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MOBILE USAGE OF DIGITAL GEOGRAPHICAL DATA IN THE APPLE IPHONE DEVICE

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Abstract

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This article deals with the possible deployment of the Apple iPhone device as mobile geoinformation technology. An examination of the possibilities of the device, the development tools and the Web Mapping Service (WMS) was followed by developing a prototype of an application called WhateverMap. The application uses maps from the WMS, which are available in the field through mobile data communication. The application interface was designed around the User Experience model so that its control is easy to grasp and intuitive. It also features support to the determination of the current location. To make working with the application more comfortable it integrates a database of WMS servers. The user is thus given an overview of all the maps available and can easily add them as desired. The application can be downloaded free of charge from Apple's AppStore on the internet.

Apple iPhone, Web Map Service, Open Geospatial Consortium, A-GPS, WhateverMap

Geographical thematic maps are frequently used in electronic format today . This is due to the ever increasing employment of electronic equipment which makes working with the maps and their further processing more comfortable. Its scope of use includes both the general public, with all the walking or driving GPS navigations, but even greater potential emerges in the field of science and research. The conclusions of many scientific reports are based on analyses involving a digital elevation model, slope, exposure, or other thematic data. For these types of analyses the electronic format of the data is almost inevitable. The analyses may spawn further maps in electronic format which then serve as a basis for additional calculations or even formulating the conclusion. Electronic maps are not intended just for office use, they are more valuable as resources when available directly in the field. Naturally, this requires harnessing mobile geoinformation technology so that the user can work with the data regardless of the current location. Mobile GIS is principally determined by the integration of the individual components – cellular phones, GPS devices, small (field) computers (palmtops), software and geographical data (RAPANT, 2006). On the one hand, we have the hardware and software, and on the other there is the actual digital geographical data.

MATERIALS AND METHODS

For geographic data it is essential to choose a suitable method of distribution. If the data is to serve a large group of receivers an appropriate choice is, for example, the Web Map Service (WMS), which is an Open Geospatial Consortium standard (www.opengeospatial.org). It is a simple HTTP interface for the distribution of georeferenced images, which the service on the server has available in the form of a database. To a pre-defined request the service returns an XML document specifying all the parameters of the service provided by the server. The document gives information about the boundaries of the area mapped by the server, listed layers, supported system of coordinates, supported image formats, etc.

Next, it is necessary to acquire the desired geographical data. A request is set up to be sent to the server. It consists of a number of parameters specified by the user, such as the boundaries of the required area, list of layers, image format and others, which detail the requirement for the geographical data or the response by the server when the data is not available. Based on the request the server provides a raster image in the required format. Although it is a standard image format,

such as JPG or PNG, when combined with the request made with specific boundaries, it becomes a georeferenced image. In the Czech Republic this service is in great demand and it is used, for example, by the Portal of the Public Administration of the Czech Republic or the Czech Land Survey and Czech Office for Surveying, Mapping and Cadastre (COSMC) and a host of state institutions and private companies. The scope of the digital geographical data provided is varied, from the basic geographical data like orthophotomaps or cadastral maps, to thematic maps related to environmental protection, forest and water management, to historical maps and highly-specialized tightly focused geographical data (KLIMÁNEK and CIBULKA, 2008).

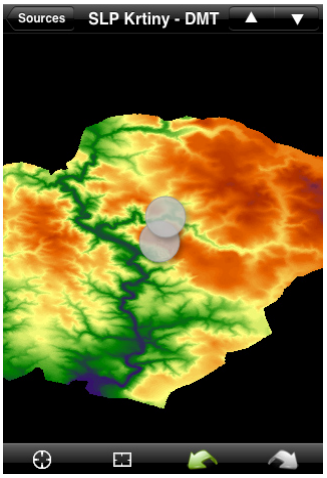
The year 2008 saw the launching on the market of the iPhone 3G device which meets all the requirements for working in the field. The device offers a sufficiently large display, battery power sufficient for a whole work shift, is capable of receiving the GPRS or 3G signal for data communication and on top of that has a highly user-friendly interface. Being a smart phone, iPhone (http://www.apple.com/iphone/specs.html) is a combination of a telephone and a mobile computer. Its arrival in the market virtually caused a revolution in the cellular phone industry. The telephone uses hardly any mechanical controls and is controlled by means of a touch screen. The ground-breaking novelty is the absence of a pen which has been replaced by finger taps. The control is more comfortable and even allows you to use various gestures such as pinching. These gestures can simulate, in a very natural way, zoom in or zoom out data observed on the telephone. The control principle influenced the style of the whole device as the fingertip does not allow for using small controls. The interface of the iPhoneOS operating system had to be adapted accordingly. Some controls are larger, others were completely remodelled. Additionally, it is possible to useeven the accelometer registering gravitational acceleration on three perpendicular axes as a control. This makes it possible to determine the angle of the device followed by adapting the application interface or even directly using it as a control. The user interface of iPhoneOS is designed in the User Experience style. All controls should strongly suggest the purpose they serve and how they should be used. The user interface is therefore customer oriented and adapted to his needs.

Although the iPhoneOS operating system has been on the market for a relatively short time, Apple put together an exceptional infrastructure for the development and distribution of applications ensuring a quick expansion of their numbers. Yet there was no application for the iPhone device capable of working together with the WMS. A combination of the technologies mentioned above which are generally available today gave an impetus for developing a prototype of such an application. Developed in the Xcode environment running under the Mac OS X Leopard operating system (developer.apple.com), the source code was written in Objective-C. The XML technology involved, which is an indispensable part of the WMS, also serves as data storage. The code was debugged using the iPhoneOS simulator from the Xcode environment and final debugging was made on the iPhone 2G and iPhone 3G devices with different versions of iPhoneOS.

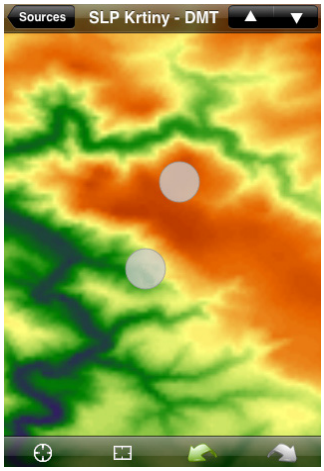
RESULTS AND DISCUSSION

The result of the development is a prototype mobile application using the WMS available through an internet connection. The prototype was called "WhateverMap". The user interface was designed with regard to the requirement for easy and intuitive control. Nearly all of the control elements and principles were taken over from the iPhoneOS operating system. Every iPhone user is familiar with them and they provide exactly the functionality that is expected from them and which is employed in numerous applications written for the device. This makes the application easy to control by everyone.

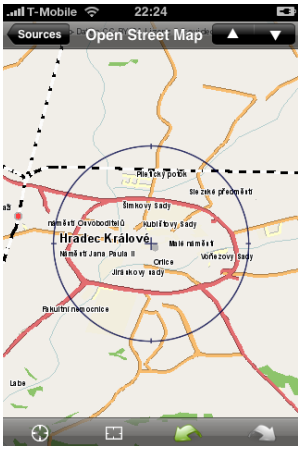
For the sake of clarity, WhateverMap features a navigation structure similar to the Mail or Free RSS Reader applications. The home screen shows a list of favourite items so that after launching the application the user can immediately choose an item with pre-defined maps. The map control to which the user is switched to next will display the maps and the user can work with them. By simply dragging a finger the map pans in the given direction. A change of scale is accomplished by pinching, it means moving two fingers on the display towards themselves or outwards. The map scale changes analogically as expected. By moving the fingers outwards the objects in the map move away from one another and the scale increases. Pinching is illustrated in Fig. 1 and Fig. 2, where the marks indicate the fingers touching the display. The response is immediate. The user can watch the map scale as it is changing and is always in control of the status the map is in. When the user is satisfied with the dis-



1: *Fingers closed*



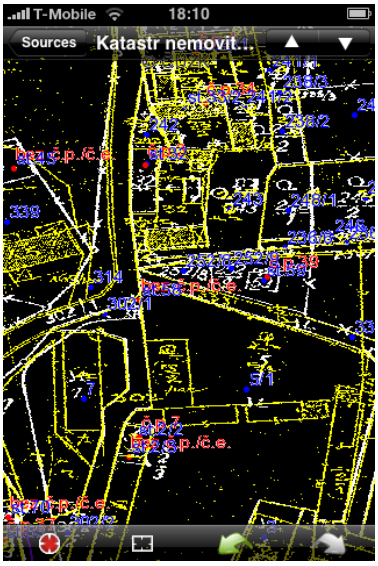
2: *Fingers open*



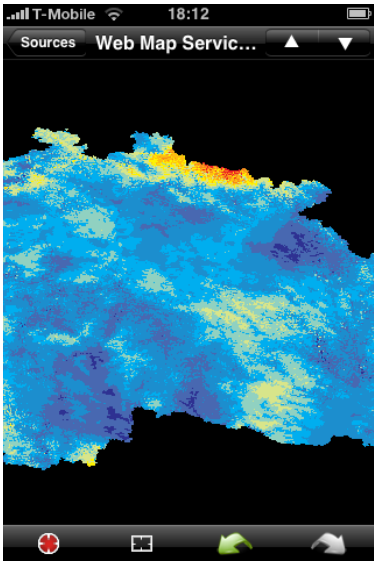
3: *Current location display with indication of accuracy*

played section of the map, the application will ask for new data from the server. The maps are then downloaded in a corresponding resolution so that the user can see the maps in the best quality.

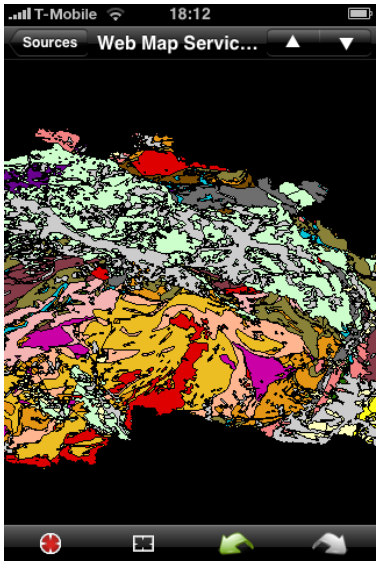
In addition to this basic functionality the user has an option of displaying the current location. Tapping a pre-defined button on the toolbar activates a search for the current location. The iPhone device need not use exclusively the GPS module to make the search as the GPS signal is not available everywhere. For example, inside a building we can hardly receive a signal of a quality sufficient to provide us with at least some location data. This is when the Wi-Fi Positioning System (WPS), using the signal of Wi-Fi networks for locating, comes to the fore. Unfortunately, the area covered by Wi-Fi networks is not very extensive and this method is limited for use inside buildings and in urban areas. In a similar way, it is possible to take advantage of GSM triangulation and use the cell towers of a cellular network to establish the location. Apple iPhone integrates the Hybrid Positioning System (XPS) which combines the three locating methods and offers the user the best of the posibilities (www.skyhookwireless.com). The resulting location has a variable position accuracy from tens to hundreds of metres, depending on the received signal from Wi-Fi, GSM and GPS. On the other hand, the method is available wherever there is at least the GSM signal and the information is retrieved much quicker than by using only the GPS module. Sometimes the location obtained in this way may be accurate enough and we save battery energy. Depending on the accuracy of receiving the coordinates, the application will display the deviation. It is presented to the user as a circle delimiting the area in which the retrieved coordinate is situated. The circle diameter symbolizes the resulting deviation (see Fig. 3). Given that Apple iPhone is a consumer good for the general public deviations need to be taken into consideration. This solution cannot be used instead of the more ac-



4: *Cadastral map*



5: *Wind speed*



6: *Geology*

curate GPS or even as a replacement of expensive measuring equipment as a result.

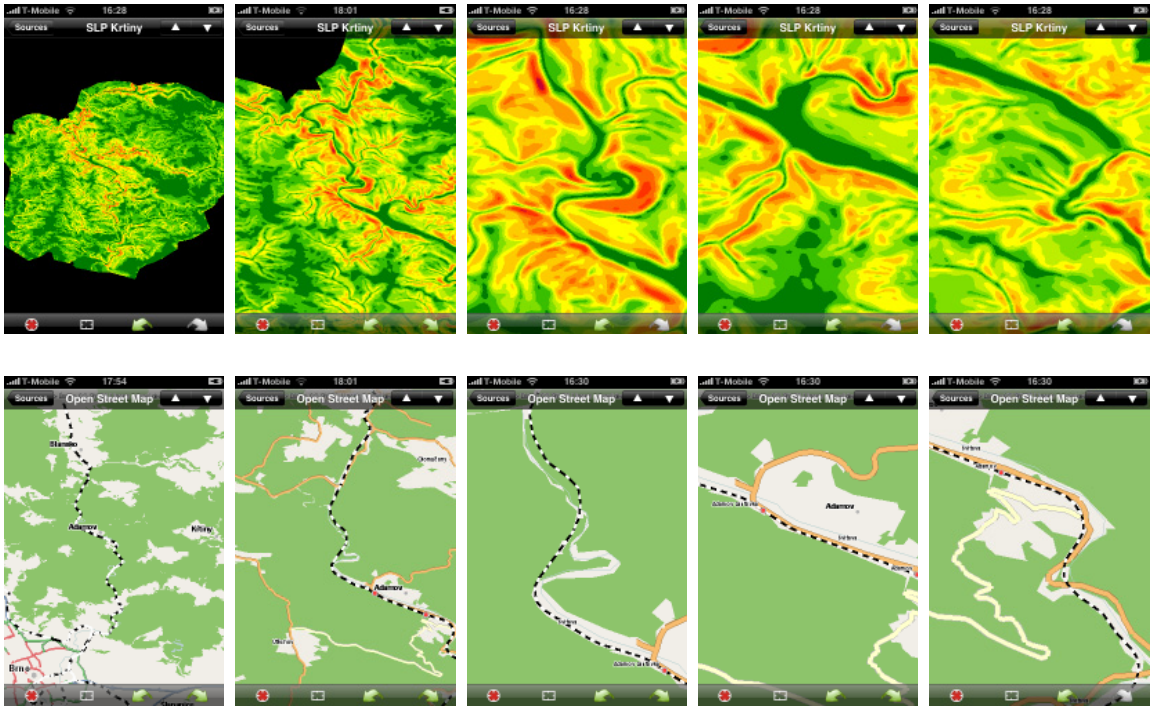
The list of sources mentioned above from which the user chooses data for display can be edited on a request. It contains mainly favourite servers with saved settings defined by the user for future use. However, producing such a list is not always an easy task. Not everybody has a grasp of all the available WMS servers. Also, to add a server, one needs to know its URL address which is usually difficult to remember. Naturally, there are catalogues collecting WMS servers, but not necessarily always containing correct data and often not sorted. And the transcription of the addresses is not comfortable even though iPhone comes with a full-fledged "qwerty" keyboard. To simplify the task of entering the addresses the application integrates a catalogue of WMS servers sorted by continents, and at a more detailed level by countries. The user spend less effort of searching for data sources on the internet and instead simply browses the catalogue and adds servers suitable to his field of interest. As it is a generally affordable device, not a high-end item, the application may have a potential for drawing the interest of the general public who have so far tapped into the WMS only sporadically.

The WMS catalogue is internal but its data is stored in XML files whose design is compatible with GeoRSS (georss.org/encodings). This step enables the solution to be extended by a complete portal dedicated to acquiring data on WMS servers in the future. A community around such a server could update information and use it as a source of data. In addition, thanks to the GeoRSS format the portal would not be limited solely to the Apple iPhone technology but could serve as a universal catalogue for the WMS. This is because the format is generally compatible with RSS readers and available for all platforms.

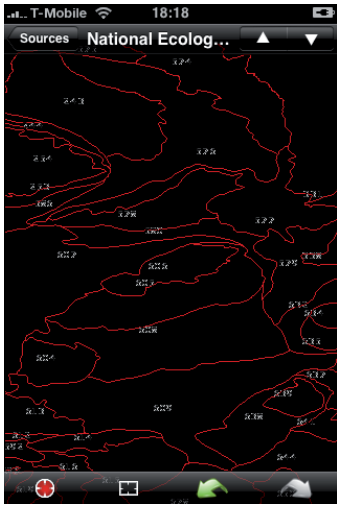
Data contained in the catalogue was sourced from various WMS catalogues available on the internet, including the best-known servers such as NASA, Open Street Map and others. The territory of the Czech Republic is covered more elaborately than the rest of the world. Sample images from a selection of WMS servers displayed by WhateverMap can be seen in Fig. 4 to 6.

While working with the map it is possible to use the history option which stores in memory the last 100 drag gestures. The history can bring up an area following a loss of the GPS signal or after displaying a section from another map server. As the history is independent of the underlying data, the same sequence of the drag gestures can be rerun over a different area as well. This enables the user to trace an element on the maps where it is clearly visible, while different maps can then serve to observe other important parameters (see Fig. 7).

Apart from displaying the maps, the application supports requests for detailed information. This is made possible by means of the GetFeatureInfo service which is part of the WMS standard. Unfortunately, the implementation of this service is optional and some WMS servers do not support it. A request is made by touching a particular feature and holding the finger on it. After a short delay the GetFeatureInfo is processed. The delay is set so as to distinguish between panning the map and making a request. A sample request is shown in Fig. 8 and 9.

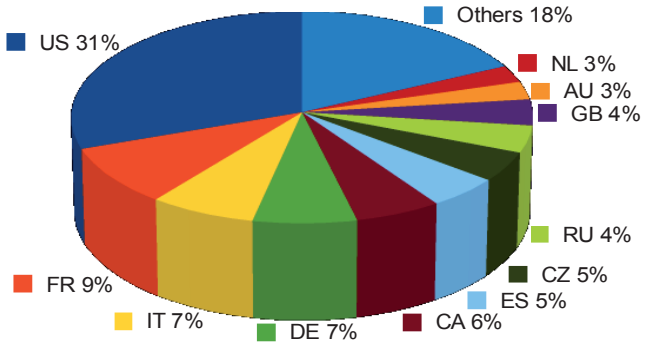


7: *Example of using the history of drag gestures in a slope map of the Křtiny Forest Training Enterprise (ŠLP Křtiny) and the Open Street Map*

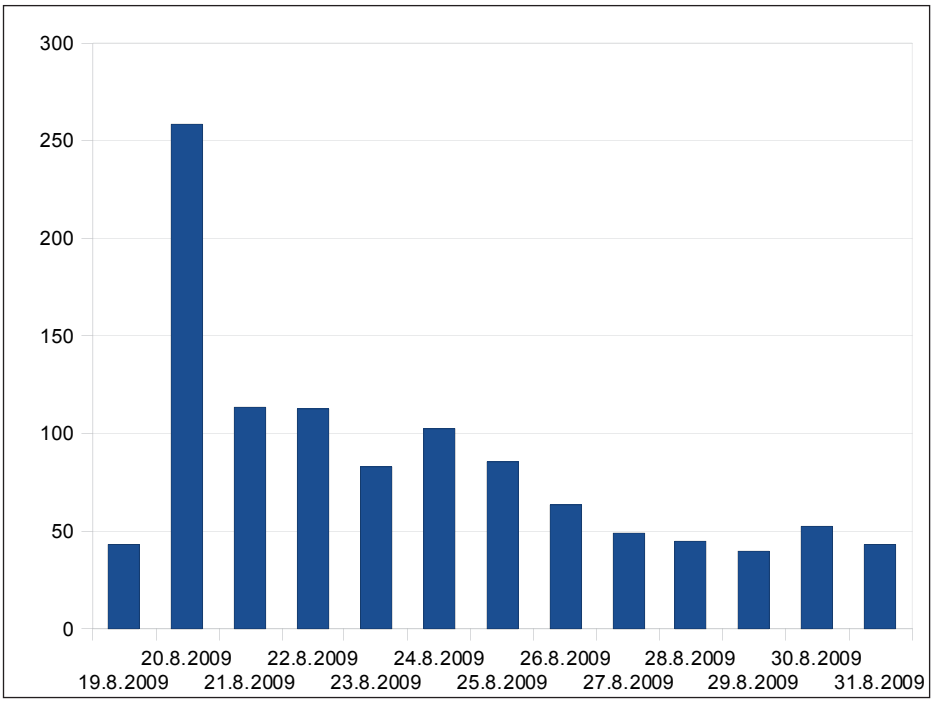


8: *Map before request*

9: *Reply to request*



10: *Percentages of user nationalities for the period of 19.8.2009 – 31.8.2009*



11: *Daily statistics for the period of 19.8.2009 – 31.8.2009*

Graph 10 and 11 show the AppStore statistics over the first calendar month. Graph 10 details the daily counts of application downloads over the first 14 days. One clearly notices the initial upsurge due to the promotion of new applications that Apple highlights in a dedicated section. Graph 11 indicates the percentages of the nationalities of users who downloaded the application. The USA have obviously the greatest share as iPhone is widespread. The Czech Republic holds the seventh position as regards the number of downloaded applications, which can be attributed to promotion by articles in specialized journals and the project web site.

SUMMARY

The WhateverMap application has succeeded in meeting the goal aimed at during its development – to provide the user with access to maps from WMS servers. The application, made publicly available on 19. 8. 2009, is distributed as freeware and during the first 7 days as many as 801 downloads were recorded. It was downloaded throughout the world via the App Store portal operated by the Apple company.

The application will continue to be extended in the future. The development might be directed towards broadening the scope of supported services. While the application currently supports only the WMS, there are other OGC standards such as the Web Feature Service (WFS) or Tile Map Service (TMS), which can be employed for a similar purpose. For example, the TMS could help resolve the problem with a slow response of the server. A WMS server must prepare every section which in some cases constitutes significant overheads in the total response time.

The final version of the application was tested by several users from different fields. During testing it was the application control that aroused the greatest interest. As Apple iPhone offers a truly revolutionary manner of control it naturally influenced the control of the whole application. It met with a very positive response on the part of the users who, compared to competitive solutions, considered it much more intuitive and easier to control. Users also appreciated the possibility of using various types of data and welcomed the altered maps tailored to their specific requirements. Some users highlighted the mobility of the whole solution and the optional use of a GPS module with the data.

The deployment of the application as a mobile GIS system has a great potential. The revolutionary control of Apple iPhone, so far quite unusual for field computers, facilitates access, together with the developed application, to digital geographical data published via web services. The device, the application and the services are available to the general public and provide unlimited access to any digital data sets. The operation scope of this application can be seen in basic information services covering a particular area (navigation, tourism, sports) or in specialized professional environments in thematic mapping, property management, crisis management, etc.

SOUHRN

Mobilní využití digitálních geografických dat v prostředí Apple iPhone

Aplikace WhateverMap splnila cíl, se kterým byla vyvíjena a to zpřístupnit uživateli v terénu mapové podklady ze serverů WMS. Aplikace byla vystavena 19. 8. 2009, je šířena jako freeware a během prvních 7 dní zaznamenala 801 stažení. Stahována byla z celého světa přes portál App Store provozovaný firmou Apple.

Aplikace bude do budoucna dále rozšiřována. Vývoj by mohl směřovat k rozšíření služeb, které aplikace podporuje. Nyní je aplikace zaměřena pouze na službu WMS, ale existují i další OGC standardy jako Web Feature Service (WFS) nebo Tile Map Service (TMS), které lze využít pro podobný účel. Například služba TMS by mohla řešit problém s pomalou odezvou serveru. Server WMS služby musí každý výřez připravit, což v některých případech činí nezanedbatelnou režii v celkové době odpovědi.

Výsledná aplikace byla také testována několika uživateli s různým zaměřením. Největší zájem při testování vzbudilo ovládání aplikace. Apple iPhone disponuje opravdu revolučním stylem ovládání. Tento styl samozřejmě ovlivnil i způsob ovládání celé aplikace. Samotní uživatelé jej hodnotili velmi pozitivně. Oproti konkurenčním řešením jej hodnotili jako mnohem intuitivnější a jednodušší na ovládání. Dále uživatelé ocenili možnost využívat různorodé podklady. Zde každý uživatel uvítal trochu jiné mapové podklady, požadavky se lišily se zaměřením uživatele. Některými uživateli byla vyzdvižena mobilita celého řešení a možnost využití GPS modulu s takovými podklady.

Využití této aplikace jako mobilního GIS má značné možnosti. Technologie Apple iPhone nabízí revoluční ovládání, které dosud nebylo běžné pro terénní počítače a v kombinaci s vyvinutou aplikací nabízí přístup k digitálním geografickým datům publikovaným přes webové služby. Zařízení, aplikace i služby jsou dostupné široké veřejnosti a nabízí neomezený přístup k libovolným digitálním

datovým sadám. Využití lze spatřovat jak v základních informačních službách o území (navigace, turistika, sport), tak ve specializovaných profesích při tematickém mapování, správě zařízení, krizovém managementu apod.

Apple iPhone, webové mapové služby, Open Geospatial Consorcium, A-GPS, WhateverMap

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