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GeoPackage: A format with database capabilities

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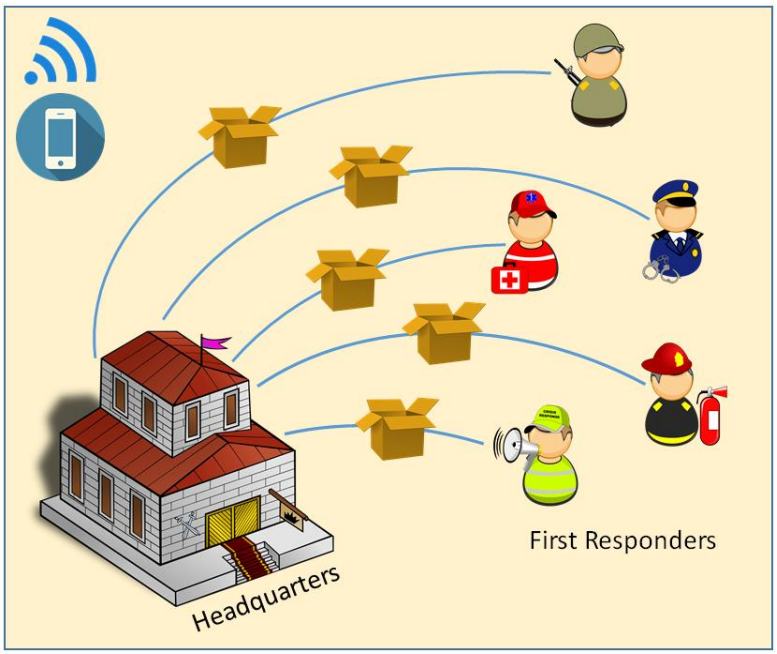
A couple of months ago the Open Geospatial Consortium (OGC) sought public comment [1] on the new version of GeoPackage Encoding Standard [2]. GeoPackage is an emerging format for geospatial data. Officially introduced three years ago, GeoPackage has already attracted the interest of organizations and vendors in N. America and elsewhere. The wide GIS community seems to still ignore its existence; however, this is expected to change drastically within the next few years.

Was there a need for a new format?

What was new with GeoPackage? Was there a need for another format? The main objective of GeoPackage developers has been to create and maintain a standard for a Geospatial data container that can operate in disconnected or limited network connectivity environments by devices of limited computing or storage capabilities in an interoperable framework. The applications of such a container are countless provided the increasing use of sensors and mobile devices (a.k.a. Internet of Things) for geospatial intelligence [3]. Some representative domains to benefit from GeoPackage include [4]: defense and intelligence, emergency management, outdoor recreation, etc.

A typical sequence of tasks for data collection, processing, and/or analysis that includes a mobile client (e.g., first responder or tactical unit in the field) and headquarters (e.g., operation management centre) under an absent or intermitted internet connectivity of the former would include: (a) upload a GeoPackage of relevant data for the study area on the mobile device before the mission; (b) update and process the GeoPackage content in the field; (c) synchronize the GeoPackage content with the enterprise database when internet connection becomes available during or after the mission.



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Not just a format to exchange and display geospatial data

GeoPackage is a database schema for geospatial data. It includes table definitions, data types, integrity assertions, and content constraints. GeoPackage Encoding Standard consists of the rules and requirements of content stored in a GeoPackage container. A GeoPackage container may host vector features and elevation data along with raster maps and imagery. Extension mechanisms are in place to support additional data types such as graphs and networks. Metadata items can also be hosted.

GeoPackage modelling competence is not limited to support the exchange and display of geospatial data. In fact, there are other formats, such as GLM, Shapefile or GeoJSON that may be more appropriate. In addition to the above, GeoPackage provides database capabilities, such as querying and indexing of the data in the container. A base set of spatial operators is defined, while this set can be extended to support application specific processing. R*tree data structure [5] is also embedded in the container to support the indexing of geometries.

In spite its modeling capabilities GeoPackage combines a bunch of other properties that make it an ideal format for cross-platform sharing of geospatial information. GeoPackage is a lightweight binary format that condenses all three vector data, raster data, and metadata in a single file. Because it is a database container, it supports direct use. Direct use is the ability to access and update data in a “native” storage format without intermediate format translations. That guarantees consistent access and update results in response to requests from different client applications [3]. In addition, GeoPackage is open, non-proprietary, and platform independent.

A GeoPackage container is built up as an extended SQLite3 open source [6] database file (*.gpkg) and can be easily extended using the extension rules specified in the standard [2]. Being built on top of SQLite makes it easy to integrate on any desktop or mobile operation system on the market. Last but not least, all needed to know is SQL [7] to use a GeoPackage.

GeoPackage is being endorsed – Let’s prepare

The need for a format to support those needs was formally expressed in 2012 [8]. It took less that fifteen months for the Standards Working Group (SWG) to draft the proposal for GeoPackage Encoding Standard (version 1), which was approved by OGC in January 2014. Since then, many major vendors (e.g., Esri, Luciad, TerraGo), open source packages (e.g., GDAL, QGIS, PostGIS, SpatiaLite), and government agencies in the US (e.g., National Geospatial-Intelligence Agency, Army Geospatial Center, Defense Advanced Research Projects Agency, Federal Geographic Data Committee) have adopted or implemented the standard.

It is anticipated that organizations in the US, Canada, and around the globe will continue to adopt GeoPackage in rising pace. As this happens, the potential of the standard will be widely recognized and new innovative uses of it will come up [9]. So it is worth for Geomatics professionals and researchers to investigate it closely. As for the academia, GIS instructors should consider including SQLite, SpatiaLite, and GeoPackage in their curriculum. Aligned to this potential, in the Department of Geodesy and Geomatics Engineering at the University of New Brunswick – a proud member of OGC – relevant lab sessions have recently been introduced in the teaching syllabus of GIS related courses.

Further Reading

[1] OGC Press release. http://www.opengeospatial.org/pressroom/pressreleases/2529
[2] OGC GeoPackage Encoding Standard (snapshot). https://portal.opengeospatial.org/files/72483
[3] Percivall, G., Leinenweber, L., and Exler, R., 2015. GeoPackage Enables Data Sharing in Mobile Apps. Geointelligence Magazine. Vol. 5. https://www.geospatialworld.net/wp-content/uploads/magazine/GeoIntelligence-Jan-Feb2015/
[4] Brachman, M., 2017. OGC GeoPackage: Enabling the Next Generation of Geospatial Technologies. http://www.opengeospatial.org/blog/2516
[5] R*tree: Spatial Data Structure. https://en.wikipedia.org/wiki/R*_tree
[6] SQLite: SQL database engine. https://www.sqlite.org/
[7] SQL: Structured Query Language. https://en.wikipedia.org/wiki/SQL
[8] OGC Press release. http://www.opengeospatial.org/node/1699
[9] GeoPackage Vision. http://geopackage.blogspot.ca/2015/09/geopackage-vision.html