

## Modern tools for development of interactive web map applications for visualization spatial data on the internet

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### **Moderní nástroje k vývoji interaktivních webových mapových aplikací pro vizualizaci prostorových dat na internetu**

*In the last few years has begun the development of dynamic web applications, often called Web2.0. From this development was created a technology called Mashups. Mashups may easily combine huge amounts of data sources and functionalities of existing as well as future web applications and services. Therefore they are used to develop a new device, which offers new possibilities of information usage. This technology provides possibilities of developing basic as well as robust web applications not only for IT or GIS specialists, but also for common users. Software companies have developed web projects for building mashup application also called mashup editors.*

**Key words:** Web, API, Mashups, GIS, GeoWeb

### Introduction

The application development for personal computers has always focused on the desktop applications. With rapid internet development there has been a change towards the online dynamic web applications. The web applications, which use the most modern technologies and standards, quickly catch up with their desktop counterparts, not only with their more sophisticated user interface but also with its functionality and usage in various fields.

The most commonly used are the desktop applications of big companies or open-source communities' applications to process and visualize spatial data in the geoinformatics field. There are many desktop applications of the same kind, but the number of the web projects allowing the same is much smaller. The most common are the web applications based on the map server's technology. Web projects such as map servers are unavailable for general users, mainly because its financial and operation conditions. Another and the most important thing in geoinformatics is the spatial data. It is the most expensive and the most precious part of the geographic information systems.

Over the past few years large software companies such as Google and Microsoft have appeared in the field of web applications development, usable in geoinformatics. Web maps' applications of these companies offer to use those function and possibilities to all internet users that until recently were only available at map servers. Those web projects also contain a number of spatial data that the users can use. With the arrival of technologies and styles of the web applications' development style, hidden under the name of Web 2.0., most map applications offer their own API, through which the users can use the functionalities of these applications within the scope or their own web projects.

The so-called mashup technology came into existence due to the combination of API web applications and various data sources. Anyone can create the mashup application by using various API web project functions and not only by using the spatial data placed on the internet. To make sure that the creation of mashup will not become a privilege of users with the programming knowledge, promising web projects with graphic user interface are coming to existence on the internet. With the help of these even a user who lacks the programming languages knowledge can interactively create his own mashup application.

### API of the web map applications

Nowadays most of the big web portals contain map applications that offer a number of functions. The users nowadays do not want to just use the applications that somebody else has prepared for them, they want to easily create their own applications within the framework of their own web sites. In order to provide

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the user the access to their applications, in most cases most companies providing the web map applications allow the access to functions and source codes of the actual applications, using the API, free of charge. The API is an abbreviation for application programming interface, which means an interface for the programming of applications. It is a collection of procedures, functions or classes of some library that a programmer can use, and also a description of how to use these libraries of functions and implement them into your own application [7].

### API of Czech applications

Web map applications of three biggest portals are mostly used in the Czech Republic. That is Seznam.cz, Centrum.cz and Atlas.cz. Out of these three portals only Seznam.cz and Atlas.cz allow map applications functions through their own API. Centrum.cz does not offer API.

The first step in order to use the API of the mentioned companies is the necessity to register at their websites and enter required information, such as domain at which API function will be used. This follows with the user receiving a key, which he puts into the source code of his web page. This serves as an identification of an authorized user. API can only be used for non-commercial web sites or web sites the use of which is not in accordance with the terms and conditions stated at the given API provider's web sites. At the non-commercial web sites API possibilities of both companies can be used free of charge.

API allows you to use a number of functions for working with map field and map elements such as the display of maps and map basis. API contains a large number of functions, such as functions for map movement, function for operation with coordinates, the functions allow the display of signs and their additional information, functions for the change of ground layers and overlay layers, functions for depiction of lines etc. and it is only up to the user how they use these possibilities in their applications [7].

Funkce API mapových služeb			
Funkce	Atlas	Seznam API 1	Seznam API 2
Zobrazení mapy	✓	✓	✓
Přidání ovládacích prvků	✓	✓	✓
Přidání značky na mapu	✓	✓	✓
Souřadnicový systém	S 42	✓	
	WGS 84	✓	✓
	JTSK	✓	
	UTM		✓
Nastavení měřítka a středu mapy	✓	✓	✓
Zobrazení informační bubliny	Bublina s textem	✓	✓
	Bublina s obrázkem	✓	
	Bublina s HTML stránkou	✓	
	Bublina se záložkami	✓	
	Bublina s patičkou	✓	
Vykreslení vektorové trasy	✓		✓
Ovládání pomocí klávesnice			✓
Výběr pomocí rámečku		✓	✓
Zobrazení měřítka a severky		✓	✓
Výběr z většího druhu mapových podkladů			✓
Vytvoření vlastní ikony	✓		

Fig. 1. API Function of czech web map applications.

### API of foreign applications

From foreign web map applications the most widely spread web projects are those of Google (Google Maps), Microsoft Live Maps and Yahoo! Maps companies. All these three companies provide API for their web map applications. Individual API can be found under the names of Google Maps API, Yahoo! Maps API and Microsoft virtual earth interactive SDK.

The API of all the three companies can be used free of charge for non-commercial use. Google is the only one that offers the use of not only API but also several other services in the Enterprise design, where fees for these services are given.

	Google Maps API	Yahoo! Maps	Microsoft virtual earth interactive SDK
Zobrazení mapy na vlastní URL	✓	✓	✓
Použití API klíče	✓	✓	-
Standardní navigační ovládací prvky mapy (zoom, pan)	✓	✓	✓
Vlastní navigační ovládací prvky mapy (zoom, pan)	✓	-	✓
Ovládání pro změnu typu mapy	✓	✓	✓
Přidání bodu na mapu	✓	✓	✓
Přidání lomené čary na mapu	✓	✓	✓
Přidání polygonu na mapu	✓	-	✓
Umístění ukazatele	✓	✓	✓
Informační okno	✓	✓	✓
Mapové události	✓	✓	✓
Zobrazení dopravních informací	✓	✓	✓
Navigace	✓	-	✓
Streetview	✓		
Zobrazení typu mapy "Bird's Eye"	-	-	✓
Vložit vlastní překryv	✓	-	✓
Přidání KML souboru na mapu	✓	-	✓
Přidání GeoRSS souboru na mapu	✓	✓	✓
Přidání JSON souboru na mapu	-	✓	-
Možnost zobrazení v 3D režimu	✓	-	✓

Fig. 2. API functions of foreign web map applications

All API web map applications contain a large number of functions in order to create your own map applications. After the comparison of the three foreign companies it has arisen that Yahoo! is providing the least number of functions at present. Google provides the most sophisticated API, which shows the largest number of Mashup applications based on Google Maps API. The Microsoft API is a close runner up.

### Tools for mashup applications' creation

Mashup can be defined as an application that combines together data from two or more data sources. For this combination the offered functionalities of different applications can be used, using the API, the result is a completely new application. The largest software companies working in the area of web application development see the potential in the mashup applications. Web projects allowing the users to create their own mashup applications in a well-arranged interactive graphical environment serve as evidence. The development of these mashup editors is at its very beginning, but it already contains many functions for easy and effective mashup application creation.

Google, Microsoft and Yahoo! offer the most sophisticated mashup editors. Microsoft and Yahoo! have chosen the way of interactive graphic development environment. Google bet on the development environment that agrees with a narrower user group, in which basic knowledge of programming is necessary.

#### Microsoft PopFly

The Microsoft PopFly environment is based on the Microsoft Silverlight technology, which was developed for the purposes of multimedia internet applications' creation. After the new Silverlight v2 version was released, several Popfly applications have been improved. The main improvement is the integration of the graphic environment for mashup development and games in Popfly. Popfly environment compared

to the mashup application development consist of three main parts. The most important one is the block list, in which individual components are sorted out into categories, then the desktop and the control panel.

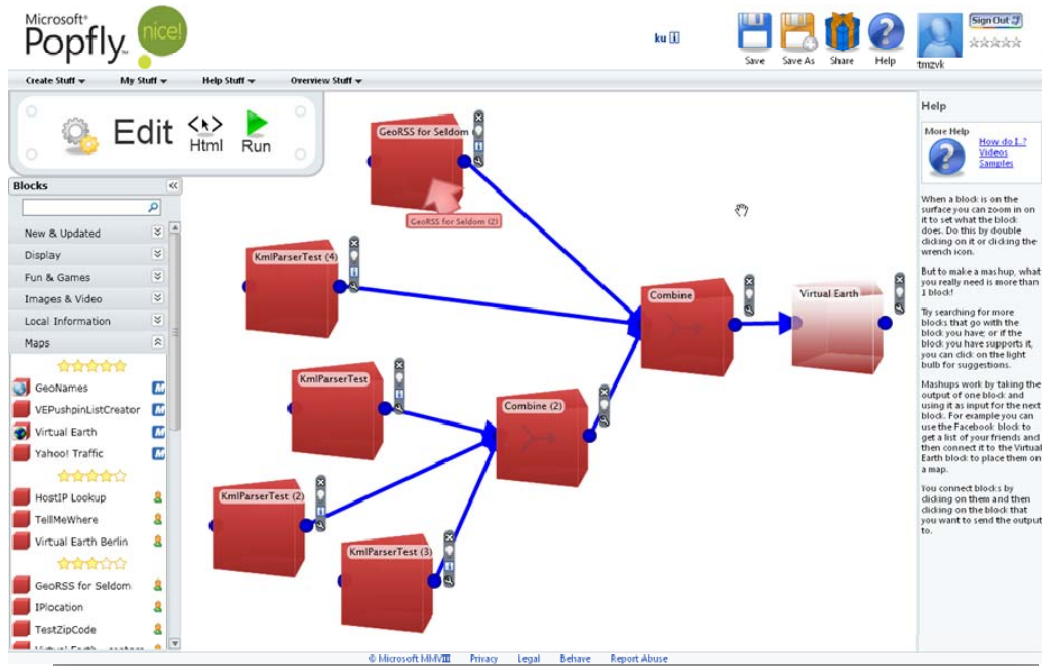


Fig. 3. Graphical user interface of Microsoft Popfly

The principle of the mashup application creation is based on piling the components on the worktop and their interconnection. The first step is the search for the required component in the holder.



Fig. 4. Parameters settings of the Microsoft Popfly component.

There are many to choose from. Components allowing, for example, the use of various data sources (RSS channels, GeoRSS, KLM and so on), the use of functionality of various services and web applications (Flickr, Facebook, Google Picasa and many others), tools output processing from used components (recycling, combination, working with text and many others), output visualization (gallery, tables, maps and others). The users have the opportunity to evaluate the individual components through assigning them golden stars. The highest ratings have the components created by Microsoft developers [5].

The shift of components from the holder onto the worktop is done through drag-and-drop control. The components can be moved elsewhere in the worktop and can be interconnected through connecting elements represented by blue arrow. Each component contain several control elements such as the removal of component from worktop, gaining information about the component or the possibility of entering the input parameters through a form. For users who know the script JavaScript language there is a possibility to switch into the advanced mode in the component setting, which shows the source code allowing to change the input and output parameters in more details than it does through the boxes of a form.

The users are also offered the opportunity to create their own components, that they can then share with other users and widen Popfly by new possibilities. A script language javascript is used to programme components. It is also possible to use AJAX, DHTML, or XAML (Silverlight). It is important to define the input and output parameters and methods that are used to interconnect individual parameters in the development. Each component also contains XMS metadata document, in which there is described what each component allows [4], [5].

### Yahoo! Pipes

The philosophy of the mashup applications' creation through Yahoo! Pipes comes from the UNIX platform, where for the command chaining the pipe is used. In Pipes the individual modules are chained in the way the output of one becomes the input of the other module. The actual graphical interface of Pipes is based on drag-and-drop environment created by AJAX technology [10].

The Pipes environment consists of three main parts. In the left part there is the holder of the individual modules, ordered into categories. The worktop occupies the biggest part of the window. Here it is possible to insert modules and to chain them. Debugger occupies the bottom part of the window. This show the output for each used module and if there is a mistake, it shows information about this mistake.

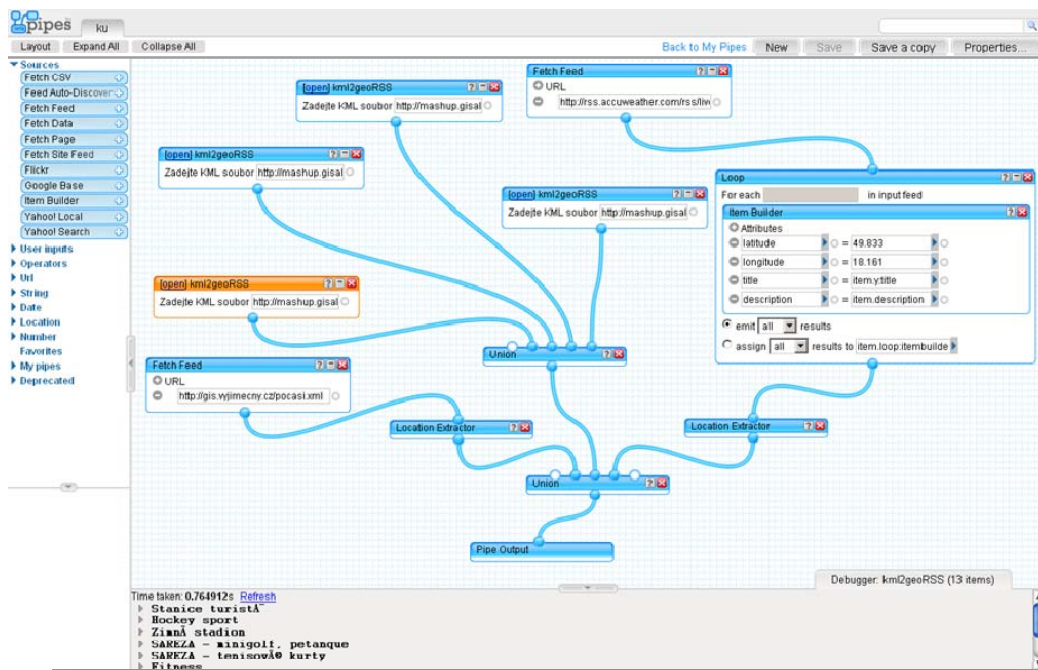


Fig. 5. Graphical user interface of Yahoo! Pipes.

The main difference between Pipes and Popfly is in the creation of the actual modules. In Popfly only users with the programming knowledge can create new components. In Pipes it is not possible to create one's own module, but it is possible to combine several offered modules and save them afterwards. The application

saved in this way can then be used as one independent module in other Pipes projects. It is necessary to mention that modules in Pipes could be rather considered as elements of schematic programming.

In order to create your own functioning mashup it is possible to share it (nasdfilet) even for other Pipes' users. Pipes also offers possibilities of how to use one's own mashup somewhere else than just at Yahoo! network. We can choose from a number of possibilities and formats, into which the result can be exported, such as i.e.: RSS, JSON, PHP, KML and others [5], [11].

### Google Mashup Editor

The Google company with its mashup editor GME (Google Mashup Editor) focuses on the users with programming knowledge. In order to create mashup application in the GME environment it is necessary to know a few existing marking and scripting languages. Google has also created a new special marking language for GME, where marks (signs?) are introduced by gm name space. All GM signs rewrite into the programme code of Javascript script language after the mashup application starts running. Besides the GM signs it is possible to use the actual code in the Javascript language or the possibility of XHTML, CSS, XML when programming mashup. GME also offers the support for data processing from RSS formats. The values can be approached in an editor using Xpath. [2], [5].

The GME environment consists of three main windows. It possible to switch between these windows at any time, using the graphical elements in the form of book-marks. The first window is called an editor and it serves for the purposes of source code writing. It is possible to switch on the possibility of having the source code commands highlighted in colour. The function of syntax check is also offered, and if you happen to find a mistake, the information about a particular mistake and its placement in the source code will be shown. The whole GME developing environment is created through AJAX technology, and it is therefore possible to programme the actual mashup application online within the scope of internet browser.

Another window is the Feed browser. Here it is possible to read any RSS or GeoRSS channel and Feed browser which will take care of its conversion into the ATOM format and the highlighting of individual parts of the source code of the channel, so that it is possible to approach the individual signs interactively and find out how to approach required information in the Editor window through XPATH.

The third window is the Sandbox, which serves to translate gm signs and to show the resulting mashup applications, as how it will look on a web page. It is a very easy and good function of how to continuously check if the application looks and works in the output as required.

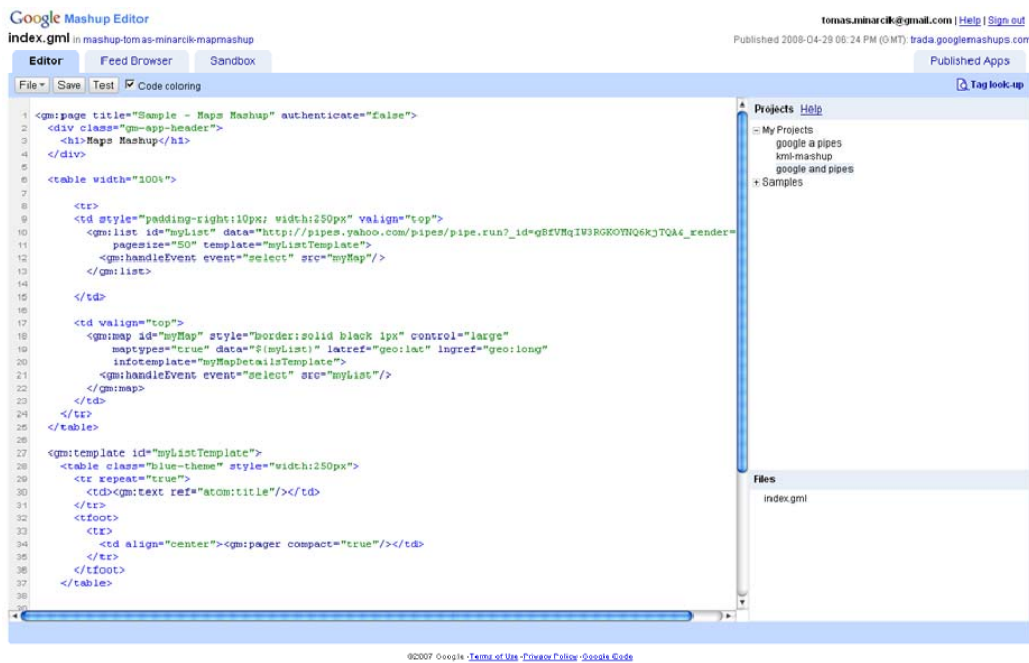


Fig. 6. Graphical user interface of Google Mashup Editor.

The finished mashups can be saved on google's server so as to allow access to all internet users. The hosting of the project at google's server can be gained for free. The project will be available at <yourtitle>.googlemashups.com [5].

### Examples of the MapMashup applications in geoinformatics

Nowadays there is a number of finished mashup applications using API web map applications, but there is only a small number of those which create interesting and sophisticated applications. There was a whole range of fields of applications' usage based on these technologies. But the problems usually arises at the beginning of application development, where it is necessary to provide appropriate data. To show you an example we present selected MapMashu applications, that currently belong to the projects which provide most information and which are based on the mentioned technologies.

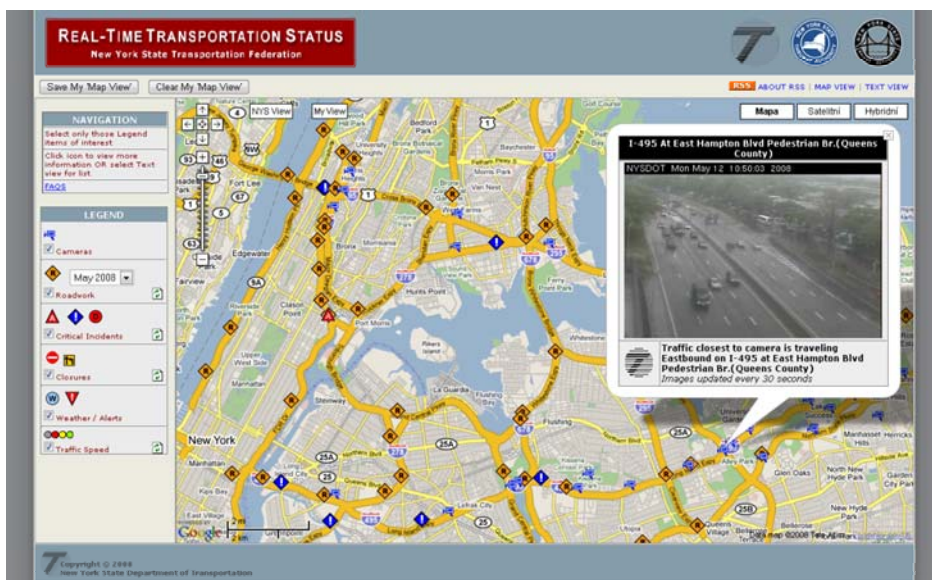


Fig. 7. Transport monitoring MapMashup in the city of New York.

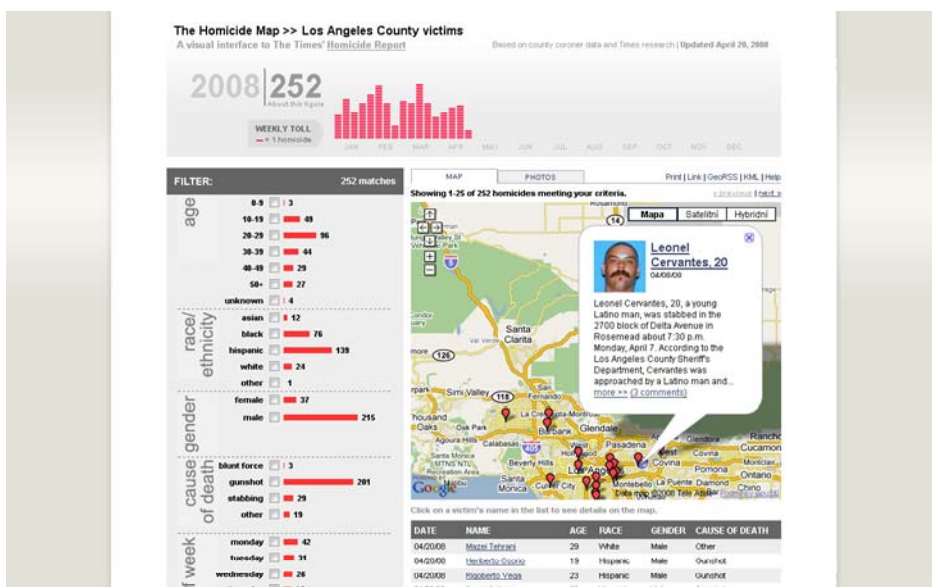


Fig. 8. MapMashup of crime rate in Los Angeles.

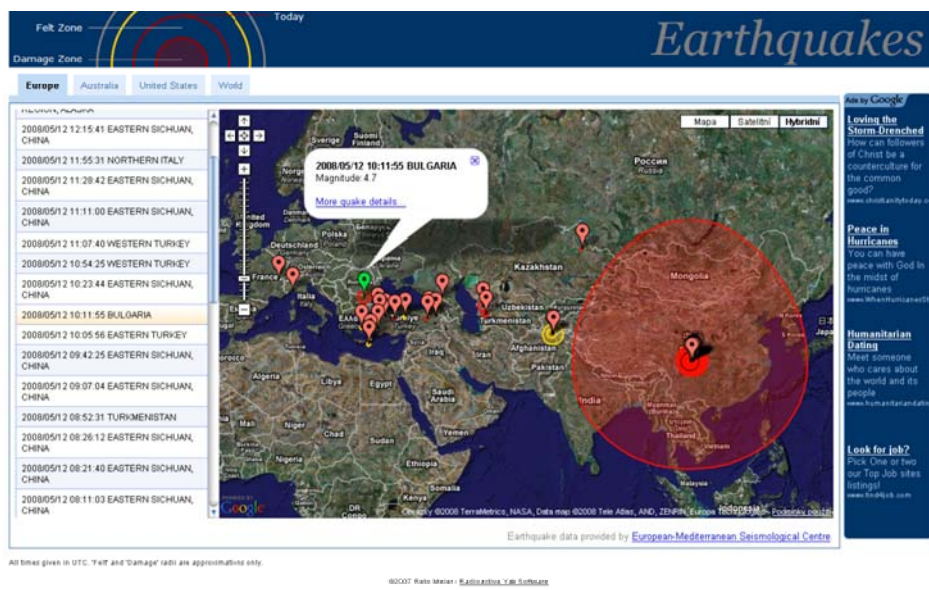


Fig. 9. MapMashup of the world's earthquakes.

## Conclusion

API possibilities and functions of individual web map applications have been extending and improving. This development is noticeable at the number of already existing operating solutions which are using the most modern web technologies. The technology of mashup applications allows the combination of more data sources and API web applications into a brand new applications, which provides more information. The opportunity to use this information is one of the ways of how to make information accessible for other internet users in a simple way, and therefore to increase its usage.

We can see fast development of the offered functions at present API map applications' possibilities, where Google is the winner at the moment. Seznam.cz is the best in the Czech Republic at the moment, putting large amount of money and hope in the map service development.

The big problem of the mashup applications is data, which in most cases, especially in the case of the spatial data, are very expensive, and only big companies can afford such a big investment.

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