



FOSS4G 2013

GeoPackage, The Shapefile Of The Future

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About Sourcepole

› QGIS

- › Core dev. & Project Steering Committee
- › QGIS Server, Printing, Plugins, ...
- › QGIS Enterprise
- › QGISCloud

› OGR / GDAL

- › Interlis drivers
- › Schema support for PostGIS driver

› Web-GIS

- › Mapfish Committer / Mapfish Appserver
- › Contributions to MapServer, Openlayers, ...



GeoPackage

- › OGC Draft January 2013, public RfC till Sept.
- › “An open standard non-proprietary platform-independent GeoPackage container for distribution and direct use of all kinds of geospatial data”
- › Vector and Raster data stored in SQLite file DB
- › GeoPackage =
~Spatialite + ~MBTiles + Metadata

- › **Self-contained, single-file, cross-platform, serverless, transactional, open source RDBMS container**
- › **Well-proven and widely used**
 - › Version 1.0: 17.8.2000
 - › Android, Mozilla, Apple, Adobe, Skype, ...
- › **Embedded database**
 - › File based, no server process
 - › C programming language
 - › Access via library (<275KiB)
 - › SQL API
 - › Dynamic type system

- › **Good SQL-92 compatibility**
 - › Joins, views, triggers
 - › Transactions
- › **Locking:**
 - › Write ahead logging (WAL) introduced in 3.7
 - › Before that write access locked database also for reading
- › **GeoPackage based on SQLite 3**
- › **Maximum size of a GeoPackage file ~140TB**



GeoPackage introduction

- › Spatial extension to SQLite embedded database
- › Like PostGIS extends PostgreSQL
- › Single file storage, SQL support
- › Spatial data types & functions
- › Multiple raster and tile pyramid data sets



GeoPackage data

- **OGC Simple Feature types (WKT, WKB)**
 - Point, MultiPoint
 - LineString, MultiLineString
 - Polygon, MultiPolygon
 - XY, XYZ, XYM, XYZM
- **WKB based BLOB**
- **One geometry column per table**
- **R*Tree index tables**
- **Raster tile sets (PNG, JPEG)**



GeoPackage functions

- › **Minimal available functions**
 - › ST_SRID, ST_GeometryType, GPKG_IsAssignable, ST_Is3D, ST_IsMeasured,
 - › ST_MinX, ST_MaxX, ... ST_MaxZ, ST_MaxM
- › **Geometry access**
 - › ST_GeomFromText, ...
 - › ST_AsText, ST_AsBinary, ST_AsGML
- › **Queries and operations**
 - › ST_Intersects, ST_Contains, ST_Touches, ...
 - › ST_Buffer, ST_Intersection, ST_Union,
 - › ST_LocateAlong, ST_LocateBetween
 - › ...



Spatial SQL examples

```
SELECT t2.Name, t2.Peoples,  
        ST_Distance(t1.geom, t2.geom) AS Distance  
FROM Towns AS t1, Towns AS t2  
WHERE t1.Name = 'Firenze' AND  
        ST_Distance(t1.geom, t2.geom) < 10000;
```

SpatiaLite: Additional features

- › CLI and GUI-Tools
- › Import and export
 - › Shapefiles
 - › DXF
- › Use of external files as virtual tables
 - › Shapefiles (+DBF)
 - › CSV/TxtTab
 - › XLS
 - › OGR datasources
- › Library for networks and routing
- › Raster data library, WFS Client, ...



- › **Multiple tile set tables**
- › **Extension of MBTiles specification**
 - › Widely used for OSM tiles download & offline storage

```
sqlite> SELECT * FROM tiles;
```

zoom_level	tile_column	tile_row	tile_data
5	13	23	[PNG data]
5	13	24	[PNG data]
5	14	23	[PNG data]
5	14	24	[PNG data]
5	15	25	[PNG data]



Metadata

- › *gpkg_contents*: list of geospatial contents
- › *gpkg_data_columns*: descriptive information about columns in user vector feature and tile matrix data tables
- › *gpkg_geometry_columns*: vector data
- › *gpkg_tile_matrix_metadata*: raster data
- › *gpkg_spatial_ref_sys*: coordinate reference system definitions
- › *gpkg_metadata*: XML metadata
- › *gpkg_metadata_reference*: row level metadata



Metadata (Extensions)

- › *gpkg_extension*: supported functionality
- › *gpkg_rtree_index*: available index tables
- › *gpkg_geometry_type_trigger*: type checks
- › More formats: WEBP, TIFF, NITF

“... reading the geopackage spec makes me want to run for the hills”



Conformance tests

› Core

- › SQLite 3 File format
- › SQLite SQL API
- › gpkg_spatial_ref_sys, gpkg_contents

› Vector Features

- › BLOB format
- › gpkg_spatial_ref_sys
- › Minimal Set of SQL functions
- › gpkg_geometry_columns

› Tiles

- › PNG/JPEG
- › gpkg_tile_matrix_metadata
- › gpkg_data_columns



Conformance tests

› Metadata

- › gpkg_metadata, gpkg_metadata_reference

› Extensions

- › gpkg_extensions
- › Other geometry BLOB formats
- › gpkg_rtree_index
- › Geometry type triggers
- › Zoom levels other than power of two
- › TIFF, NITF



GeoPackage Advantages

- › Data exchange *and* direct use
- › Single file
- › Vector *and* raster
- › From mobile to server
- › Custom extensions possible (SLD, “LYR”, “OGS”)
- › Promote GeoPackage
 - › Provide GeoPackage
 - › Ask for GeoPackage
- › Open Data!



Shapefile comparison

- › **Less files (multiple layers, indices, ...)**
- › **Eliminate column name limits (>10!)**
- › **64-bit IEEE Floating point type**
- › **Embedded Unicode support**
- › **Raster data**
- › **Integrated metadata (Projection, etc.)**
- › **Library with SQL API (Insert, Join, etc.)**



Links

› **GeoPackage Candidate Standard:**

- › <http://www.opengeospatial.org/standards/requests/105>
- › <https://github.com/opengis/geopackage>

› **SQLite:**

- › <http://www.sqlite.org/>

› **SpatiaLite:**

- › <http://www.gaia-gis.it/gaia-sins/>
- › <http://live.osgeo.org/>

› **MBTiles:**

- › <https://github.com/mapbox/mbtiles-spec>



Thank you! - Questions?



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