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Open Geospatial Consortium

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TECHNICAL PAPER

CANDIDATE SWG DRAFT

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KEYWORDS

The following are keywords to be used by search engines and document catalogues.

OGC, GeoSPARQL, 3D

PREFACE

To come...

SECURITY CONSIDERATIONS

The following security considerations apply...

IV SUBMITTING ORGANIZATIONS

The following organizations submitted this Document to the Open Geospatial Consortium (OGC):

- Organization one
- Organization two
- Organization three

V SUBMITTERS

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1 SCOPE

1 SCOPE

2

CONFORMANCE

2 CONFORMANCE

3

NORMATIVE REFERENCES

3 NORMATIVE REFERENCES

There are no normative references in this document.

4 TERMS AND DEFINITIONS

4 TERMS AND DEFINITIONS

No terms and definitions are listed in this document.

5

ABSTRACT

5 ABSTRACT

To come...

6 KEYWORDS

6 KEYWORDS

To come...

7 CONVENTIONS

7 CONVENTIONS

8

INTRODUCTION

8 INTRODUCTION

9

BENEFICIARIES AND BENEFITS

9 BENEFICIARIES AND BENEFITS

This section describes the beneficiaries and benefits of representing data, including geospatial data, using semantic and graph technologies. Furthermore, a collection of use cases demonstrate how semantic and graph technologies are used together with spatial data to tackle real world problems.

9.1. Beneficiaries

9.1.1. Beneficiary 1: Someone who benefits

9.2. Benefits

The benefits of semantic and graph technologies are outlined below.

9.2.1. Benefit B1: My benefit

10

CURRENT CAPABILITIES

10 CURRENT CAPABILITIES

10.1. GeoSPARQL

GeoSPARQL is the most common geospatial extension of SPARQL. It was accepted as an OGC standard in 2012 and revised as GeoSPARQL 1.1 in 2024.

According to the standard document, “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 an extension to the SPARQL query language for processing geospatial data”.

10.1.1. Requirements addressed

In order to define which capabilities GeoSPARQL needs to adopt for full 3D compatibility, we first take a look at GeoSPARQL 1.1 current capabilities with regards to 3D.

10.1.1.1. Vocabulary

GeoSPARQL 1.1 defines a class Geometry as a subclass of SpatialObject. An instance of Geometry is not restricted to two dimensions. A more finegranular classification of Geometries can be done using the Simple Features Vocabulary, a vocabulary extending the class geo:Geometry with further geometry types. The Simple Features vocabulary allows for the definition of 3D variants of:

- (Multi)Points
- (Multi)LineStrings
- (Multi)Polygons

but does not include commons 3D primitives, such as cubes or Mesh surfaces which are integral parts of 3D representations.

Concerning metadata of 3D models, GeoSPARQL 1.1 provides properties which can be reused in 3D contexts. In particular, the properties are:

- geo:hasVolume
- geo:hasMetricVolume

Further 3D-related metadata properties such as projection matrices are not part of the current GeoSPARQL 1.1 standard.

10.1.1.2. Geometry Relations

Relations between geometries have been defined using three different sets of rules:

- Simple Features Relations
- Egenhofer Relations
- Region Connection Calculus RCC8

All geometry relations are only defined for 2D geometries and do not take into account the third dimension.

10.1.1.3. Literals

A first requirement for 3D support is the ability to save 3D data in a knowledge graph. GeoSPARQL 1.1 defines a variety of String literal formats, which are investigated for the storage of 3D data.

Table 1

Literal Type	Z-Coordinate Supported	2.5D	3D
WKT Literal	Yes	Yes	Yes
GML Literal	Yes	Yes	Only with extension Schema
KML Literal	Yes	Yes	As import from COLLADA
GeoJSON Literal	Yes	Yes	Yes
DGGS Literal			

GeoSPARQL 1.1 also does not restrict the usage of coordinate reference systems with 3D support. There are currently almost 300 coordinate reference systems in the database epsg.io which can be used to describe 3D data encoded in the GeoSPARQL graph literals listed above.

10.1.1.4. Query functions with 3D support

GeoSPARQL 1.1 functions currently do not offer fully-featured 3D support. However, there are functions which may take into account the Z coordinate, if they are available.

Table 2

GeoSPARQL function	Z-Coordinate Supported	2.5D	3D
geof:is3D	Yes	Yes	Yes
geof:minZ	Yes	Yes	Yes
geof:maxZ	Yes	Yes	Yes

These functions check for the presence of Z coordinates or filter out maximum and minimum Z coordinates of the given geometry.

10.1.2. Adoption of GeoSPARQL 1.1

11

REQUIREMENTS FOR GEOSPARQL 3D

11 REQUIREMENTS FOR GEOSPARQL 3D

This section provides an overview of feedback received on the current version of the GeoSPARQL standard (version 1.1) regarding 3D usage. This feedback helps to identify some of the barriers to use, and to outline requirements that have not been addressed that may encourage greater uptake.

11.1. Proposed extensions for GeoSPARQL 3D

11.1.1. Extension 1:

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ANNEX N: N

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ANNEX O: HISTORY

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TTL	World Wide Web Consortium, *RDF 1.1 Turtle Terse RDF Triple Language*, W3C Recommendation (25 February 2014). https://www.w3.org/TR/turtle