# Where are the other mobile buddies around town ?

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**Abstract:** *The study WOMBAT (Where are the Other Mobile Buddies Around Town) focuses on the feasibility question: "Is it feasible at this point in time and considering today's technology constraints to introduce location based services to fulfil the demands of the youth market?". The comparison is achieved by identifying key requirements of the youth market and using these requirements to develop realistic user scenarios which are then mapped onto the capabilities of a select number of positioning technologies. The study addresses a problem currently faced by many operators in that it strives to unravel which location technologies could be the most fruitful options for the future. It does this from the perspective of a proposed high user group – young people.*

## Introduction

Imagine being 16 years of age. You probably like to arrange to meet your friends while on the move to catch up with them or perhaps to head off to a party or bar. A location based service (LBS) that supports this kind of 'micro-co-ordination' [12][13], enabling friends to make arrangements while on the move, might well be a killer application for the youth market. In this study we investigate if there is a potential need for such a service among youth. Furthermore, the needs are compared against capabilities of standardised cellular network positioning systems in order to find out if such technologies are presently able to support these and other potential youth market-focused scenarios. The remainder of this paper describes the process in more detail, taking one of the scenarios derived from the user understandings to demonstrate the mapping process.

## The youth market and the need for location based services

As the first step in this work we concentrated on the investigation of youth cultures and their mobile service needs. Existing data and material on young people were sourced from academic journal articles and books on youth culture, market research data, press articles, and data from various ongoing research projects. These sources were pulled together to form an understanding of young peoples' lifestyles, culture and use of current mobile technology. This understanding in turn was used to derive needs for mobile location-based services. Overall, the focus was on the European youth market, but was not limited to this.

Key findings from the material we examined are that young people are high users of current mobile phones [16] which appear to be an intrinsic part of their lifestyles. While there is great

diversity among young people, those going through similar life transitions or in similar life stages appear to have similar needs and behaviours many of which are supported by the use of mobile phones. Communication, particularly with peers is a key use of mobile phones [12][17]. The need to belong to a peer group tends to be strong among youth. Mobile phones allow young people to flexibly arrange and rearrange schedules especially en route (micro-coordination); to give real-time updates of social events; to know where their peers are; to be accessible to peers; to maintain social and emotional bonds with them through the use of SMS to send jokes etc.; for display and status, for example, displaying popularity through the size of their calling circle and the number of calls and SMS received; and for experimentation and flirting [13][20].
Another significant finding is that mobile phones are used a great deal indoors including in the home. We should also be aware of the needs of parents and other important individuals in the lives of young people, such as their best friends or boy/girlfriend, as the needs of these people can prompt purchase of a mobile phone, for instance, parental fears over safety currently lead to phone acquisition, hence such people may stimulate subscription to new services and purchase of new products [13][14][24].

The common needs and behaviours of young people suggest various location based services that should appeal to this age group, for instance, a location tracking service to aid young people's flexible scheduling (micro-coordination) of their social lives. In particular, young people make social arrangements with their peers who are of greater importance to them than their family from around the age of puberty [2][9]. As this "scheduling" usage of mobile phones seems to have such an important role in young people's lives, this suggested an opportunity for a location based service to support this function better, more of which later.

## GSM Positioning Technologies

There are a large number of developments related to mobile location services of the future generation. A broadening range of different position determining systems such as Cell-ID (also referred as Cell Of Origin - COO) [8][23], TOA (Time Of Arrival) [8], AOA (Angle Of Arrival) [18], signal level technique [24], E-OTD (Enhanced Observed Time Difference) [8] and its successor OTDOA (Observed Time Difference Of Arrival) in 3G networks [22][23] and wireless-assisted satellite-based positioning (GPS/GLONASS/GALILEO) [26][27][28], show a heterogeneity that makes it difficult to address by operators.

Initially, we covered most of the well known methodologies mentioned above but at this point we believe that only well-standardised technologies such as Cell-ID, TOA, E-OTD and A-GPS [1][7][11][21] will allow the cellular operator to perform location-based roaming in the long term. The expected quality of service can be assessed in terms of the following characteristics: the accuracy achieved, which can vary quite widely from 5m (A-GPS) to a few kilometres (COO); the usage environment, with only A-GPS failing to operate in pure indoors or closed environments and the other three technologies operating in every environment; the speed of response with all technologies offering results within 5 seconds, which can be considered as a fast response in any case.

As can be seen from figure 1, the plotting of the values in terms of accuracy[1] and usage environment[2] does not lead to a single value for each type of technology but to a range of values which are shown by an irregular 'shape' drawn onto the graph's plane. As can be

[1] Values reflects the dispersion in terms of spatial precision

[2] Open space is understood as an outside location with a clear view of sky and no major physical obstacles nearby (buildings, trees, etc); Built-up area is a typical urban area that can occur both in cities and village, that is, streets sided by buildings, trees, etc. Indoors stands for closed environments in general, although fully or 'pure' indoors is considered a completely closed environment such as an interior room, a pocket or a case, and 'intermediate' indoors is a closed environment with access to a view of the sky, such as a car, a windowed room, etc.

expected, due to the high dependency on many variables but particularly on environmental conditions and on network infrastructure restraints, the expected 'behaviour' of each technology might be quite variable. Each location technology is outlined next in order to describe the form of the shapes provided in the diagram.

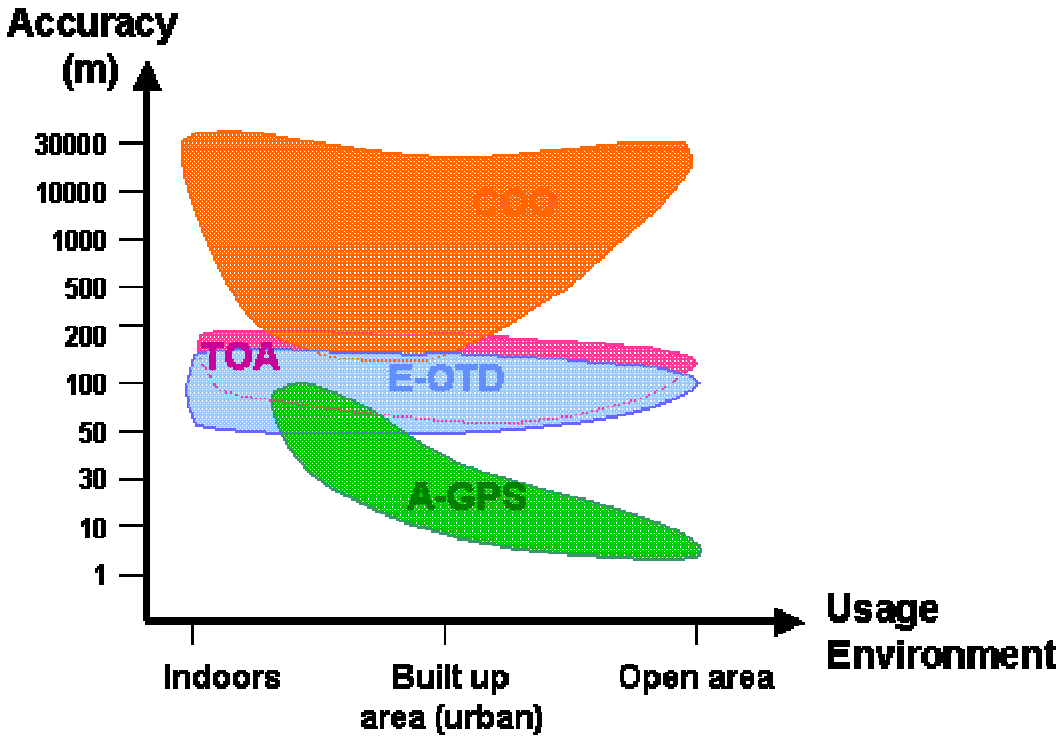


**Figure 1 Accuracy versus usage environment of positioning technologies**

*COO* – Considering Accuracy, in open areas, most commonly occurring in the countryside, networks use bigger cells, up to macro-cells of about 30km. In built-up areas, cells tend to be smaller, going to micro- or even smaller pico-cells of about 150-200m in some cases [6]. This justifies the slope on the right-hand side of the shape. Indoor environments can be found both in the countryside (macro-cells) and in urban areas (micro- / pico-cells) which implies a widely varying range of possible accuracy. In this latter case (urban areas), due to interference, the closer cell might not be the one that is available so another cell further away might be used, lowering the accuracy.

*E-OTD* and *TOA* – These two technologies have very similar behaviour, with E-OTD giving a slight better overall accuracy [4][5]. The spread in values is smaller in open areas due to (theoretically) fewer multi-path effects. The service is available independent of the usage environment.

*A-GPS* – A-GPS performance is more affected in pure indoor environments, although it still performs in intermediate situations (inside a car, open rooms). The accuracy improves in open areas due to less restrictions on GPS signal detecting [15][19]. This is the technology that, theoretically, gives the best accuracy.

This analysis makes it evident that no single technology has a clear advantage over the others, and the disparities are both technological, economical and in terms of the quality of the results. This implies that the final selection of one particular location technology may depend heavily on meeting user requirements, since the final aim is to provide a usable and useful service to the user.

## Benchmarking of Requirements

A number of realistic user scenarios were derived from the understanding of the youth market. These scenarios were then mapped onto the technical capabilities as described above to provide an awareness of the key issues of technology selection to meet user needs requirements. A service which would allow scheduling is outlined below in order to demonstrate the mapping process.

| **Scheduling (location tracking to aid micro-coordination)** | |
|---|---|
| **Age** | Across all age groups |
| **Issue** | Mobile phones (SMS messages and voice calls) are currently used for the 'micro-co-ordination', or flexible scheduling of social and practical arrangements. |
| **Example** | A group of friends have arranged to meet in town before going to a concert. One friend is waiting for the others to arrive. He wants to know if he has enough time to go into a shop before his friends arrive; he checks his mobile device to see their locations and realises that one is nearby and the others are on the train roughly five stops away. So, he decides to wait for the close-by friend before going into the shop. |
| **Requirements** | The information seeker, i.e. the person doing the tracking, would rather know location in terms of passing certain locations/landmarks or being in certain locations at particular times (locations with time stamps). The information seeker wants to know how current the information is. At least two locations are required to view motion/progress of the device user. The information seeker wants to know how long it will take for the friends to arrive. |

As might be expected, it is not an easy matter to graphically represent these requirements into a feasible and clear representation. It was easily apparent when examining the scenario in light of the technology capabilities that speed of response did not seem to be relevant; nowadays technologies easily can deliver location information within 10 seconds [4], so the accuracy in terms of time would be more than acceptable for the user. However, it is important for the reader to note that in this study we looked only into generic technology functions (i.e. how long does it take for the technology to calculate the location of a particular mobile device) and the implications of service integration and service performance are not gauged.

The parameters for figure 2 were derived in terms of best imagined service capabilities from the user point of view. The conclusions drawn from the scenario suggested that localities of around 20 meters in dimension needed to be addressed as beyond that, line of sight by the naked eye might not be possible, e.g. it might be difficult to see a person in crowded areas (such as a concert or busy street). The definition of the usage environment is slightly easier in that it is likely the service would be used by people who are indoors and outdoors, and that users would want to locate friends even if the mobile device was being carried in a bag (in technical terms this is indoors), therefore it has to work both indoors and in open spaces.

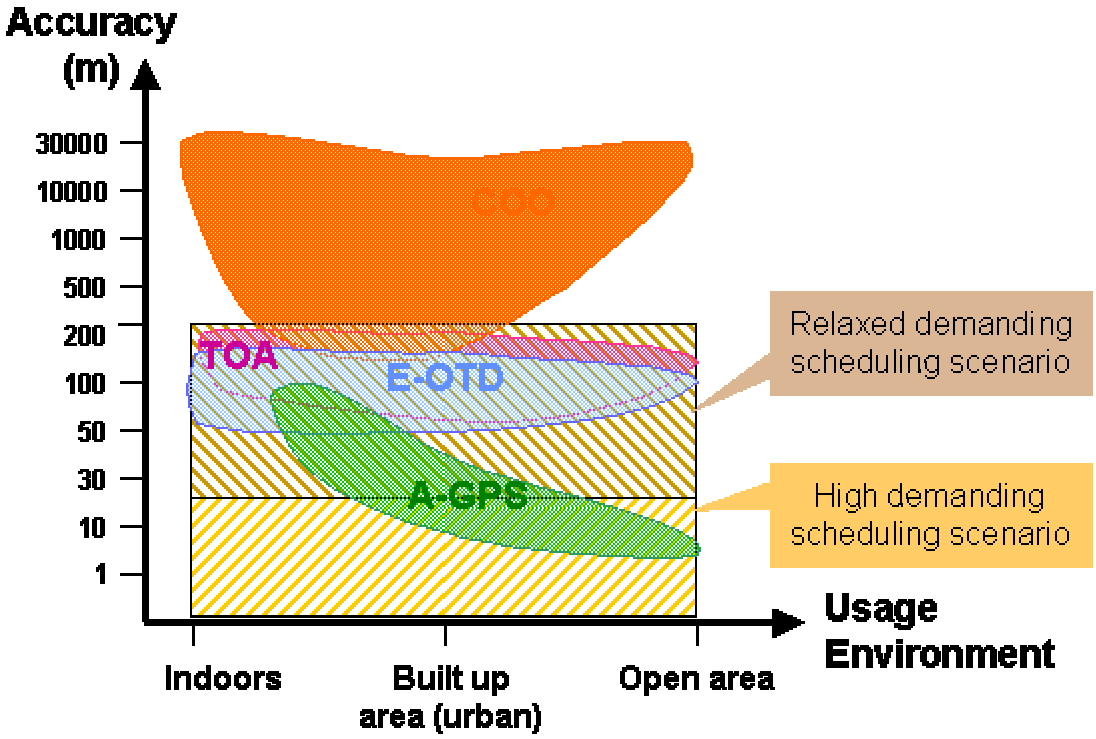


**Figure 2 – Mapping of Usage Scenario**

Applying the mapping of the scenario to the technology capabilities, we found that the scenario requirements could not be met by the current capabilities of the positioning technologies. From a feasibility point of view, this suggested that virtually no standardised GSM positioning technology could meet the requirements as we defined them in this project.

The results from the first approach led into a second iteration of the mapping. The requirements in the scenario were re-addressed and benchmarked once again against the technology capabilities. The estimates used in the first iteration were based on the assumption that the service should operate within all the boundaries and in almost every conceivable situation of the scenario. As such the requirements were extremely demanding. Therefore, in the second iteration, the requirements have been relaxed to represent a typical usage situation or the lowest imaginable acceptable service level.

The second approach in figure 2 revealed that rethinking the acceptable size of the locality to around 200m would allow the user in the scenario to locate a friend within a space the size of a street block or a larger building. The analysis shows that two different standardised positioning systems fulfil the relaxed requirements of the second approach. Those technologies are E-OTD and TOA (note that A-GPS does not work properly indoors).

## Conclusion

The focus of this feasibility study was on whether there was a need for LBS within the youth market and if yes, are there technologies on the market or up-and-coming technologies to meet these kinds of needs. The study took an innovative approach to this question by using a solid social science basis from which to derive the needs, culminating in a series of user scenarios. It then iteratively mapped these scenarios onto technology capabilities to examine

the different levels of service that could be offered and the likelihood of their acceptance by the user.
The results revealed that virtually no positioning technology is able to meet the requirements, and only by limiting the service offering in terms of accuracy and usage environment, can some of the current technologies begin to meet the needs of the youth market.
To conclude, the message from this study is that when the needs of the youth market are considered only selected services could be offered at this point in time due to technical limitations. These services could be most fruitfully met by either E-OTD or TOA. At this point in time and using the technologies considered in this study, the introduction of services which rely on high levels of accuracy, particularly indoors, are likely to be rejected by the youth market, due to poor and unacceptable service levels. Any tracking services should be introduced with caution and on the premise that they are primarily outdoor services providing general whereabouts, rather than 'pinpointing' [3]. However, the outlook for the future is more promising when hybrid systems are considered. In particular this study suggests that the merging of the accuracy provided by A-GPS and the wide environment coverage offered by OTDOA (a successor of E-OTD in 3G networks) [10] could be the best way forward to provide viable services for the youth market.

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