Web Services for Geospatial Mobile AR

Christine Perey
PEREY Research & Consulting
cperey@perey.com

Introduction

Many popular mobile applications already use the smartphone’s built-in sensors and receivers to simplify the lives of users. For example, the user’s position as provided by the GPS receiver is an automatically-generated input for the route calculation in a navigation application. The direction and speed of travel, detected by the accelerometer or changes in the GPS reading, is another input that informs the application and permits a relatively accurate time of arrival. Social applications, such as Highlight and Vyclone, use the position of the user in relation to friends and people with like interests, to provide value-added services. Vyclone looks for others who are shooting video nearby and then edits the video clips together so the same footage can be seen from multiple angles.

The Augmented Reality-assisted service for virtual office workers, WorkSnug, finds the nearest open WiFi hotspot and superimposes its whereabouts on the live camera view. WorkSnug Pro also has an integrated decibel meter, which records and reports the noise levels at each hot spot and sends it to the service database.

Tagwhat provides applications and services that find and deliver actionable content about the places around a user. By using the user’s location and combining that APIs with many business services and social networks, Tagwhat searches for and, using push notification, delivers the most highly relevant and timely content, like special offers and events, to the user’s screen.

These are examples of mobile device-based location sensors providing context and, by sending to the cloud more information about the user context, filtering data provided back to the application’s user.

Next Generation location-based services (NGLBS) are a class of emerging contextually-aware “feeds” that filter information in real time based on the user’s position. Using open, standards-based Web Services interfaces, companies providing such services will be able to merge, or “mashup” and also filter more than “only” the data set within the service provider’s own servers. Mobile AR applications and services that rely on user location for context must leverage this trend, providing data visualization in camera view in addition and as an alternative to map or list view.

The Problem

Over the past 12 months, contextually-aware mobile application “behaviors” have been rapidly trending. Unfortunately, many of the services to which the applications are sending requests for contextually-relevant information use proprietary interfaces.
Application developers that want to develop contextually-aware services may:

- develop their own data, with or without crowd-sourcing mechanisms, and limit their users’ access to these data,
- license third party data sets and limit their users’ access to these data, or
- write to and use the unique features of each third-party service interface, relay the data from the third party service to developer’s servers, where they can merge and filter the data as needed by the user and according to the preferences and context settings of the mobile client application.

All of these strategies place heavy burdens on developers.

**Solutions**

Developer effort can be reduced significantly with the use of open data, linked data and, above all, open Web-based services. Using widely available, royalty-free standards for their interfaces, more developers will have access to more diverse data sets in their services and the era of contextually-aware mobile services will blossom.

When contextually-aware mobile services are common, there will be an enormous amount of data available. To reduce risk of cognitive overload, users will be best served by applications that offer a range of visualization options. For geospatially-referenced data, the options will include visualization on a map, in a list according to the proximity to the user (closest points at the top of the list) and in AR camera view.

**Standards for Location-based Data**

Nearly 500 members-strong, the OGC has been developing geospatial information system standards for more than 20 years. In collaboration with ISO, W3C and other standards organizations, the OGC delivers the deepest and widest set of specifications for the query, management, delivery and visualization of geospatially-referenced information.

OGC standards are ubiquitous in industrial, government and military settings where computation, bandwidth and display resources are designed to meet the needs of highly demanding applications. Users rely on real time computation, data analyses and processing, transmission between servers and clients, and rendering of data in 3D in high resolution.

OGC-based services have not been widely used in mobile due to the limited computation, memory, bandwidth and display resources accessible to mobile platforms and their users. As mobile devices get more suited to computationally-demanding tasks, higher resolution display alternatives proliferate and network bandwidth for mobile devices increases, barriers are falling.
OGC-enabled Mobile Applications

In 2012, as part of the OGC Interoperability Program Web Services-9 testbed, the consortium members re-evaluated the suitability of mobile resources and infrastructure with respect to geospatial application service requirements and found mobile devices and networks highly appropriate for OGC-enabled applications. Existing standards for Web services and processing services do not require changes before being used by developers to enrich their mobile applications and services.

In fact, OGC-enabled mobile software clients and services will be able to use precisely the same REST architectures as are currently deployed with hundreds of desktop and workstation applications.

In its Mobile Engineering Report [1], the OGC defines an OGC-enabled mobile client software application as:

- running on a mobile operating system;
- using mobile-embedded features, such as touch screen and orientation sensor, for optimized mobile user experience;
- using the device's sensors as contextual data for filtering;
- implementing one or more OGC services and/or data container specifications; and
- visualizing or updating those data as the user context or real time data change.

Levels of Users

The OGC Mobile Engineering Report describes three levels of users of OGC-enabled mobile applications:

- General User
- Power User
- Developer

General users run OGC-enabled client software and services without needing to be aware of the underlying technologies. For example, the user of a contextually-aware application assumes that when choosing the “search” feature to find data for local POIs, these are stored in the cloud and, should there be multiple databases queried, the results will be seamlessly integrated and appear on the screen in order of relevance and, perhaps, proximity.

Power users of OGC-enabled applications and services are able to identify data sets they need and use OGC-enabled interfaces for customizing their information “feeds” on the fly. The user of a construction site visiting software client, for example, can choose which type of materials to examine when arriving at a building site.

Developers of OGC-enabled mobile applications use the standards to create services for mobile platform users.
Mobile Devices in the OGC Architecture

The following architectural sketch illustrates the role of mobile within infrastructures implemented using the OGC standards portfolio. By combining HTTP-based Web service communication, an OGC-enabled mobile application can support any number of features, such as communication with remote Web services, application servers, or data stores using proprietary protocols, as well as access and manipulate locally-stored proprietary data files or data bases.

![Diagram of Mobile Devices in the OGC Architecture]

Figure 1: Mobile devices in the OGC Architecture

The OGC-enabled client software interacts either directly or indirectly with services/formats and makes the data available to the user. OGC-enabled Mobile Apps cover the full range from locally-installed data usage up to fully-synchronized Web service communicating intermittently or continuously with cloud-hosted data and services.

OGC Web Services

OGC Web Services (OWS) are OGC standards defining how geospatial information is accessed and used in Web applications. The OGC defines four Web service interface standards.

Web Map Services

The OpenGIS® Web Map Service Interface Standard (WMS) provides a simple HTTP interface for requesting geo-registered map images from one or more distributed geospatial databases. A WMS request defines the geographic layer(s) and area of interest to be processed. The response to the request is one or more geo-registered map images (returned as JPEG, PNG, etc) that can be displayed in a browser application. The interface also supports the ability to specify whether the returned images should be transparent so that layers from multiple servers can be combined or not.

Web Map Tiling Services

The Web Map Tile Service (WMTS) Implementation Standard provides a standard based solution to serve digital maps using predefined image tiles. The service advertises the tiles it has available through a standardized declaration in the ServiceMetadata document common to all OGC web services. This declaration defines the tiles available in each layer (i.e. each type of content), in each graphical...
representation style, in each format, in each coordinate reference system, at each scale, and over each geographic fragment of the total covered area. The ServiceMetadata document also declares the communication protocols and encodings through which clients can interact with the server. Clients can interpret the ServiceMetadata document to request specific tiles.

The WMTS standard complements the existing Web Map Service standard above. The WMS standard focuses on flexibility in the client request enabling clients to obtain exactly the final image they want. A WMS client can request that the server creates a map by overlaying an arbitrary number of the map layers offered by the server, over an arbitrary geographic bound, with an arbitrary background color at an arbitrary scale, in any supported coordinate reference system. The client may also request that the map layers be rendered using a specific server advertised style or even use a style provided by the client when the WMS server implements the OGC Styled Layers Descriptor (SLD) standard. However, all this flexibility comes at a price: server image processing must scale with the number of connected clients and there is only limited potential to cache images between the server and client since most images are different.

Web Feature Services

The Web Feature Services (WFS) standard specifies the behaviour of a service that provides transactions on and access to geographic features in a manner independent of the underlying data store. It specifies discovery operations, query operations, locking operations, transaction operations and operations to manage stored parameterized query expressions:

- Discovery operations allow the service to be interrogated to determine its capabilities and to retrieve the application schema that defines the feature types that the service offers.
- Query operations allow features or values of feature properties to be retrieved from the underlying data store based upon constraints, defined by the client, on feature properties.
- Locking operations allow exclusive access to features for the purpose of modifying or deleting features.
- Transaction operations allow features to be created, changed, replaced and deleted from the underlying data store.
- Stored query operations allow clients to create, drop, list and described parameterized query expressions that are stored by the server and can be repeatedly invoked using different parameter values.

Web Coverage Services

The OGC Web Coverage Service (WCS) supports electronic retrieval of geospatial data as “coverages” – that is, digital geospatial information representing space/time-varying phenomena. This document specifies the WCS core; every implementation of a WCS shall adhere to this standard. This standard thus defines only basic requirements. Extensions to the core will define extensions to meet additional requirements, such as the response encoding. Indeed, additional extensions are required in order to completely specify a WCS for implementation. A WCS provides
access to coverage data in forms that are useful for client-side rendering, as input into scientific models, and for other clients. As WMS and WFS service instances, a WCS allows clients to choose portions of a server's information holdings based on spatial constraints and other query criteria.

**Awila AR Browser**

OGC member, Augmented Technologies, is using the Web Feature Service Interface Standard and Geography Markup Language (GML v2.0) Encoding Standard to transfer geospatial data from cloud-hosted data to the Awila client application. Awila is the first mobile AR browser to use OGC standards for delivering existing location-based datasets to Android smartphones for exploration and viewing. Via OGC standards users can visualize data without the need for background mapping or manually entering their location.

![Awila Client Server Architecture](image)

**Figure 2.** Awila Client Server Architecture supports diverse data providers.

Awila is designed to display geospatially-referenced datasets and 3D scenes from a variety of sources. Using data tiling, localized caching and OGC Web services, Awila can display local views of network-based and locally-stored assets. Augmented Technologies is also working to develop readers that implement ARML2, an OGC candidate standard.

**OGC-enabled Mobile Roadmap**

Using well-established OGC processes, such as interoperability testbeds, and internationally-approved protocols, OGC members are collaborating to meet future mobile AR user requirements. Based on requirements, the OGC members can:

- propose or develop appropriate extensions of existing standards,
- use standards specified in other internationally-recognized standards bodies, or
- begin development of new standards within the OGC (e.g., GeoPackage) for use as part of systems that deliver services to OGC-enabled mobile applications and services.
Next Steps

Companies publishing geospatial data sets that are not currently accessible to mobile applications should explore the possibility of implementing OGC-compliant Web Services and interfaces to their services. These will permit geospatial mobile AR experience developers to more easily access the data quickly and provide it for visualization in AR camera view exclusively or in addition to map and list views.

Mobile AR publishing and content management systems should explore the use of OGC-compliant Web services and interfaces to streamline the development of mobile AR experiences that rely on geospatially-referenced data.

References