

Mobile phone localization based human search methods

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General information:

- up to 98% of people entering the mountains have their mobile phones with them
- mobile phones constantly seek the most powerful Base Transceiver Stations (BTS) leaving their logging attempt signals on the weaker ones also
- TOPR has an agreement with Polish Police department responsible for search of lost citizens, GSM logging data and phone activity is available
- calls history and texting activity is also available for 24 hrs

Difficulties:

- only an active mobile phone can be located precisely
- low to feeble coverage in the mountains is a problem
- mobiles often rely on distant BTSs
- no unified standard of information provided by GSM operators
- logging and calls history, texting activity is not stored in the network for prolonged periods of time, after 24 hrs some of this information is erased



Searching for mobiles based on data
provided by mobile network operator
aka
triangulation

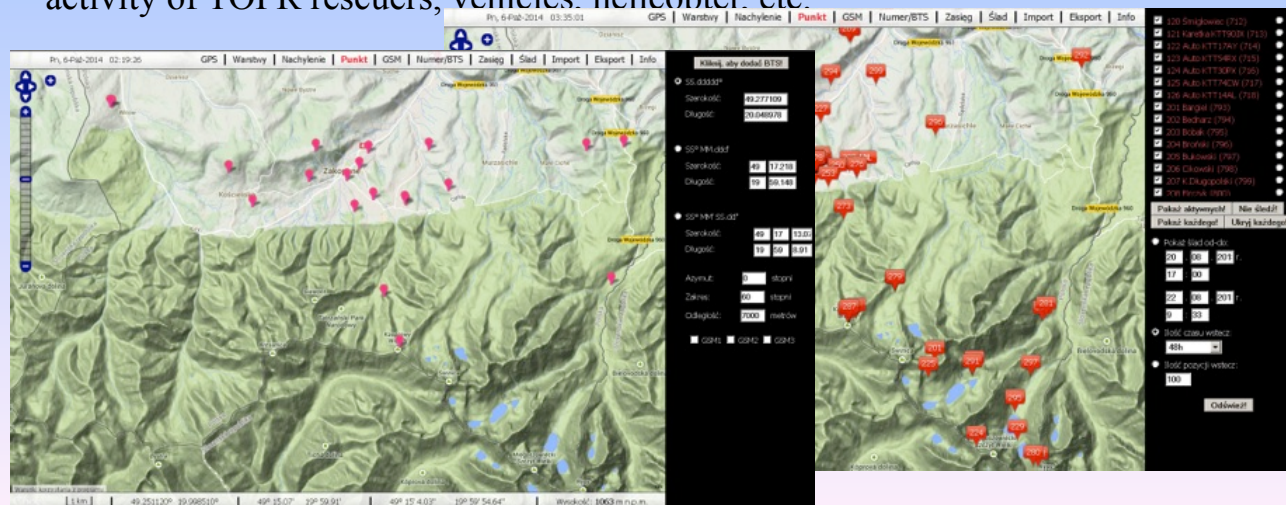
Searching for mobiles based on data provided by mobile network operator



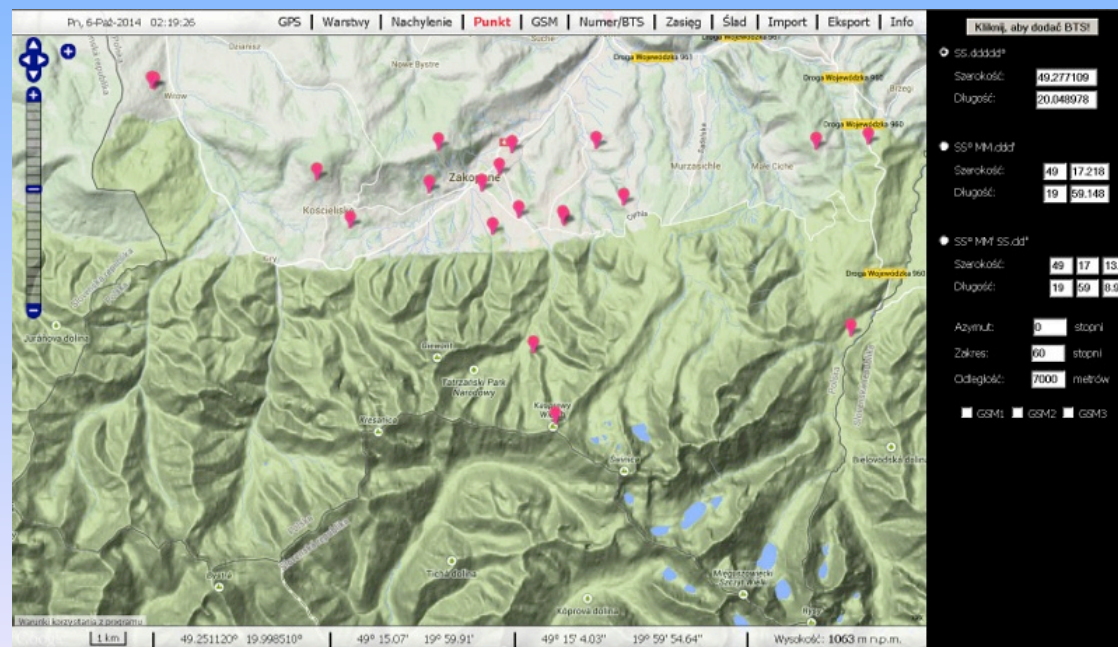
This method allows only for determining of area of search (for rescuers, dogs)

Necessary elements :

- mobile number of the lost person
- network operator data concerning BTS positions and their antennas
- computer with internet access, web browser
- for us: access to gps.topr.pl – software on TOPR server integrating all logging activity of TOPR rescuers, vehicles, helicopter, etc.

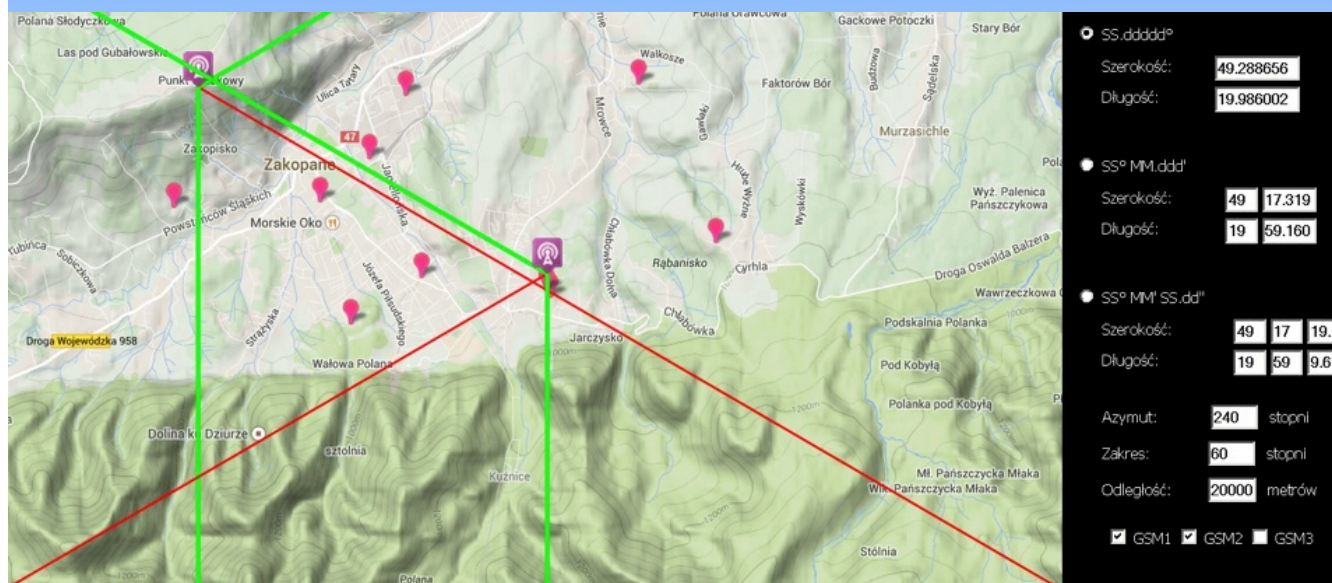


Searching for mobiles based on data provided by mobile network operator



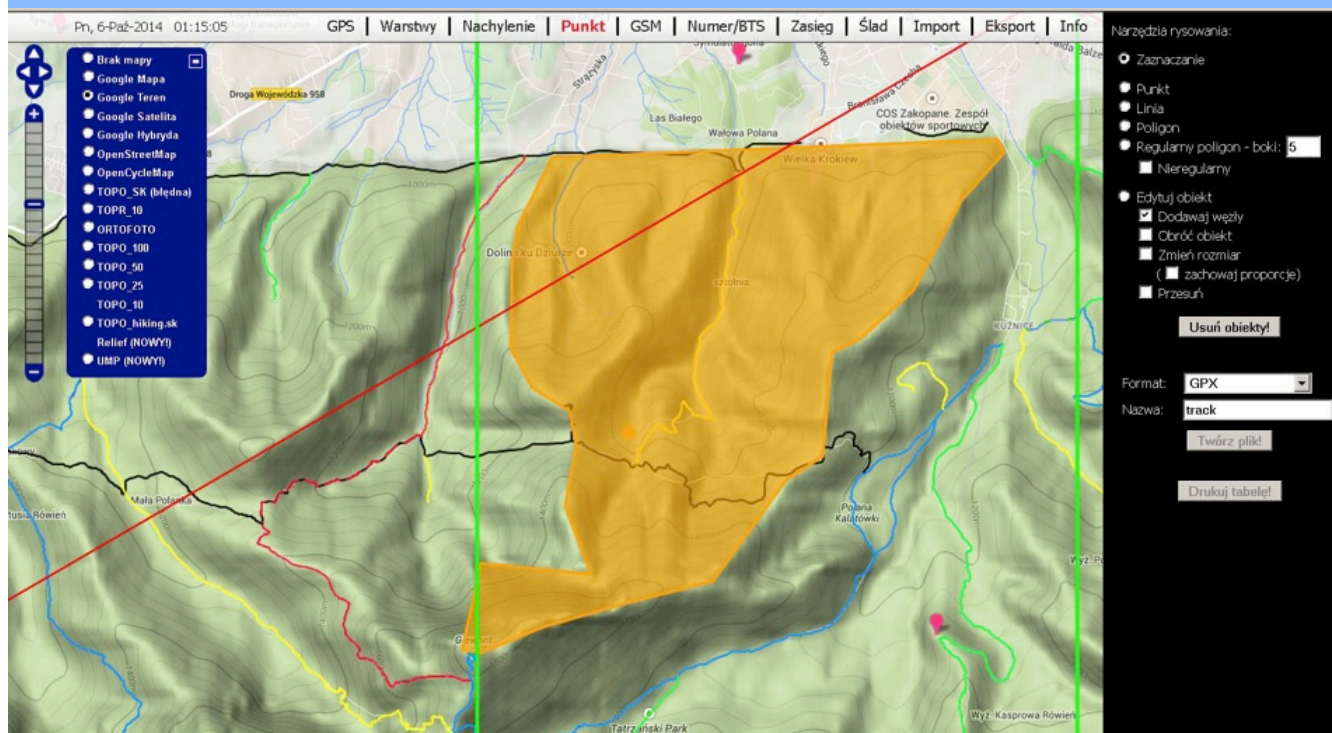
- precision of the method varies, distribution of BTSs is crucial
- precision also depends on terrain features
- data on a map has to be further analyzed by human operator

Searching for mobiles based on data provided by mobile network operator



- scope of BTSs and antennas which have contacted the phone is presented on map
- terrain covered by at least two antennas has to be determined

Searching for mobiles based on data provided by mobile network operator



- area to be searched has to be isolated on a map taking into consideration the terrain – a human is indispensable (no appropriate software)

Searching for mobiles based on data provided by mobile network operator



Pros:

- area of search can be determined fast
- the method can be implemented on fairly simple equipment

Cons:

- terrain search has to be conducted by means of traditional terrestrial search procedures (human and dogs senses)
- personal data of the searched individual has to be provided by the Police
- GSM signal repeaters make precise location of the phone problematic



Search for phones using GSM receivers
with directional antenna - with prior
resetting the phone onto free GSM
frequency

Search for phones using GSM receivers with directional antenna - with prior resetting the phone onto free GSM frequency



This method allows for locating a functioning mobile phone with accuracy comparable to an avalanche beacon

Range: 20 km (in perfect conditions)

Necessary elements:

- phone number of the searched person
- network operator data concerning BTS and antennas positions
- it is necessary to free a channel on a BTS and to transfer the communication with the phone onto that frequency
- search device with directional antennas
- means of transport quickening the search: helicopter, snowmobile, car, ATV...



Search for phones using GSM receivers with directional antenna - with prior resetting the phone onto free GSM frequency



Pros:

- vast range allowing for efficient search
- great directional precision enabling search for people buried in avalanches

Cons:

- the mobile phone must be within mobile network coverage
- noticeable size of the device
- necessity to have agreements with GSM operators and electronic communications agency (to use GSM frequencies)



Search with a system independent from GSM
network operators.

Ghost GSM transceiver search method.

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Search with a system independent from GSM network operators. Ghost GSM transceiver search method.



The method allows to locate a functioning phone with accuracy comparable to avalanche beacon.

Range: 1 km (in perfect conditions)

Necessary elements:

- BTS-simulating device (ghost BTS)
- directional antenna equipped search device (finder)
- means of transport quickening the search: helicopter, snowmobile, car, ATV...

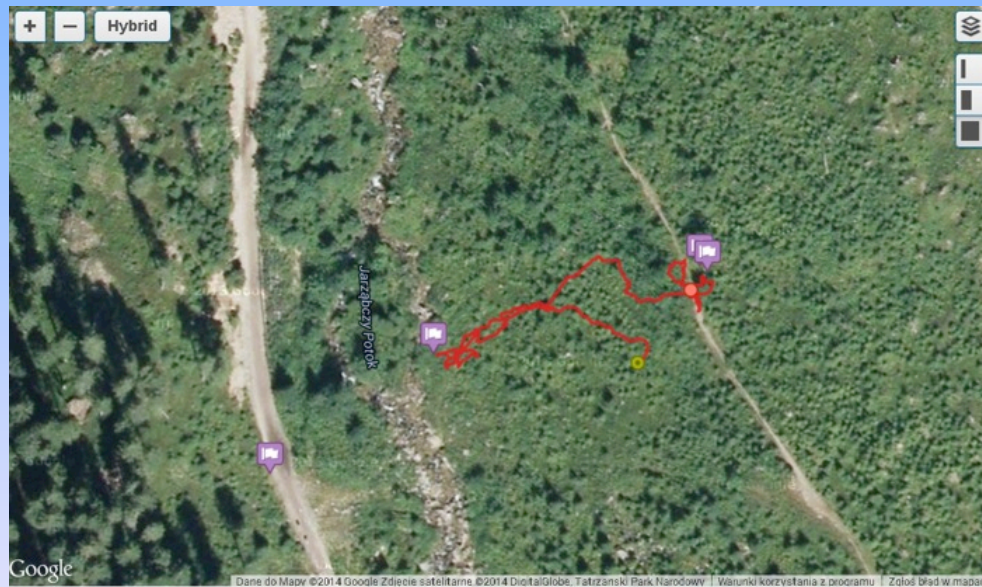


ASSA tests 2013



- 13.36 ghost BTS on, network scan, channel search established
- 13.42 finder (relying on the channel) acquires phone signal, distance 72m.
- 13.48 phone found, actual phone distance 85 m from BTS
- IMEI and IMSI known in this scenario, message send from ghost bts to all other phone users within range

ASSA tests 2013



14.29 ghost bts on, network scan, channel search established

14.31 finder acquires phone signal, distance 50m.

14.44 phone found 88 m from BTS

IMEI, IMSI known, precise search with cross method

ASSA tests 2013



11.08 ghost bts on, network scan (no network coverage), search channel established

11.28 finder acquires phone signal: 197 m from ghost BTS

11.39 precise search

11.42 phone found 254m from BTS

IMEI and IMSI known

Search with a system independent form GSM network operators.
Ghost GSM transceiver search method.



Pros:

- great search accuracy allowing for searching people buried in an avalanche
- search possible with no mobile network coverage
- search for phone of unknown number possible (software presents list of all phones logged to ghost BTS)
- range of ghost BTS can be adjusted from 100 m to 1 km, it does not interfere with mobile network

Cons:

- limited range is a disadvantage in quick search of extensive terrain
- noticeable size of portable BTS device
- necessary approval of such activity by national communications agency (obtained)

Conclusions

- The two search devices are still prototypes – need more enhancement
 - Terrain search with the aforementioned devices must be refined
 - Only triangulation allows for localizing an inactive phone
 - Obtaining all legal agreements (in any method) may pose a problem
 - None of the methods presented is optimal – they all perform well in certain circumstances
 - The methods are not meant to replace existing methods e.g. avalanche beacons
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- Mobile search methods may be the only solution (no beacon, patient unconscious)

Thank you!

