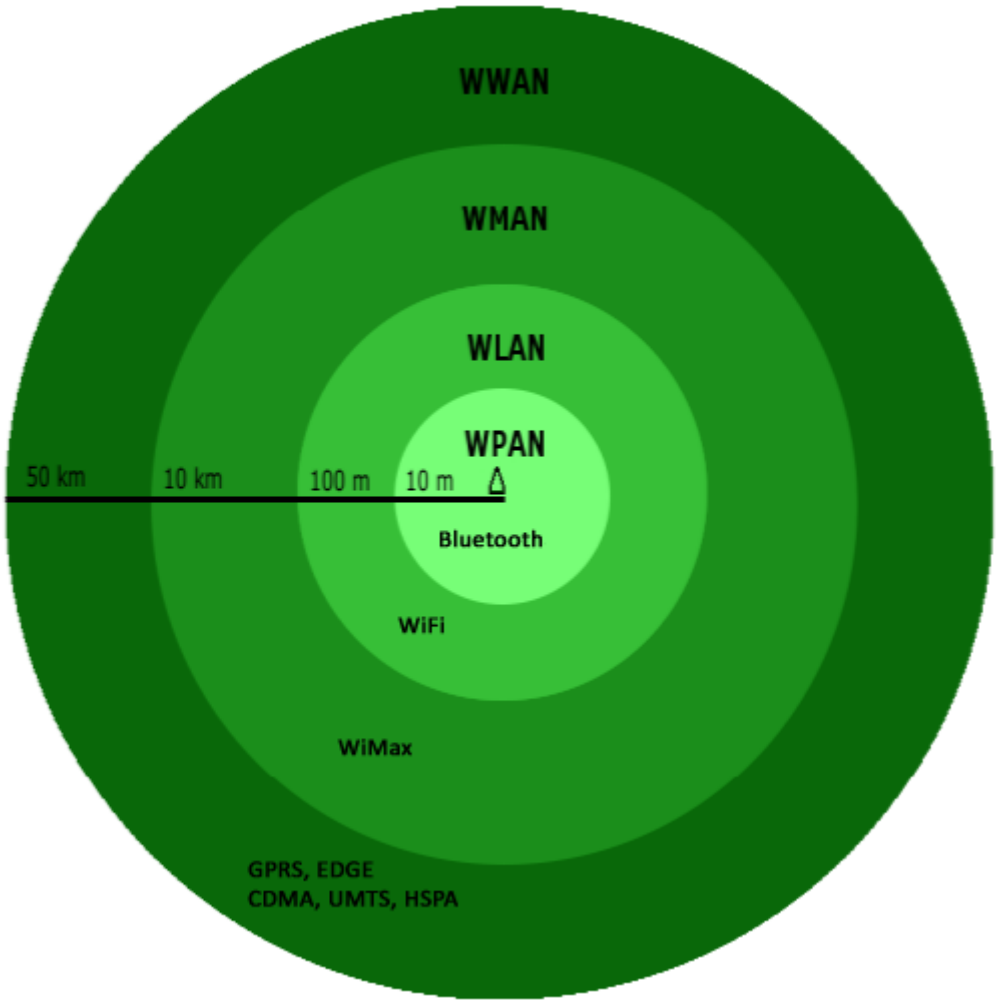

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Fig. 1. Typology of wireless data networks by range

1.2 Mobile devices

Mobile devices constitute one of the basic component of LBS and telematic services and serve as entering gate to these services for users. Connection of LBS and telematics was also a discussed theme on the last conference Telematics Detroit 2011. There were thoughts heard, that mobile device with the highest competitive ability suitable for these services is a smart mobile phone, which is a so called multipurpose mobile device. The opposite of this mobile device are so called one-purpose devices, as for example navigation device GPS or modem for wireless and mobile data technologies.

For LBS users one-purpose device is often integrated to multipurpose mobile device as smartphone, notebook or PDA. In telematics, one-purpose devices as navigation device GPS or data modem are usually integrated in mobile unit of vehicle.

Nowadays there is also an increase in the number of users who handle with multipurpose mobile device with support of wireless and mobile data technologies, which is therefore able to use LBS and mobile internet, which is often used by LBS.

1.3 Location and identification technologies

Location technologies used in LBS or telematic services are able to provide information about where a user stays or identify what kind of request he/she is interested in. Location and identification technologies are one of basic building blocks for using LBS and telematic services – they enable to realize actions as position location, identification or navigation.

Nowadays, the most frequently used technologies for location is GPS in connection with aGPS technology (Assisted GPS), which provides faster location and helps especially when there is no visibility to navigation satellites, as for example inside buildings, in tunnels etc. However, the acurateness of location in these cases is much worse, as well as in case of using another possible alternative, which is the method of location by using BTS (Base Tranciever Station) in mobile networks GSM or UMTS. For identification can then be used technology NFC (Near Field Communication), RFID (Radio Frequency Identification) or identification technology of QR-codes (Quit Response code), which is applied only in LBS but is useless in telematic services.

Tab. 2 - Methods of localization in LBS and telematics

Method of localization	**Average accuracy [meters]**	**Advantages**	**Disadvantages**
BTS	250 – 5000	Works in NLOS. Excellent cover (in the Czech Rep. 95-99%) of area and availability. Short time of inicialization. Low battery consumption. Does not load network transmission.	Not very accurate localization.
GPS	5 – 20	Highly accurate localization. Excellent cover of area and availability. Does not load network transmission.	LOS necessary. Longer inicialization.
aGPS	10 – 50	Works in NLOS.	Load network transmission (GPRS).

		Relatively accurate localization. Excellent cover (in the Czech Rep. 95-99%) of area and availability. Short time initialization. Low battery consumption (by GSM).	
IPS (Bluetooth, WiFi, etc.)	1 – 10	Works in NLOS. Highly accurate localization. Short time inicialization.	Additional wireless infrastructure necessary. Load network transmission.

Source: (12) - author, edited: author

1.4 Information system

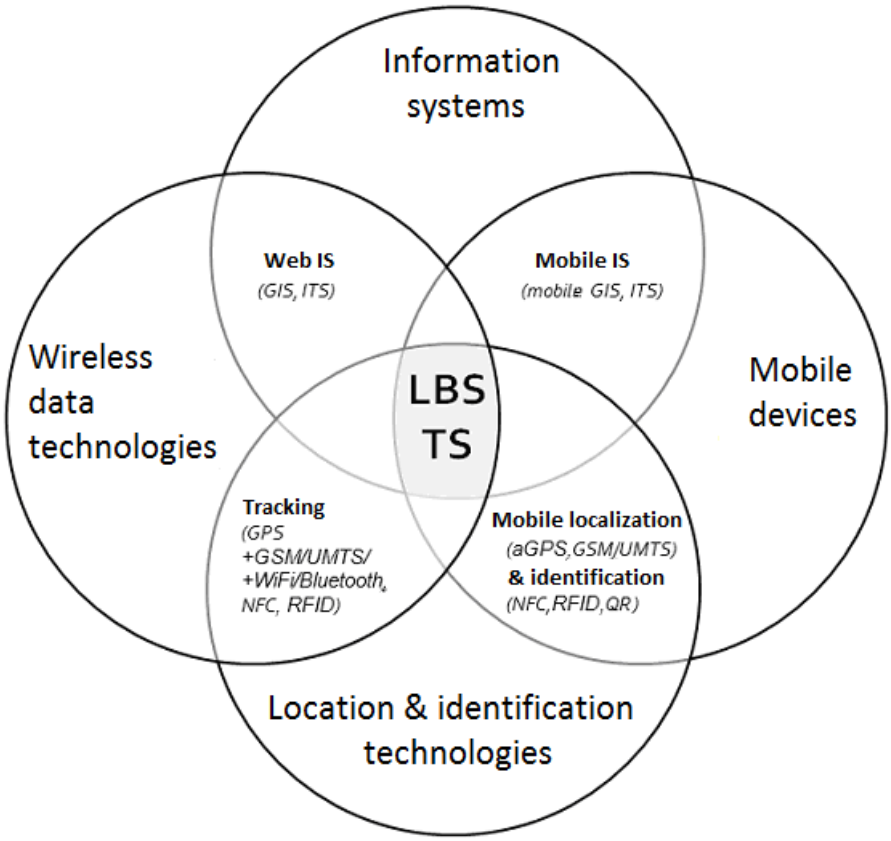
The last component of LBS and telematic services, which is necessary to mention, is an information system. It is basically a connection between these services and previously mentioned technologies, which it covers by hardware, software and data basis. Information system enable to store, change and analyze data and to show them, in case of these services, in forms required for geografic or tradic applications.

In LBS, geografic information system (GIS) is especially used, most often in the form of mobile GIS or web GIS. In telematic services we talk about intelligent transport system (ITS). Information systems are nowadays a very inhomogeneous pillar though; they are very diverse and non-standardized in LBS as well as in telematic services.

2. LOCATION BASED SERVICES AND MEANS OF THEIR UTILIZATION IN TELEMATIC SERVICES

In the previous chapter key components which constitute basic building blocks of LBS and telematic services were identified. These components consist of technologies which are in LBS and telematic services in various degrees integrated to one functional system. This system allows realizing wide spectrum of services, oriented according to areas of usage.

Thanks to the use of identical components (which consists of wireless data technologies, location and identific technologies, mobile devices and information systems), with same mutual relations of various technologies, there is a very strong approximation, even up to a considerable blending of LBS and telematic services, which thus manifests their convergence trend. In this case the process of convergence is perceived as a process of gradual merging of two up to now separate systems – LBS and telematic services – which is caused by identical mutual relations and their interactions. The diagram below shows relations among LBS, telematic services and their technologies.



Source: author

Fig. 2. Diagram of mutual relations between LBS, telematic services and their technologies

2.1 Spectrum of events and applications of LBS and telematic services

There are identical ways of user access to the LBS and telematic services. The first is based on their active requirement - as a "pull" service (e.g. when required by downloading an electronic document via Bluetooth), the second is the launch of the application of these services indirectly, based on various events as a "push" service (e.g. routing in mobile technologies). Elementary events to which LBS and telematic services can respond are as follows (5):

- position detection,
- searching,
- navigation,
- identification,
- check events states.

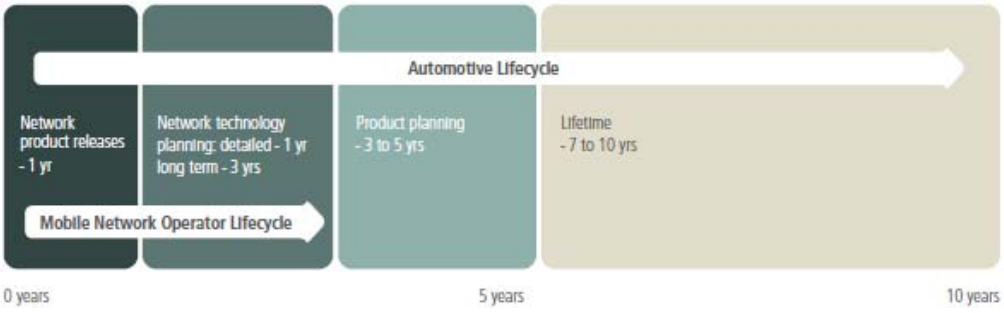
On the basis of the above actions it is possible to create applications of LBS and telematic services enabling to provide a wide range of services to the local transport and tourism, which include the following services (1):

- information services – seeking local objects of interest (restaurants, hotels etc.) and events, electronic guide, local weather forecasts,

- navigation services – tourist navigation or car navigation,
- monitoring and management services – fleet management and mobile sources, tracing,
- promotion services – marketing tools providing content according to user location,
- social services – use of geosocial networks (Foursquare, Google Latitude, Facebook Places etc.) with user profiles,
- emergency services – systems of emergency calls in case of traffic accident (in particular Europe-wide service eCall which in case of accident sends information about car location, time etc. to line 112 (2)),
- payment services – possibility to pay for local content or services (highways, parking).

2.2 Accessibility and risks of LBS and telematic services

The problem of telematic services is low flexibility and frequent availability of basic services only (mostly navigation). The reason is a long development life cycle of telematic systems integrated in vehicles compared to LBS available on mobile devices. This long development life cycle of products in automotive industry is showed in the following figure.



Source: (11)

Fig. 3. Development life cycle of products in automotive industry

Producers recognize this problem and thus try to ensure the availability of Internet in vehicles by using telematic systems like BMW ConnectedDrive, OnStar RemoteLink, Audi Connect etc. Another possibility is a connection (e. g. using WiFi) of telematic systems to mobile devices that can use LBS applications from the Internet and the data from telematic systems (e. g. the fuel in the tank). Interoperability between mobile device and telematic services is therefore desirable. This concept enables the availability of LBS specifically designed for use in a vehicle in which will help to increase the flexibility of telematic services and to extend the spectrum of provided services. In case that a car is equipped with an integrated web browser (a so called in-car browser - for example ConnectDrive available in BMW cars) LBS applications can be displayed directly on a display in vehicle.

Among the risks of both services belong primarily foisting information and services on users against their will, personal data breach (from user´s profile) and misuse of access history. Leaving user´s imprint in place and time can also cause problems as these data can be

used for stalking (for example when creating or updating a so-called Point of Interest in geo-social network Foursquare in LBS).

2.3 Limitations of LBS support in telematic systems

The concept of LBS utilization in telematic systems as described in chapter 2.3 unfortunately still faces some major obstacles throughout all components of these services. The most significant problem is a permanent low coverage of modern mobile data technologies in the Czech Republic. This factor cannot be directly affected and thus speeded up by vehicle and telematic systems producers. The following table shows these problems in detail.

Tab. 3 - Telematic systems limitations from the point of view of LBS and telematic services identified key components

Component	Usage limitations in telematic systems
Information system (see chapter 2.4)	In-car browsers usually don´t support current web technologies used by LBS applications (e.g. BMW ConnectDrive doesn´t support Java, Flash, Silverlight technologies).
Location and identification technologies (see chapter 2.3)	IPS location method using short distance technologies (WPAN - Bluetooth/WLAN – WiFi, see tab. 1) and due to is applicable in vehicles only when stationary.
Mobile devices (see chapter 2.2)	A vehicle as a complex mobile device has mobility limitations – it depends on whether or not a road is passable. The problem of telematic systems with in-car browsers often lies in hardware tools that are not appropriate for LBS web application processing (e.g. BMW ConnectDrive has a very slow microprocessor).
Wireless data technologies (see chapter 2.1)	Even in case of leading car producer that uses telematic systems (BMW) only basic GPRS and EDGE technologies are currently available. They enable very slow data transfer (86/237 kbps) and don´t offer QoS (Quality of Services). The problem described above isn´t solved even by support of more modern data technologies in telematic systems (e.g. AudiConnect supports UMTS (15)) – due to consistently low coverage of Czech Republic by UMTS (especially in non-urban areas), which is currently (as of 30.6. 2012) is only 47.9 % for T-Mobile, at only 26 % for Vodafone and Telefónica O2 then 28.5 % (13). More modern technologies have even far less coverage.

Source: author

CONCLUSION

Overlapping goals and common technological base of LBS and telematic services (which provide services and information related to user's location) led to considerations of convergence of both services. The term "convergence" is traditionally understood as a process

of gradual merging of two hitherto separate systems, mainly motivated by technological reasons. In this contribution, therefore, technologies constituting the basic elements (aka key components) of LBS and telematic services were identified in Chapter 1; Chapter 2 examined their closely linked mutual relations, as demonstrated on figure 2, which illustrates the surveyed confirmed convergence of LBS and telematic services. It was found that through the use of the same key components (which are wireless data technology, location and identification technology, mobile devices and information systems), with the same mutual relations of the various technologies, there is a very strong approximation, even up to a considerable blending of LBS and telematic services. The most inhomogeneous pillar as it currently appears is information technologies which are very diverse and not standardized in LBS as well as in the telematic services, even in their key services such as the distribution of emergency information in transport.

In chapter 2.2 problem of telematic services was diagnosed, which is little flexibility and frequent access of basic services only - as a suitable solution to this problem a closer integration of LBS and telematic services was identified by using telematic systems such as BMW ConnectedDrive, Audi Connect and OnStar RemoteLink, which thus enables the telematic services to use a rich spectrum of services otherwise available only through LBS. The spectrum of these LBS was outlined in chapter 2.1. Key limitations of using current telematic systems for LBS and telematic services realization (from the view of key components) were identified in chapter 2.3.

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