

Testbed-12 GeoPackage Change Request Evaluations

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Abstract

Testbed 12 work has resulted in Change Requests (CRs) to the GeoPackage Encoding Standard. CRs have been submitted to the GeoPackage Standards Working Group (SWG) as GitHub issues. This engineering report (ER) summarizes the results of these activities.

Business Value

This ER shows how the OGC Testbed process furthers the SWG process.

What does this ER mean for the Working Group and OGC in general

OGC Testbeds are an opportunity to evaluate and assess the most problematic parts of the OGC standards baseline. Realistic experiments are often the best way to resolve issues that arise.

How does this ER relate to the work of the Working Group

This ER documents the direct impact that Testbed 12 has had on the SWG work.

Keywords

ogcdocs, testbed-12, GeoPackage, Change Request

Proposed OGC Working Group for Review and Approval

GeoPackage SWG

Chapter 1. Introduction

1.1. Scope

Several CRs have been submitted against the current GeoPackage 1.1 standard. These change requests require further evaluation to determine the path forward. This ER describes the evaluations of the change requests and the recommendations to the GeoPackage SWG.

1.2. Document contributor contact points

All questions regarding this document should be directed to the editor or the contributors:

Table 1. Contacts

Name	Organization
Jeff Yutzler (editor)	Image Matters LLC

1.3. Future Work

No future work is planned to this document.

1.4. Foreword

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. The Open Geospatial Consortium shall not be held responsible for identifying any or all such patent rights.

Recipients of this document are requested to submit, with their comments, notification of any relevant patent claims or other intellectual property rights of which they may be aware that might be infringed by any implementation of the standard set forth in this document, and to provide supporting documentation.

Chapter 2. References

The following documents are referenced in this document. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the normative document referred to applies.

- OGC 06-121r9, OGC® Web Services Common Standard

NOTE: This OWS Common Standard contains a list of normative references that are also applicable to this Implementation Standard.

- OGC 12-128r12, OGC® GeoPackage Encoding Standard

Chapter 3. Terms and definitions

For the purposes of this report, the definitions specified in Clause 4 of the OWS Common Implementation Standard [OGC 06-121r9] shall apply.

3.1. Abbreviated terms

- API: Application Program Interface
- CRS: Coordinate Reference System
- FK: Foreign Key
- GPKG: GeoPackage
- PK: Primary Key
- SDK: Software Development Kit
- SQL: Structured Query Language
- SWG: Standards Working Group
- WKT: Well-known Text

Chapter 4. Change Requests

The following table describes the sections that will appear later in this document.

Table 2. Summary of Document Content

Section Number	Description	Source
4.1	Multi-resolution Vector Data	Testbed-12
4.2	Non-spatial Tables	External
4.3	Deprecating Requirement 69	Testbed-12
4.4	Deprecating non-Interoperable Extensions	Testbed-12
4.5	Column Name for WKT for Coordinate Reference Systems	External
4.6	Add Elevation Extension to standard	GPKG-EE IE
4.7	Remove Minimal Set of Rows from gpkg_spatial_ref_sys	Testbed-12
4.8	Clarification of Acceptable Extensions	External
4.9	Vector Tiling Extension	Testbed-12
4.10	TIN Extension	Testbed-12

4.1. Multi-resolution Vector Data

Reference: [GitHub](#)

Vector data is regularly rendered onto a map view. The density of the feature data that can reasonably be rendered on a particular map depends on the map's scale. To support multiple map scales, providers regularly produce multiple versions of the vector geometries.

4.1.1. Status Quo

During previous GeoPackage discussions, a consensus was reached that there should only be a single geometry column in each feature table. The consequence of this decision is that the only way to support multiple geometries for each feature type is to have multiple tables and/or views. However, there is currently no standard way to do this.

4.1.2. Alternatives Considered

1. Create a set of geometry tables, one for each scale range. (The original design duplicated the attributes as well, but the consensus was that this was wasteful and to use joins to avoid the duplication.) Create a metadata table that links scales to the geometry tables. Client applications

then read from the appropriate geometry table.

2. Create an ancillary geometry table for each feature table. For each feature, create a set of generalized geometries and store in the table the recommended scale denominators for each. Scale ranges may be generated based on visualization requirements. If a generalized geometry differs very little from scale range to scale range, scale ranges can safely be merged to avoid duplication. Client applications then read from the appropriate geometry table.

4.1.3. Recommended Approach

The recommended approach is #2.

There is a benefit to not having fixed scale ranges. For mobile, fixed scale ranges do not necessarily render ideally. This also prevents duplicating generalized geometries that are appropriate for multiple scales.

However, it was determined that it would be premature to encode this into the standard at this time. We recommend researching this topic in Testbed 13 or in a separate interoperability experiment.

4.1.4. Example Table

Table 3. Generalized Geometry Table Data Types

Column Name	Type	Description	Key
id	INTEGER	Primary Key	PK
feature_id	INTEGER	id in Feature user tables	FK
min_scale_denom	REAL	Minimum scale denominator	unique
max_scale_denom	REAL	Maximum scale denominator	unique
geom	BLOB	geometry	

4.2. Non-spatial Tables

References: [GitHub](#), [Change Request](#)

A strict reading of the GeoPackage specification does not allow non-spatial attribute tables. Data providers need to deliver attribute tables that do not contain geometry properties. For example, a GeoPackage containing real-estate or parcel management data would need to contain:

- a tiled image of the subject area
- a feature table of the parcel boundaries (properties such as parcel ID, parcel geometry, area, etc.)
- a non-spatial attribute table defining property ownership (properties such as parcel ID, purchase date, sale date, owner, etc.)

Based on the existing standard, the non-spatial table cannot be included unless you define the GeoPackage as an "Extended GeoPackage".

Requiring any GeoPackage that contains non-spatial tables to be declared as an "Extended GeoPackage" is not reasonable and does not promote interoperability.

4.2.1. Alternatives Considered

Approach #1: Creating an extension that would make these tables discoverable. A simple extension such as the following would support this:

gpkg_extensions column	value
table_name	Actual table name
column_name	NULL
extension_name	gpkg_non_spatial
defintion	TBD
scope	read-write

Approach #2: Redefining the definition of "Extended GeoPackage" and adding a section to the core specification allowing non-spatial attribute tables in a basic GeoPackage would eliminate the problem. This requires some relatively minor updates to sections 1 and 2 and does not introduce any obvious backwards compatibility issues.

4.2.2. Recommendation

We recommend Approach #2.

4.2.3. SWG Response

Approach #2 was adopted by the SWG at the September TC.

4.3. Deprecating Requirement #69

References: [GitHub](#), [Change Request](#)

4.3.1. Recommendation

It is difficult, if not impossible, to comply with [Requirement 69](#) "SQL functions that operate on GeoPackageBinary geometries as specified in other extensions SHALL operate correctly on the non-linear geometries specified in this extension." because the functions could have been loaded via an extension such Spatialite which cannot be changed, and does not support the non-linear geometries.

4.3.2. SWG Response

The SWG voted to deprecate this requirement. The removal of this requirement will allow for

interoperable storage and retrieval of the geometries, while not requiring but allowing existing functions to work with the geometries.

4.4. Deprecating non-Interoperable Extensions

References: [GitHub](#), [Change Request](#)

The “User Defined Geometry Types Extension of GeoPackageBinary Geometry Encoding” extension was determined to have the following issues:

- The geometry encoding is not specified in the extension and therefore a supplemental document explaining the encoding would be required. In the absence of this document, there is no way for an application developer to support this extension and therefore it is not interoperable.
- Multiple developers could implement the encoding of a new, but similar geometry type such as `EllipticalCurve` in different ways.
- Existing spatial functions will not work with the new geometry types and could potentially cause errors or skip data if used.

4.4.1. SWG Response

The GeoPackage SWG voted to remove this extension for the reasons above.

The SWG also voted to remove two additional extensions, “Geometry Type Triggers” and “Geometry SRS ID Triggers”, from the encoding standard as they directly relate to User-Defined Geometry Types Extension and will no longer be required.

4.4.2. Future Work

The SWG believes that content contained in these extensions would be better suited in a best practice document. This document could outline how to create a complete and interoperable User Defined Geometry Type Extension, including the details of the geometry encoding and how it can be used with existing spatial functions. This would allow two independent developers to create User-Defined Geometry Type extensions that follow the same template and make it easier for clients of the extensions to adopt.

4.5. Column Name for WKT for Coordinate Reference Systems

References: [GitHub](#), [Change Request](#)

4.5.1. Recommendation

The “WKT for Coordinate Reference Systems” extension was designed to align to a new OGC Encoding Standard, OGC 12-063r5. The text in GPKG 1.1 (including the column name) incorrectly references “12-163” instead. We recommend updating the reference to the proper value.

4.5.2. SWG Response

The SWG voted to correct the column name. This change corrects all references to the proper “12-063”. The GeoPackage SWG regrets the error. This change is considered to be low-risk. At worst, implementers may need to populate a redundant column to satisfy clients that use this extension but only support GPKG 1.1.

4.6. Remove .gpkx Option

References: [GitHub](#), [Change Request](#)

4.6.1. Recommendation

The OGC GeoPackage specification outlines in great detail the extension mechanism. In order for an application to determine what extensions are currently available, it must open the GeoPackage and query the `gpkg_extensions` table. It is likely that an application that supports no extensions can still access the GeoPackage without issue, especially if the application accesses a GeoPackage in a read-only fashion and the `gpkg_extensions.scope` column indicates a value of “write_only”. The presence of the “.gpkx” extension provides no real value. Applications still need to open the GeoPackage to determine if the extensions impose any additional requirements on accessing the data and therefore the “.gpkx” extension serves no purpose.

Applications will need to recognize two separate file extensions. There is a distinct possibility that application developers will only support the mandatory “.gpkg” file extension.

4.6.2. SWG Response

The SWG determined that this option served no discernible purpose and therefore voted to eliminate it and strikethrough the text in the standard.

4.7. Remove Minimal Set of Rows from `gpkg_spatial_ref_sys`

References: [GitHub](#), [Change Request](#)

4.7.1. Recommendation

Requirement 11 in the GeoPackage specification provides a minimal listing of rows that shall be contained in the `gpkg_spatial_ref_sys` table. These rows may not be necessary for the content of the GeoPackage and should not be required. They cause issues for possible profiles of the GeoPackage specification because these profiles may restrict the allowed CRSs, this restriction may not include EPSG:4326. Furthermore, since the allowed CRSs are defined, the value of `srs_id` of -1 for undefined Cartesian coordinate reference systems and the `srs_id` of 0 for undefined geographic coordinate reference systems will never be required. It is our recommendation to update this requirement so that the `gpkg_spatial_ref_sys` table MAY contain these entries.

4.7.2. SWG Response

As of the time of publication, this was still an open issue.

4.8. Clarification of Acceptable Extensions

References: [GitHub](#), [Change Request](#), [Change Request](#).

4.8.1. Recommendation

We recommend that the current GeoPackage 1.1 tables be evaluated and that additional requirements be added stating (as appropriate) that semantics are immutable for specific tables and as such cannot be changed via a profile or extension.

4.8.2. SWG Response

The SWG has had an informal policy position that the definition and semantics of existing columns could not be changed. Therefore it updated [Requirement 58](#) to clarify these rules.

4.9. Add Extension for Vector Tiles

References: [GitHub](#), [Change Request](#)

While tiling and the use of multiple levels of details are a proven technique for raster data, it is relatively new for vector data, due to the increased complexity compared to raster tiling and lack of standardization on the topic.

4.9.1. Recommendation

We recommend that a future interoperability experiment or testbed evaluate this extension for interoperability. Once interoperability is proven, it should be considered as an addition to the GeoPackage Encoding Standard as an extension.

4.9.2. SWG Response

As of the time of publication, the SWG had not yet acted on this CR.

4.10. TIN Extension

References: [GitHub](#), [Change Request](#)

The current GeoPackage standard is in need of a method for storing elevation data. We recommend a table for triangulated irregular networks (TIN) and an additional table for gridded elevation data.

4.10.1. Recommendation

We recommend that a future interoperability experiment or testbed propose an approach for implementing this capability then evaluating it for interoperability. Once interoperability is proven,

it should be considered as an addition to the GeoPackage Encoding Standard as an extension.

4.10.2. SWG Response

As of the time of publication, the SWG had not yet acted on this CR.

Appendix A: Revision History

Table 4. Revision History

Date	Release	Editor	Primary clauses modified	Descriptions
June 15, 2016	J. Yutzler	.1	all	initial version
October 20, 2016	J. Yutzler	.2	all	comments integrated
October 28, 2016	J. Yutzler	.3	3, 4	terms updated
November 15, 2016	J. Yutzler	.4	4	added additional CR