COMPARISON OF GOOGLE MAPS API AND OPENLAYERS FOR WEBGIS DEVELOPMENT

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ABSTRACT: Many free, open source, web based, Geographic Information Systems (GIS) are shown to be an efficient and inexpensive way to disseminate feature rich and theme orientated map presentations. With web 2.0 technologies to creatively craft web user interfaces coupled with a strong versatile spatial processing backend, the end result of these freeware products are just as compelling to use in predefined use cases as any marketed brands. Putting aside the spatial analytical functionality, the tools to render maps and information ultimately determines the success of any GIS products. There are several free rendering software libraries for developers of WebGIS systems to choose from and the most popularly implemented are Google Maps API and OpenLayers. Both are JavaScript technologies that work seamlessly within the web browsers and can display layers of information at the users' discretion. But which technology should one use? For this report, we will compare and discuss the limitations and usability of these two technologies, and try to identify their usable domains.

INTRODUCTION

There are several free web mapping services to choose from ever since the push for the development and sharing of free geospatial data by the OpenStreetMap, founded by Steve Coast, in 2004 (Web Mapping, 2011). However, some could say that freely available web map services really found traction when the search and services giant Google released Google Maps and Google Earth as free public utilities in 2005 (Web Mapping, 2011). Incorporating many functionalities such as displaying different base maps, finding direction, searching locally or world wide area of interest, and etc, Google Maps has alleviate people's need for multiple mapping equipments. To popularize the already popular Google Maps, Google released a slew of Google Maps API in JavaScript and flash to allow developers to create their own mapping applications over multiple platforms.

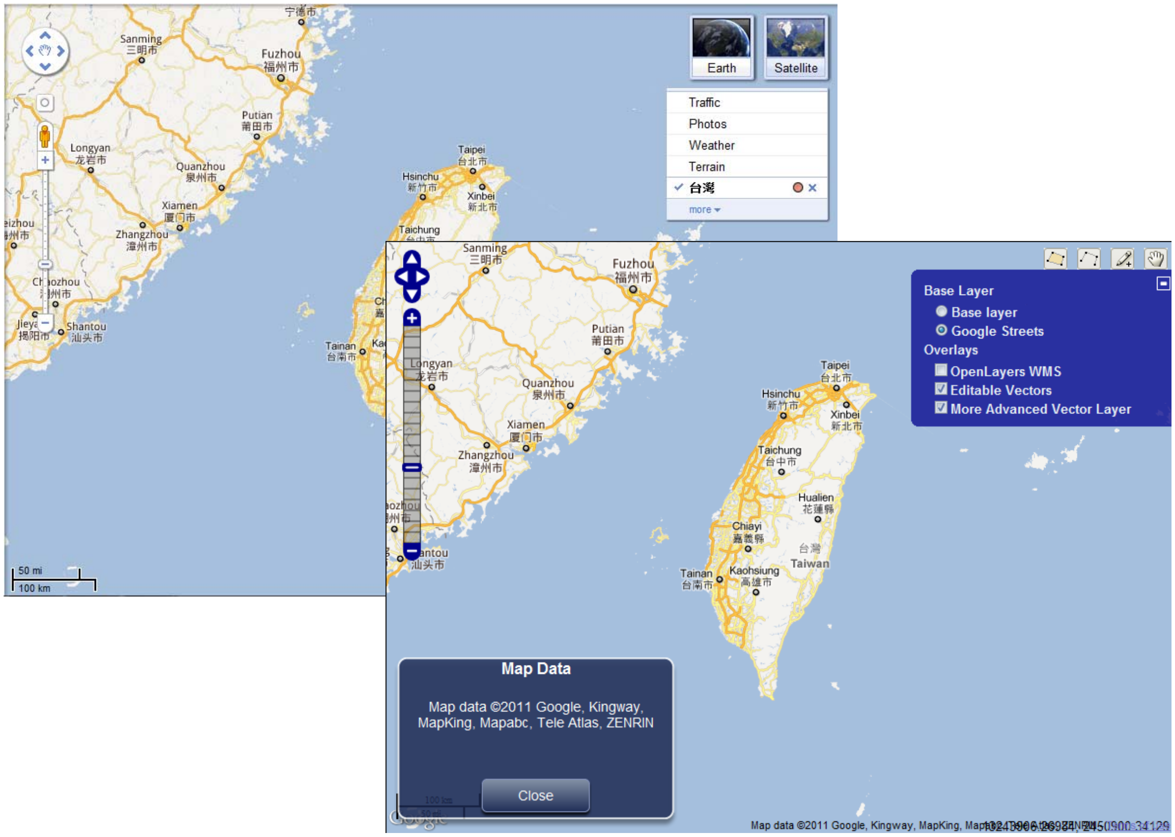
With the readily available free web mapping services on the web, geospatial scientist across multiple disciplines have taken advantage of these free resources to create web based geographic information system (or WebGIS) applications. Many WebGIS applications apply the client/server model where users interact with a map with graphic user interface on the client side and all users' queries are sent back to the spatial analyzing system on the server side. Even though there are services such as Google Maps which provides elegant maps and multifunction API, many WebGIS applications did not initially adapt Google Maps as the client side web map front end. Instead of Google Maps, most WebGIS implementation uses OpenLayers.

OpenLayers was developed in 2006 (Web Mapping,) by a geographic search and referencing solutions company called MetaCarta. MetaCarta envisioned OpenLayers as an open source option which rivals Google Maps. OpenLayers' mission statement:

> "As a framework, OpenLayers is intended to separate map tools from map data so that all the tools can operate on all the data sources. This separation breaks the proprietary silos that earlier GIS revolutions have taught civilization to avoid. The mapping revolution on the public Web should benefit from the experience of history." (OpenLayers, 2005)

OpenLayers is a robust set of JavaScript library which at first glance looks very similar to Google Maps. Although less elegant in design, OpenLayers has a great advantage over Google Maps because it provides developers with full control when designing web mapping application.

The latest version of both Google Maps and OpenLayers are both very good candidates for WebGIS applications. However, even though OpenLayers allow developers free reign on its JavaScript library, Google Maps maybe a better choice for its efficiency and search integration. And conversely, efficiency comes at a price of multiple limitations which might make OpenLayers a better choice over Google Maps.



Base Layer
○ Base layer
● Google Streets
Overlays
☐ OpenLayers WMS
☑ Editable Vectors
☑ More Advanced Vector Layer

Map Data

Map data ©2011 Google, Kingway, MapKing, Mapabc, Tele Atlas, ZENRIN

Figure 1. Here are the screen shots of the map view of Google Maps (left) and OpenLayers (right). When applied Google Maps as base layer, differed only by the navigation aesthetic, both maps are otherwise nearly identical.

GOOGLE MAPS

Advantage

The public version of Google Maps covers various needs of users with respect to a map application. Ever since its release in 2005, Google have continued to provide updates on its maps, landmarks, shops and other information which are relevant to the masses. Through its latest version of Google Maps API (version 3), developers can take advantage of various capabilities such as (Google Maps API, 2005):

StreetView – provide panoramic view of a specific location,
Google Earth – allow the display of three dimensional features with full rotation and tilting capabilities
Elevation – provide elevation information on specific location
Geocoding – translating addresses to coordinates and vice versa
Direction – provide direction between two locations

The other significant advantage of using Google Maps as a WebGIS front end is its mobile out reach. Google Maps API is integrated into Google's Android mobile operating system and other popular mobile device. Enlisting mobile device is beneficial to WebGIS because it can be utilized as a real time data gathering device and investigative tool.

Disadvantage

As with any non-open source software, there is always some limitation put in place so a company can profit off the power users. The limitations placed on Google Maps by Google are both for profit (forces power users to use Google Maps API Premier) but also to ensure quality of service and reduce potential conflicts. These restrictions are as follow (Google Maps API, 2005):

Limited queries – All websites that uses Google Maps Static API are limited to 1000 image queries per day. Any overuse within a 24 hours period will be considered as an abuse and may be subjected to rejection of queries until the next day.

URL length restriction – Google Maps Static API uses URL to generate Google Maps within a webpage. The URL defines the map type, feature markers, zoom level, centering location, and other map parameters. All these parameters must form an URL no longer than 2048 characters to execute a successful query and return a map image.

No third party WMS/WFS layer support – Google Maps itself have a good variety of feature data which can lay on top of one of the four default base maps (road map, satellite image, terrain, and transparent major road map + satellite image). Aside from these maps, API users can not import other base layer maps of their choice.

KML/KMZ size restriction – In order to display custom layer features, users can convert features into KML or KMZ files with the following restrictions:

Table 1. KML restrictions.

Maximum fetched file size (raw KML, raw GeoRSS, or compressed KMZ)	3MB
Maximum uncompressed KML file size	10MB
Maximum number of Network Links	10
Maximum number of total document-wide features	1,000

KML/KMZ reloading – Google Maps caches user generated KML for unspecified minutes. Therefore KML/KMZ file is required to be placed in a publicly accessible network domain before it is able to be displayed. However, updating KML/KMZ files can be controlled manually through a combination of refresher tags, though it is confusing to setup.

OPENLAYERS

Advantage

OpenLayers attains almost all the same functionality to construct a JavaScript web map application as Google Maps API. WebGIS developers may prefer OpenLayers over Google Maps because the developers do not have to contempt with the predetermined restrictions. Perhaps some of the most notable features are its native support to create mash-up of maps from multiple sources. OpenLayers can interact and retrieve base maps from third party APIs (Google, Yahoo, Bing, ESRI Mappings, OpenStreetMap and etc.) and can also create feature layers (raster and vector) directly from WMS/WFS servers as well as vector file formats (KML, GPX, GeoJSON, GeoRSS, ArcXML and etc.) (Hazzard, 2011)

```
var yahoo_hybrid = new OpenLayers.Layer.Yahoo(
        "Hybrid",
        {type: YAHOO_MAP_HYB, numZoomLevels: 24}
);
var yahoo_satellite = new OpenLayers.Layer.Yahoo(
        "Satellite",
        {type: YAHOO_MAP_SAT, numZoomLevels: 20}
);
var yahoo_street = new OpenLayers.Layer.Yahoo(
        "Street",
        {}
);
```

Sample Code 1. An example of a setup of three Yahoo! Maps as layers in a OpenLayers map application.

```
map = new OpenLayers.Map('map_element',{
        units: 'm',
        projection: new OpenLayers.Projection('EPSG:900913'),
        displayProjection: new OpenLayers.Projection("EPSG:4326"),

});
```

Sample Code 2. An example of a projection setup for a OpenLayers map application with the European Petroleum Survey Group (EPSG) codes.

Different map sources often results in a major problem regarding incorrect map projection and coordinate system. Fortunately, OpenLayers natively supports a limited ability to perform projection transformation when defining map viewer. In the case when a more complex projection transformation is required, OpenLayers can employ the use of external library Proj4js (a JavaScript library that provides methods for coordinate transformations between map projections and longitude/latitude, including datum transformations, in a web client (Proj4js, 2008)).
It is important to note that OpenLayers implementation do not cache any vector files used for viewing feature data. Therefore file formats such as KML do not need to include other definitions for refresher and document expiration setting.

Disadvantage

By choosing OpenLayers to create web mapping applications developers are forgoing well developed toolsets from web mapping service providers such as Google Maps. Even though OpenLayers has the abilities to communicate with third party APIs, its primary function is to retrieve map images as base layer. Even so, developers can still utilize those toolset by creating other subroutine which OpenLayers does not provide, translating the result into vector file formats and feed it back to the OpenLayers application.

Even though there is no upper limits in how many features or layers that you can put onto an OpenLayers map application, developers need to be aware of the right balance between data and performance. Too much features populating a layer or too much layer displaying simultaneously is very taxing on the web browser to display. In this case, Google Maps' restrictions on the number of features to display and their complexity have merit over OpenLayers.

CONCLUSION

Google Maps and OpenLayers are both well featured API and are both good choices as the front end of a WebGIS application. Ultimately, the choice of using which API library depends on the theme of the WebGIS application. If the goal of WebGIS application is to display high resolution imagery on a specific coordinate system and requires high spatial accuracy when superpositioning features from multiple sources, then OpenLayers is a better choice because of its flexibility to acquire data. If the WebGIS application focuses on less sensitive information where only the general location of the features is required to be displayed then Google Maps provides a streamlined solution coupled with several of Google's services (OpenLayers vs, 2009).

Developers who are avid users of Google Maps should be aware of the underlying risks. As mentioned earlier, any company, including Google, would seek to profit or benefit or both from the services which they provide. Google is quite well known for its mission to organize the information of the world. At the moment Google Maps is a treasure trove for users' queries for location information. While free of cost, there is a premium cost to maintain the service. Until the day when Google Maps seize to be a source to profit from, then Google may decide to terminate this service to reduce cost or utilize the spending to create other services. Although OpenLayers applications would still be affected if this scenario comes to fruition, developers can recover from it quickly by adjusting the application base layer to other map services. This would make OpenLayers a better and safer choice in that possible future.

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