LOCATION BASED SERVICES IN GSM NETWORKS AND NEW POSSIBILITIES FOR THEIR APPLICATION IN TRANSPORT

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Summary: An enormous growth of mobile communication gives new challenges for new services creation. One of the possibilities is to focus attention on the localisation and localisation based services. It gives for mobile networks customers new information about position of another customers or subjects. This paper deals with utilisation possibilities of the localisation technology "Cell ID" and improvement of its accuracy.

1. INTRODUCTION

Technology for localisation of position is in GSM network implemented. It opens new opportunities for creation of broad area of new services - localisation based services (LBS). Implementation of such services is viable without modifying network infrastructure (GSM 900/1800), and the users do not need special mobile terminals or phones.

2. CELL ID

One of technologies that can be used for LBS is Cell ID. It's based on location of the geographic position of customers by using the cell or sector of cell, in which a customer or mobile terminal is situated.

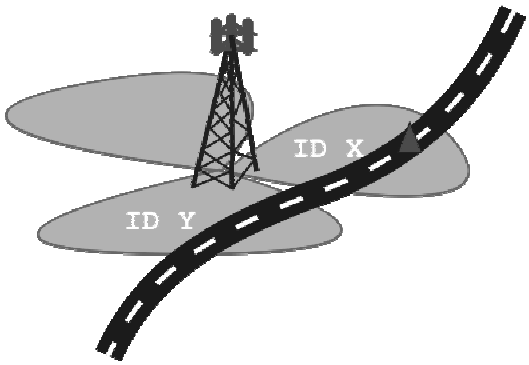

Fig. 1: Cell ID uses information about cell.

Large disadvantage of the Cell ID technology is in its not very high accuracy for some applications. The accuracy depends on the cell dimension, what can be few hundreds square meters till few tens square kilometres. An additional problem with location position by Cell ID can be established connection with some remote cell, or signal reflections from different obstructions [3]. This can create significant error of position location.

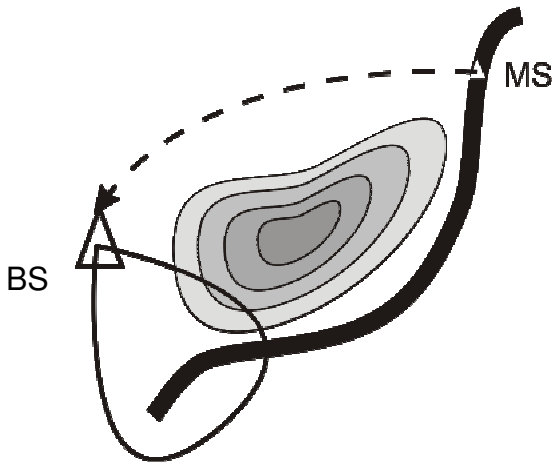

Fig. 2: Presentation of new established connection or signal reflections from different obstructions

3. INVESTIGATION OF ACCURACY OF CELL ID

Simple measurements were executed for the investigation of accuracy of Cell ID localisation. On the road line Žilina – Bratislava were located positions with GPS receiver. Simultaneously to that measurement of geographic position request for GSM localisation was sent to find actual position. These measurements were realized approximately every two minutes, what corresponds to the road distance approximately 2 to 5 km. Such localisation measurements were repeated 58 times at all. Two measurements failed from whole experiment. It was dependent on the conditions of roadway and geographic position. The time of request reaction was approximately 20 – 30 seconds. The road was in geographic heterogonous landscape. The undertaking of measurement was not only to definite approximated accuracy but also to reach necessary density of GSM measurements for future LBS services development.
From obtained measured results, were next conclusion obtained:

- cell size is from 1 km^2 in residential areas in towns till some tens km^2 in rural areas

- propagation due to signal reflections is evident, what make the accuracy of position location significantly worse
- requests density for localisation should be reduced in some cases because it lead to cell overlapping
- it is possible to improve accuracy of the position location for some application by using of additional information e.g. information about geographical position of roads or railway trains
- cell size reduction is obvious in town environment
- car direction movement can be defined based on GSM information

GSM LBS is applicable for services, which:

- do not require high precision accuracy of position (not under few hundred meters),
- are based on detection of direction of movement
- need to count numbers of mobile phones ore terminals in some cell or cell segment e.g. number of cars at the defined road section

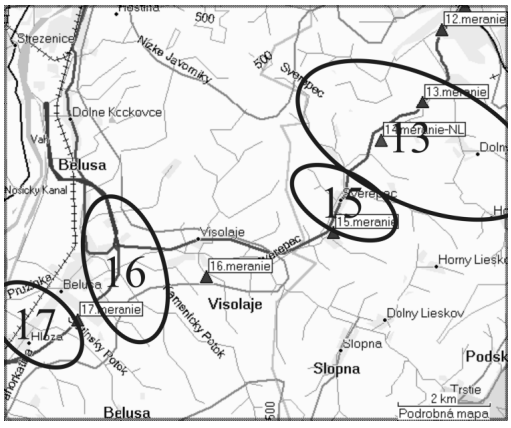

Fig. 3: Demonstration of provided measurements by GPS and GSM network

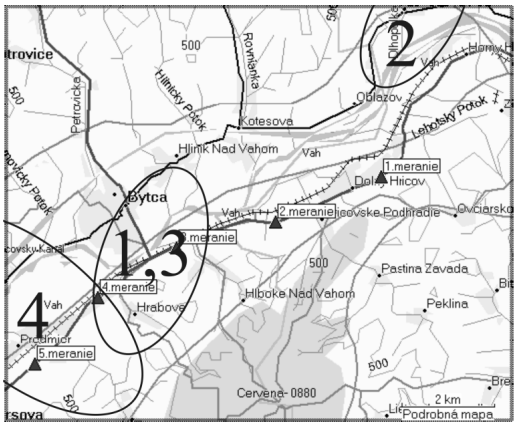

Fig. 4: Reflection or receiving of further signal, for confirmation is necessary to know BTS layout.

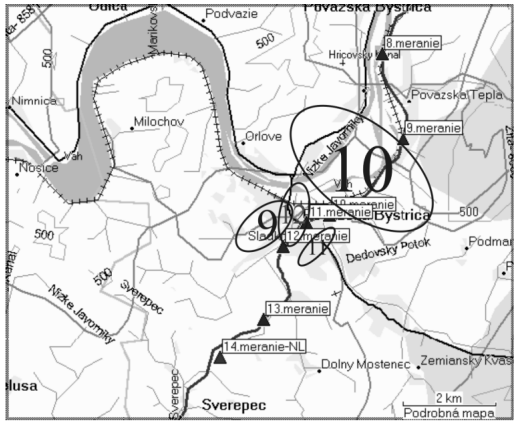

Fig. 5: Smaller cells but more frequent signal reflexion in the urban environment

4. DESIGN OF NEW LOCATION BASED SERVICES WITH USING CELL ID

Suitable statistic data processing gives new opportunities to make more accurate LBS. Obtaining additional data from BTS can lead to new possibilities in LBS, for example by using TA (Timing Advance). *Note: There is used just Cell ID technology in Slovakia today [3].*

Current services are relatively monotonous and offer just specific information about localisation of customers. Their future development will necessary need more dynamism, so they will be more interesting for customers to offer them higher added value in new opportunities (dynamic messages by region, using in tourism, in trade etc.). Third opportunity is in utilisation of existing information for the creation of information with new added value. One of the possibilities is to collect and monitor data from BTS. It opens possibilities e.g. for new services for support of transport by monitoring of density of traffic, detecting information about position of chosen vehicles (buses or passenger-trains on longer distance) and to provide obtained localisation data for travellers.

5. USING LBS FOR ITS (INTELLIGENT TRANSPORTATION SYSTEMS) SUPPORT

Nowadays, when big demand is given on the development and utilisation of new services in Intelligent Transport Systems, it creates the new area for utilisation of GSM based LBS for such applications.

6. CELL ID METHOD USING FOR ITS

One function of ITS is also monitoring number of migrated cars on specific road sector and consecutive traffic situation evaluation. Cell ID method can be simply use here if car drivers or cars are GSM network customers (terminals) with possibility to localise them.

7. TRAFFIC SITUATION

If in some cell or sector number of cars is monitored, higher number of not moving or slowly moving cars can signalise some traffic inconvenience.

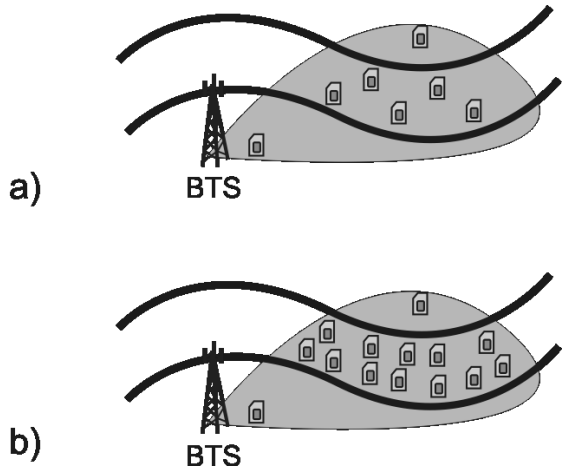

Fig. 6: a) normal situation b) number of cars grow after accident.

8. NUMBER OF CARS IN SECTOR

The measurement of this parameter is given by determining number of new cars in chosen cell or sector per time unit. This approach gives possibility to identify histogram of number of driven cars in time.

9. APPROXIMATE MEASUREMENT OF VELOCITY AND VEHICLE MOVEMENT WITH GSM

Just one cell is enough for approximate velocity measurement needs. If two rationally spaced BTS are used, can additionally information detected e.g. blocking of one or both directions. The velocity measurement principle is depicted in the fig. 7. For approximate measurement of velocity we need to detect time when first contact comes in two different cells, which are located in the same direction of cars movement. From these data can be consequently approximate velocity of vehicles estimated.

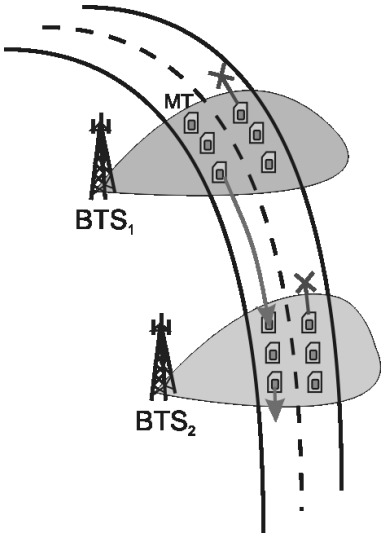

Fig. 7: The procedure of the measurement for detecting velocity and blocking road in one direction.

Which direction is blocked is evident from fig. 7. If is monitored movement in particular mobile stations, which are registered in BTS_1 and then movement at BTS_2, it can be detected that this direction is not blocked. If increasing of mobile terminals (cars), which are registered in BTS_2 into BTS_1 is stopped, it can be indicator, that this direction is blocked.

10. UTILISATION OF LBS AT EMERGENCY MEDICINE

Identification of the position can use also during accident. If the request for emergency medicine on demand is applied by GSM network, it will be determinate area of location by mobile terminal (phone). Connecting of such information with information system for emergency medicine cam seriously contribute to the speed of rescue action.

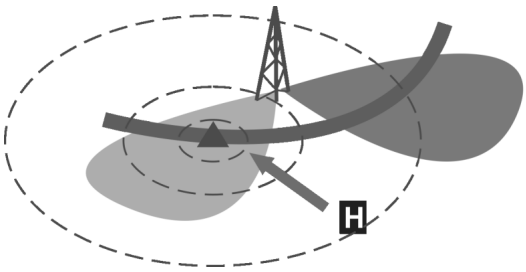

Fig. 8: Utilisation of LBS in case of trafic accident.

11. TECHNICAL SUPPORT

For the obtaining of information about the traffic situation some necessary technical support is needed. In the first place it is the hardware and software equipment, which will collect and transmit information from basic stations. Next step is consequential comparing and evaluation these data

eventually data from another sources (camera, inductive sensors on road, police). Consequential executed and evaluated data will be offered to the public and e.g. to the traffic police ore health care in the service forms (mms, www, navigation, dynamic information tables …).

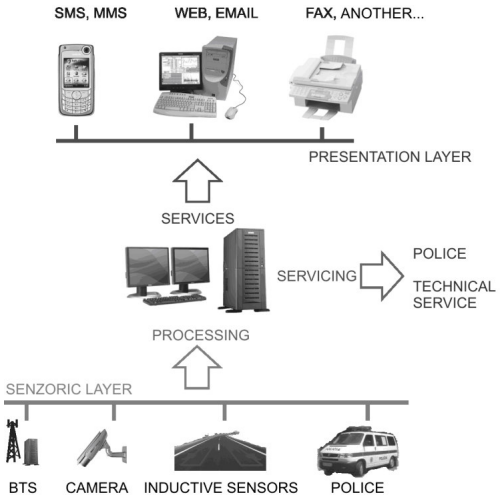

Fig. 9: Information system

12. CONCLUSION

Even though Cell ID method give us not precise position location, it is acceptable for many applications in which more "macro localisation" is needed or enough. However is the position location relatively imprecise, it is possible to design new added value services, which can be interesting for customers. It exists opportunity Cell ID availing in transport and it can bring interesting and relatively simply realizable services for improvement of different areas of traffic management and in some cases in medicine etc.. However Cell ID's accuracy is limited in services design opportunity, in many area it is enough for new added value service design, but many legislative aspect are needed for such praxis applications.

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