

Web Map Server

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1. Introduction

To understand the term of Web Map Server, some background knowledge of Computer Network, Client/Server, Web application, Web Service, Map, and Web Map Service is needed.

- Computer Network

A system that computers can communicate with each other. Messages, or data packets travel among computers based on a broadcast/receive, or request/respond style. The infrastructure of a computer network has 7 layers based on OSI (Open System Interconnection) model, from top to the bottom, they are application layer, presentation layer, session layer, transport layer, network layer, data link layer and physical layer. When a user opens his web browser and searches an address in Yahoo maps, it is an instance of Web Map Service, but we won't analysis how Yahoo has the server setup and connected to the network (at the physical layer) or how the data is encrypted (at the presentation layer), web map service discussed here is on the top of the application layer.

- Client/Server

A network architecture that computers in a network to follow such that they can communicate to each other. A client is a program running on a computer which sends out a request (usually through a web browser like Internet Explorer or Firefox), a server is a program running on a computer (might be the same computer) which listens to the request and responds to the request (usually a web pages is returned to the client's web browser).

- Web Application

An application delivers itself to the users over a network. Client/server architecture is well adapted in designing a web application. Web browser is the most common platform on which a client program is running. A graphic user interface is very common in a web application which is different to web service as the later one may not need a user interactive graphic interface.

- Web Service

According to W3C's definition [1], "Web services provide a standard means of interoperating between different software applications, running on a variety

of platforms and/or frameworks." The architecture is showed in the following diagram [2].



Fig 1. Web Service and its service oriented architecture

The capability to interoperate is the key feature for a web service which makes it possible that heterogeneous applications can work together [3]. It is mainly a set of standards of data exchange between applications. From an end user's aspect, we can simplify the difference between a web application and a web service by saying the web application is more like person-to-server interactions over HTTP and HTML while web service is more like server-to-server interactions over HTTP, SOAP and XML. From a developer's aspect, we can simplify web service as a programming library on the web, as web service publishes its functionality via SOAP such that other web applications, including other web services (a type of application) can use.

- Map

According to OGC (Open Geospatial Consortium), a "map" is a portrayal of geographic information as a digital image file suitable for display on a computer screen [4]. A map is not the data itself. Image file formats include raster image format like PNG, GIF or JPEG, or occasionally as vector-based format as Scalable Vector Graphics (SVG) or Web Computer Graphics Metafile (WebCGM) formats [5][6].

- Web Map Service (WMS)

According to OGC, WMS produces maps of spatially referenced data dynamically via the following three operations [5]:

- returns service-level metadata
- returns a map whose geographic and dimensional parameters are well-defined
- returns information about particular features shown on a map (optional)

From above discussion, we can argue that WMS is a special instance of web service which returns maps [12]. On the other side, WFS (Web Feature Service) returns map data itself. WMS publishes its ability of produce maps, e.g. the operations and available geographic information through the application metadata in the format of XML. The special aspect of WMS comparing to other web service is WMS usually is invoked by a request sending from a standard web browser in the form of Uniform Resource Locators (URLs), which means in the term of “server-to-server”, the first “server” is more likely not a server but a simple web browser application.

- Web Map Server

In the domain of Geographic Information System (GIS), the term of “Web Map Server” is usually referred as the computer provides “Map Service” to respond the clients’ requests, most likely, the request is sent to the server from a web browser. Now we can redraw the architecture diagram to show how web map server sits in the structure of Web Map Service. We omitted the Discovery Agencies as it is optional and not required by OGC.

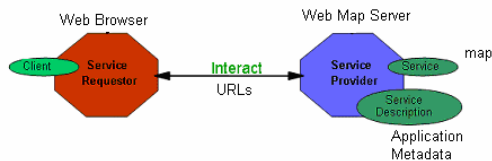


Fig 2. Web Map Service architecture

2. Implementation Specification

OGC has an international standard on Web Map Server Interface published on 2004. Besides of setting standards of map data, such as coordinates system and projection method etc., it mainly focus on specifying the three operations offered by a server as we listed above and showed in the following diagram. Particularly, they are:

- GetCapabilities
- GetMap
- GetFeatureInfo (optional).

This Clause specifies the implementation and use of these WMS operations in the Hypertext Transfer Protocol (HTTP) Distributed Computing Platform (DCP).

The standard also leverage the web map service into two categories, if the web map server supports all the three operations, the web map service it

provides is “queyable WMS”, if it only supports the first two operations, it is “Basic WMS”.

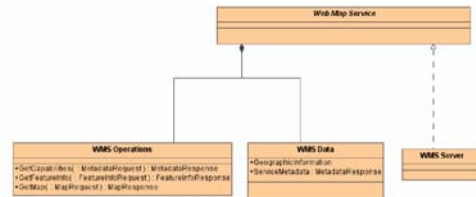


Fig 3. Web Map Service Interface

By utilizing the WMS operations and WMS data a web map server reveals, a user can easily configure a URL to retrieval the maps on a web browser directly, although most likely such URL is generated from a client application. An example listed below shows a client application retrieves two maps in four layers from two web map servers and combines the two maps (hurricane satellite image and population map) together on a web browser.

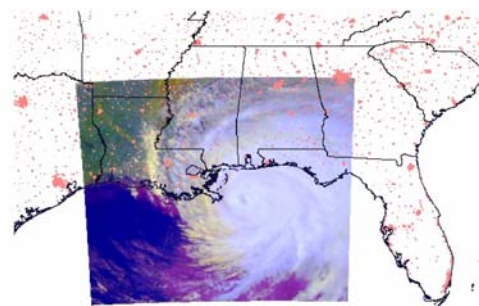


Fig 4. An example of composite map from two separate map servers

3. Examples

We would first introduce some popular commercial map service and then introduce some development environment can be used to build a web map server.

3.1 Applications

Most of the commercial applications we listed here publish their application metadata with a different format as API interface, although the API’s specification is not completely compatible to OGC’s standard, it serves the same purpose, to facilitate other application or service to use their map service, the data and the spatial operations it provides.

3.1.1 MapQuest

MapQuest is a free Web Map Server, owned by AOL. The map creation software was originally developed by GeoSystems to generate maps for customers. That code was adapted for use on the internet to create the web service [4]. MapQuest lunched their new service called OpenAPI(Beta) recently, which is a free service that allows user to

integrate routing, geocoding, mapping and other location-based functionality into his own web application.

3.1.2 Yahoo! Maps

Yahoo! Maps is a free Web Map Server, provided by the Yahoo! Network. [4]. The new Yahoo! Maps offers totally three API families (AJAX, Flash, Simple API) to fit different application's special needs of using their map service.

3.1.3 Google Maps

Google Maps is a free Web Map Server, owned by Google. It offers draggable street map and satellite images for the whole world, as well as a route planner and business locator which does not cover the whole world yet. A related product is Google Earth, a standalone program that offers enhanced globe-viewing features [4][11]. Google Maps offers Google Maps API to let user use their map service in user's own application.

3. 2 Development platforms

3.2.1 ArcIMS

ArcIMS is a commercial development environment for delivering dynamic maps and GIS data and services via the Web. It provides a highly scalable framework for GIS Web publishing that meets the needs of corporate Intranets and demands of worldwide Internet access. ArcIMS services can be used by a wide range of clients including custom Web applications, the ArcGIS Desktop, and mobile and wireless devices. Using ArcIMS, city and local governments, businesses, and other organizations worldwide publish, discover, and share geospatial information [8].

3.2.2 MapServer

MapServer is an Open Source development environment for building spatially-enabled internet applications. MapServer was originally developed by the University of Minnesota in cooperation with NASA and the Minnesota Department of Natural Resources in 1990's and it is getting more and more popular and has the user all over the world. [7][9][10].

3.2.3 MapBuilder

MapBuilder.net is a new Web2.0 service or rapid mashup development tool to build custom Google and Yahoo maps without any knowledge of the Google/Yahoo Maps API and JavaScript [13]. A visual interface is provided to the developer to ease the process of building a map.

4. Summary

Web Map Server is the key component in the architecture of Web Map Service which responds to

client's (web browser, web application, or other web service) request and offers map related services. Map Web Server usually will follow certain standard to let its users to know its service by publishing its application metadata or API specifications.

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