1 Extended Abstract

Practical part of this work dealt with determining the position of searching for mobile phone based on the measured parameters from BTS station. These parameters by which to determine the position were: Cell and Timing advance. In determining the position of a mobile phone were used these methods: CGI without and with considering directional zones and CGI+TA without and with considering directional zones. Furthermore, this work dealt with measuring the signal level. Target of the first measurement was to determine the impact of material constraints introduced between the GSM module (MC75i EDGE Terminal) and the BTS stationon the signal level and the second and also final measurements verified the effect of distance from the station to drop the signal level.

1.1 Determine the position of a mobile phone by a single BTS station

In the first measurement of the test determining the position of a mobile phone by a single BTS station were measured the following values Cell ID: 17570 and 17572. Both of these identification numbers of cells belonged to a station owned by O2. Dislocation of individual transmitters had a cover 90°. This BTS station was located in these coordinates:17°49´34.88”E, 49°56´51.19”N. Because it was not known maximum station range, so was presumed normal range 35 km , which corresponds also with the maximum value TA, then 63.

To verify whether the maximum value TA corresponds to the maximum range of the BTS station can use this formula:

$$Dis\tan ce = TA \cdot TA_0 + TA_0$$
$$Dis\tan cet = 63 \cdot 547 + 547$$
$$Dis\tan ce = 35008m$$

With this conversion was verified the correctness of the procedure, since the maximum value TA corresponded to the maximum range of the BTS stations

Another parameter measured was TA_N, which is a parameter that determines the time delay in transmission of radio signals between mobile phone and BTS station. Measured value $TA_N = 2$. After measuring this parameter was important to be converted into the distance.

Conversion of measured value at a distance:

$$Dis\tan ce = TA_N \cdot TA_0 + TA_0$$
$$Dis\tan ce = 2 \cdot 547 + 547$$
$$Dis\tan ce = 1641m$$

To determine the position of the CGI methods were used without and with considering directional zones and CGI + TA with and without considering directional zones. For all these methods have found a serched mobile phone in the areas identified on the basis of measured results and therefore we can say that determine the positions was held to correctly. The restricted area a searched mobile phone can be seen in Figures 1-4 see fig.1 - 4

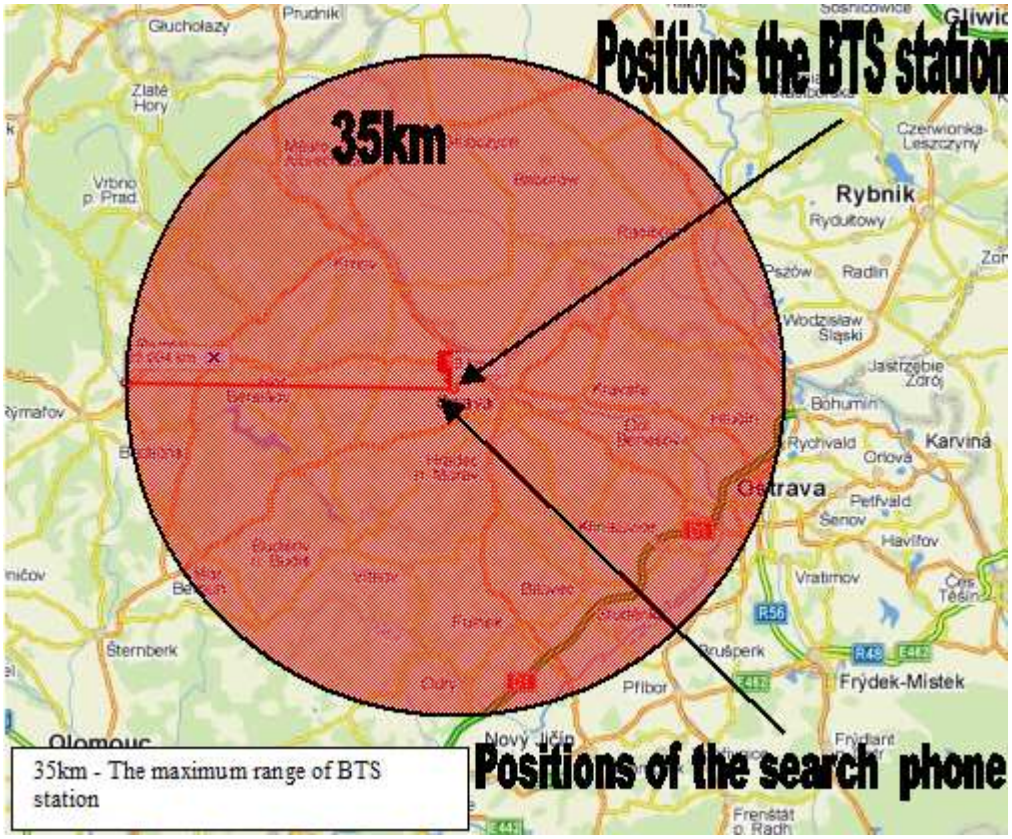

Fig.1: *CGI method, without considering directional zones*

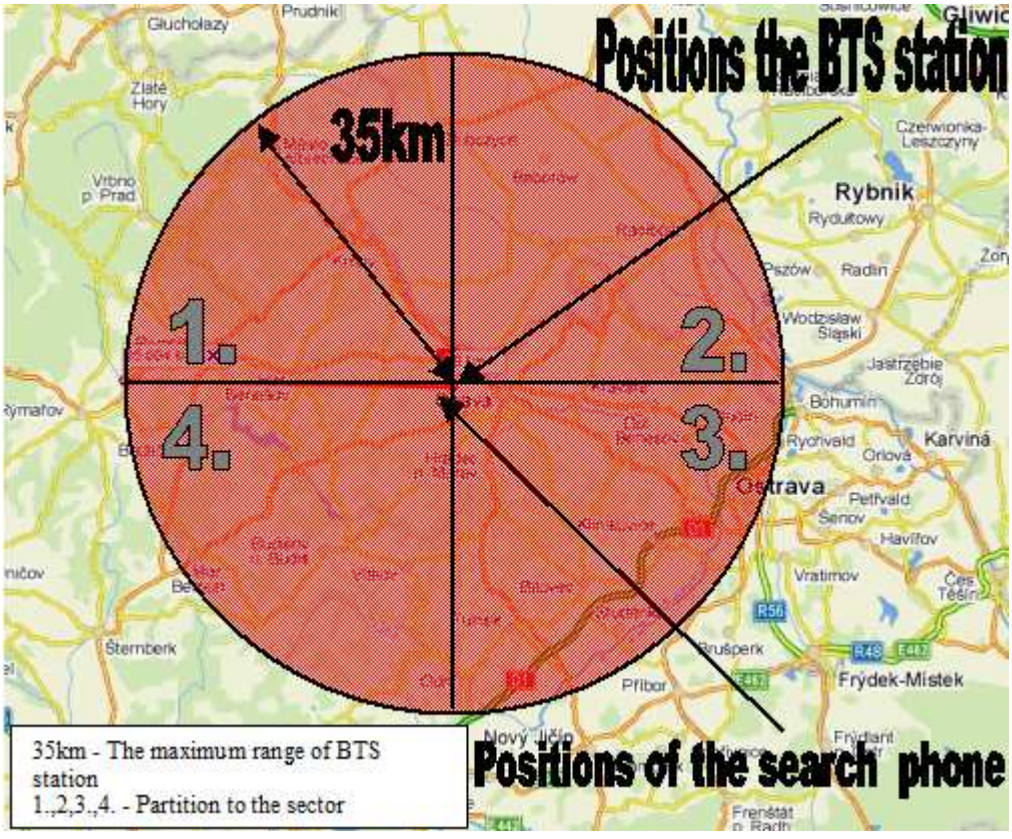

Fig.2: *CGI method, with considering directional zones*

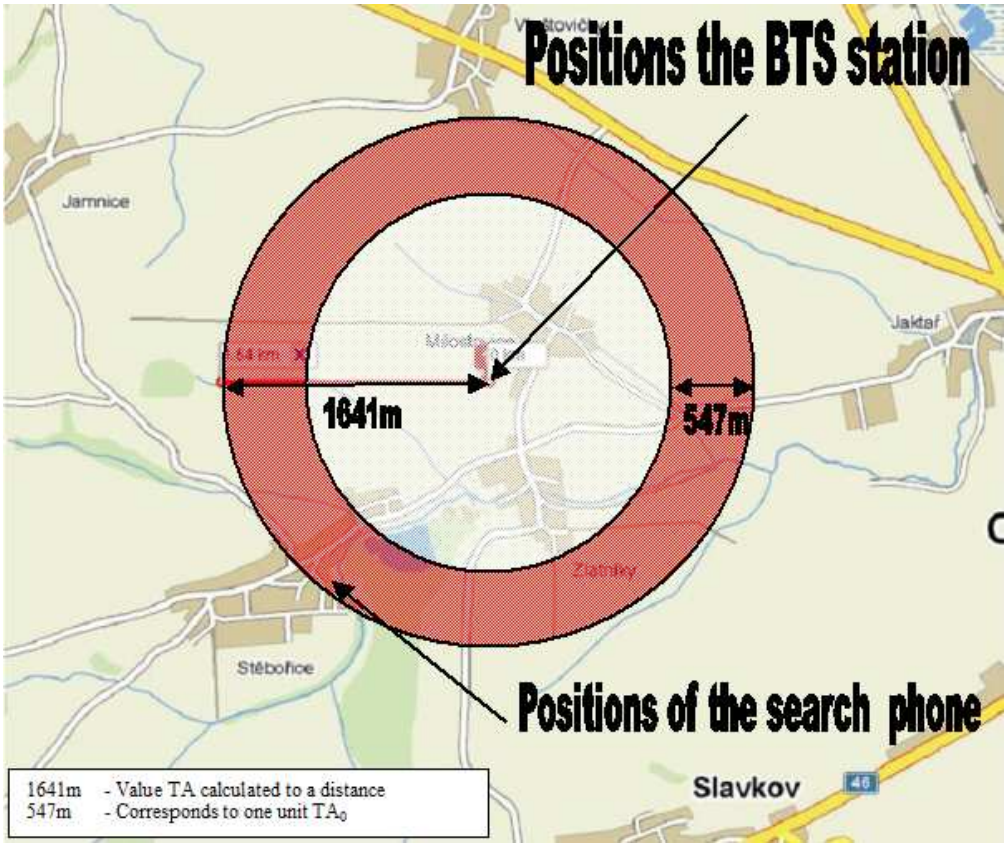

Fig.3: *CGI + TA method, without considering directional zones*

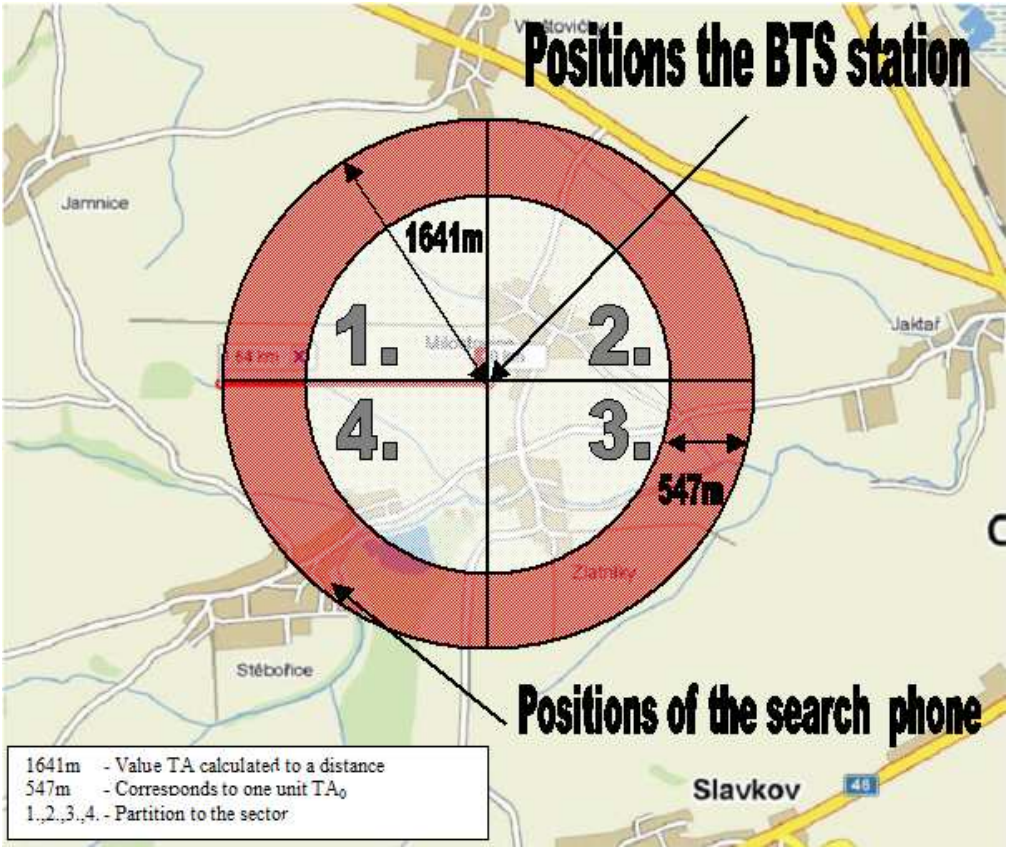

Fig.4: *CGI + TA method, with considering directional zones*

1.2 Testing service“Where is…“in practise andsubsequent varification by measurements

In another measurements were used applications from operator T-Mobile with title "Where is ..." in order to determine how the operator will determine the position of search a mobile phone, at the knowledges of all information. Subsequently, localization was performed by direct measurement on the coordinates of search a mobile phone. After posting the requirements to the operator to determine the position of searching a mobile phone, which was located in the countryside with minimal settlement and then in the city have been delivered informations of which were these most important:
Landscape with minimal settlement:

- Longtitude, E (Longitude) - 17.84428 °
- Latitude, N (Latitude) - 49.93539 °
- Estimate Accuracy (+/-) - 1000-500m

A city with a greater density of the network:

- Longtitude, E (Longitude) - 17.91843 °
- Latitude, N (Latitude) - 49.93281 °
- Estimate Accuracy (+/-) - 1000-500m

At the localization by direct measurements were then measured the following parameters with values:

Landscape with minimal settlement:

- Cell ID - BTS station 1. = 42676
- Cell ID - BTS station 2. = 42512
- TA_N - Value BTS station 1. = 5
- TA_N – Value BTS station 2. = 7

A city with a greater density of the network:

- Cell ID - BTS station 1. = 35308
- Cell ID - BTS station 2. = 35316
- Cell ID - BTS station 3. = 35317
- TA_N - Value BTS station 1. = 2
- TA_N - Value BTS station 2. = 0
- TA_N - Value BTS station 3. = 2

At both measurements were used to determine the position of the CGI + TA method with considering the directional zones. Using the measured values of the Cell ID have been defined the coordinates of the BTS stations and using the values of TA_N after calculating on the distance have been defined their annular zones. In the absence of the BTS stations have any information, they were addressed to the dislocation of directional transmitters with covering 120°. At the localization using direct measurements in the landscape with minimal settlement appeared determination of the position more exactly than from the operator T-Mobile and in the city this determined position was similar.Since the search mobile phone at the two measurements was in the area designated on the basis of measured values, can be this determine of the position and measurement considered fair, see fig 5 and 6

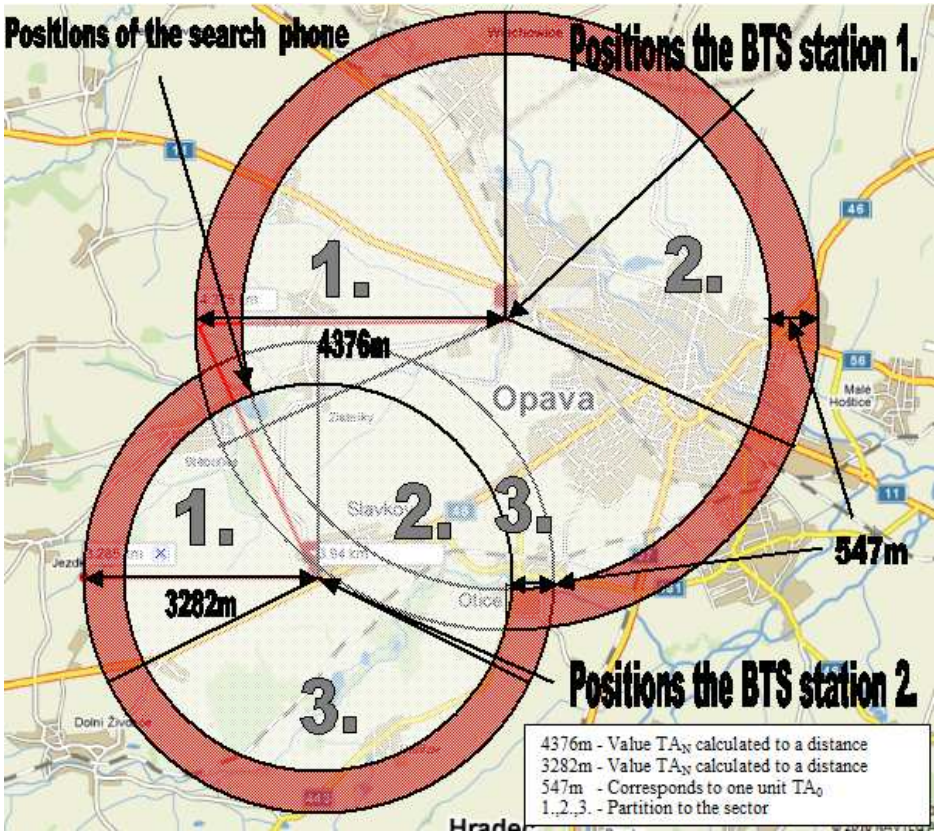

Fig.5: *Verification of the position in the landscape with a minimal settlement by measurement*

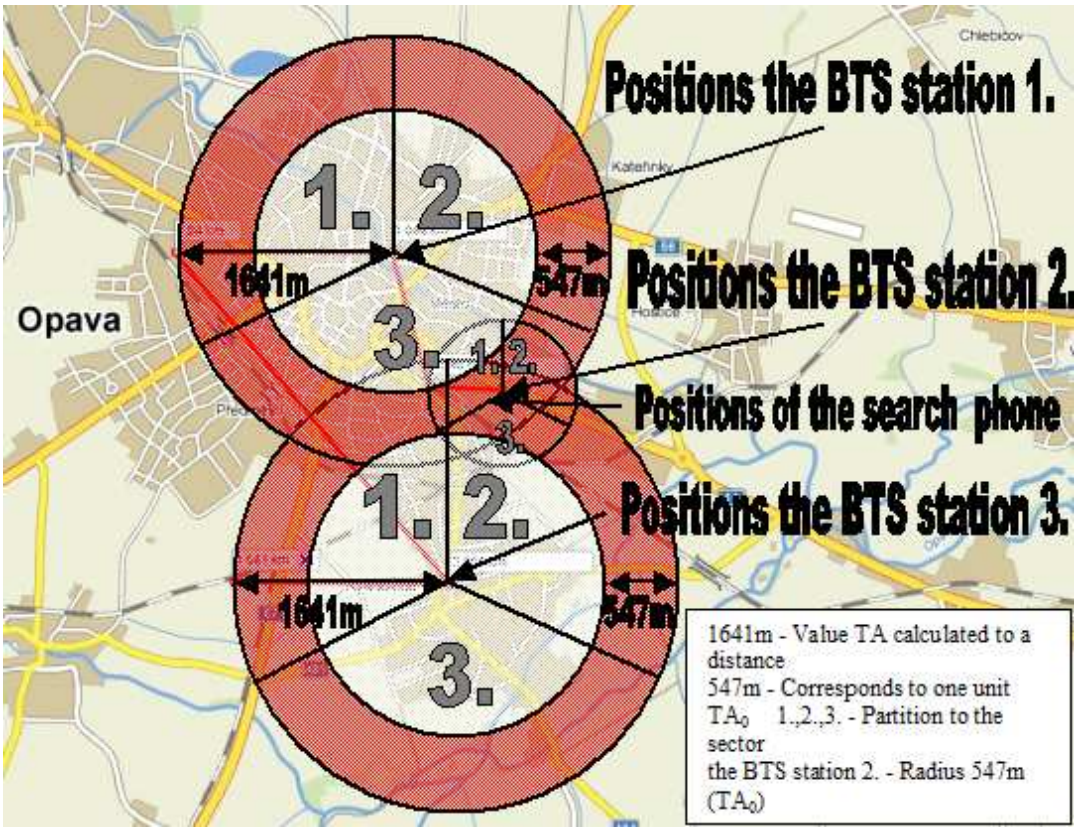

Fig.6: *Verification of position in a town with a greater density of the network by measuring*

1.3 Effect of materil barriers to the signal level

The aim of further measurements to determine the impact of material barriers introduced between the GSM module (MC75i EDGE Terminal) and BTS station, on the signal level. Individual barriers have been made of these materials: ytong, wood, cardboard, polystyrene and foam. All these barriers had the same dimensions: height 17cm, width 15cm, length 19 cm and 2 cm thick wall barriers At each measurement were scaned 100 values of the signal level in [dBm], using the GSM BTS program and for each individual measurement was from these values calculated diameter, median, minimum, maximum, and variance.The first measurement was carried out without the influence of barriers and all values were based on -42 dBm.At other measurements, where were already used barriers the values were changed at least, which resulted more from the intensity fluctuations of the received signal.Therefore we can say that made barriers to the signal level had no effect. Measurements were made with a direct view to the BTS station at a distance of 927 m and in the signal path, there was no other barrier that would have a major influence.on this measure .

1.4 Level measurement BTS station

Last measurement checked the influence of distance from the BTS station on decrease of the signal level.Measurements were made in an scanning 50 samples of the signal level in [dBm], measured at each position after 100 meters using GSM BTS and GSM module.Subsequently, from these values was calculated diameter, the median, minimum, maximum and variance.In this measurement was found the maximum signal level on 1000m.Decrease of the signal level to the BTS station is given by the horizontal setting of the transmitter / receiver and decrease of the signal level at the increasing distance is given by increasing area coverage and hence lower intensity.This decrease of the signal level can be best seen in the graph, see graph.1.

Graph.1: *The dependence of decrease of the signal level on the distance from the BTS station*