Improving the Qos of Location Services Using Adaptive and Environment-Aware Positioning

(Work in Progress)

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***Abstract*- Location Based Services (LBS) are an important aspect of the ubiquitous wireless world and are paving the way to provide users with customizable services anywhere and at anytime. LBS have varying accuracy requirements and not all location methods can provide the required LBS accuracy at a particular geographical location due to error sources. The sources of errors include geographical sources, wireless environment sources, measurement bias, geometric sources, etc. This paper presents work in progress on the development of an adaptive and environment-aware positioning based on the dynamically varying factors that affects the location method. The developed location method will allow mobile network operators to compare different location methods to ensure the provision of guaranteed quality of service to the mobile user and optimized usage of infrastructure.**

Keywords- *Location Based Services, Location methods, accuracy, Quality of Service, error sources, GPS-less UE*

1. INTRODUCTION

Location Based Services (LBS) enable mobile users to connect to points of interest at a particular geographical location providing real-time and personalized service based on the current location [1-3, 5]. These services are location information services based on wireless technology and are accessible through user equipment (mobile phones, Personal Digital Assistants (PDA), etc) [3-5].

Geographical location finding capability is a feature in the mobile network which makes it attractive, optimized and successful [1, 3, and 4]. This is because it gives the mobile users access to location based service anywhere at any time; for example assists in locating friends and family, enhances quicker emergencies and rescue operation [1, 3] etc. Mobile operators' also have the opportunity to provide value-added services and generate revenues from other services other than voice and data [5, 6].

The QoS offered in LBS is dependent on the amount that the mobile network operators and the users are willing to invest [3]. With a feature-rich modern smart phone users get better accuracy using the assisted GPS (AGPS) location method, but unfortunately most users (especially in developing countries) are not able to invest in these high-end devices [3, 7, 8].

To ensure guaranteed QoS delivery to GPS-less (user equipment with no GPS) users, the accuracy offered by network-based location methods needs to be improved. Better accuracy can be achieved by giving adequate consideration to dynamically varying error sources affecting location methods to achieve optimal use of mobile network infrastructure and provision of required QoS to LBS [3, 8].

The relationships among radio environment, geographical features, location systems and the accuracy of these systems are complex. Mobile operators and the safety community involved in LBS have expressed a desire to take such factors into consideration to provide more accurate location service but "*unfortunately there is currently little factual information from which to establish or evaluate weighing factors*" of these dynamically varying parameters [9].

The QoS of LBS is affected by the terrain variation, environmental factors, cell size and multipath propagation [3, 9] etc. Table 1 shows radiolocation methods, the observables, the measured parameters and the error sources to indicate accuracy degradation sources.

There are three negotiable QoS parameters in LBS; horizontal and vertical accuracy of the geographical location and response time [2]. Currently, for applications of LBS related to emergency response the vertical accuracy is not considered [2]. In this work in progress paper, the vertical accuracy and the response time will not be considered and horizontal accuracy will be referred to as "accuracy".

Accuracy of a location method is a measure that defines how close the location measurement (the calculated location) is to the actual location of the mobile station being located [9, 10].

II SOLUTION APPROACH

It is intended to develop an adaptive and environment-aware location method. The environmental-aware approach will take into consideration the assumed geographical location of the user and the adaptive approach will choose a location method based on the varying error sources at the geographical location.

Table 1: Location methods and Error Sources [Adapted from 5, 6, 8 and 11]

Radiolocation method	Observables	Measured by	Error sources
Proximity sensing	Cell-id, coordinates	Sensing of pilot signals	Cell size/radii/sector, operation mode of UE multipath propagation, location equipment
Lateration	Range (circular lateration)	Travelling time of pilot signals, path loss of pilot signal. (For synchronized BS, i.e. TOA)	Non-line-of-sight (NLOS), multipath propagation, medium access, multiple access interference, number of measurements, location equipment
	Range Difference (hyperbolic lateration)	Travelling time difference of pilot signals, path loss difference of pilot signal (For non- synchronized BS such as GSM and UMTS-FDD, i.e. TDOA)	
Angulation	Angle	Antenna Arrays	NLOS, bad resolution of antenna arrays, number of measurements, multipath propagation, medium access, location equipment.
Dead Reckoning	Position and direction of motion, velocity and distance	Any other location method Gyroscope Accelerometer Odometer	Unevenness of the road surface, error accumulates with distance
Pattern Matching	Visual images or fingerprint	Camera Received Signal Strength	Multipath propagation, scene modification
Hybrid methods	Enhance Cell ID Cell ID +TA Cell ID+RSS Cell ID +TA+ RSS	Measured as stated above	Errors are same but accuracy is optimized and errors reduced.

III SIMULATION AND EXPECTED RESULT

To evaluate the efficiency of the proposed scheme, a novel simulation model will be designed and developed. The simulation will take into consideration varying error sources, the number and size of the cells, the geographical locations of the BS and varying channel propagation schemes. It is also intended that there will be a hardware simulation for proof of concept.

It is expected that the devised approach will enable matching the provision of guaranteed QoS to LBS users and optimization of mobile operator's infrastructure.

IV CONCLUSION

We have explored the fundamental problem of poorly guaranteed QoS offered to GPS-less UE requesting for LBS. This is due to dynamically varying error sources that affects the QoS of LBS and mitigates against the provision of accurate services to GPS-less users.

The concept proposed in this paper takes into consideration the geographical features of the wireless environment and the geometric features of the wireless network. An adaptive selection method will also be developed to effectively choose the best location method to be used based on the error sources and accuracy of location methods.

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