

Developing 3D Geoportal for Wilayah Persekutuan Iskandar

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Abstract

Portal development of disseminating geospatial information via web has a positive growth over the last few years in Malaysia and elsewhere. Related agencies, i.e. both government and private are in the process of disseminating spatial information to their respective users as could be seen in national geospatial data centre, national mapping agency, local authorities, and newly created business entities for such as Iskandar Region Development Authority (IRDA) in Johor. These agencies, in fact are considered as major implementers of such geospatial information systems, especially the local government authorities. Geospatial portal has proven its importance as communication medium among the government agencies, government to business and government to public. However, at present, most geoportals are based are meant for 2D spatial data and relatively very few geoportals were meant for 3D spatial information.

This paper presents the development of 3D geoportal for *Wilayah Persekutuan Iskandar (WPI)*. It discusses the visualization aspect of 2D and 3D geospatial information and functionalities and people in regional or city planners could benefit from such 2D and 3D systems. Development tools such as XML, GML, KML, and CityGML were utilized; issues and challenges related to the 3D geoportal will be discussed and highlighted.

(Key words: 3D geoportal, GML, KML, CityGML)

1. Introduction

Geospatial portal (geoportal) is a popular online communication medium for related agencies, i.e. both government and private in disseminating spatial and aspatial information to their respective users. At present, most local geoportals development are meant for 2D geospatial content and relatively very few geoportals were meant for 3D content.

Nevertheless, a descriptive and sharable 3D geospatial visualization model, especially for city and landscape, is highly demanded in many fields, e.g. city-planning. Most of the users from these fields have already experienced with their existing geoportal for 2D

geospatial information distribution. Therefore, 3D geoportal would serve more meaningful and usable virtual presentation of the geospatial content.

This paper presents the development of 3D geoportal for *Wilayah Persekutuan Iskandar* (WPI), the Iskandar Region Development Authority (IRDA), a newly created business entities in Johor, Malaysia. It discusses the visualization aspect of 2D and 3D geospatial information and functionalities and people in region such as city planners could benefit from such 2D and 3D systems. Development tools such as XML, GML, KML, and CityGML were utilized; issues and challenges related to the 3D geoportal are discussed and highlighted.

2. Study Area - Wilayah Persekutuan Iskandar (WPI)

This study has focused on the administrative area of WPI, namely the South Johor Economic Region (SJER). From a physical planning perspective, the SJER is defined as a geographic area in the southern part of Johor that will benefit from the economic opportunities that will be promoted within the region.

It approximately covers more than 200,000 hectares combining the entire district of Johor Bahru, Jeram Batu sub-district, Sungai Karang sub-district, Serkat sub-district, Pulau Kukup sub-district and all within the district of Pontian, as shown in Figure 1.0

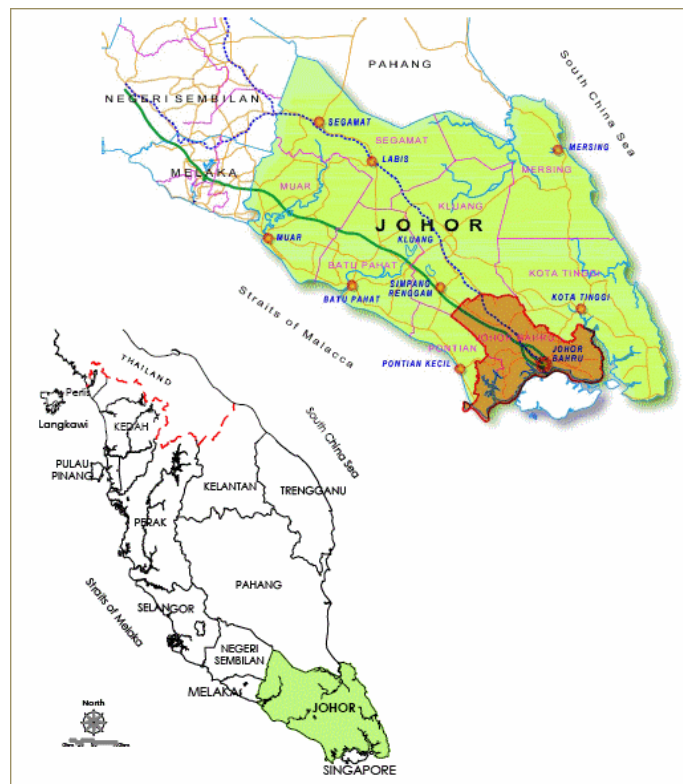


Figure 1.0: Study area.

3. XML-based Formats

3.1 X3D (eXtensible 3D)

Web3D Consortium has defined X3D as a royalty-free open standards file format and run-time architecture to represent and communicate 3D scenes and objects using XML. According to Vries and Zlatanova (2004), X3D can be considered as the XML version of VRML (Virtual Reality Modeling Language).

X3D format could be used for online 3D geospatial data visualization in web browser by using viewer plug-in or players. This format has no restriction in presenting 2D data and 3D data in a viewer, and many X3D viewers are downloadable. The viewer also supports some navigation functionalities.

Encoding X3D via file translation from VRML is also applicable and straight forward via translator. Figure 2.0 shows a sample output of the study area in X3D file (translated from VRML file) which is originally generated from commercial-of-the-shelf (COTS) application.

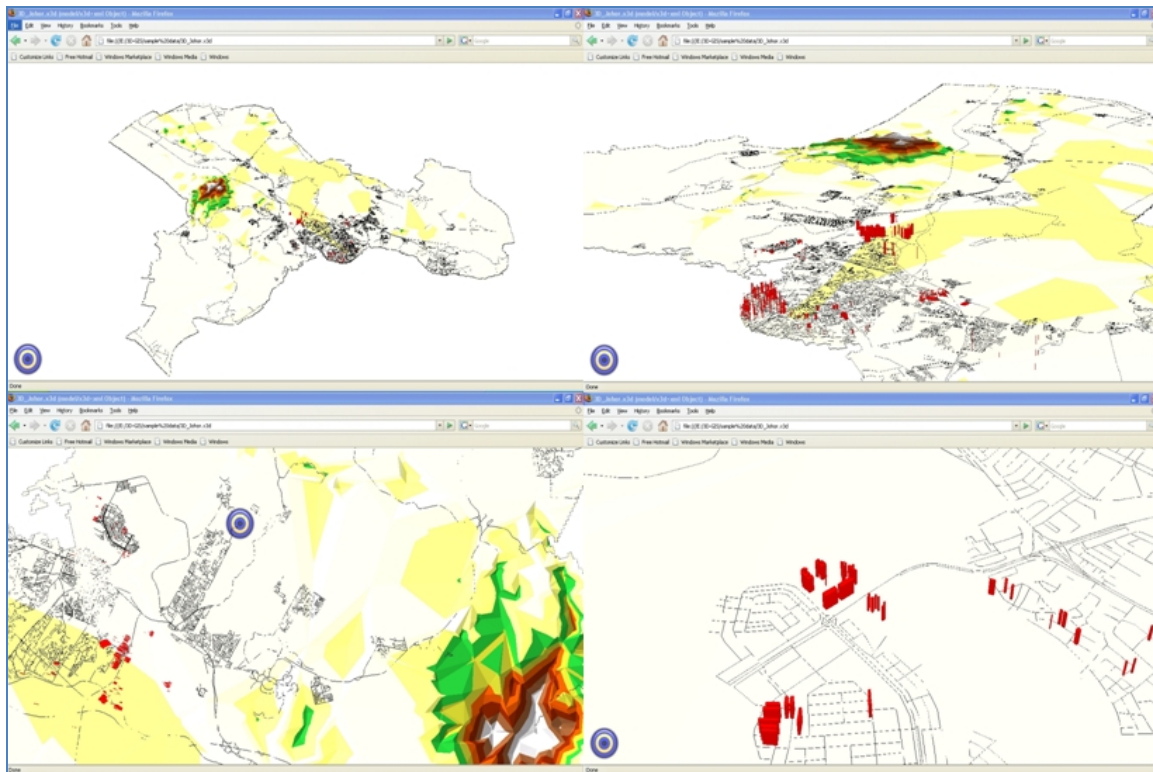


Figure 2.0: Example views of study area (in X3D) presented in X3D plug-in viewer.

3.2 KML (Keyhole Markup Language)

KML is a XML-oriented display language that aims for online geographical object virtualization. It has now become one of the specifications and shared under OGC (Open GIS Consortium). Based on the project document of OGC for KML, namely the OGC 07-147r2, KML is an XML grammar used to encode and transport representations of geographic data for display in browsers ,such as Google Earth, ArcGIS Explorer, etc., 2D

web browser application (i.e. Google Map), or 2D mobile application (i.e. Google Map for mobile).

The study area dataset which originally presented in SHP and DWG file format are converted into KML by leveraging some COTS applications. The local coordinate system used in the dataset was firstly transformed into WGS coordinate system which is used by Google Earth and Google Map. The file format conversion remains the symbology for styling the data layers. Figure 3.0 shows example views of the converted dataset presented in Google Earth.

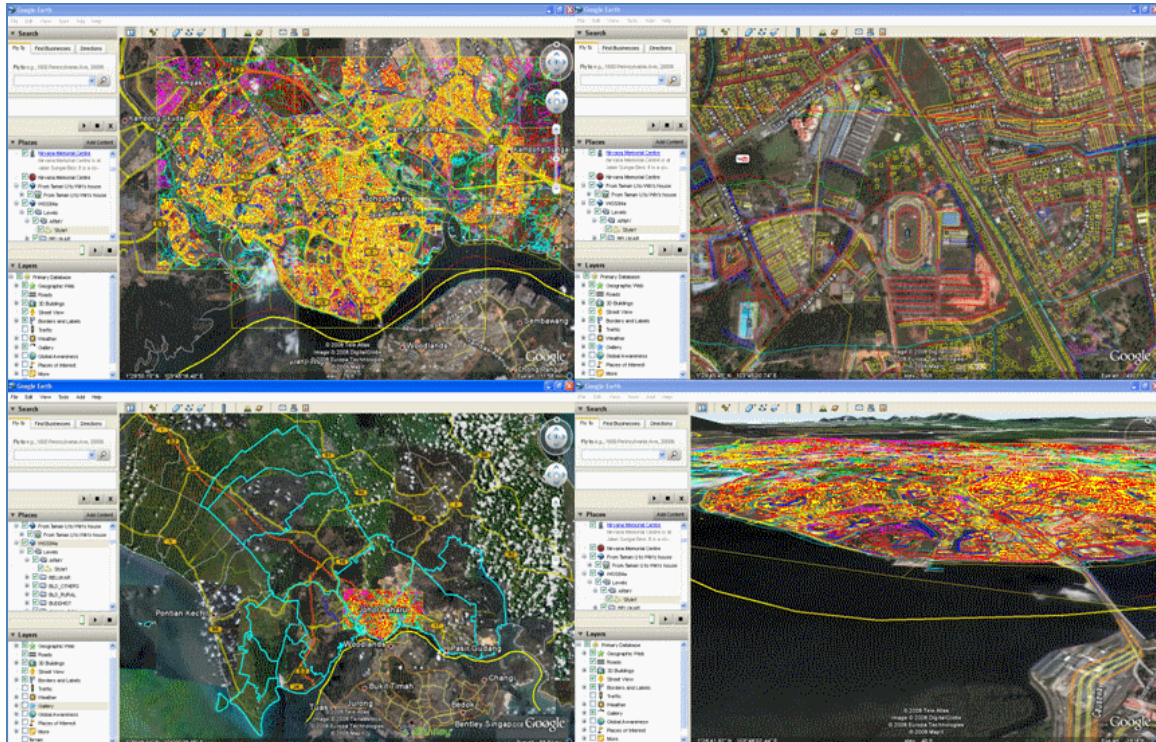


Figure 3.0: Example views of study area (in KML) displayed in Google Earth.

4. CityGML (City Geography Markup Language)

CityGML is also an XML grammar could be used for 3D geoportal development but it naturally serves different function compares to KML and X3D. It is based on GML 3(Geographical Markup Language 3) to provide more specific description of city model in 3D context.

It is documented in the OGC Best Practices Document for CityGML Implementation Specification, namely OGC 07-062 version 4.0, that CityGML is designed as an open data model defining the classes and relations for the most relevant topographic objects in cities and regional models with respect to their geometrical, topological, semantical, and appearance properties.

Lapierre and Cote (2007) mentioned that CityGML is meant for exchanging semantically rich 3D urban objects in Extensive Markup Language (XML), either through a file or

served through WFS (Web Feature Server). In another words, WFS (Web Feature Services) is an essential method to generate CityGML output. The semantic information contained in the model can be used in the styling process which generates graphics and represented as a KML/COLLADA or X3D files.

5. WPI 3D GeoPortal Implementation

The 3D GeoPortal of WPI is designed to not only display 3D dataset, but also 2D dataset. Proper navigation tools for both 2D and 3D data browsing has also been designed and implemented in the portal by leveraging the available APIs of the plug-in. Besides virtualizes the geography data, the portal allows searching, querying and presenting tabular information attached, based on the desire methods required by the city planner. The portal is also aimed to display the thematic properties stored in the CityGML elements graphically and interoperate with other CityGML viewers etc.

5.1 Assessing X3D and KML for 3D geospatial visualization

Both X3D and KML are encoded using XML but only readable in the specific viewer plug-ins such as Bitmanagement X3D viewers read X3D content and Google Earth browser read KML content. Each of these languages consists of elements that are used to describe geometry, symbology, link and so forth based on the defined schema.

KML is selected and being used for this geoportal development after the assessment and consideration. Besides of the performance of the language itself, the availability and capability of the viewers is one of the factors of the assessment too. Generally, KML is much suitable for this development because:

- a. KML does better linear or polygonal geometry display in the viewer.
- b. The native browser of KML, namely Google Earth contents fruitful geospatial information like satellite imagery, road map etc which can supplement to the provided geospatial dataset.
- c. The navigation functionalities are user friendly and commonly used by the desire user groups.

5.2 Geospatial data preparations

The scale of details for the geospatial data presentation in the geoportal is referred to the multi-scale modeling of CityGML as guide. According to the OGC Best Practices Document for CityGML Implementation Specification, in a CityGML dataset, the same object may be represented in different LOD (Level of Details) simultaneously, enabling the analysis and visualization of the same object with regard to different degrees of resolution. LODs are also characterized by differing accuracies and minimal dimensions of objects.

For this geoportal, the geospatial data is presented in LOD 1 and LOD 2, depending on the zoning and land use area. Basically, the Special Economic Corridor (SEC) area is planned to display in LOD 2 and LOD 1 3D visualization is applied to the rest which mostly housing estate, open space or natural environment area. Some basic classifications used for this geoportal are listed in Table 1.0. The classification is defined based on the OGC Best Practices Document for CityGML Implementation Specification.

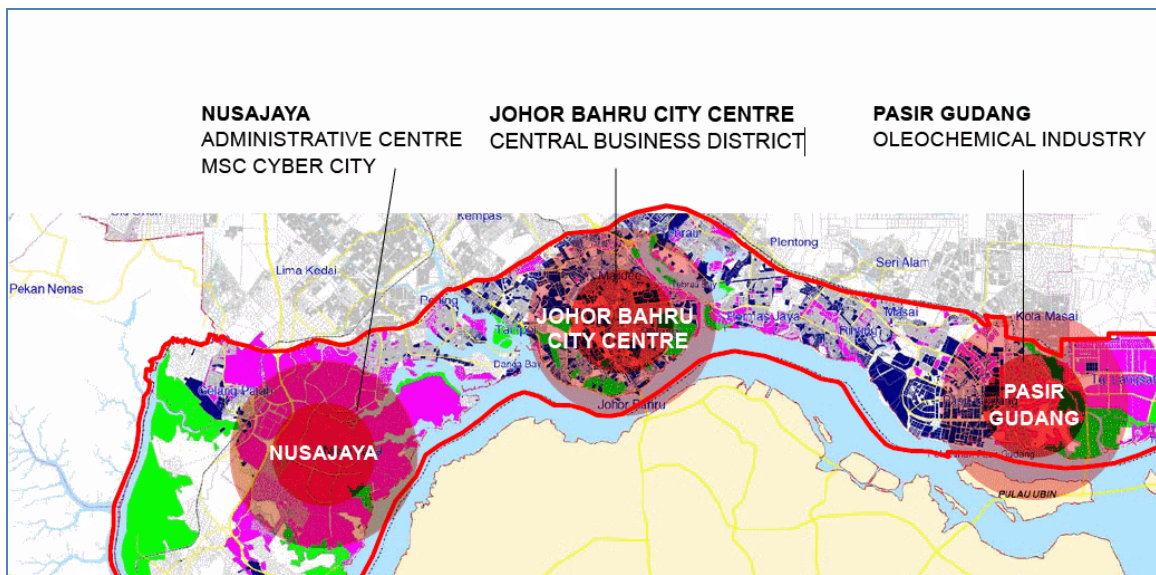


Figure 4.0: Special Economic Corridor (SEC) area of WPI.

	Special Economic Corridor (SEC) area	None SEC area
Level of Details	2	1
Model scale description	City district area	City regional area
Class of accuracy	medium	low
Building	Block Object	Object with roof
Roof type	flat	Roof type and orientation

Table 1.0: Some basic classifications of LOD used for the geoportal

This study utilizes the topography map as data source for the geoportal development. A common GIS data preparation routine such as data cleanup, database structure design, database population, coordinate system definition, etc. are worked in order to produce the desire geospatial data. Depending on the usage of the data, some of the data layers are stored as KML for static map publishing and some of the data layers are stored in MySQL database for dynamic map content retrieving.

5.3 GeoPortal design and development

The 3D geoportal is designed to run on open source platforms due to the challenge of limited options of COTS platforms for online 3D geospatial data virtualization. For this, the Google Earth is chosen as the platform. The Google Earth Plug-in and its JavaScript API enables embedding Google Earth into the web pages. Using the API developers can

draw markers and lines, drape images over the terrain, add 3D models, or load KML files etc to build 3D map applications.

There are two map viewers presented in the geoportal GUI layout in order to perform 2D and 3D map display. As the 3D map is leveraging on the KML file for display, the Google Map, on other hand, is utilized for 2D map presentation. However, the 2D data is also overlaid with the 3D layer in the 3D viewer for better visualization purpose. The seamless map display retrieving from the same KML file content in both platforms provide perfect combination for 2D and 3D map presentation. The available APIs enable the control of map navigation from one viewer to another.

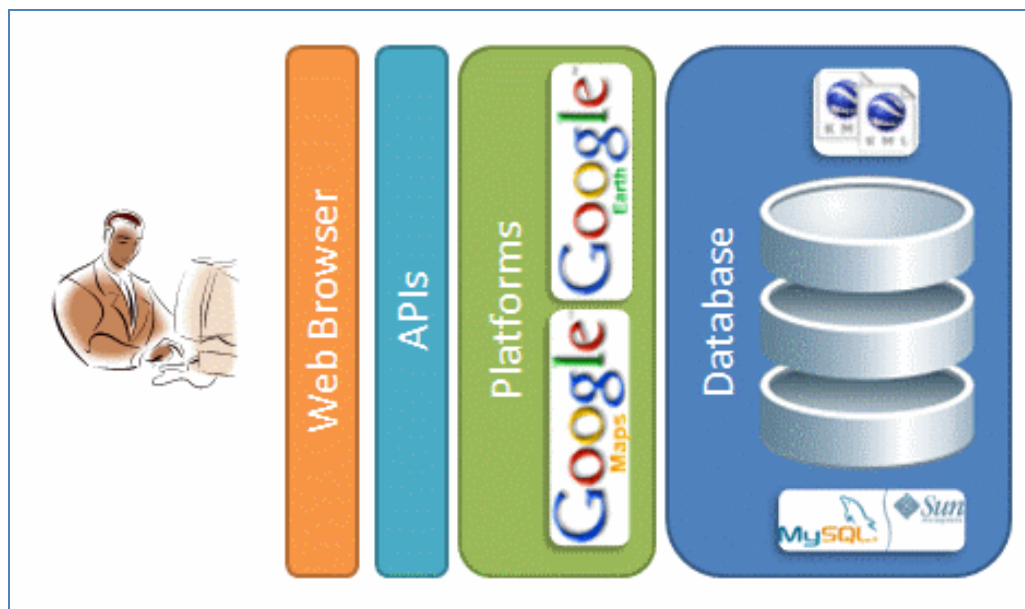


Figure 5.0: Geoportal Design.

The geoportal GUI design focuses on the users' requirement for accessing the desire functions or geographical area. There are five easy access buttons designed on the geoportal GUI to direct users to the desire zone area from the five development zones categorized under Comprehensive Development Plan for SJER. The Camera element in KML is used to specify views of the desire zone area in 3D map. Navigation tools like zooming and panning are created based on the APIs provided for Google Map and Google Earth plug-in. Users can freely toggle on or off the KML file for overlaying purposes in 2D and 3D viewers. Searching through the local database content and display tabular information describing the geospatial data are available functions on the geoportal GUI that serve the user requirement well.

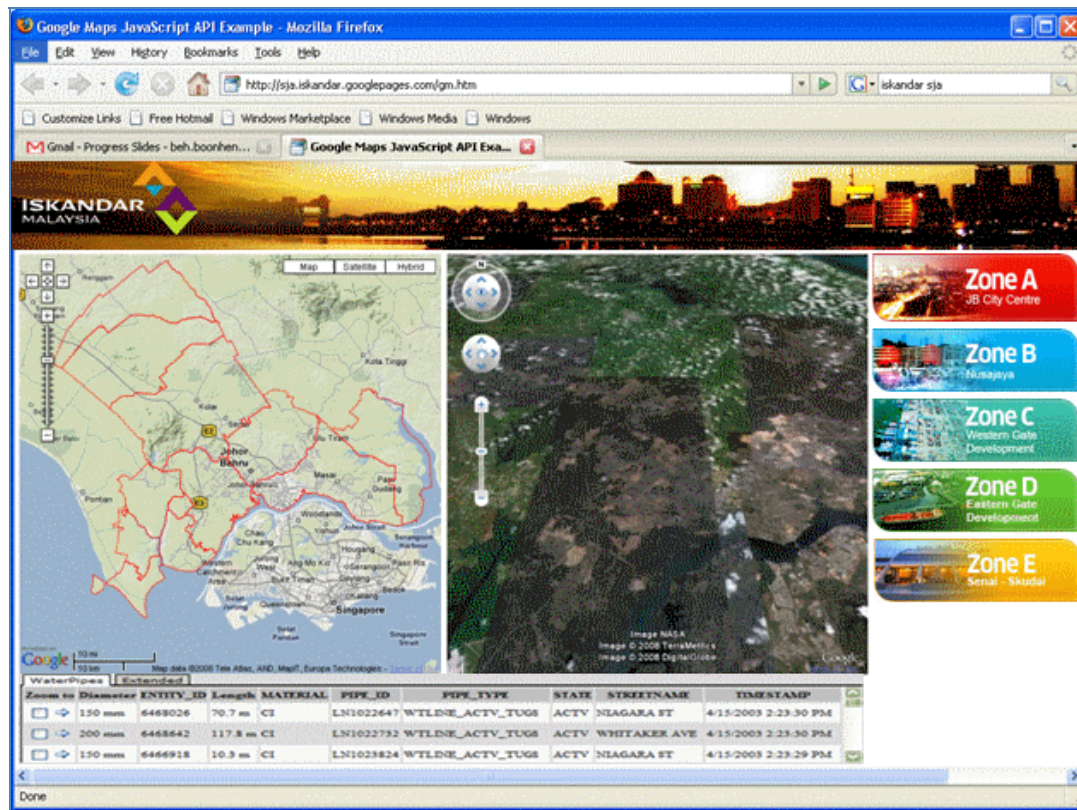


Figure 6.0: Sample prototype GUI for WPI 3D geoportal.

6. Discussion

We have realized that selection and assessment of 3D visualization file format and its viewer are essential, especially its graphic rendering capability. We also noticed that the graphic rendering of X3D for linear and polygonal object are slightly imperfect compared to KML. This phenomenon can affect the visualization quality of the 3D city model and hence provide incomplete or wrong information to the users.

The Google Map API generates an ID key which is very crucial for the geoportal development. The APIs provide GMapTypeControl that enable users to toggle between map type, including GMap_Satellite_3D_Map type to launch the Google Earth viewer. Changing map type display for 2D and 3D is just by toggle the map type control display in the viewer. Nevertheless, placing the wrong Map API ID will cause the added KML data does not display in the viewer.

KML file size can rapidly increase while dealing with large dataset. This is potentially affect to the geoportal performance and requires longer time to complete the graphic rendering. Therefore, using database to store the KML required data is an ideal solution. The required KML content can be generated on the fly based on users input.

7. Concluding Remarks

In this paper we have described the process of implementing 3D geoportal for WPI using open source platform, namely Google Earth and Google Map. KML file format works perfectly with these platforms and provides many possibilities for displaying 3D geographical data online using the KML elements by leveraging the APIs provided for the respective platforms. KML is also a proven language for visualizing CityGML geometry and thematic model.

However, besides totally depending on open source platform, it would be great if we could integrate with the COTS map server products for the Google Earth APIs 3D mapping and visualization.

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