



## PRESENTATION OF OBJECTS AND SPATIAL PHENOMENA ON THE INTERNET MAP BY MEANS OF NET RESOURCE ADDRESS PARAMETERIZATION TECHNIQUE

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### Summary

Over the course of several years, web cartography which changed the way of presentation and exchange of information gained new sense. Techniques development and availability of geo-information tools in connection with net data transfer new quality enabled to create maps accessible in real time according to user's preference.

The aim of the paper is to characterize and evaluate technique of parameterization for net resource URL address (Uniform Resource Locator). Examples of maps presented in a browser's window according to set parameters defined in accordance with rules in force in the range of API programistic interfaces of chosen map services were presented in the paper. Maps developed by URL link parameterization technique were put to functional tests. Moreover, efficiency and utility tests were performed.

Performed tests show that creating maps with help of discussed technique needs knowledge and expert abilities which may cause difficulties to less advanced users and its use allows to evoke maps in the browser's window but in the limited range.

### Keywords

URL resources addressing • web cartography • geo-visualization

### 1. Introduction

The Internet plays bigger and bigger role in interpersonal communication. It is among others influenced by new forms of information transfer, more perfect telecomputer tools and also access to cordless network services.

Over the course of several years, web cartography and topic data geo-visualization gained new sense, especially in modeling, analyses and presentation of phenomena occurring in natural environment and having spatial reference [Król and Bedla 2013, Prus and Budz 2014], also in spatial planning [Andrzejewska et al. 2005, Trystuła 2013, Król and Szomorova 2015], geo-marketing [Allo 2014], tourism and in many other levels.

Web cartography changes the way of presentation and information exchange. Kowalski [2000] notices that despite technological, economic and legal hindrances,

numerical maps, spatial visualizations and cartographic animations become an inseparable part of web publications.

Interest in web cartography results among others from techniques and geo-information tools including API programistic interfaces (Application Programming Interface) which enable creating of topic maps.

API programistic interface is a set of procedures, protocols and tools with help of which computer programmes communicate with each other. The map prepared in such a way can be enriched with contents chosen by a user and then put in frames of any hypertext document [Dąbrowski and Sawicki 2010].

Popularity of techniques available within API programistic interfaces results largely from the fact that they enable access to data of global range and support creating of interactive maps for personal use. Moreover, these techniques are relatively simple in using, increase efficiency of work with geographic information and they are also available free of charge [Chow 2008].

Attractiveness of interactive maps results most of all from advantages of the Internet itself as medium but also from their variety as well as quickness of access to geographic information by their means. Kowalski [2012] pays attention that beyond typical cartographic features, web maps have got two extra important features: interactivity and many-sidedness (hyper-mediality) thanks to which they perform functions transcended over typical cartographic tasks.

Web maps wide spectrum includes elaborations with different degree of complexity and varied content beginning from static maps and finishing at complex geo-information systems [Okonek 2010]. Importance of a new range of help available through map services such as Google Maps and Bing Maps increases. Interactive topic maps become more often a web services component and called mashups.

The aim of the paper is to characterize and evaluate the technique of parameterization for net resource URL address (Uniform Resource Locator) which enables creating of topic maps presented in the browser's window according to given parameters.

## 2. Materials, methods and tools

Trial to characterize the technique of parameterization for net resource network addresses (URL links) which allows to evoke in the browser's window a map of spatial phenomena with determined parameters was performed in the paper. Maps evoked by means of the objective technique as well as the technique itself were put to functional tests also described as "black-box testing". That method consists in programmes testing without access to particular information concerning their building. Tests are performed on the basis of functional assumptions that should be fulfilled by the programme according to documentation. Black-box testing method allows to test a chosen fragment of functioning of the whole programme and the test itself usually describes programme's response to activities given by a user. In that context, testing is understood as a process of software starting in a controlled way in order to consider if it acts according to expectations.

Functional tests allow to identify programme's imperfections such as incorrect or missing functions, irregularities in interface activity, mistakes in data structures or access to data bases or the problems with efficiency. However, they do not indicate where the mistake in programme's code is [Madiha and Waqas 2015].

Advantage of black-box testing method is performing tests from the point of view of routine using of application. It is advisable to perform tests by persons without programistic knowledge which increases result's objectivity. However, the method demands accurate specification and guidelines for tested cases.

While performing tests, attempts to measure map services efficiency, functionality available in the range of tested techniques identification and also evaluation of their availability for users without expert geo-information knowledge were made. Research of dependence between efficiency and usability and also the type of web browser where the map is evoked were not performed.

Efficiency tests of evaluated services were made with use of PageSpeed Insights (Google Developers) application. This application simulates service activity in stationary and mobile devices measuring its efficiency at the same time. The result of the test locates on the scale between 0 and 100 points. Estimation on the level of at least 80 points means that the tested web page functions relatively well, however, its chosen parameters could be optimized (Table 1).

**Table 1.** Web site efficiency according to the PageSpeed Insights test

Point scale	0–19	20–39	40–59	60–79	80–89	90–100
Realisation technique	Very bad, web site to be rebuilt	Bad, web site to be rebuilt	Mean, many elements should be improved	Sufficient, many elements should be improved	Good	Very good

Source: author's study

Functional tests consisted in wording questions to maps server. Questions took URL addresses form of definite web resource. URL address idea was in that case restricted to web site address which is written in the browser's address window. Attributes of URL questions (URL Query String Parameters) made accessible by chosen map services within API programistic interfaces were put to parameterization (Table 2). Services were chosen because of the number of users as well as popularity in the world according to the Alexa ranking – “The top 500 sites on the web, Reference, Maps” criteria [Alexa 2015].

System of Alexa statistics generating (Actionable Analytics for the Web) is the most popular in the United States of America and in Asia and slightly less in Europe. Patented technology of measurement allows to analyse numbers of users who visit web pages. Alexa rankings receive world-wide recognition and are a good point of reference for marketers and web site creators.

Uniform Resource Identifier (URI) is an internet standard that enables to identify web resources. URI is a chain of marks written according to a definite syntax. This

chain determines the name (URN) or address (URL) of the resource identified by given URI. URI can be classified as URL (Uniform Resource Locator) or URN (Uniform Resource Name). URI is a superior concept and includes URL and URN as two different ways of presentation of the same address.

**Table 2.** Tested map services

Map service	Base URL address of map resource
Bing Maps Create a Custom Map URL	<a href="http://bing.com/maps/default.aspx?parameters">http://bing.com/maps/default.aspx?parameters</a>
MapBox HTML embeds	<a href="https://a.tiles.mapbox.com/v4/parameters">https://a.tiles.mapbox.com/v4/parameters</a>
Google Maps Query String Parameters	<a href="http://maps.google.pl/maps?parameters">http://maps.google.pl/maps?parameters</a>
MapQuest Link to MapQuest	<a href="http://mapq.st/map?parameters">http://mapq.st/map?parameters</a>

Source: author's study

URL is a unified format of addressing resources which serves to identifying information, data or services available in the Internet, indicates resource location and the way of its downloading [Berners-Lee et al. 2004, Mayrhofer and Spanring 2010].

Evoking maps in the browser's window by means of URL link was tested according to project assumptions which included map presentation of two objects: Bagry Reservoir and Płaszowski Pond (Kraków, Małopolska). Moreover, while testing map services, particular attention was paid to documentation availability as well as trainings and help systems.

In IT, parameterization of URL addresses is ranked in the group of techniques of codes writing and described as WYWIWYG (What You Write Is What You Get). Supporting of codes programming (in slang also called as "hand coding") can be realized through applications with definite functionalities such as among others: key words colouring, automatic addition of words, context suggestions, additional windows of features, key short cuts, automatic shutting and colouring of brackets or validation of syntactic correctness [Filutowicz et al. 2011]. URL addresses parameterization was made by means of Notepad++ (6.8.0 version) application which is a developed text editor made accessible free of charge within the frames of general public licence GNU GPL (GNU General Public License).

### 3. Characteristics of chosen geodata deliverers

Buczek and Marmol [2007] notice that geo-information is an important element in the process of informative society shaping and one of the most efficient forms to present spatial information is a picture. Map services simplify spatial identification of objects, facts and events [Bac-Bronowicz et al. 2008]. Maps can well display developed

text description of object location or drive route [Korycka-Skorupa 2002, Medyńska-Gulij 2007].

There are many cartographic services with various popularity, map services market position and different functionalities available in the Internet.

The most famous are Microsoft Bing Maps, Google Maps, AOL MapQuest (North America), MapBox, OpenStreetMap, Baidu Maps (China, Japan) or Yandex Maps (Russia). In the paper, some of them were put to tests and characterized. According to Dąbrowski and Sawicki [2010], the biggest possibilities to create own maps are given by Google Maps [2015] and Bing Maps [2015] portals, particularly with regard to API programistic interfaces range. Google Maps and Bing Maps services were chosen because of free of charge available functionalities.

AOL MapQuest [2015] service was chosen considering firm history, specific character of make and its return to the world-wide market of map services. MapBox [2015] was tested taking into consideration connections with OpenStreetMap project and great importance attached to graphic quality of popularized ortophotomaps.

### 3.1. Microsoft Bing Maps

Microsoft is a firm from the computer brand the leading products of which are operating systems of computers and mobile devices. Microsoft also competes on the markets of cataloguing and information searching services (Bing browser) as well as map services (Bing Maps).

Microsoft Bing Maps is a wide spectrum of services connected with map elaborations popularizing. Bing Maps service provides access to road maps, satellite and air photographs and also three-dimensional buildings visualizations. Searching for objects and routing between given points are its basic functionalities. Moreover, it enables travelling on virtual city streets ("Streetside" application), routing and it also makes available different functions that can be used in creating web site applications. Service is joined with the Internet browsers such as Bing and Microsoft Internet Explorer.

Bing Maps makes accessible API programistic interface with help of which it is possible to create web applications with use of map elaborations through functionalities programming, adding own information to the map (points, lines and polygons) and many others.

### 3.2. Google Maps

Google Maps service was chosen according to its popularity. Google is now one of the most identified make in the world. Its name originates from math term "googol" which means a number  $10^{100}$  that was to reflect endless amount of information in the Internet [Boguś 2011].

Google browser is the most often visited web site in the world and Google Maps service takes in Alexa topic ranking [2015] the fourth place just after MapQuest, Bing Maps and Mappy services. In Google Maps map service, a user is able to browse road,

topographic, satellite and hybrid maps. Moreover, the service makes available many other functionalities including: objects searching, routing and its modification, looking through panoramic city presentations (Street View), exploration of virtual world images in three dimensions (Google Earth) and many others [Pawłowski and Malinowski 2008]. Google Maps has got open character, gives access to tools that enable users to create topic maps and place them in the Internet.

### 3.3. AOL MapQuest

AOL MapQuest map service is one of the three most popular ones in the world according to the ranking “The top 500 sites on the web, Reference, Maps” [Alexa 2015]. MapQuest service is an American pioneer on the map services market which has changed this brand’s perception. MapQuest platform is one of the first places in the Internet where interactive maps were available. The firm’s history starts in 1967 in cartographic services branch (road maps print-outs for petrol stations). In 1994 the firm was renamed “GeoSystems Global Corporation” and in 1996 MapQuest.com service came into existence. In 2000 the make was taken over by America Online.

### 3.4. MapBox

Mapbox [2015] is a map service established in 2010, presented as a platform for creators of various map solutions. MapBox team creates and makes accessible tools which serve to project and publish maps according to given parameters. The firm concentrates on creating interactive and possible to be configured maps from open data sources mainly from OpenStreetMap [2015] resources, LANCE-MODIS NASA (National Aeronautics and Space Administration) [2015] data and also its own sources. The aim of the firm is expansion on the map services market, especially in the range of non-standard topic elaborations, f. ex. illustrating the range of intensity of different spatial phenomena occurrence including these with environmental, economic and industrial importance. MapBox assumes the most commercial form of all tested services making available to sell access packets with definite specification. Free of charge access is the simplest in functionality.

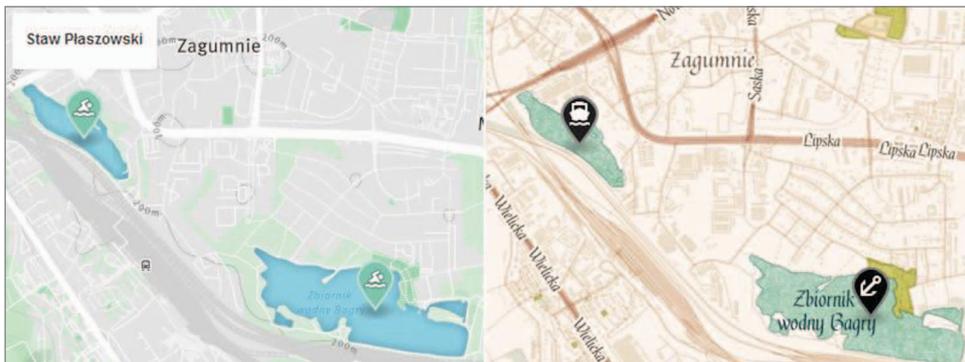
## 4. Characterization of chosen URL addresses parameterization aspects

Analysing technical-planning documentation of tested techniques, the one prepared and made accessible within the frames of Bing Maps (Bing Developer Center) help system was evaluated at the very most. Bing Maps (Create a Custom Map URL) network addresses parameterization technique is presented here in numerous examples. URL parameters available in API allow to create a link in the browser’s window that evokes an interactive map showing objects of points, lines and polygons character. Objects plotted on the map can be described with text and graphics. Usage of the links parameterization technique within Bing Maps service does not need to register user’s account

and one of its advantages is possibility to personalize a map and URL address programming simplicity.

Manual parameterizing of URL address of the concrete map with use of techniques available within MapBox service is possible, however, the solution is less effective than creating a map with help of the creator accessible after registration of the MapBox user's account. A map is constructed in the creator by means of graphic interface. Application generates URL address of the network resource. However, parameters of the map created in such a way are coded and it is not possible to edit them manually. The tool is well-developed and simple in usage, it allows to create personalized maps in an automated way. Though, it needs to be registered and logged. Moreover, to use a map created in such a way, a MapBox "token" is needed. A token is composed of a row of marks which allows to conjoin a network resource with a user as well as to generate statistics of f. ex. given map openings.

One of advantages of the MapBox creator is varied topic set of map bases and also possibility to diversify and personalize POI points (points of interest plotted on the map) (Fig. 1).



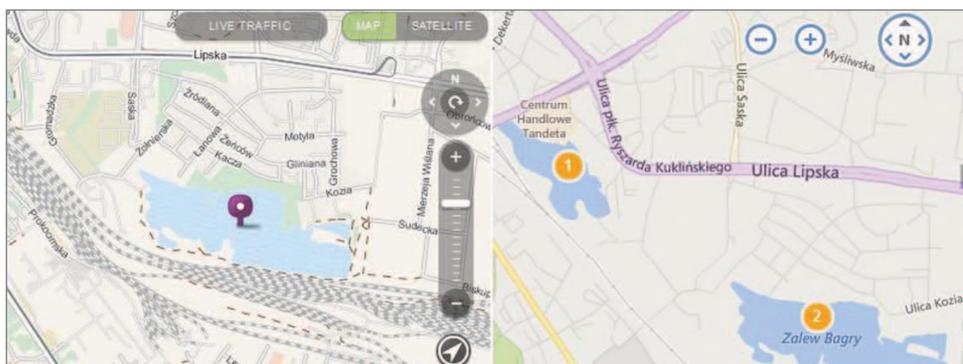
Source: author's study with MabBox usage

**Fig. 1.** Stylized map of Bagry oraz Płaszów reservoirs location in Krakow – “Run, Bike and Hike” and also “Pirates” map bases, view in the Internet browser's window

Constructing of dynamic maps with use of the URL addresses programming technique has got restrictions. Apart from matters of available functionalities, one of the basic limitations is URL address length. This limit is 2,048 marks and concerns every URL address regardless of a link programming technique. For example, MapBox token consists of 97 marks and it is an element of URL link. So it decreases the number of marks that can be used to plot own information on the map.

Users who are not interested in thorough investigation of coding documentation of questions to a server can use a form that in real time generates link to the map according to given parameters made accessible within MapQuest service (Fig. 2). URL

address creating consists here in entering of map attributes values in the fields of the form which is MapQuestweb site component. This solution is comfortable and useful. When the form is insufficient, users can have the use of documentation of extensive URL links parameterization.



Source: author's study with MapQuest and BingMaps usage

**Fig. 2.** The map of Bagry nad Płaszów reservoirs location in Krakow, prepared in MapQuest and BingMaps services, view in the Internet browser's window

Evoking a map in the browser's window according to programmed parameters of URL address is also possible within the frames of Google Maps service. Defining a question to the maps' server is realized by means of definite parameters of URL path (URL Query String Parameters). Examples of URL link parameterization with use of chosen attributes were presented in Table 3. Presented code is responsible for displaying an interactive map in the browser's window and is composed of the basic address of the map resource (<http://maps.google.com/maps>) and next chosen maps' attributes and their values, for example for Google Maps: `ll=50.036878,19.978551&q=Zalew+Bagry &z=14&t=k&hl=PL`, attribute "ll" values are latitude and longitude coordinates, whereas the parameter itself defines the point of map picture centering; "q=Zalew+Bagry" attribute evokes the question to the maps' server concerning the object called "Zalew Bagry" and when it exists – the marker is plotted on the map; "z=14" attribute defines the grade of approximation of map's view (the level of map browser's scale), and "t=k" attribute decides about the map base's type (possible values are: "m" – map, "k" – satellite, "h" – hybrid, "p" – terrain).

**Table 3.** URL address parameterization for example of GoogleMaps device

Google Maps, Query String Parameters
<code>http://maps.google.pl/maps?ll=50.037399,19.978213&amp;q=Zalew+Bagry&amp;z=14&amp;t=p&amp;hl=PL</code>

Source: author's study based on Google Maps

## 5. Tests form, results and conclusions

URL addresses recording (URL encoding) written in the browser's address line was performed with disregard of percent encoding. Marks reserved for URL (exclusive marks that play determined functions in URL addresses) were not replaced by the other marks sequence because it was leaved in competence of browser's software. Its task is marks conversion. In Table 4, a base URL address and its transformation in the browser's address window after evoking a map was presented, on the example of a question to MapQuest map server. Coma mark which belongs to the group of reserved marks with special purpose was replaced by marks sequence "%2C"; round bracket "(XX)" is converted to the marks: "%28XX%29" and plus mark "+" replaces the space one.

**Table 4.** URL address example – the base record and the transformed one after pasting in the browser's address window and marks conversion, on the example of MapQuest resources

Link to MapQuest – base record
<a href="http://mapq.st/map?q=50.032716,19.990521(Zalew+Bagry,+zbiornik+wodny+na+terenie+Krakowa,+powstały+w+wyniku+zatopienia+wyrobisk+żwirowni.)&amp;center=50.032716,19.99-0521&amp;zoom=14&amp;maptype=map">http://mapq.st/map?q=50.032716,19.990521(Zalew+Bagry,+zbiornik+wodny+na+terenie+Krakowa,+powstały+w+wyniku+zatopienia+wyrobisk+żwirowni.)&amp;center=50.032716,19.99-0521&amp;zoom=14&amp;maptype=map</a>
Link to MapQuest – transformed record
<a href="http://www.mapquest.com/?le=t&amp;q=50.032716%2C19.990521%28Zalew+Bagry%2C+zbiornik+wodny+na+terenie+Krakowa%2C+powsta%C5%82y+w+wyniku+zatopienia+wyrobisk+%C5%BCwirowni.%29&amp;center=50.032716%2C19.990521&amp;zoom=14&amp;maptype=map&amp;vs=map">http://www.mapquest.com/?le=t&amp;q=50.032716%2C19.990521%28Zalew+Bagry%2C+zbiornik+wodny+na+terenie+Krakowa%2C+powsta%C5%82y+w+wyniku+zatopienia+wyrobisk+%C5%BCwirowni.%29&amp;center=50.032716%2C19.990521&amp;zoom=14&amp;maptype=map&amp;vs=map</a>

Source: author's study based on MapQuest

Results of functional tests allowed to demonstrate lacks in locations of chosen environmental objects situated in Poland's area when evoking them by geographic names. These lacks were identified in MapQuest and MapBox services (Table 5). Testing consisted in trying to present in the browser's window the chosen object by means of its own name coded in URL address. Moreover, the result of the test was verified with use of the browser which is a component of evaluated service.

Geographic names of chosen reservoirs from northern, central, and southern Poland of local character: Warmia and Mazury – Surwile Pond, Hławki Lake, Tuchel Lake, Mazanskie Lake; Kraków – Płaszowski Pond, Bagry Reservoir and Gorlice vicinity – Klimkówka Reservoir were used in tests. Availability of geographic names of such objects in database can testify to its specificity's degree. Presentation of the map of objects given in the test with help of URL address parameterization technique in MapQuest and MapBox services is only possible when geographic coordinates are given. In case of MapQuest service, it can result from the fact that this service is the most popular one in the United States of America and works of its project team are concentrated on the North America. Moreover, both services are in a development phase.

**Table 5.** Criteria and result of functional tests

Test criterion	Bing Maps	Google Maps	MapQuest	MapBox
Resource access token	Lack	Lack	Needed for API	Registration required, necessary, authorized access
Object's evoking by its geographic name	Lacks not found	Lacks not found	Lacks found	Lacks found
Point objects presentation	Difficulties not found	Difficulties not found	Difficulties not found	Difficulties not found
Presentation of objects of surface character	Difficulties not found	Possible with API usage	With use of the other techniques	With use of MapBox interface
Access to user's interface	Free	Free	Free	Registration required, authorized access
Language version	Poland	Poland	English-speaking, In the new service uncover, problems with Polish marks projection	English-speaking
The other, characteristic	Developed and intuitive set of instructions (tutorial)	Shortcuts of link parameters recording	Not stated	Developed palette of map bases

Source: author's study

Bing Maps, Google Maps and MapQuest services enable free URL address parameterization and evoking a map of given parameters in the browser's window. Otherwise is in the event of MapBox service where usage of discussed technique is only possible after encoding in token's address (Table 6).

**Table 6.** An example of a hyperlink created by means of MapBox creator where token identifying the map with a user was coded

```
https://a.tiles.mapbox.com/v4/baku11.9b029369/page.html?access_token=pk.eyJ1ljoIYmFrdTEwY2MDNmODNjODIxOTVmdmZDNkNmFiOTQ3MzczYTk2In0.vC2nSVRiOsYe5_becDDJaQ#14/50.0363/19.9708
```

Source: author's study based on MapBox

Efficiency tests of evaluated services come to similar level (Table 7). The high points score of responsive test (Responsive Web Design – RWD) allows to state that every service-provider sets much store by usability of map services and mobile devices.

**Table 7.** Web site efficiency according to PageSpeed Insights test

Map service	Bing Maps	Google Maps	MapQuest	MapBox
Desktop point score				
Page activity speed	84	91	78	71
Mobile point score				
Page activity speed	58	78	47	55
Usability	95	99	94	100
Sum	237/300	268/300	219/300	226/300

Source: author's study

Efficiency test consisted in measurement of efficiency and usability (only in mobile procedure) of URL address submitted to parameterization. URL addresses for particular map services differ in the way of recording and number of used marks. So the question appears if it influences the test's point result.

PageSpeed Insights belongs to Google applications group which would mean that applications were mutually optimized. However, point result of Google Maps (268/300) shows that the measurement depends on external conditions that cannot be influenced by programmers.

PageSpeed Insights efficiency and usability test has got synthetic character. Its result should be treated illustratively as contribution to farther studies in which users would take part. Moreover, it is one of many available tests which should be performed crosswise. Only tests performed in such a way will allow to estimate real efficiency and usability of Internet service.

From the user's point of view, from among evaluated services, web site resource address parameterization technique is the most accurately described in documentation and help system of Bing Maps service. With its help, a link which evokes a map with points described by text and graphics in the browsers' window can be created relatively simply. Google Maps and MapBox services develop possibility to locate their own objects on the map by means of web applications set into action in the browser's window (with exclusion of coding). Map Quest service presented in 2015 new opening of a maps browser which is still in a development phase. By contrast, MapBox draws users' attention to stylistics and map bases variety.

## 6. Summary

In communication, information's exchange and popularizing by means of the Internet, both in real time and in the form of a sent message, various communicators and Internet mail are often used. The technique presented in the paper allows in a relatively simple way to prepare a hyperlink which will evoke a map according to given parameters in the browser's window. Location of a service point, route or area range of any phenomenon can be coded in a hyperlink and then sent by e-mail, communicator or

made accessible on forum, in a commentary or blog's pages. Information prepared in such a way enriches a text message. Map's parameters can be coded manually or with use of a map generator.

Creating of spatial objects' maps by means of URL addresses parameterization technique needs expert knowledge, practice and geo-information abilities so it can present problems to less advanced users. So map services often make accessible solutions which automate link parameterization process (MapQuest, MapBox), usually in the form of web applications. Moreover, using described technique can be hindered by English-speaking documentation as well as lack of guidebooks and trainings of "step by step" type. URL links parameterization has also limited functionality. So it can serve to pass information on the map but in the limited range.

Application programmes (creators, code generators), usually net and relatively simple in use that automate and facilitate to create a map constitute alternative for URL questions coding. Their usage does not need expert geo-information knowledge and graphic service interface leads a user through a map's creating process which allows to define its parameters with help of icons, scroll bars and check boxes. Functionality of net map creators can be also limited and insufficient in case of more advanced projects. Then API programistic interface is used.

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