

## GIS services in telemetry and visualization

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**Abstract.** These days telemetry, especially in the area of vehicles and services robotics, it is more than only measurement and communication. The first task of the telemetry is the measurement of all the necessary physical properties of an object. The second task is the communication. The third task of the telemetry is the visualization and interpretation of the measured and transferred data. Location of information, object orientation and position are very important for data post processing and interpretation, especially for the mobile robots and the vehicles. Using the powerful GIS system the visualization is more understandable for system operators and users in general. The use of the public accessible GIS systems or data resources such as the Google Earth and similar local systems may speed up the application design and provides a wide range of scientists, technicians or other people with the measured data.

**Keywords:** KML, Google Earth, public accessible GIS systems

### 1 Introduction

These days by the term telemetry we do not understand only measurement and transmission of data but also their presentation and visualization (Fig. 1.). The first part is a sensor which measures all the physical values which are necessary for the particular task. Another part is a terminal for the transmission of data to the server where they are processed and archived. The last part is a visualization and presentation of the data measured by GIS systems accessible to public (Google Earth, Google Maps, Mapy, Amapy).

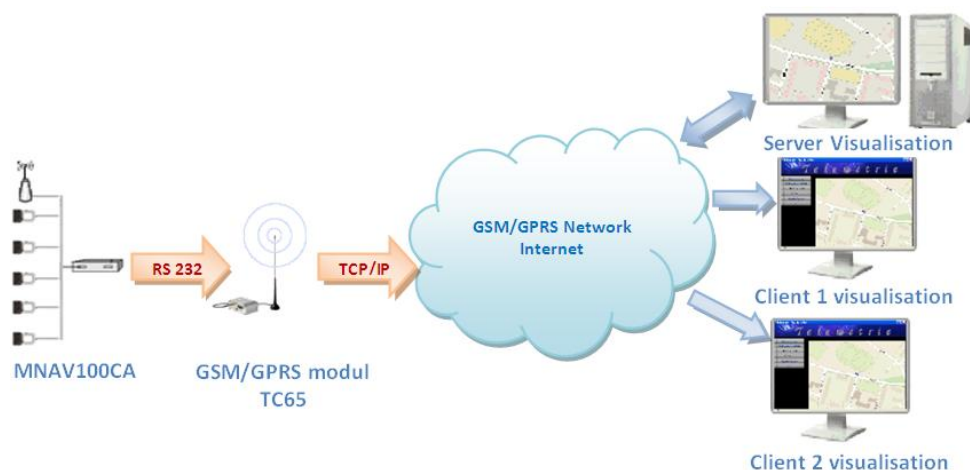


Fig. 1. The telemetric blocks

## 2 Measurement of data

The first part of telemetry is the measurement of data. The measurement uses a digital sensor MNAV100CA (Fig. 2) by Crossbow. The digital sensor includes accelerometers, angular rate sensors, magnetometers for use in inner loop control applications as well as static pressure altitude), dynamic pressure (airspeed) sensors, GPS receiver for the exact determination of the position of an object and 8 servo PWM output channels. The output data are periodically transferred in a digital (RS-232) format to the communication part.

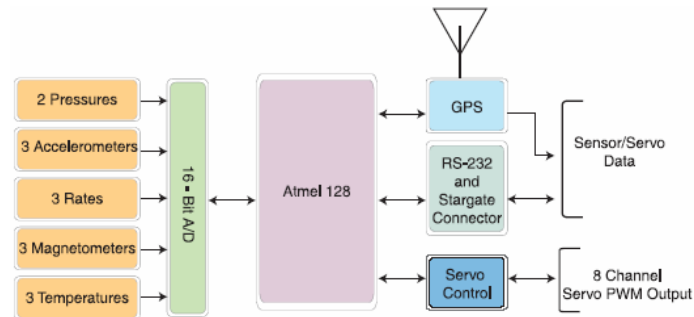


Fig. 2. The scheme of the sensor MNAV100CA

## 3 Communication and data transmission

The communication part is used for the transmission of the measured data to the server where they are processed and saved to the database. The communication is ensured by the radio GSM/GPRS terminal TC65 by Siemens (Fig.3.). The terminal offers various interfaces (I2C bus, SPI bus, USB interface, serial interface, SIM interface, AD convertor and IO ports) for the connection of other devices or sensors for more extensive diagnostic of the object. As the TC65 terminal belongs to the series of the intelligent modules, it is equipped by a powerful processor ARM7 with memory (400kB RAM and 1,7MB Flash). Thank to this module can be used not only for the transmission of data but also for the control of the object. The terminal also has functions which ensure an error-free communication in the GSM network. It also has a technology which enables the use of the terminal in all mobile networks all over the world. The transmission of data the from terminal to the server is arranged by the TCP/IP protokol.

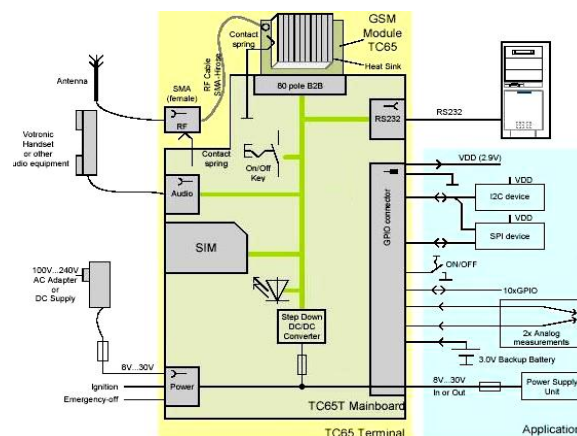


Fig. 3. The terminal TC65

The terminal also includes a M2M Architekt library which considerably oversimplifies the application development. By the library we actually mean an application controlled by events, where we set our own code. M2M Architekt uses a simple and intuitive API which really versimplifies the access to a hardware terminal (see Fig. 4.). The library includes API commands for: Identification of the module, monitoring of the operation parameters (temperature, state of the battery, state of the GSM and GPRS), for the service of the critical states (temperature, battery, disconnection antenna), SMS, CSD, HTTP, TCP/IP, FTP, SMTP, POP3, GPIO,AD, serial communication, pulse counter, scheduler, login (critical states, error states and info states), for the usage of txt files (read, write, create) and databases.

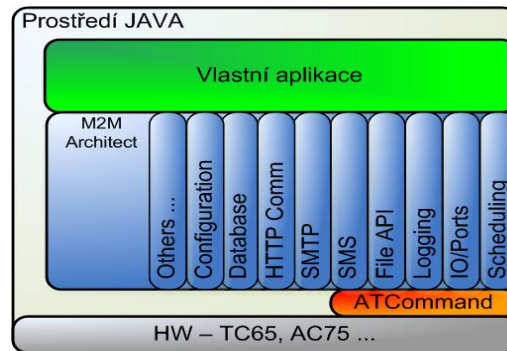


Fig. 4. The access to a hardware terminal

## 4 Presentation and visualization of the data

The data transmitted by the terminal are received by the server (the server automatically confirms that the data have been received), processed and saved into the database. Server includes a local visualization (accessible only to the administrator) and also a visualization accessible to everybody on the Internet (Fig. 5.). It is possible to process the visualization of the monitored object in two ways. The first method is a web visualization and the second method is a visualisation with the help of KML file which can be opened in the Google Earth application.

### 4.1 Web visualisation

In case of the web visualization the map is created by the help of application interfaces (API) of the particular map servers which enable a very simple and fast online display of the position of the monitored object, its description and other date. Individual data about the position and other monitored data are loaded from the database and they are displayed on the map by the help of marks. The marks also include all the measured data and the position of the object is defined by the position loaded from the database. The user can choose from a wide range of maps: a standard map, air or historical one.

The display and the implementation of the map into a personal web sites is processed directly in the code of the particular website by the help of the JavaScript and API. The individual API commands for the creation of the web map, marks addition and so on are in tag <script> and </script>.

The providers of the map servers accessible to public:

- Atlas.cz
- Seznam.cz
- Google.com

**Atlas.cz**

Atlas provides web maps amapy.cz. The advantage of this provider is that the key is generated for a particular web domain on which the maps will be displayed. Amapy has a function for the drawing of the vector lines and they can add more information to individual displayed points.

**Seznam.cz** (map with a mark Fig. 5)

These web maps are provided on mapy.cz. The main disadvantage of this provider is that each key has to be generated directly to a particular website on which we want the map to be displayed. MAPY.CZ do not display the vector lines in comparison to other providers. We are limited only by the map of Europe here as well.

**Google.com**

Another map provider is Google on maps.google.com. There are not any license terms and the key is generated for the particular domain as well as on amaps.cz. These days there is a detailed map of the whole world on the portal as well as a detailed map of the Czech Republic. Unfortunately the loading of these maps is slower in comparison to the competitors'. As these are the most often used ones.

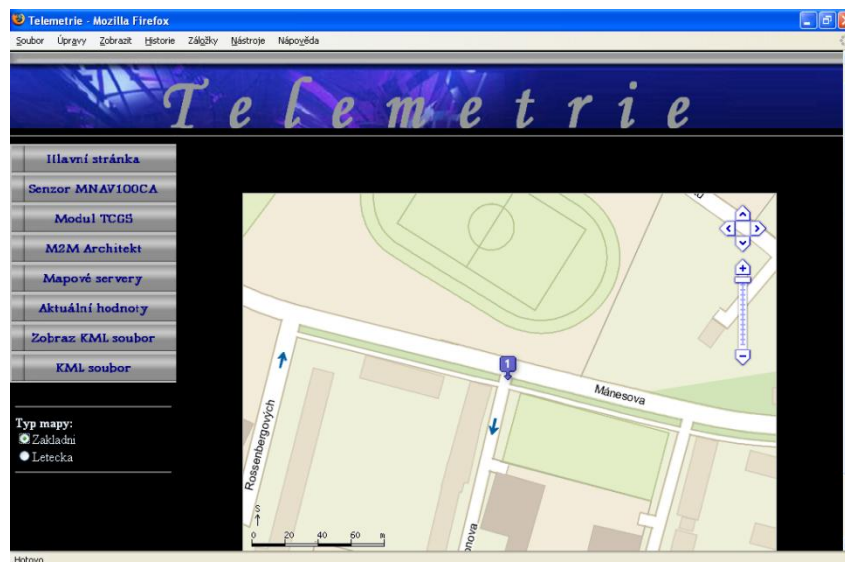


Fig. 5. Displayed a map with the help of api.mapy.cz

## 4.2 KML file

KML file is based on XML for the presentation of two and three-dimensional data. This file was firstly created for the Google Earth application. Gradually it was implemented into others GIS systems including Google maps. For the display of marks KML file uses a coordinate system WGS84. The display of KML file on Google maps is enabled when the user has written a full address of the file on maps.google.com. It is also possible to load the file by API commands. It is possible to display individual marks and vector lines as well. The particular vector lines can have different colours. This is suitable especially when the speed of the object is monitored (it is possible to display where the object speeds up and where it slows down). The structure of the KML file is displayed on Fig. 6.

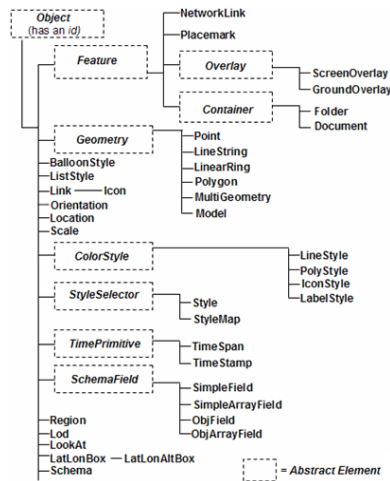


Fig. 6. The structure of the KML file

The file is automatically generated when the item “KML file” is chosen from the menu of the website. Then the user has two possibilities. They can either download the file and view it in the Google Earth (Fig. 7) or they can choose the item “Zobraz KML soubor” and is redirected to the Google maps where the access to the file will already be entered.

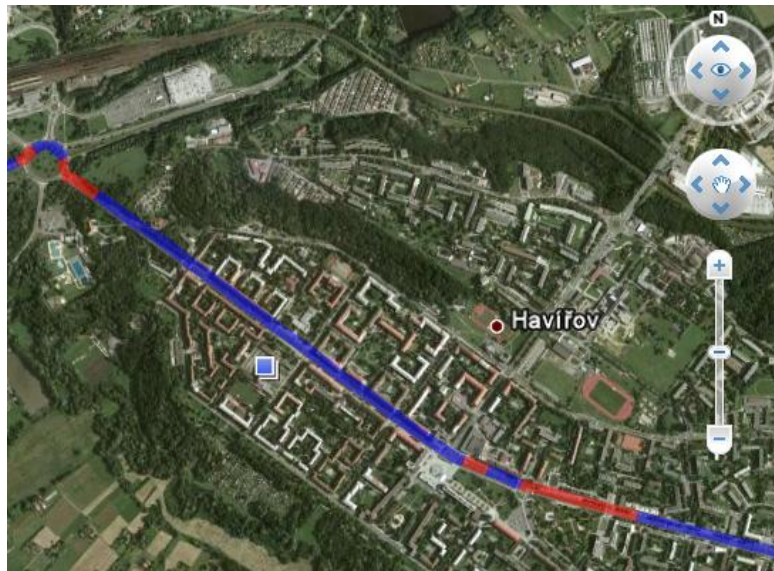


Fig. 7. The KML file opened in the Google Earth

The main advantage of the KML file is undoubtedly its possibility of the comparison of the real measured data with the real terrain. With the help of marks it is possible to display various information for example about weather, temperature, pressure, humidity, wind speed, rain-fall but also the picture from webcams or cameras (Fig. 8). As the structure of the KML file is very simple and the programs (Google Earth, Google Maps) in which the file can be opened can be spread freely. It is possible to use it in all the industrial field where it is necessary to compare data with the terrain.

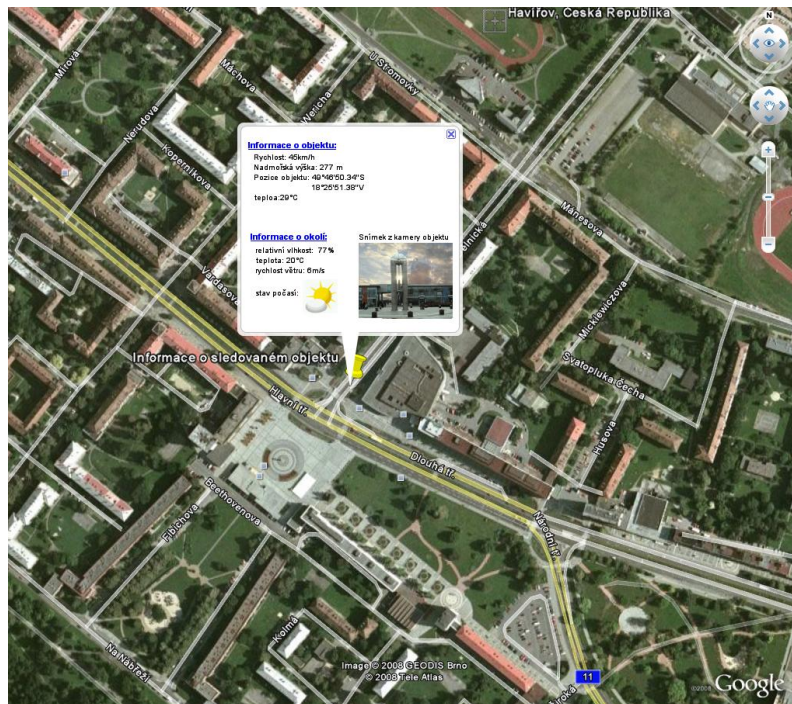


Fig. 8. The mark with all information

## 5 Conclusion

The using of the public accessible GIS systems or data resources such as the Google Earth and similar global or local systems may speed up the application design and provides a wide range of scientists, technicians or other people with the measured data. Secondary it could speed up data interpretation on users side, that make the application more important and open measured data to wide public communities. transportation, agriculture, solar – wind – or water power plant, weather prediction as well as emergency services. Convergence of GIS, telecommunication and measurement technologies may open new perspective market in the close future.

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6. Centrum Holdings: [www.amapy.cz](http://www.amapy.cz)