

# GeoSPARQL 1.1 Release Notes

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### *Preface*

This document provides the set of revision notes for OGC GeoSPARQL 1.1 [OGC 22-047] and does not modify that standard.

This document provides the details of edits, deficiency corrections, and enhancements of the above-referenced standard. It also documents those items that have been deprecated. Finally, this document provides implementations details related to issues of backwards compatibility.

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.

## Abstract

*GeoSPARQL defines a core set of Semantic Web classes, properties and datatypes for the representation of spatial information on the web and SPARQL extension functions for spatial data queries.*

# Introduction

## Scope

The OGC GeoSPARQL standard supports representing and querying geospatial data on the Semantic Web. GeoSPARQL defines a vocabulary for representing geospatial data in RDF, and it defines extensions to the SPARQL query language for processing geospatial data.

GeoSPARQL Version 1.1 contains no breaking changes to 1.0, but does contain additions and clarifications. Profile resources, new ontology elements, and new functions were added. The major changes are summarized in the tables below.

## Major changes between versions 1.0 and 1.1

The major changes are given in the tables below.

New resource	Location
Profile definition	<a href="http://www.opengis.net/def/geosparql">http://www.opengis.net/def/geosparql</a>
GeoSPARQL Rules in RIF	<a href="http://www.opengis.net/def/geosparql-rifrules">http://www.opengis.net/def/geosparql-rifrules</a>
RDF validation file (SHACL Shapes)	<a href="http://www.opengis.net/def/geosparql-shapes">http://www.opengis.net/def/geosparql-shapes</a>
SPARQL Service Descriptions	<a href="http://www.opengis.net/def/geosparql/servicedescription">http://www.opengis.net/def/geosparql/servicedescription</a>
Requirements of GeoSPARQL modeled in RDF	<a href="http://www.opengis.net/def/geosparql/reqs">http://www.opengis.net/def/geosparql/reqs</a>

The SHACL Shapes are also available as a test suite.

The following new ontology elements and new functions are normatively defined in the OGC GeoSPARQL 1.1 specification document.

New element	Section
<i>Classes</i>	

New element	Section
Spatial Object Collection class	Class: <a href="#">geo:SpatialObjectCollection</a>
Feature Collection class	Class: <a href="#">geo:FeatureCollection</a>
Geometry Collection class	Class: <a href="#">geo:GeometryCollection</a>
<b><i>Spatial Object Properties</i></b>	
hasSize	Property: <a href="#">geo:hasSize</a>
hasMetricSize	Property: <a href="#">geo:hasMetricSize</a>
hasLength	Property: <a href="#">geo:hasLength</a>
hasMetricLength	Property: <a href="#">geo:hasMetricLength</a>
hasPerimeterLength	Property: <a href="#">geo:hasPerimeterLength</a>
hasMetricPerimeterLength	Property: <a href="#">geo:hasMetricPerimeterLength</a>
hasArea	Property: <a href="#">geo:hasArea</a>
hasMetricArea	Property: <a href="#">geo:hasMetricArea</a>
hasVolume	Property: <a href="#">geo:hasVolume</a>
hasMetricVolume	Property: <a href="#">geo:hasMetricVolume</a>
<b><i>Feature Properties</i></b>	
hasBoundingBox	Property: <a href="#">geo:hasBoundingBox</a>
hasCentroid	Property: <a href="#">geo:hasCentroid</a>
<b><i>Geometry Serializations</i></b>	
geoJSONLiteral	RDFS Datatype: <a href="#">geo:geoJSONLiteral</a>
asGeoJSON	Property: <a href="#">geo:asGeoJSON</a>
asGeoJSON function	Function: <a href="#">geof:asGeoJSON</a>
kmlLiteral	RDFS Datatype: <a href="#">geo:kmlLiteral</a>
asKML	Property: <a href="#">geo:asKML</a>
asKML function	Function: <a href="#">geof:asKML</a>
dggsLiteral	RDFS Datatype: <a href="#">geo:dggsLiteral</a>
asDGGS	Property: <a href="#">geo:asDGGS</a>
asDGGS function	Function: <a href="#">geof:asDGGS</a>
<b><i>Non-topological Query Functions</i></b>	
area	Function: <a href="#">geof:area</a>
boundingCircle	Function: <a href="#">geof:boundingCircle</a>
concaveHull	Function: <a href="#">geof:concaveHull</a>
coordinateDimension	Function: <a href="#">geof:coordinateDimension</a>
dimension	Function: <a href="#">geof:dimension</a>

New element	Section
geometryN	Function: <a href="#">geof:geometryN</a>
geometryType	Function: <a href="#">geof:geometryType</a>
is3D	Function: <a href="#">geof:is3D</a>
isEmpty	Function: <a href="#">geof:isEmpty</a>
isMeasured	Function: <a href="#">geof:isMeasured</a>
isSimple	Function: <a href="#">geof:isSimple</a>
length	Function: <a href="#">geof:length</a>
maxX	Function: <a href="#">geof:maxX</a>
maxY	Function: <a href="#">geof:maxY</a>
maxZ	Function: <a href="#">geof:maxZ</a>
metricArea	Function: <a href="#">geof:metricArea</a>
metricDistance	Function: <a href="#">geof:metricDistance</a>
minX	Function: <a href="#">geof:minX</a>
minY	Function: <a href="#">geof:minY</a>
minZ	Function: <a href="#">geof:minZ</a>
numGeometries	Function: <a href="#">geof:numGeometries</a>
spatialDimension	Function: <a href="#">geof:spatialDimension</a>
transform	Function: <a href="#">geof:transform</a>
<b><i>Spatial Aggregate Functions</i></b>	
aggBoundingBox	Function: <a href="#">geof:aggBoundingBox</a>
aggBoundingCircle	Function: <a href="#">geof:aggBoundingCircle</a>
aggCentroid	Function: <a href="#">geof:aggCentroid</a>
aggConcaveHull	Function: <a href="#">geof:aggConcaveHull</a>
aggConvexHull	Function: <a href="#">geof:aggConvexHull</a>
aggUnion	Function: <a href="#">geof:aggUnion</a>

GeoSPARQL 1.1 also adds several new helpful resources:

- Profile Definition: a formal listing of all the GeoSPARQL 1.1 resources, defined using [the W3C Profiles Vocabulary](#).
- GeoSPARQL Rules in Rule Interchange Format (RIF)
  - and a RIF rule generation script
  - GeoSPARQL 1.0 indicated a RIF template but not a RIF file
- RDF data validation file
  - defined using SHACL shapes

- GeoSPARQL / CQL mappings
  - informative description of interoperability between the Common Query Language & GeoSPARQL
  - of relevance to the the delivery of GeoSPARQL data via systems such as the OGC's Web Feature Service [WFS] and OGC API Features [OGCAPIF] which implement CQL
- Alignments (mappings) to fifteen other well known and/or spatial ontologies
  - that are either commonly used with GeoSPARQL or could be

## Document contributor contact points

All questions regarding this document should be directed to the contacts provided below or the referenced standard editor(s).

Table 1. Contacts

Name	Organization
Linda van den Brink	Geonovum
Nicholas J. Car	SURROUND Australia Pty Ltd

## References

The following normative documents are new or updated references in the standard to which these Release Notes apply.

- [OGCOM ISO19156](#), *ISO 19156: Geographic information — Observations and measurements*
- [IETF3987](#), Internet Engineering Task Force, *RFC 3987: Internationalized Resource Identifiers (IRIs)*
- [OWL2](#) *OWL 2 Web Ontology Language Document Overview (Second Edition)*
- [RDF](#), *RDF 1.1 Concepts and Abstract Syntax*
- [RDFS](#) *RDF Schema 1.1*
- [RIFCORE](#), *RIF Core Dialect (Second Edition)*
- [SPARQL](#), *SPARQL 1.1 Query Language*
- [SPARQLPROT](#), *SPARQL 1.1 Protocol*
- [SPARQLRESX](#), *SPARQL Query Results XML Format (Second Edition)*
- [SPARQLRESJ](#), *SPARQL 1.1 Query Results JSON Format*

## Terms and definitions

GeoSPARQL 1.0 contained only acronyms in its Terms & Definitions section, for example:

GeoJSON      Geographic JavaScript Object Notation

GFM	General Feature Model (as defined in ISO 19109)
XML	Extensible Markup Language

GeoSPARQL 1.1 contains those acronyms, with additions such as *Spatial Reference System* (SRS), but it also contains a list of 11 defined terms such as:

## RDFS

RDF Schema provides a data-modelling vocabulary for RDF data. RDF Schema is an extension of the basic RDF vocabulary.

and

## coordinate reference system

A coordinate reference system (CRS) is a coordinate system that is related to an object by a datum.

These definitions have been included to clear up ambiguity regarding the origin and exact use of terms in GeoSPARQL.

# Change Log

## KEY

- Source:
  - Change Request
  - GitHub Issue
  - Other
- Identifier: Change Request number or issue number and pull request/commit in GitHub
- Type:
  - A=Administrative
  - S=Substantive
  - C=Critical

See [Description of Critical Changes](#) for more information on critical changes and [Description of Substantive Changes](#) for more information on substantive changes.

- Section: Section number in the updated document
- Description: Brief text describing the change
- Purpose: the reason for the change:
  - Clarity
  - Consistency

- Interoperability
- Perfunctory
- Readability
- Usability

## Change Table

Table 2. Change Log

Source	Identifier	Type	Section	Description	Purpose
1	<a href="#">PR #48</a>	S	8.8.3	GeoJSON literals in GeoSPARQL	Add support for a format that is very common for representing geospatial data on the Web.
2	<a href="#">PR #88</a>	S	8.8.5	Discrete Global Grid System (DGGs) literals in GeoSPARQL	Add support for using a list of DGGs identifiers to describe a geometry.
7	<a href="#">PR #57</a>	S	8.10	SPARQL functions for performing spatial aggregations of data.	To be able to work with sets of geometries.
33	<a href="#">PR #72</a>	S	6.3	New properties <a href="#">hasSize</a> , <a href="#">hasLength</a> , <a href="#">hasArea</a> , <a href="#">hasVolume</a> and <a href="#">hasSpatialResolution</a>	Extension of the ontology for indicating spatial resolution, areas, proportional relations (e.g. area overlaps).
69	<a href="#">PR #75</a>	S	8.8.4	KML literals in GeoSPARQL	Add support for OGC KML for completeness.
5	<a href="#">PR #117</a>	S	6.4.3, 6.4.4	New properties <a href="#">hasCentroid</a> , <a href="#">hasBoundingBox</a>	Useful for visualization, indexing and discovery.
	<a href="#">PR #140</a>	A	Annex C	Simple Features for SQL mappings	Describe interoperability between functions and properties from Simple Features for SQL to GeoSPARQL
	<a href="#">PR #145</a>	A	Annex B	Query example for min and max functions	Show how min and max work
	<a href="#">PR #146</a>	S	8.9	Functions <a href="#">isEmpty</a> , <a href="#">isSimple</a> , <a href="#">dimension</a> , <a href="#">length</a> , <a href="#">area</a> .	Extra functions for performing non-topological spatial operations
148	<a href="#">PR #150</a>	S	6.2.3	Class SpatialObjectCollection	To support OGC API
148	<a href="#">PR #150</a>	S	6.2.4	Class FeatureCollection	To support OGC API

Source	Identifier	Type	Section	Description	Purpose
148	<a href="#">PR #150</a>	S	8.6.2	Class GeometryCollection	To support OGC API
	<a href="#">PR #151</a>	S	8.9.15, 8.9.30	<code>geometryN</code> and <code>numGeometries</code> functions	To work with geometries in collections
142	<a href="#">PR #155</a>	S	6.3,8.7	Metric properties	Convenience properties without the need to indicate units when working with metres.
164	<a href="#">PR #193</a>	A	3, 4	Terms & definitions and normative references	To have direct access to explanations of terms that are used in the specification but not defined in the ontology.
204	<a href="#">PR #210</a>	S	6.3.5, 6.3.6	Perimeter properties	To distinguish between length and perimeter of a thing.
	<a href="#">PR #216</a>	A	6	Ontology overview figure	Understanding the spec
191	<a href="#">PR #221</a>	A	Separate resource	JSON-LD context	Implementation of GeoSPARQL ontology in JSON-LD
113	<a href="#">PR #173</a>	A	Separate resource	SHACL shapes	Validation
212	<a href="#">PR #225</a>	A	B.1	Functions summary table	Better documentation of functions, inputs and outputs, and whether they apply specifically to 2d or 3d objects.
206	<a href="#">PR #226</a>	A	8.9.1	Description of function behaviours	Clarification of behaviour of functions.
74	<a href="#">PR #234</a>	A	Annex E	Alignments to other ontologies	Support common usage patterns for GeoSPARQL with external ontology elements, and provide guidance on how GeoSPARQL can be used with other, existing, spatial ontologies.
43	<a href="#">PR #240</a>	A	Separate resource	German translation of ontology	For greater worldwide adoption.
	<a href="#">PR #245</a>	A	8.4	Explanation of role of CRS in geometric computations	Clarification



Source	Identifier	Type	Section	Description	Purpose
259	<a href="#">PR #274</a>	A	8.3	Recommendation to use QUDT for units of measure	Offers guidance on unit of measure vocabulary
273	<a href="#">PR #275</a>	A	8.9.13	Clarification of <b>distance</b> function	Explanation of the <b>unit</b> argument.
247	<a href="#">PR #284</a>	A	10.3.1	Improvement of examples	Documentation.
278	<a href="#">PR #300</a>	A	8.2	Paragraph about GeoSPARQL and Simple Features Access - Common Architecture	Explain how GeoSPARQL is based on SFA-CA.
286	<a href="#">PR #324</a>	S	8.9.5, 8.9.12	Metric buffer and distance functions	Functions without unit argument, to simplify implementation and use.

## Description of Critical Changes

There are no critical changes in this release.

## Description of Substantive Changes

### Collection classes

GeoSPARQL 1.1 adds three classes for collection types:

- **SpatialObjectCollection**
- **FeatureCollection**
- **GeometryCollection**

These classes allow the organization of spatial objects, features and geometries in collections and are added to support the sorts of data models used by systems such as OGC APIs.

The collection class and the object class, such as **FeatureCollection** & **Feature** class, are related by the standard RDFS property **rdfs:member** whereby the collection class *has as a member* the object.

In RDF, an example of this for **FeatureCollection** / **Feature** may look like this:

#### NOTE

```
ex:col-1
  a geo:FeatureCollection ;
  rdfs:member ex:feature-a ;
  .
```

```
ex:feature-a
  a geo:Feature ;
  .
```

This is noted here to avoid confusion as to the direction of the object/collection relation.

## New size properties

GeoSPARQL 1.1. includes several new scalar Spatial Object properties related to size for indicating spatial resolution, areas, and proportional relations (e.g. area overlaps):

- `hasSize`
- `hasLength`
- `hasPerimeterLength`
- `hasArea`
- `hasVolume`
- `hasSpatialResolution`

Note that a property `hasLength` was already present in GeoSPARQL 1.0; `hasPerimeterLength` was added to distinguish between length (e.g. the length of a football field) and perimeter (i.e. the added lengths of all sides, in the case of a polygon) of a thing.

These properties do not have tightly defined range values so that they may be used with any RDF measurement/metrology system although GeoSPARQL makes a recommendation to use [QUDT](#) for measurements and units of measure. Annex C exemplifies these properties with QUDT.

## Metric properties

GeoSPARQL 1.1 also adds convenience properties for working with scalar values in metres as datatype properties, not value/unit properties as per QUDT standard use. For each `has...` property in the section above, there is a `hasMetric...` property with a datatype range specified to be in metres. For example `hasMetricArea` in `m^2` for `hasArea`.

## New Feature properties

GeoSPARQL 1.1. includes two new properties `hasCentroid` and `hasBoundingBox`. These can be used to link a Feature with a point geometry corresponding with the centroid of its geometry, or with a simplified geometry-representation corresponding to the envelope of its geometry, respectively. The centroid is typically used to show location on a low-resolution image, and both centroid and bounding box are useful for indexing and discovery functions.

# New geometry serializations

GeoSPARQL 1.1 includes support for representing geometry data in RDF in several additional formats:

- GeoJSON
- Keyhole Markup Language (KML)
- Discrete Global Grid System (DGGS)

As with the geometry serializations that were already supported in v1.0, for each new serialization an RDFS Datatype, a property and a function are defined:

- `geoJSONLiteral`
- `asGeoJSON`
- `asGeoJSON` function
- `kmlLiteral`
- `asKML`
- `asKML` function
- `dggsliteral`
- `asDGGS`
- `asDGGS` function

## Extra functions for performing non-topological spatial operations

GeoSPARQL 1.1 adds several new functions for performing spatial operations:

- `isEmpty`
- `isSimple`
- `dimension`
- `length`
- `area`

## Functions for geometry collections

GeoSPARQL 1.1 adds two functions for working with geometries in collections:

- `numGeometries`
- `geometryN`

These functions can be used to get the number of geometries in a collection, and to get the nth geometry in a collection.

# Spatial aggregate functions

GeoSPARQL 1.1 defines a set of functions for performing spatial aggregations of data:

- `aggBoundingBox`
- `aggBoundingCircle`
- `aggCentroid`
- `aggConcaveHull`
- `aggConvexHull`
- `aggUnion`

These functions support working with sets of geometries, e.g. to calculate the minimum bounding box or centroid of a set of geometries.

## Metric buffer and distance functions

To accompany metric properties, GeoSPARQL 1.1 also adds several functions that assume metres. These functions can be used without unit argument, and were added to simplify implementation and use.

The functions are:

- `metricBuffer`
- `metricDistance`

## Future Work

As of the release of GeoSPARQL 1.1, the GeoSPARQL Standard Working Group proposes a next minor release of GeoSPARQL 1.2 in late 2022 or early 2023. The SWG is also considering a more major release, perhaps GeoSPARQL 2.0, after that. The intention is that backwards-compatible additions only will be added to GeoSPARQL 1.2, but potentially major, breaking, changes will be added to GeoSPARQL 2.0.

Determining scope for future GeoSPARQL releases is an open and public process undertaken by the SWG in the course of their regular meetings.

Release scope is shown by the SWG allocating Issues raised against the Standard in its online source code repository:

- <https://github.com/opengeospatial/ogc-geosparql/issues>

Milestones indicate Issue's potential release, for example the [Issue #301 "Handling of Z-coordinates by geometry functions is underspecified"](#) is allocated Milestone GeoSPARQL 1.2.

# Appendix A: Revision History

Date	Release	Editor	Primary clauses modified	Description
2022-07-15	0.1	L. van den Brink	all	initial version
2022-07-21	0.2	N.J Car	all	minor formatting updates
2022-07-21	0.3	L. van den Brink	all	minor formatting updates
2022-07-27	0.4	N.J Car	all	minor formatting & template updates
2024-01-12	0.5	N.J Car	metadata	final published version numbers