Paper for Consideration by S-100WG2

The OGC GeoPackage Specification – Discussion Paper

Submitted by:	IHO Secretariat
Executive Summary:	This paper proposes a standardised method of encoding/packaging and distributing S-100 based products for use in ECDIS.
Related Documents:	S-100, S-99, S-101, S-102, S-111 and
Related Projects:	IHO S-100/S-101 Test Bed Project (Interoperability Specification Group).

Introduction / Background

Currently there are a several types of S-100 based specifications that define product datasets which are intended for use by (S-100 based) ECDIS. These include vector, raster and grid types of data which employ different encoding formats. Some examples of these data types / encoding formats are provided below:

Product	Type	Encoding	Additional files
S-101 (ENC)	Vector	ISO/IEC 8211 (modified)	Feature portrayal catalogues, text and image files, distribution catalogue files.
S-102 (Bathy Surface)	Coverage (quadrilateral grid)	HDF5 / (XML)	BAG API files, readme.txt, binary config files, (for transformation and other geodetic data).
S-111 (Surface Current)	Coverage (grid/raster)	HDF / GeoTIFF + XML	Metadata (xml) feature/portrayal/distribution catalogues
S-411 (Ice Information)	Vector	GML (XML)	Metadata (xml) feature/portrayal/distribution catalogues

In addition to ENC dataset files, there are be numerous ancillary files (e.g. text, picture, catalogue, metadata …) that will have to be managed in an S-100 ECDIS.

This paper invites the S-100WG to consider the Open Geospatial Consortium (OGC) **GeoPackage** specification which is a container specification that make use of a file based database. The specification is being widely implemented as a (**"direct use"**) container for various geospatial applications and may be of relevance for S-100 product delivery.

Analysis

What is the OGC GeoPackage?

GeoPackage is an Open Geospatial Consortium (OGC) Specification. It is an open, standards-based, platform-independent, portable, self-describing, compact format for transferring geospatial information.

It can be compared to a document binder in which sheets (datasets) can be added or removed. It describes a set of conventions for storing vector features and raster imagery at various scales within a **SQLite** database. It supports direct use access i.e. data sets can be accessed and updated in their "native" storage format without the need for intermediate format translations.

GeoPackage was designed to be lightweight and fully contained in a single ready-to-use file. This makes it suitable for applications that operate in a disconnected mode, but it can also support file sharing via cloud storage, USB drives, etc. The specification uses spatial indexes in order to speed up queries and also supports an extension mechanism for internal metadata (It implements the 19115/19139 metadata standards). Extensions to the specification could be proposed under the IHO/OGC MoU agreement if required.

What is SQLite?

SQLite is the GeoPackage container. It's a self-contained, single-file, cross-platform database that has a very small footprint. It is used extensively as an embedded database for mobile software application but works just as well as a GIS database or as a backend database to web applications.   SQLite is file based (i.e. does not run as a service), and can be used on almost all operating system. It is portable across 32-bit and 64-bit machines and can be swapped between big-endian and little-endian architectures. Other characteristics include; SQL-92 compatibility, support for joins, views, triggers and transactions. It has a maximum file size limit of 140TB.

SQLite is open source project and its ongoing development and support is made possible by a group of "SQLite Consortium" corporate members. The source code is in the public domain and is thus free for use for any purpose, commercial or private. The SQLite website (http://sqlite.org/) claims that it is the most widely used database in the world. (This is due to its extensive use in smart phone and mobile devices). SQLite3 databases can also be directly accessed using the from the Lua scripting language (see http://lua.sqlite.org).

How does GeoPackage implement the geo-spatial elements in SQLite?

The GeoPackage spatial extension is implemented in a similar way to other geospatial databases (e.g. the PostGIS extension to PostgreSQL).

It contains data and metadata tables with specified definitions, integrity assertions, format limitations and content constraints. The GeoPackage document describes a set of conventions for storing vector features, tile matrix sets of imagery and raster maps at various scales. It implements the OGC Simple Feature types based on the joint OGC/ ISO "Well Known Text" (WKT) standard (ISO 19162:2015 - Well-known text representation of coordinate reference systems). The GeoPackage model is presented below.
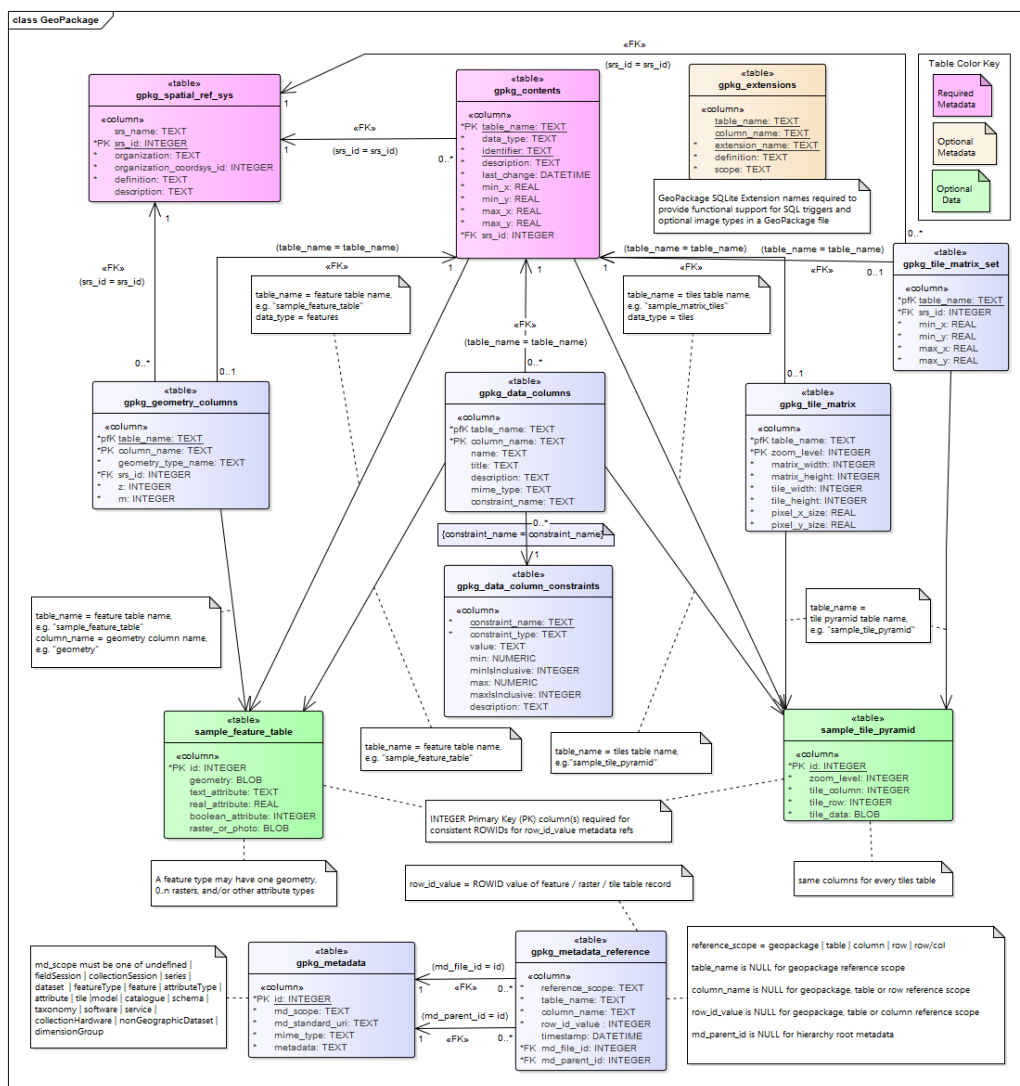

Figure 1 - GeoPackage UML Model

<u>How could GeoPackage benefit the delivery of products and services intended for ECDIS use?</u>

The use of GeoPackage could simplify the packaging and delivery of digital data for use in S-100 based ECDIS. It could simplify the way in which ECDIS access data and also improve the way in which datasets are managed and updated within ECDIS. Ancillary files (e.g. picture, pdf, word, text, xml metadata …) could be stored as BLOB (binary large object) types together with ENC data or they could be stored as separate files.

As a single file container, GeoPackage could drastically reduce the number of files that will have to be distributed, managed and updated. This could have a positive impact on data supply chain logistics. S-63 data authentication and encryption could possibly be used for distributing GeoPackage files. <This needs to be checked>

Due to the ubiquitous nature of the SQLite database and the broad implementation of the GeoPackage specification, S-100 data products could be used by applications running on different platforms (phone, iPad or PC) different operating systems (Android, Windows, iOS). Furthermore, most proprietary and open source GIS applications are able to read and write to GeoPackage in its native format.

GeoPackage can include both raster (coverage) and vector types in the same file and could possibly be extended to accommodate grid (S-102) data. <This needs to be checked>.

Discussion/Conclusions

ECDIS systems have to operate in a disconnected (or limited network connectivity) environment, and S-100 based systems will have to process large numbers of data sets in various encoding formats.

An open, standards-based, application-independent, platform-independent, portable, interoperable, self-describing, data container such as GeoPackage, could solve many of the data interoperability issues that are currently being worked on by the S-100WG.

As GeoPackage could suitable for recording (capturing) real time information and may be suitable for other e-Navigation purposes such as recording vessel track and dynamics (black-box) information.

The S-100WG are invited to consider whether GeoPackage could be used to improve data product delivery next generation of ECDIS.

Action Required of S-100TSM

The S-100WG is invited to:

      a.   Note the GeoPackage proposal and, discuss whether it could be used for S-100 related products and services.