Understanding and Working with the OGC Geopackage

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Introduction

- Introduction to Simple Features
- What is the GeoPackage?
- Esri Support
- Looking ahead…
Geographic Things
Why add spatial data to a database?

• The premise:
   - People want to manage spatial data in association with their standard business data.
   - Spatial data is simply another “property” of a business object.

• The approach:
   - Utilize the existing SQL data access model.
   - Define a simple geometry object.
   - Define well known representations for passing structured data between systems.
   - Define a simple metadata schema so applications can find the spatial data.
   - Integrate support for spatial data types with commercial RDBMS software.
Feature Tables contain rows (features) sharing common properties (Feature Attributes).

Geometry is a Feature Attribute.
Simple Feature access model based on SQL

Data Access

Database Connection

Query

Cursor

Value

Type 1 (e.g. string)

Type 2 (e.g. number)

Geometry

Spatial Reference

Geometry

Point

Line

Area
Simple Feature Geometry

- Geometry
  - SpatialRefSys
    - Point
    - Curve
      - LineString
    - Surface
      - MultiSurface
        - MultiPolygon
        - MultiLineString
    - GeomCollection
      - MultiPoint
      - MultiCurve
Some of the Major Standards Involved

- **ISO 19125**, Geographic Information - Simple feature access
  - Part 1: common architecture
  - Part 2: SQL Option
- **ISO 13249-3**, Information technology — Database languages — SQL Multimedia and Application Packages — Part 3: Spatial
- **ISO 19107**, Geographic information — Spatial schema
- **ISO 19111**, Geographic information — Spatial referencing by coordinates — Part 1: Fundamentals
- **ISO 19162**, Geographic information — Well known text for coordinate reference systems
- OpenGIS Simple Features Specification for SQL, Revision 1.1
- OpenGIS Topic 2 — Spatial Referencing by Coordinates
- OGC 12-063r5, Geographic information — Well known text for coordinate reference systems
Spatial Database
Shape files in a database

- Multi-user, seamless, scalable
- Leverage SQL
  - Geometry Types
  - Spatial indexing
  - Query processing
  - Storage

- Implications for data modeling
  - Simple feature information model with related tables
  - Search and scan, not traversal

- The “master database” concept
  - Entity-relationship modeling
  - Database architects (gods)
What is a GeoPackage?
What is GeoPackage?

• A single container for the storage and use of vector, raster, and tiled caches.
• Available for use on virtually any modern platform – mobile, laptop, workstation, server.
• Described by a manifest.
• Defined by an open standard, free of license.

Permissive OGC License
What is the GeoPackage?

Introduction

- OGC standard for the exchange and direct use of vector geospatial features and tiled raster data.

- Interoperable across enterprise and personal computing environments, and is specially designed for use on Mobile devices where connectivity is limited.

- Implemented on top of SQLite.

- May contain vector data, tiled raster data or both.
What is the GeoPackage
Specifications

• Max size: Approximately 140TB.
  - Lower size limits may be imposed by the file system and is noted in the specification.

• Geometries
  - Similar to Esri ST_Geometry
  - Based on OGC 99-049 OpenGIS® Simple Features Specification for SQL Revision 1.1 5, 1999, Clause 2.3. Point, Line and Polygon data supported.
What is the GeoPackage
Specifications

• Tiled Raster Data
  - OGC 07-057r7 OpenGIS® Web Map Tile Service Implementation Standard version 1.0.0 2010-04-06 (WMTS)

• Data Types
  - SHORT INTEGER, LONG INTEGER
  - FLOAT, DOUBLE,
  - TEXT, BLOB
  - DATETIME.

See the GeoPackage standard (http://www.geopackage.org/spec/) for details.
What is the GeoPackage?

Esri History

• In 2014 Esri announced the support of the new Open Geospatial Consortium (OGC) GeoPackage Encoding Standard.

• Esri actively participated in the development of this standard.

• One of the very early adopters of the specification – supporting it even before it was approved by OGC membership as a final standard.
What is the GeoPackage?

### Versions

<table>
<thead>
<tr>
<th>ArcGIS Version</th>
<th>GeoPackage Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.2.2</td>
<td>Beta</td>
</tr>
<tr>
<td>10.3.1</td>
<td>1.0(1.0.1)</td>
</tr>
<tr>
<td>10.5</td>
<td>1.1</td>
</tr>
<tr>
<td>10.5.1</td>
<td>1.2 (beta)</td>
</tr>
</tbody>
</table>
What is the GeoPackage?

Supported Data Types

- Simple vector (Points, Lines, Polygons)
- Standalone Tables
- Tiled Raster
Esri Support
Esri Support
Software

- ArcMap, ArcCatalog (10.2.2)
- ArcGIS Pro (1.2)
- Runtime (10.2.4 java, 10.2.8 Android)
Esri Support
General

• Create
  - CreateSQLiteDatabase Geoprocessing Tool
Esri Support
Vector

• Draw
• Import/Export
  - Copy/Paste, FeatureClass2FeatureClass, Table2Table
• Query
• Edit only through code. No edit session.
• ST_Geometry functions
• **Draw**
  - 10.5, 1.5 and before: Use Add Raster Layer.
  - 10.5.1, 2.0: Add like any other supported raster.

• **Import**
  - 10.4.1 and before: Raster2GPKG
    - [https://github.com/Esri/raster2gpkp](https://github.com/Esri/raster2gpkp)
  - 10.5, 2.0: AddRasterToGeoPackage Geoprocessing Tool.
Spatial Type (optional)

The spatial type to install with the new SQLite database.

- **ST_GEOMETRY**—Esri’s spatial storage type. This is the default.
- **SPATIALITE**—Spatialite spatial storage type.
- **GEOPACKAGE**—
• Download and install raster2gpkg tool from Git Hub (10.3.1, 10.4, 10.4.1).
  (https://github.com/Esri/raster2gpkg)
Loading an Image (10.5)

Add Raster to GeoPackage

Load raster datasets into an OGC GeoPackage raster pyramid.

 conversion tools:
- Excel
- From GPS
- From KML
- From PDF
- From Raster
- From WFS
- JSON
- Metadata
- To CAD
- To Collada
- To Coverage
- To dBASE
- To Geodatabase
- To GeoPackage

Add Raster to GeoPackage
• The OGC standard that defines ST_Geometry includes a set of functions that allow you to create, insert, update and query the ST_Geometries via SQL.

• Using the SQLite3.exe command line tool you can open a ST_Geometry database, import the ST_Geometry dll and then execute the ST_Geometry functions.

• Select the buildings that are not completely contained within one lot:

  SELECT DISTINCT (building_id) FROM bfp, lots WHERE st_intersects (lot, footprint) = 1 AND st_contains (lot, footprint) = 0;
In ArcGIS Desktop the ST_Geometry libraries can be found in Desktop10.5\DatabaseSupport\SQLite\Windows32 or from my.esri.com

To load bring up SQLite3.exe.

```
SQLite3 MyData.sqlite
> SELECT load_extension('c:\Program Files\ESRI\Desktop10.5\DatabaseSupport\SQLite\Windows32\stgeometry_sqlite.dll','SDE_SQL_functions\cs_init');
```
Esri Support
Not Supported at this time

• Editing
• Metadata
Looking Ahead
Looking Ahead

- Loading Tile Caches directly into GeoPackage Tiled Raster.
- Loading an Area Of Interest into a GeoPackage Tiled Raster.
- GeoPackage support was not included in Runtime Update 1. It is scheduled for Update 2, late November 2017.
Wrap Up
Wrap Up

- What is the GeoPackage?
- Esri Support
- Looking ahead…
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