Open Geospatial Consortium

Submission Date: <yyyy-mm-dd>

Approval Date: <yyyy-mm-dd>

Publication Date: 2022-02-06

External identifier of this OGC® document: http://www.opengis.net/doc/{doc-type}/{standard}/{m.n}

Internal reference number of this OGC® document: YY-nnnrx

Category: OGC® Discussion Paper

Editor: Charles Heazel

OGC Dynamic Features Discussion Paper

Document type:	OGC® Discussion Paper
Document subtype:	
Document stage:	Draft
Document language:	English

Table of Contents

i. Abstract

<Insert Abstract Text here>

ii. Keywords

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

ogcdoc, OGC document, <tags separated by commas>

iii. Preface

NOTE

Insert Preface Text here. Give OGC specific commentary: describe the technical content, reason for document, history of the document and precursors, and plans for future work. > 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.

iv. Submitting organizations

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

Organization name(s)

v. Submitters

All questions regarding this submission should be directed to the editor or the submitters:

Name Affiliation

Chapter 1. Scope

NOTE Insert Scope text here. Give the subject of the document and the aspects of that scope covered by the document.

Chapter 2. References

The following normative documents contain provisions that, through reference in this text, constitute provisions of 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.

NOTE

Insert References here. If there are no references, state “There are no normative references”.

References are to follow the Springer LNCS style, with the exception that optional information may be appended to references: DOIs are added after the date and web resource references may include an access date at the end of the reference in parentheses. See examples from Springer and OGC below.

Smith, T.F., Waterman, M.S.: Identification of Common Molecular Subsequences. J. Mol. Biol. 147, 195–197 (1981)

May, P., Ehrlich, H.C., Steinke, T.: ZIB Structure Prediction Pipeline: Composing a Complex Biological Workflow through Web Services. In: Nagel, W.E., Walter, W.V., Lehner, W. (eds.) Euro-Par 2006. LNCS, vol. 4128, pp. 1148–1158. Springer, Heidelberg (2006)

Foster, I., Kesselman, C.: The Grid: Blueprint for a New Computing Infrastructure. Morgan Kaufmann, San Francisco (1999)

Czajkowski, K., Fitzgerald, S., Foster, I., Kesselman, C.: Grid Information Services for Distributed Resource Sharing. In: 10th IEEE International Symposium on High Performance Distributed Computing, pp. 181–184. IEEE Press, New York (2001)

Foster, I., Kesselman, C., Nick, J., Tuecke, S.: The Physiology of the Grid: an Open Grid Services Architecture for Distributed Systems Integration. Technical report, Global Grid Forum (2002)

National Center for Biotechnology Information, http://www.ncbi.nlm.nih.gov

ISO / TC 211: ISO 19115-1:2014 Geographic information — Metadata — Part 1: Fundamentals (2014)

ISO / TC 211: ISO 19157:2013 Geographic information — Data quality (2013)

ISO / TC 211: ISO 19139:2007 Geographic information — Metadata — XML schema implementation (2007)

ISO / TC 211: ISO 19115-3: Geographic information — Metadata — Part 3: XML schemas (2016)

OGC: OGC 15-097 OGC Geospatial User Feedback Standard. Conceptual Model (2016)

OGC: OGC 12-019, OGC City Geography Markup Language (CityGML) Encoding Standard (2012)

OGC: OGC 14-005r3, OGC IndoorGML (2014)

Chapter 3. Terms and Definitions

This document uses the terms defined in Sub-clause 5.3 of [OGC 06-121r8], which is based on the ISO/IEC Directives, Part 2, Rules for the structure and drafting of International Standards. In particular, the word “shall” (not “must”) is the verb form used to indicate a requirement to be strictly followed to conform to this Best Practice.

For the purposes of this document, the following additional terms and definitions apply.

3.1. term name

text of the definition

Chapter 4. Conventions

This sections provides details and examples for any conventions used in the document. Examples of conventions are symbols, abbreviations, use of XML schema, or special notes regarding how to read the document.

4.1. Identifiers

The normative provisions in this document are denoted by the URI

http://www.opengis.net/spec/{standard}/{m.n}

All requirements and conformance tests that appear in this document are denoted by partial URIs which are relative to this base.

Chapter 5. Dynamic Features

Introductory text

5.1. Geometry in 3 Dimensions

Proposition: We already have sufficient standards to define 3-D geometric objects.

5.1.1. CityGML

CityGML defines the geometry of city objects using the geometric primitives and aggregate elements defined in ISO 19107.

Volumetric shapes are defined using the Boundary Representation (B-Rep) approach. B-Rep defines a 3-dimensional surface which serves as the interface between the interior of the volumetric shape and the exterior. This surface is usually defined by a collection of shape elements which together form a closed surface. CityGML also allows a surface to be defined by a point cloud.

Some structures, such as a tunnel or overpass, pose difficulties for this model. The surface can be constructed so that it continues into the interior of the structure. That would make the interior of a tunnel external to the tunnel object. Not always a desireable result. CityGML provides the concept of a "Closure Surface". A Closure Surface is a surface which is a logical part of the object but does not correspond to a physical part of the object. For example, the entrance to a tunnel can have a closure surface. This surface allows you to treat the tunnel as a single three-dimension entity, even though there is a hole in the bounding surface.

https://en.wikipedia.org/wiki/Boundary_representation

Also look at IndoorGML, and Land/Infrastructure. These three OGC standards should use a common geometry.

5.1.2. SPICE

https://naif.jpl.nasa.gov/naif/toolkit.html

At first glance SPICE has many similarities to CitGML.

5.2. Temporal Geometry

Proposition: We have sufficient standards to define geometries which change with time.

5.2.1. ISO 19141 - Moving Features

"ISO 19141:2008 defines a method to describe the geometry of a feature that moves as a rigid body."

But a look at 19141 suggests much more than that.

[ISO 19141 Main] | *images/ISO_19141_Main.bmp*

MF_TemporalGeometry

MF_TemporalGeometry is a specialization of MF_OneParamGeometry in which the parameter is time as expressed by TM_Coordinate. TM_Coordinate is specified in ISO 19108; it expresses time as a multiple of a single unit of measure such as year, day, or second.

MF_OneParameterGeometry

A one parameter set of geometries is a function f from an interval t Î [a, b] such that f(t) is a geometry and for each point P Î f(a) there is a one parameter set of points (called the trajectory of P) P(t) : [a, b] ® P(t) such that P(t) Î f(t). A leaf of a one parameter set of geometries is the geometry f(t) at a particular value of the parameter. The set of geometries forms a prism that is the set of points in the union of the geometries (or the union of the trajectories).

The type "MF_OneParamGeometry" acts as the root classifier for all geometric object classified as one parameter sets of geometric objects. As a one-paramter set, they have "leaf" projections (for each parameter value. As geometric objects they act as the infinite union of all their "leaf" (cross sections for each parameter value).

So if our object it defined by a bounding surface, and that surface is made up of a number of shapes descended from MF_TemporalGeometry, then the surface geometry of our object can change over time. Hence it is not rigid. ISO 19141, when used with CityGML, can also define deforming (plastic) bodies.

5.3. Temporal Properties

Proposition: Features can change in state as well at location

ISO 19141 introduced the concept of a One Parameter Geometry.

MF_OneParamGeometry:

A one parameter set of geometries is a function f from an interval t Î [a, b] such that f(t) is a geometry and for each point P Î f(a) there is a one parameter set of points (called the trajectory of P) P(t) : [a, b] ® P(t) such that P(t) Î f(t). A leaf of a one parameter set of geometries is the geometry f(t) at a particular value of the parameter. The set of geometries forms a prism that is the set of points in the union of the geometries (or the union of the trajectories).

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According to the Feature Model, geometry is a property of a Feature. Since we have defined MF_OneParamGeometry, it stands to reason that there can be a MF_OneParamProperty. Likewise, there can be a subclass MF_TemporalProperty.

Therefore, MF_TemporalProperty can represent any Feature Property which changes with time. The JSON encoding standard for Moving Features provides us whith this capability.

5.3.1. TemporalProperties Object

A TemporalProperties object is a JSON array of ParametricValues objects that groups a collection of dynamic non-spatial attributes and its parametric values with time.

ParametricValues Object

A ParametricValues object is a JSON object that represents a collection of parametric values of dynamic non-spatial attributes that are ascertained at the same times. A parametric value may be a time-varying measure, a sequence of texts, or a sequence of images. Even though the parametric value may depend on the spatiotemporal location, MF-JSON Prism only considers the temporal dependencies of their changes of value.

5.4. Articulated Geometries

Given a suite of standards which allow you to define time-variant geometric elements, then the next step is to take a collection of those elements and assemble them into a complex object.

An articulated geometry is such an aggregation where each element has less than 6 degrees of freedom. Each element can move, but its movement is constrained by attachment to one or more additional elements.

The aggregate as a whole can also move, but that movement becomes more complex. typically we would model movement of the whole as a trajectory of the center of mass. However, the center of mass of an articulating Feature will change as the relative position of the elements change.

5.5. Complex Articulated Systems

This may be a redundant section.

5.6. Mass Properties

This may be a redundant section.

5.7. The Problem of Time

Proposition: Time is in the eye of the beholder. So all measurements of time must be local.

Dynamic Features are not tied to an Earth-centered static existance. Yet the concepts of time used in the geospatial community are almost exclusivly based on Earth-centric astronomical phenomena. They also assume a rather coarse degree of granularity. For dynamic features we need to use local clocks with precision down to the nanosecond. We are less concerned with absolute time than with relative time. State B was achieved 37 nanoseconds after State A.

It’s only when we begin aggregating these dynamic elements that we begin to worry about "absolute" time. Even then, we are more likely to convert from one local clock to another then to convert to an absolute time.

So if all time is local, we need a Temporal Reference System concept which captures the parameters needed to transform across TRS. A temporal equivalent to GeoPOSE.

Introduce the Timer concept from MISB.

5.8. Temporal Reference Systems

May be redundant

5.9. Dynamic Features at Relativistic Velocities

At very high velocities, measurements between moving features sufer from relativistic effects. The proposition is to build on Minkowski SpaceTime to address these cases.

More to come.

Annex A: Revision History

Date	Release	Editor	Primary clauses modified	Description
2016-04-28	0.1	G. Editor	all	initial version

Annex B: Bibliography

NOTE

Example Bibliography (Delete this note).

The TC has approved Springer LNCS as the official document citation type.

Springer LNCS is widely used in technical and computer science journals and other publications

- For citations in the text please use square brackets and consecutive numbers: [1], [2], [3]

– Actual References:

[n] Journal: Author Surname, A.: Title. Publication Title. Volume number, Issue number, Pages Used (Year Published)

[n] Web: Author Surname, A.: Title, http://Website-Url

[1] OGC: OGC Testbed 12 Annex B: Architecture. (2015).