System Comparisons for GML (Geography Markup Language) Services

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Abstract: With regarding to web GIS, OGC promotes WFS allowing a client to retrieve geospatial data encoded in GML which is a modeling language to encode the semantics, syntax and schema of geospatial information resources. Even though GML provides benefits for geographic description, it is too heavy to be processed by mobile devices. In order to address the issue, this paper evaluates GML service with WFS server and GML viewers. Through this paper, we get analyses of properties of GML geospatial data and the effects on wireless devices, which are expected to be fundamental materials onto a design of mobile applications.
Keywords: GML, Web GIS, WFS, Mobile GIS, Mobile Device.

1. Introduction

With regarding to standard of web GIS, OGC promotes research projects and proposes implementation specifications of web interfaces. WFS specifies web interfaces for describing data manipulation operations on geographic features. It allows a client to retrieve geospatial data encoded in Geography Markup Language from multiple WFSs. GML is a modeling language to encode the semantics, syntax and schema of geospatial and geoprocessing-related information resources. It is an XML encoding for the transport and storage of geographic information, including both the geometry and properties of geographic features. Even though GML provides benefits for the geographic description, it is said that it is too heavy to be processed by mobile devices such as Smartphones and PDAs. In order to address the issue, this paper evaluates a GML service on multiple devices with a WFS server and GML viewers on Windows environments.

The rest of this paper is organized as follows. Section 2 describes details on GML and introduces a GML service promoted by OGC, the WFS. The experiments, results and analyses are presented in Section 3. Finally, we conclude this paper in Section 4.

2. Geography Markup Language (GML)

A geographic feature, an abstraction of a real world phenomenon associated with a location relative to the Earth, has been a starting point for modeling of geographic information. Recently, the *Geography Markup Language (GML)* becomes a new modeling language to encode the semantics, syntax and schema of geospatial and geoprocessing-related information resources. GML is an XML encoding for the transport and storage of geographic information, including both the geometry and properties of geographic features. GML utilizes the OpenGIS abstract specification geometry model. GML includes the ability to handle complex properties.

Like any XML encoding, GML represents geographic information in the form of text. While a short while ago this might have been considered verboten in the world of spatial information systems, the idea is now gaining a lot of momentum. Text has a certain simplicity and visibility on its side. It is easy to inspect and easy to change. Add XML and it can also be controlled.

GML is based on the abstract model of geography developed by OGC. This describes the world in terms of geographic entities called features. Essentially a feature is nothing more than a list of properties and geometries. Properties have the usual name, type, value description. Geometries are composed of basic geometry building blocks such as points, lines, curves, surfaces and polygons. For simplicity, the initial GML specification is restricted to 2D geometry, however extensions will appear shortly which will handle 2 1/2 and 3D geometry, as well as topological relationships between features. GML encoding already allows for quite complex features. A geometrically complex feature can consist of a mix of geometry types including points, line strings and polygons. It also supports a FeatureCollection which is a collection of GML features together with an Envelope, a collection of properties that apply to the FeatureCollection and an optional list of spatial reference system definitions.

As one of service platforms, OGC proposes Web Feature Service (WFS) supporting INSERT, UPDATE, DELETE, QUERY and DISCOVERY of geographic features. WFS delivers GML representations of simple geospatial features in response to queries from HTTP clients. Clients access geographic feature data through WFS by submitting a request for just those features that are needed for an application. WFS can either be a basic WFS, which implements the GetCapabilities, DescribeFeatureType and GetFeature interfaces, or a transaction WFS, which, in addition to supporting all the interfaces of a basic WFS, implements the Transaction interface.

3. Service Experiments and Analysis

Even though the *GML* provides benefits for the geographic description, it is said that it is too heavy to be processed by mobile devices such as laptop computers and PDAs. In order to address the issue, this paper evaluates the *WFS* on multiple devices with a *WFS server* and *GML viewers* on Windows environments. In the experiment, we measure and evaluate system performances: *the GML parsing time*, *the GML loading time*, and *the GML drawing time*.

On systems on which the GML viewer is run, we take two different types of mobile devices: a PDA and a laptop computer. The PDA has Intel PXA250 applications processor (400MHz) chip and 64MB SDRAM on Microsoft Pocket PC 2002 operating system. It also equips 802.11b Wi-Fi wireless network card supporting 11Mbps. The laptop computer has Intel Centrino Mobile 1.6MHz CPU chip, 1GB DDR SDRAM and built-in wireless network equipment using 802.11b Wi-Fi card supporting 11Mbps.

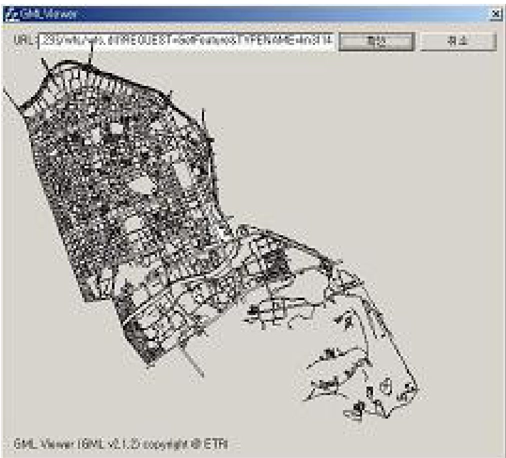


Fig. 1. GML Viewer.

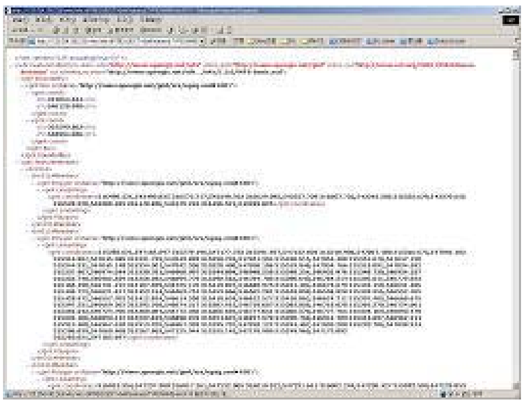
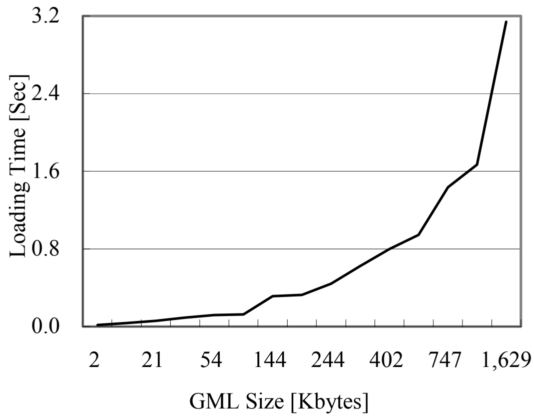


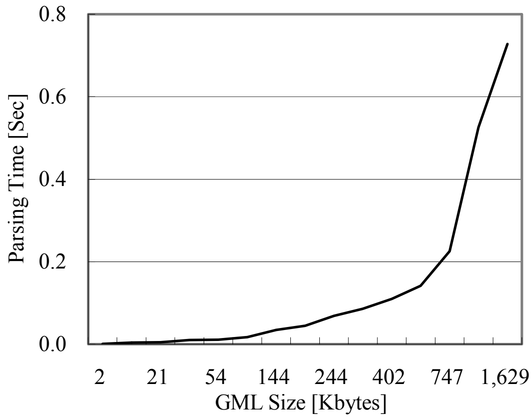
Fig. 2. GML Viewing on Web Browser.

For experiments, we take 15 different GML data: they have different volume and information such as outlines or road of a district. Fig. 1 shows a GML viewer, connecting the WFS server and receiving, parsing, and drawing GML data. The displayed data is about a district of part of Seoul. In addition, Fig. 2 has details on GML data which has coordinate information and is viewed on general web browser.

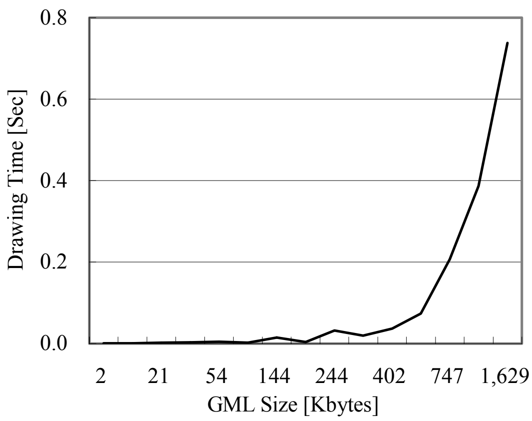
Fig. 3 shows results of system performance of GML services on laptop computer. And each has values for loading, parsing and drawing time for GML data. Larger data volume is more the overhead to process GML data. And the mobile device takes similar time to parse and draw spatial information.



(a) Loading Time on Laptop.

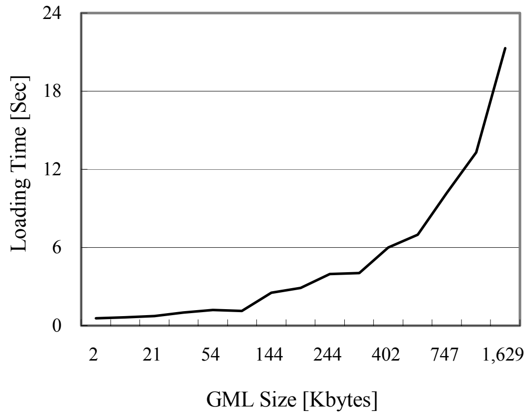


(b) Parsing Time on Laptop.

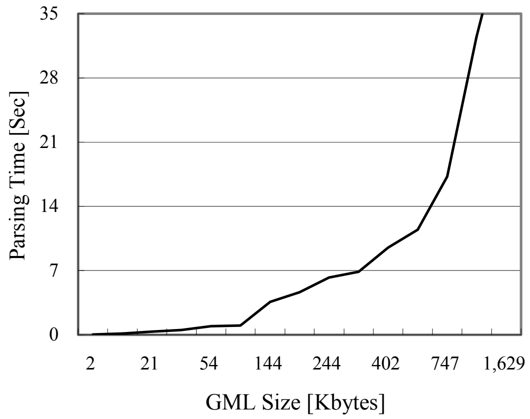


(c) Drawing Time on Laptop.

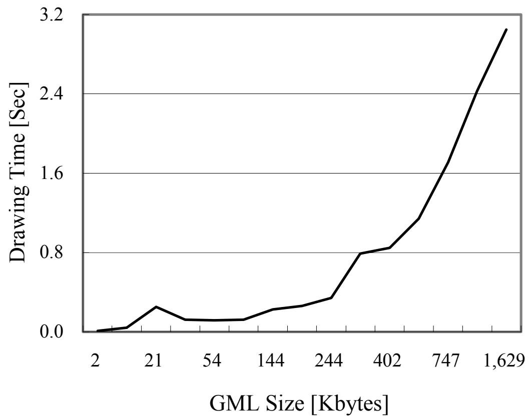
Fig. 3. System Performance on Laptop.



(a) Loading Time on PDA.



(b) Parsing Time on PDA.



(c) Drawing Time on PDA.

Fig. 4. System Performance on PDA.

Fig. 4 shows results of system performance of GML services on laptop computer. Each has values for loading, parsing and drawing time for GML data, too. In general, larger data volume is more the overhead to process GML data, which is same to the result showed in Fig. 3. As volume becomes large, the overhead gets an exponential growth rate. On comparison between two mobile devices, the laptop computer has lower overhead to process the GML service than that of the PDA. Especially we can intuitively recognize the difference of time spent to load and parse the GML data. The PDA takes even more than 40 seconds only for parsing large volume of data: about 1.5Mbytes.

4. Conclusions

The development of GIS has been highly influenced by the progress of Information Technology (IT). Web computing is the single most important current IT trend, with mobile computing following on fast, and GIS has been at the forefront of adopting both technologies to great benefit.

In this paper, we touched the performance issues of geospatial web service. Especially, we took GML, which was a XML-based description model for geographic features on the Earth, and WFS, which was providing GML representations of simple geospatial features in response to queries from HTTP clients. This paper reviewed the concepts and position of mobile and web GIS including standards. Then we studied GML on detail, because it had important properties that become a fundamental format of data transferring on web service architectures. In experiments, we took advantage of WFS providing GML notification containing outline and road information of administrative district of Seoul city.

Through this paper, we got analyses of properties of GML geospatial data and the effects on wireless devices. The research results are expected to be fundamental materials onto a design of system architecture for mobile devices. An implementation of GML services using SOAP, web transferring protocol from World Wide Web Consortium (W3C) are on our next research work.

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