BIOGRAPHICAL INFORMATION

Peter van Muyden
EPCOR CAD/GIS Analyst
EPCOR

Specific Experience

Peter works in the EPCOR Information Technology branch. He supports the team which is responsible for the design and development of EPCOR's CAD and GIS systems. This team provides support and direction for the EPCOR Infrastructure Division, which consists of Water Services and Power Generation, Distribution and Transmission. The team consists of six full time members.

Past Experience

Peter joined EPCOR (formerly Edmonton Power) in 1980 and developed the Power AM/FM recording system. When Edmonton's Water Services joined EPCOR, CAD/GIS team also took over the support of their GIS and CAD systems.

Professional Memberships

GeoSpatial Information Technology Association
Bentley MicroStation Community

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ABSTRACT

Dynamic time animation provides a significant new analytical dimension to Google Earth's popular location based internet product. This presentation is intended to depict an independent perspective on the functionality of Google Earth including the new dynamic time animation.

EPCOR developed an in-house automatic vehicle location application (AVL) as one of the first GeoSpatial business applications it created using Google Earth's dynamic time animation functionality.

This presentation will include a discussion of the background of Google Earth which started as a company called Keyhole. The explanation of the XML based data storing method, that includes the time animation functionality, will be addressed at a level of technical detail that all listeners may understand. Live online examples, including the EPCOR AVL application, will be presented to demonstrate how this time-based display can be used for both personal and business use.

It is now possible for anyone with Internet access to enjoy visually rich location based displays that were previously available only to those with direct access to GIS, such as in a company and government agency.

GIS may now be considered a tool like a word processor or a spreadsheet which most people can understand and afford. Google Earth can be downloaded at no cost for personal use and restricted commercial use.

EPCOR BACKGROUND

Headquartered in Edmonton, Alberta, EPCOR provides power and water solutions to customers in Canada and the United States. EPCOR started the implementation of an AM/FM system in 1979 as part of the city wide geospatial data sharing project called GBIS(Geographic Base Information System), now called GeoEdmonton. Over the last 25 years, Edmonton utilities and their partners have been successfully sharing geospatial data. Using an accurate common shared base map, all GeoEdmonton partners are able to enter, maintain and share their geospatial utility data. The results of having this common shared base map, with tools to overlay all the utilities' geospatial facilities, have exceeded the original design expectations.

GOOGLE OVERVIEW

Google's mission is to organize the world's information and make it universally accessible and useful.

As a first step to fulfilling that mission, Google's founders Larry Page and Sergey Brin developed a new approach to online search that took root in a Stanford University dorm room and quickly spread to information seekers around the globe. Google is now widely recognized as the world's largest search engine -- an easy-to-use free service that usually returns relevant results in a fraction of a second.
(http://www.google.com/corporate/index.html)

In 2001, Google maintained a network of over 500,000 servers grouped in clusters in cities around the world. The servers are commodity-class x86 PCs running customized versions of GNU/Linux. The hardware and software is heavily optimized for searching and indexing of content. Currently the company is building, among others, a 30 acre data center facility in Oregon.
(http://en.wikipedia.org/wiki/Google_platform)

WHAT'S A GOOGLE?

"Googol" is the mathematical term for a 1 followed by 100 zeros. The term was coined by Milton Sirotta, nephew of American mathematician Edward Kasner, and was popularized in the book, "Mathematics and the Imagination" by Kasner and James Newman. Google's play on the term reflects the company's mission to organize the immense amount of information available on the web.
(http://www.zorgloob.com/1_followed_by_100_zeroes.htm)

GOOGLE EARTH BACKGROUND

Google Earth was formed by Google when they purchased Keyhole on October 27, 2004. Keyhole was the 3D digital earth pioneer — the only company to deliver a 3D digital model of the entire earth via the Internet. Keyhole's groundbreaking EarthStream™ technology combines advanced 3D graphics and network streaming innovations to produce a high performance system that runs on standard PC's and commodity servers. Both high performing and intuitive to use, Keyhole's solutions enable anyone to manipulate a rich map of the earth composed of imagery and feature information. Originally the software was sold online at a very reasonable price. After Google purchased Keyhole, they made a free version available. Street level geocoding and routing is available for the U.S., Canada, France, Italy, Germany and Spain.

DATA SOURCES

The visual effects achieved by 'Google Earth' is a result of using the American, Shuttle Radar Telemetry Mission (SRTM) level 1 (3 arc second with absolute vertical accuracy of 16 meters at 90% confidence) elevation data and draping the digital terrain model (DTM) generated from this data with satellite imageries from -

- EarthSat (MDA Federal now): NaturalVue data from the Landsat TM sensor at a resolution of approximately 30m. This is the lowest resolution coverage and is available for the earth.
- Digital Globe: Natural colour, 60cm Pan sharpened data from the Quick Bird satellite. This data is available for selected places, generally larger cities around the world.
- Sanborn: Digital aerial photographs. This is the coverage at the highest resolution and is available for select US cities.

The fine resolution of the Digital Elevation Model (DEM) obtained as a result of using the SRTM data, results in even minor topographic features like quarries being detected and represented on the DEM. This was a quantum leap in DEM's availability in the public domain which, before 'Google Earth', had to be generated using the GTOPO30 dataset from the United States Geological Survey (USGS).

The Latitude - Longitude readings available on the status bar above the navigation consol give a resolution of 0.01 arc sec, which on the ground translates to a ground distance of approximately 0.3 meters. According to Derek Clarke, Chief Director, Surveys and Mapping, Department of Land Affairs, Cape Town (South Africa) these status bar readings gives users a false sense of accuracy because the image latitudes and longitudes are calculated. (Derek Clarke)
(http://en.wikipedia.org/wiki/Shuttle_Radar_Topography_Mission)

SUPPORTED OBJECTS

Google Earth supports the placement of point features, text, lines, shapes and images. The graphics objects can be placed at fixed elevation (relative to the ground), or clamped to the ground.

KML FILE STRUCTURE

KML (Keyhole Markup Language) is an XML-based language for managing three-dimensional geospatial data in the program Google Earth. (The word *Keyhole* originates from the earlier name for the software that became Google Earth.)
The KML file specifies a set of features (placemarks, images, polygons, 3D models, textual descriptions, etc.) for display in Google Earth, Maps and Mobile. Each place always has a longitude and a latitude. Other data can make the view more specific, such as tilt, heading, altitude, which together define a "camera view." KML shares some of the same structural

grammar as Geography Markup Language (GML). Some KML information cannot be viewed in Google Maps.
KML files are very often distributed as KMZ files, which are zipped KML files with a .kmz extension. When a KMZ file is unzipped, a single "doc.kml" is found along with any overlay and icon images referenced in the KML.
(http://en.wikipedia.org/wiki/.kml)

Not all versions of Google Earth can ***create*** all the KML based Google Earth objects but all versions can ***view*** them. Due to the nature of the XML based language anybody can create Google Earth objects by using program tools or text editors such as Notepad.

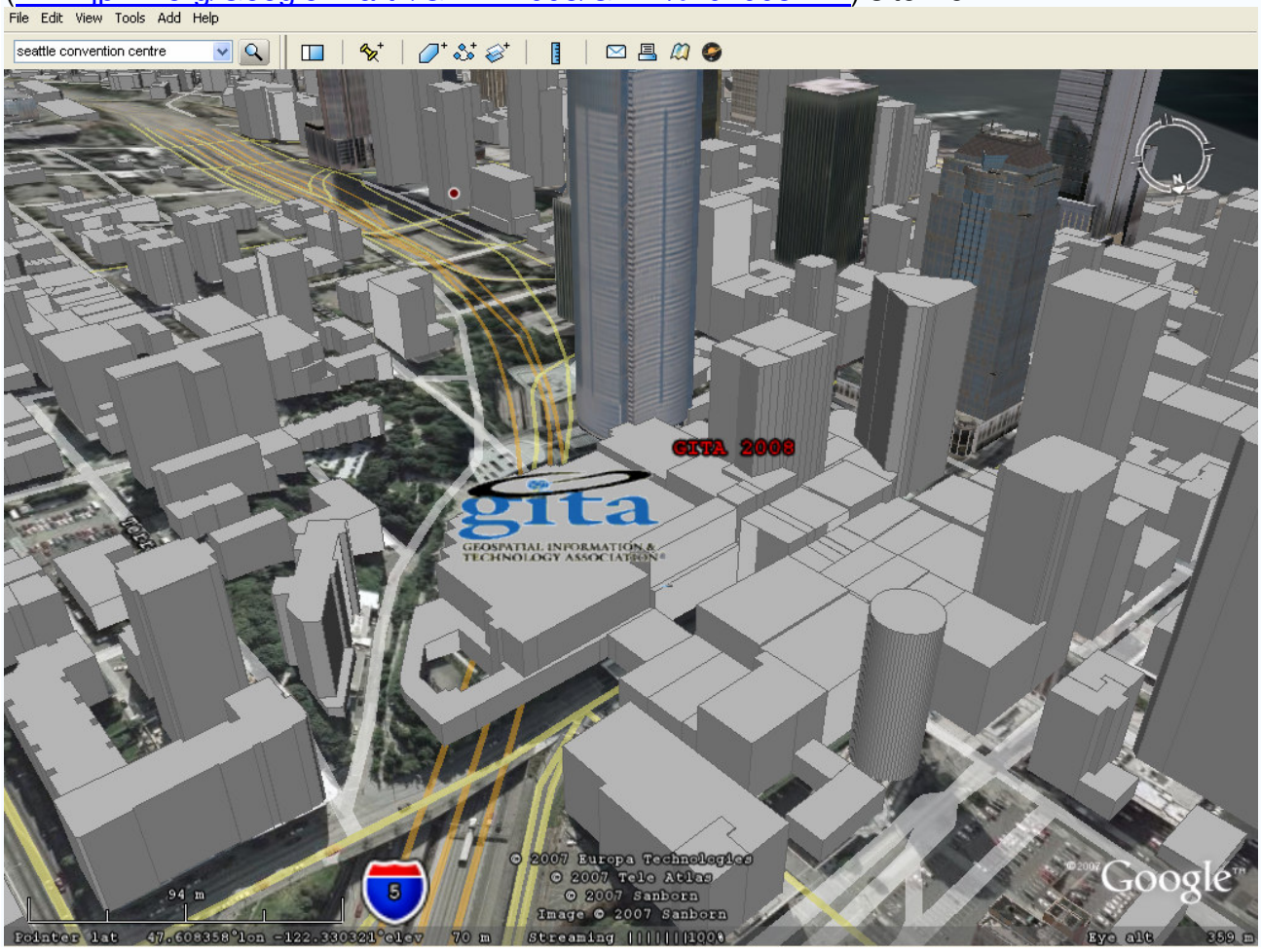
Following is a very basic KML example with comments in red:

```
<?xml version="1.0" encoding="UTF-8"?>
<kml xmlns="http://earth.google.com/kml/2.2">
<Document>
"Name of the place mark"
      <name>GITA 2008.kml</name>
      <Style id="sh_Gita">
            <IconStyle>
                  "Scale of the icon"
                  <scale>3.07273</scale>
                  <Icon>
            "The name of the icon and note that Gif transparency is supported"
                        <href>Gita.gif</href>
                  </Icon>
            </IconStyle>
            <LabelStyle>
                  <color>ff0000ff</color>
            </LabelStyle>
            <ListStyle>
            </ListStyle>
      </Style>
      <StyleMap id="msn_Gita">
            <Pair>
                  <key>normal</key>
                  <styleUrl>#sn_Gita</styleUrl>
            </Pair>
      </StyleMap>
      <Placemark>

            "View display"
            <name>GITA 2008</name>
            <LookAt>
                  "Longitude of the view"
                  <longitude>-122.3317515502376</longitude>
                  "Latitude of the view"
                  <latitude>47.61123779106331</latitude>
                  "Elevation of the view display"
                  <altitude>0</altitude>
                  "Range of the view display"
                  <range>577.1705886494357</range>
                  "Tilt of the view display"
                  <tilt>57.59681639507232</tilt>
                  "Compass bearing of the view display"
```

```
                  <heading>-169.6964918861013</heading>
                  <altitudeMode>relativeToGround</altitudeMode>
            </LookAt>
            <styleUrl>#msn_Gita</styleUrl>
            <Point>
                  <altitudeMode>relativeToGround</altitudeMode>
      "The coordinates of the icon including the altitude"
                  <coordinates>-
122.3311122963087,47.61161394354981,28</coordinates>
            </Point>
      </Placemark>
</Document>
</kml>
```

More KML documentation can be found at http://earth.google.com/kml/. The example KML code listed above creates the 2008 Seattle GITA conference (www.jpvm.org/Google_Earth/GITA_2008/GITA%202008.kml) site view:



DYNAMIC TIME ANIMATION SYNTAX

KML has two time elements, which are derived from TimePrimitive:

- **TimeSpan** - specifies a <begin> and <end> time for a given Feature

```
<TimeSpan>
<TimeSpan id="ID">
  <begin>...</begin>     <!-- kml:dateTime -->
  <end>...</end>         <!-- kml:dateTime -->
</TimeSpan>
```

- **TimeStamp** - specifies a single moment in time for a given Feature

```
<TimeStamp>
<TimeStamp id=ID>
  <when>...</when>      <!-- kml:dateTime -->
</TimeStamp>
```

More information regarding the time index can be found by clicking on the following URL: (http://code.google.com/apis/kml/documentation/time.html)

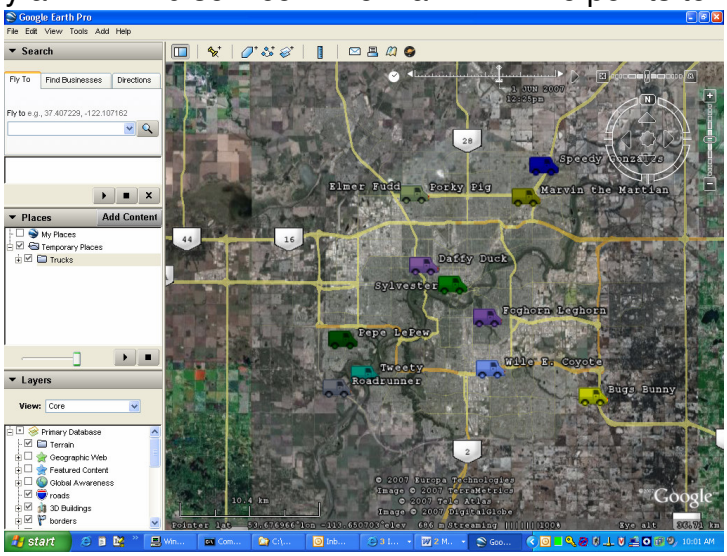
GOOGLE EARTH LOCATION ACCESS

Location access can be by address, city, country or Latitude and Longitude. Similar input can be used for routing. Once a location is displayed the user can search for additional information. For example, find all swimming pools in a town.

EXAMPLE OF BUSINESS USE

EPCOR is implementing a new Mobile Work Force Management (MWFM) project and as part of this project, an AVL dispatch display was required to show the location of vehicles and work orders. Because of the user friendly interface, it was decided to use Google Earth for this task. A side benefit is the routing which is part of Google Earth. The orders and trucks displays can be filtered by using the tree view.

To create this AVL display three KML files are used. There is one main, one truck and one order KML file containing the current location of all the trucks and orders. The order and truck files are recreated every minute by a .NET 2.0 service. The main KML file points to the previous named KML files. In the main KML file there is a setting which refreshes the truck and order KML files every minute. This creates the dynamic display. This Google Earth based AVL display was a very cost effective solution which took less then 40 hours to complete. The Google Earth based routing was a side benefit which helps the dispatch staff with time estimates. Please note that for this demonstration the names are all made up.



EXAMPLES OF PERSONAL USE

There are thousands of examples of Google Earth use and as long as the application is for personal or internal commercial use, the free version Google Earth can be used. To download GPS waypoint, tracks or routes a subscription based version called Google Earth Plus is needed. There are freeware programs such as GPSBabel which can create KML files from many sources. (www.gpsbabel.org/)

You now can create a Geo referenced index of all the places in the world you have been.

The ability to import a 3D CAD object is an asset both for personal and commercial use. It gives architects a look and feel as to how a building fits in the surroundings. The picture to the right is a 3D MicroStation file which was converted to a KML file. The CAD file settings such as views, layers and material transparency are migrated to the KML file. In Google Earth the 3D is preserved. Layers can be turned off and on by using the Google Earth tree view.

Most commercial real estate companies now provide for sale properties in a Google Earth view. It is a great way to filter and look at potential properties. The following link is from a Colorado realtor: (http://www.coloradofuture.com/GoogleEarthInfo.aspx)

RoboGeo is a product which allows you to georeference your digital pictures. To use this product you create a GPS track or waypoints while taking pictures. Once the pictures are up loaded on your computer the program will georeference the pictures. This is done by associating the digital pictures' time to the track time which provides the location. Here is an example of the use of RoboGeo. During a sailing trip from Ft. Lauderdale to St. Martin, I had my GPS create a track of the trip. Afterwards, the pictures were associated to the track which created the Google Earth KML file shown

below. By clicking on the camera icons in Google Earth the picture which was taken at that location is displayed.

GOOGLE EARTH VERSIONS

Google Earth versions	Google Earth	Google Earth Plus	Google Earth Pro
	Free version for home/personal use	Paid version for home/personal use	Paid version for professional use
Price	Free	$20*	$400*
Imagery Database	Primary	Primary	Primary
Performance		enhanced	fastest
Fly from space to anywhere on the planet	x	x	x
Search for schools, parks, restaurants, and hotels	x	x	x
Get driving directions	x	x	x
Tilt and rotate the view in 3D	x	x	x
Printing images	1000 pixels	1400 pixels	2400 pixels
Saving Images	1000 pixels	1000 pixels	2400 pixels
Drawing tools		basic	enhanced
GPS device data import (read only)**		x	x
Spreadsheet data import		100 points	2500 points
Support	website only	website, email	website, email, phone
**subscription-based annual fee ** verified support for Magellan and Garmin devices only*			

Enterprise based version are available where customers can display their own GeoSpatial data sets. Add on data sets such as traffic counts are available for an additional cost. (http://www.google.com/earth/earth_enterprise.html)

LICENSE AGREEMENT RESTRICTIONS

For most commercial use of Google Earth the Pro version has to be used. A realtor would have to use a Pro version to create the KML file for listings but anybody who is looking for a potential house can use the free downloaded version. However, with the free Google Earth 4.2 version, commercial use is allowed as long as it is only for internal company use. The following section is copied out of the Google Earth license agreement

1. USE OF SOFTWARE
Use of Software. For an individual end user, the Software is made available to and may be used by you only for your personal, non-commercial use according to these Terms of Service and the Software documentation. *For a business entity user, the Software may be used by you and your employees for internal use according to*

these Terms of Service and the Software documentation (individual end users and business end users are collectively referred to as "You" herein).

Restrictions. You agree not to use the Software in connection with or in conjunction with a system in a vehicle that offers real-time route guidance or turn-by-turn maneuvers. You agree not to use the Software for any bulk printing or downloading of imagery, data or other content.

POINTS OF INTEREST

If you have Google Earth loaded, the geographic location of the following links will be displayed after double clicking on them. Due to the nature of the distribution of the papers by GITA, to make the links work I have to store them on my FTP site. Normally the Hyperlink will work as long as the source document and linked files are in the same folder as the source document.

Use the time slider to see a 3D display of how the city of London skyline has changed over the years.	http://services.google.com/earth/kmz/city_london_timeline_n.kmz
Seattle Convention Centre the site of the 2008 GITA convention	http://www.jpvm.org/Google_Earth/GITA_2008/GITA%202008.kml
Rexhall place the home of the Edmonton Oilers	http://www.jpvm.org/Google_Earth/GITA_2008/Rexall%20Place.kmz
Brian Flood's time animation showing when the states joined the union. (Brian Flood)	http://code.google.com/apis/kml/documentation/us_states.kml
EPCOR Headquarters	http://www.jpvm.org/Google_Earth/GITA_2008/Epcor%20Headquarters.kmz
The next link points to a scaled down model of a disputed area on the Chinese/Indian border. The model was built beside a military facility.	http://www.theregister.co.uk/2006/07/19/huangyangtan_mystery/
Eiffel Tower in Paris.	http://www.jpvm.org/Google_Earth/GITA_2008/EiffelTower.kmz
Edmonton Tim Hortons stores	http://www.jpvm.org/Google_Earth/GITA_2008/tim%20hortons.kmz
3D house at Chateau Heights. Layers can be turned off (level 11 is the railing)	http://www.jpvm.org/Google_Earth/GITA_2008/House%20at%20Chateau%20Heights.kmz
Edmonton to Seattle drive	http://www.jpvm.org/Google_Earth/GITA_2008/Edmonton,%20AB,%20Canada%20to%20GITA%202008.kmz
Drive from Peter's house to EPCOR Centre. This data was collected with a Garmin GPS. The KML file was created using GPSBabel	http://www.jpvm.org/Google_Earth/GITA_2008/Home_to_work.kmz
Brian Flood's animation of the London Eye giant ferris wheel (Brian Flood)	http://code.google.com/apis/kml/documentation/london_eye.kmz

Earth animation showing the snow cover over one year. Data provided by NASA	http://code.google.com/apis/kml/documentation/TimeSpan_example.kml

WEBSITE LINKS

There are many interesting Google Earth website links and here are a few:
Google Earth basics by Frank Taylor (http://www.gearthblog.com/basics.html)
Google Earth Community (http://bbs.keyhole.com/ubb/ubbthreads.php/Cat/0)
Google Earth Blog by Frank Taylor (http://gearthblog.com/)

CONCLUSION

Over the last four years Google Earth, Microsoft and AOL have contributed major advancements in GIS to the location based community. Virtually anybody now can create and maintain location based data. Because Google Earth can import scanned data, users can also take advantage of the easy to use user interface to access data such as site plans. Now with the dynamic time animation, users can display their location based data in an animated fashion.

As per Wade Roush; Move over, Rand McNally: Google Earth is becoming the standard (electronic) tool for organizing geographical information (Wade Roush). In fact, with more than 100 million copies of Google Earth downloaded between June 2005 and March 2006 (and an undisclosed number since then), Google stands to dominate the online mapping industry.

GIS is now a tool which most people can afford and understand.

REFERENCES

Wade Roush (2006) *Annotating the Earth Move over, Rand McNally: Google Earth is becoming the standard tool for organizing geographical information.* [Online] Available from: www.technologyreview.com/read_article.aspx?id=17537&ch=infotech [Accessed 27 November 2007]

Brian Flood **(2007)** *Ferries Wheel* [Online] Available from: http://code.google.com/apis/kml/documentation/london_eye.kmz [Accessed 27 November 2007]

Derek Clarke **(2005)** *Latitude - Longitude readings* [Online] Available from: http://www.gisdevelopment.net/magazine/years/2005/nov/23_2.htm [Accessed 28 November 2007]