



OGC API - MOVING FEATURES - PART 1: CORE

DRAFT STANDARD
Implementation

CANDIDATE TC VOTE DRAFT

Version: 1.0.draft

Submission Date: 2023-05-19

Approval Date: 2029-03-30

Publication Date: 2029-03-30

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ABSTRACT

Moving feature data can represent various phenomena, including vehicles, people, animals, weather patterns, etc. The OGC API – Moving Features (OGC API – MF) is a Draft Standard defining a standard interface for querying and accessing geospatial data that changes over time, such as the location and attributes of moving objects like vehicles, vessels, or pedestrians. The OGC API – MF provides a standard way to manage these data, which can be helpful for applications such as transportation management, disaster response, and environmental monitoring. OGC API – MF also includes operations for filtering, sorting, and aggregating moving feature data based on location, time, and other properties.

The OGC API – Moving Features – Part 1: Core specifies a set of RESTful web service interfaces and data formats for querying and updating moving feature data over the web. OGC API Standards define modular API building blocks to spatially enable Web APIs in a consistent way. OpenAPI is used to define the reusable API building blocks with responses in JSON and HTML.

The OGC API family of standards is organized by resource type.

Table 1 – Overview of Resources

| RESOURCE | PATH | HTTP METHOD | DOCUMENT REFERENCE |
|--|--|------------------|-------------------------------------|
| Collections metadata | /collections | GET, POST | Resource Collections |
| Collection instance metadata | /collections/{collectionId} | GET, DELETE, PUT | Resource Collection |
| MovingFeatures | /collections/{collectionId}/items | GET, POST | Resource Moving Features |
| MovingFeature instance | /collections/{collectionId}/items/{mFeatureId} | GET, DELETE | Resource Moving Feature |
| TemporalGeometry Sequence | /collections/{collectionId}/items/{mFeatureId}/tgsequence | GET, POST | Resource Temporal GeometrySequence |
| TemporalPrimitive Geometry instance | /collections/{collectionId}/items/{mFeatureId}/tgsequence/{tGeometryId} | DELETE | Resource Temporal PrimitiveGeometry |
| Queries for Temporal PrimitiveGeometry | collections/{collectionId}/items/{mFeatureId}/tgsequence/{tGeometryId}/{queryType} | GET | TemporalGeometry Query Resources |
| TemporalProperties instance | /collections/{collectionId}/items/{mFeatureId}/tproperties | GET, POST | Resource Temporal Properties |
| TemporalProperty instance | /collections/{collectionId}/items/{mFeatureId}/tproperties/{tPropertyId} | GET, POST | Resource Temporal Property |

KEYWORDS

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

ogcdoc, OGC document, OGC Moving Features, OGC Moving Features JSON, Moving Features Access, API, OpenAPI, REST, trajectory

PREFACE

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SECURITY CONSIDERATIONS

The OGC API – Moving Features – Part 1: Core Draft Standard does not mandate any specific security controls. However, it was constructed to add security controls without impacting conformance, the same as the [OGC API – Common – Part 1: Core](#).

This document applied the Requirement [/req/oas30/security](#) for OpenAPI 3.0 Security support.

SUBMITTING ORGANIZATIONS

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

- Artificial Intelligence Research Center, National Institute of Advanced Industrial Science and Technology
- Université libre de Bruxelles
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1

SCOPE

SCOPE

The scope of the OGC API – Moving Features – Part 1: Core is to provide a uniform way to access, communicate, and manage data about moving features across different applications, data providers, and data consumers in contexts where the effects of Einstein's relativity are not significant. The OGC API – MF defines a set of API building blocks that enable clients to discover, retrieve, and update information about moving features, as well as a data model for describing moving features and their trajectories.

The OGC API – Moving Features – Part 1: Core Draft Standard defines an API with two goals.

- First, to provide access to representations of Moving Features that conform to the OGC Moving Features JSON Encoding Standard.
- Second, to provide functionality comparable to that of the OGC Moving Features Access Standard.

The OGC API – Moving Features Draft Standard is an extension of the OGC API – Common and the OGC API – Features Standards.

2

CONFORMANCE

CONFORMANCE

This Standard defines two requirements / conformance classes that describe different levels of compliance with the Standard. These requirements / conformance classes help to ensure interoperability between other implementations of the Standard and allow data providers to specify which parts of the Standard they support. The standardization target is “Web APIs”.

The conformance classes for OGC API – Moving Features are:

- Collection Catalog
- Moving Features
- Common Requirements

The conformance class defines the minimum requirements for an API to be compliant with the OGC API – Moving Features Draft Standard. This includes support for querying and retrieving information about moving features using HTTP GET requests. Also, the conformance class enables clients to add, modify, or delete features from the server using HTTP POST, PUT, and DELETE requests. Lastly, the conformance class adds support for querying and retrieving features based on their temporal characteristics, such as their position at a specific time or their velocity over a given time interval.

Implementers of the OGC API – MF can choose which conformance classes they want to support based on the specific needs of their use case and the capabilities of their software. However, to be considered compliant with the Standard, an implementation shall support at least the Core conformance class.

The URIs of the associated conformance classes are:

Table 2 – Conformance class URIs

| CONFORMANCE CLASS | URI |
|-----------------------------------|---|
| MovingFeatures Collection Catalog | http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/conf/mf-collection |
| MovingFeatures | http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/conf/movingfeatures |
| Common Requirements | http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/conf/common |

Conformance with this Standard shall be checked using all the relevant tests specified in Annex A of this document. The framework, concepts, and methodology for testing, and the criteria to be achieved to claim conformance are specified in the [OGC Compliance Testing Policies and Procedures](#) and the [OGC Compliance Testing website](#).

3

NORMATIVE REFERENCES

NORMATIVE REFERENCES

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Policy SWG: OGC 08-131r3, *The Specification Model – Standard for Modular specifications*. Open Geospatial Consortium (2009).

Hideki Hayashi, Akinori Asahara, Kyoung-Sook Kim, Ryosuke Shibasaki, Nobuhiro Ishimaru: OGC 16-120r3, *OGC Moving Features Access*. Open Geospatial Consortium (2017). <http://www.opengis.net/doc/is/movingfeatures-access/1.0.0>.

Kyoung-Sook KIM, Nobuhiro ISHIMARU: OGC 19-045r3, *OGC Moving Features Encoding Extension – JSON*. Open Geospatial Consortium (2020). <http://www.opengis.net/doc/IS/mf-json/1.0.0>.

Clemens Portele, Panagiotis (Peter) A. Vretanos, Charles Heazel: OGC 17-069r4, *OGC API – Features – Part 1: Core corrigendum*. Open Geospatial Consortium (2022). <http://www.opengis.net/doc/IS/ogcapi-features-1/1.0.1>.

Charles Heazel: OGC 19-072, *OGC API – Common – Part 1: Core*. Open Geospatial Consortium (2023). <http://www.opengis.net/doc/is/ogcapi-common-1/1.0.0>.

Charles Heazel: *OGC API – Common – Part 2: Geospatial Data (Draft)*. OGC 20-024, Open Geospatial Consortium, <http://docs.ogc.org/DRAFTS/20-024.html>

Panagiotis A. Vretanos, Clemens Portele: *OGC API – Features – Part 4: Create, Replace, Update and Delete (Draft)*. <http://docs.ogc.org/DRAFTS/20-002.html>

E. Levinson: IETF RFC 2387, *The MIME Multipart/Related Content-type*. RFC Publisher (1998). <https://www.rfc-editor.org/info/rfc2387>.

E. Rescorla: IETF RFC 2818, *HTTP Over TLS*. RFC Publisher (2000). <https://www.rfc-editor.org/info/rfc2818>.

G. Klyne, C. Newman: IETF RFC 3339, *Date and Time on the Internet: Timestamps*. RFC Publisher (2002). <https://www.rfc-editor.org/info/rfc3339>.

T. Berners-Lee, R. Fielding, L. Masinter: IETF RFC 3986, *Uniform Resource Identifier (URI): Generic Syntax*. RFC Publisher (2005). <https://www.rfc-editor.org/info/rfc3986>.

R. Fielding, J. Reschke (eds.): IETF RFC 7230, *Hypertext Transfer Protocol (HTTP/1.1): Message Syntax and Routing*. RFC Publisher (2014). <https://www.rfc-editor.org/info/rfc7230>.

R. Fielding, J. Reschke (eds.): IETF RFC 7231, *Hypertext Transfer Protocol (HTTP/1.1): Semantics and Content*. RFC Publisher (2014). <https://www.rfc-editor.org/info/rfc7231>.

- R. Fielding, J. Reschke (eds.): IETF RFC 7232, *Hypertext Transfer Protocol (HTTP/1.1): Conditional Requests*. RFC Publisher (2014). <https://www.rfc-editor.org/info/rfc7232>.
- R. Fielding, Y. Lafon, J. Reschke (eds.): IETF RFC 7233, *Hypertext Transfer Protocol (HTTP/1.1): Range Requests*. RFC Publisher (2014). <https://www.rfc-editor.org/info/rfc7233>.
- R. Fielding, M. Nottingham, J. Reschke (eds.): IETF RFC 7234, *Hypertext Transfer Protocol (HTTP/1.1): Caching*. RFC Publisher (2014). <https://www.rfc-editor.org/info/rfc7234>.
- R. Fielding, J. Reschke (eds.): IETF RFC 7235, *Hypertext Transfer Protocol (HTTP/1.1): Authentication*. RFC Publisher (2014). <https://www.rfc-editor.org/info/rfc7235>.
- M. Nottingham, E. Wilde: IETF RFC 7807, *Problem Details for HTTP APIs*. RFC Publisher (2016). <https://www.rfc-editor.org/info/rfc7807>.
- H. Butler, M. Daly, A. Doyle, S. Gillies, S. Hagen, T. Schaub: IETF RFC 7946, *The GeoJSON Format*. RFC Publisher (2016). <https://www.rfc-editor.org/info/rfc7946>.
- M. Nottingham: IETF RFC 8288, *Web Linking*. RFC Publisher (2017). <https://www.rfc-editor.org/info/rfc8288>.
- T. Bray (ed.): IETF RFC 8259, *The JavaScript Object Notation (JSON) Data Interchange Format*. RFC Publisher (2017). <https://www.rfc-editor.org/info/rfc8259>.
- Open API Initiative: OpenAPI Specification 3.0.3, <https://github.com/OAI/OpenAPI-Specification/blob/main/versions/3.0.3.md>

4

TERMS AND DEFINITIONS

TERMS AND DEFINITIONS

This document uses the terms defined in [OGC Policy Directive 49](#), 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 document and OGC documents do not use the equivalent phrases in the ISO/IEC Directives, Part 2.

This document also uses terms defined in the OGC Standard for Modular specifications ([OGC 08-131r3](#)), also known as the 'ModSpec'. The definitions of terms such as standard, specification, requirement, and conformance test are provided in the ModSpec.

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

4.1. application programming interface (API)

an interface that is defined in terms of a set of functions and procedures, and enables a program to gain access to facilities within an application

[Source: Dictionary of Computer Science – Oxford Quick Reference, 2016]

4.2. coordinate

one of a sequence of numbers designating the position of a point

Note 1 to entry: In a spatial coordinate reference system, the coordinate values are qualified by units.

[source: ISO 19111]

4.3. coordinate reference system (CRS)

coordinate system that is related to an object by a datum

Note 1 to entry: Geodetic and vertical datums are referred to as reference frames.

Note 2 to entry: For geodetic and vertical reference frames, the object will be the Earth. In planetary applications, geodetic and vertical reference frames may be applied to other celestial bodies.

[source: ISO 19111]

4.4. dataset

collection of data, published or curated by a single agent, and available for access or download in one or more formats

[source: [DCAT](#)]

4.5. datatype

specification of a value domain with operations allowed on values in this domain

Examples: Integer, Real, Boolean, String and Date.

Note 1 to entry: Data types include primitive predefined types and user definable types.

[source: ISO 19103]

4.6. distribution

represents an accessible form of a dataset

Note 1 to entry: EXAMPLE: a downloadable file, an RSS feed or a web service that provides the data.

[source: [DCAT](#)]

4.7. dynamic attribute

characteristic of a feature in which its value varies with time

[source: [OGC 19-045r3](#)]

4.8. feature

abstraction of a real-world phenomena

Note 1 to entry: A feature can occur as a type or an instance. Feature type or feature instance should be used when only one is meant.

[source: ISO 19109]

4.9. feature attribute

characteristic of a feature

Note 1 to entry: A feature attribute can occur as a type or an instance. Feature attribute type or feature attribute instance is used when only one is meant.

[source: ISO 19109]

4.10. feature table

table where the columns represent feature attributes, and the rows represent features

[source: OGC 06-104r4]

4.11. geographic feature

representation of real-world phenomenon associated with a location relative to the Earth

[source: ISO 19101-2]

4.12. geometric object

spatial object representing a geometric set

[source: ISO 19107:2003]

4.13. leaf

<one parameter set of geometries>

geometry at a particular value of the parameter

[source: ISO 19141]

4.14. moving feature

feature whose position changes over time

Note 1 to entry: Its base representation uses a local origin and local coordinate vectors of a geometric object at a given reference time. [source: ISO 19141]

Note 2 to entry: The local origin and ordinate vectors establish an engineering coordinate reference system (ISO 19111), also called a local frame or a local Euclidean coordinate system. [source: ISO 19141]

[source: [OGC 19-045r3](#)]

4.15. property

facet or attribute of an object referenced by a name

[source: ISO 19143]

4.16. resource

entity that might be identified

Note 1 to entry: The term “resource”, when used in the context of an OGC Web API standard, should be understood to mean a web resource unless otherwise indicated.

[source: [Dublin Core Metadata Initiative – DCMI Metadata Terms](#)]

4.17. resource type

a type of resource

Note 1 to entry: Resource types are re-usable components that are independent of where the resource resides in the API.

[source: [OGC 19-072](#)]

4.18. trajectory

path of a moving point described by a one parameter set of points

[source: ISO 19141]

4.19. web API

API using an architectural style that is founded on the technologies of the Web
[source: [W3C Data on the Web Best Practices](#)]

4.20. web resource

a resource that is identified by a URI
[source: [OGC 17-069r4](#)]

5

CONVENTIONS

CONVENTIONS

This section 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.

5.1. Identifiers

The normative provisions in this Standard are denoted by the URI

<http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0>

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

5.2. Use of HTTPS

For simplicity, this OGC Standard only refers to the HTTP protocol. This is not meant to exclude the use of HTTPS. This is simply a shorthand notation for “HTTP or HTTPS”. In fact, most servers are expected to use HTTPS and not HTTP.

6

OVERVIEW

6.1. General

The OGC API – Features Standard enable access to resources using the HTTP protocol and its associated operations (GET, PUT, POST, DELETE, etc.) The OGC API – Common Standard defines a set of features which are applicable to all implementations of OGC API Standards. Other OGC Standards extend OGC API – Common with features specific to a resource type.

This OGC API – Moving Features – Part 1: Core Draft Standard defines an API with the goal to:

- Provide a standard interface for creating (HTTP POST), retrieving (HTTP GET), updating (HTTP PUT), and deleting (HTTP DELETE) **Moving Features**, with conformance to the OGC Moving Features JSON Encoding Standard (OGC 19-045r3).

Resources exposed through an OGC API may be accessed via a Universal Resource Identifier (URI). The URI representation in this Draft Standard is composed of three sections:

- Dataset distribution API: The endpoint corresponding to a dataset distribution, where the landing page resource as defined in OGC API – Common – Part 1: Core is available (subsequently referred to as Base URI or {root}).
- Access Paths: Unique paths to Resources.
- Query Parameters: Parameters to adjust the representation of a Resource or Resources like encoding format or sub-setting.

Access Paths are used to build resource identifiers. This approach is recommended, but not required. Most resources are also accessible through links to previously accessed resources. Unique relation types are used for each resource.

Table 3 summarizes the access paths and relation types defined in this Standard.

Table 3 – Moving Features API Paths

| PATH TEMPLATE | RELATION | RESOURCE |
|-----------------------------------|----------|---|
| Collections | | |
| {root}/collections | data | Metadata describing the Collection Catalog of data available from this API. |
| {root}/collections/{collectionId} | | Metadata describing the Collection Catalog of data which has the unique identifier {collectionId} |

| PATH TEMPLATE | RELATION | RESOURCE |
|---|----------|--|
| MovingFeatures | | |
| {root}/collections/{collectionId} /items | items | Static information of MovingFeature about available items in the specified Collection |
| {root}/collections/{collectionId}/items/{mFeatureId} | item | Static information describing the MovingFeature of data which has the unique identifier {mFeatureId} |
| {root}/collections/{collectionId}/items/{mFeatureId}/tgsequence | items | Sequence of TemporalPrimitiveGeometry about available items in the specified MovingFeature |
| {root}/collections/{collectionId}/items/{mFeatureId}/tgsequence/{tGeometryId} | item | Temporal object describing the TemporalPrimitive Geometry of data which has the unique identifier {tGeometryId} |
| {root}/collections/{collectionId}/items/{mFeatureId}/tgsequence/{tGeometryId}/{queryType} | | Identifies an Information Resource of type {queryType} associated with the TemporalPrimitiveGeometry instance |
| {root}/collections/{collectionId}/items/{mFeatureId}/tproperties | items | Temporal object information of TemporalProperties about available items in the specified MovingFeature |
| {root}/collections/{collectionId}/items/{mFeatureId}/tproperties/{tPropertyName} | item | Temporal object describing the TemporalProperty of data which has the unique identifier {tPropertyName} |

Where:

- {root} = Base URI for the API server
- {collectionId} = An identifier for a specific **Collection** of data
- {mFeatureId} = An identifier for a specific **MovingFeature** of a specific **Collection** of data
- {tGeometryId} = An identifier for a specific **TemporalPrimitiveGeometry** of a specific **MovingFeature** of data
- {tPropertyName} = An identifier for a specific **TemporalProperty** of a specific **MovingFeatures** of data
- {queryType} = An identifier for the query pattern performed by an implementation instance of the OGC API – MF.

Figure 1 shows a UML class diagram for OGC API – Moving Features (OGC API – MF) which represents the basic resources of this Standard, such as **Collections**, **Collection**, **MovingFeatures**, **MovingFeature**, **TemporalGeometrySequence**, **TemporalPrimitiveGeometry**, **TemporalProperties**, and **TemporalProperty**. In this Standard, a single moving feature can have temporal geometries, such as a set of trajectories. Also, the moving feature can have multiple temporal properties, and each property can have a set of parametric values.



Figure 1 – Class diagram for OGC API – Moving Features

6.2. Search

The core search capability is based on [OGC API – Common](#) and thus supports:

- bounding box searches,
- time instant or time period searches, and
- equality predicates (i.e. *property=value*).

OGC API – Moving Features extends these core search capabilities to include:

- spatiotemporal queries for accessing **TemporalGeometry** resources.

6.3. Dependencies

The OGC API – Moving Features (OGC API – MF) Draft Standard is an extension of the OGC API – Common and the OGC API – Features Standards. Therefore, an implementation of OGC API – MF shall first satisfy the appropriate Requirements Classes from OGC API – Common and OGC API – Features. Also, the OGC API – MF Standard is based on the OGC Moving Features Encoding Extension for JSON (OGC MF-JSON) Standard. Therefore, an implementation of OGC API – MF shall satisfy the appropriate Requirements Classes from OGC MF-JSON. Table 4 identifies the OGC API – Common and OGC API – Features Requirements Classes which are applicable to each section of this Standard. Instructions on when and how to apply these Requirement Classes are provided in each section.

Table 4 – Mapping OGC API – MF Sections to OGC API – Common, OGC API – Features, and OGC MF-JSON Requirements Classes

| API – MF SECTION | API – MF REQUIREMENTS CLASS | API – COMMON, API – FEATURES, MF-JSON REQUIREMENTS CLASS |
|------------------|-----------------------------|---|
| Collections | /req/mf-collection | http://www.opengis.net/spec/ogcapi-common-2/1.0/req/collections , http://www.opengis.net/spec/ogcapi-features-4/1.0/req/create-replace-delete |
| MovingFeatures | /req/movingfeatures | http://www.opengis.net/spec/ogcapi-features-1/1.0/req/core , http://www.opengis.net/spec/ogcapi-features-4/1.0/req/create-replace-delete , http://www.opengis.net/spec/movingfeatures/json/1.0/req/trajectory , |

| API – MF SECTION | API – MF REQUIREMENTS CLASS | API – COMMON, API – FEATURES, MF-JSON REQUIREMENTS CLASS |
|------------------|---|---|
| | | http://www.opengis.net/spec/movingfeatures/json/1.0/req/prism |
| HTML | inherit all requirement (no modification) | http://www.opengis.net/spec/ogcapi-common-1/1.0/req/html |
| JSON | inherit all requirement (no modification) | http://www.opengis.net/spec/ogcapi-common-1/1.0/req/json |
| GeoJSON | inherit all requirement (no modification) | http://www.opengis.net/spec/ogcapi-features-1/1.0/conf/geojson |
| OpenAPI 3.0 | inherit all requirement (no modification) | http://www.opengis.net/spec/ogcapi-common-1/1.0/req/oas30 |

7

REQUIREMENTS CLASS “MOVING FEATURE COLLECTION CATALOG”

REQUIREMENTS CLASS “MOVING FEATURE COLLECTION CATALOG”

7.1. Overview

REQUIREMENTS CLASS 1: MOVING FEATURE COLLECTION CATALOG

| | |
|----------------------|--|
| IDENTIFIER | http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/req/mf-collection |
| TARGET TYPE | Web API |
| CONFORMANCE CLASS | Conformance class A.1: http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/conf/mf-collection |
| PREREQUISITES | http://www.opengis.net/spec/ogcapi-common-2/1.0/req/collections http://www.opengis.net/spec/ogcapi-features-4/1.0/req/create-replace-delete |
| NORMATIVE STATEMENTS | Requirement 1: /req/mf-collection/collections-get Requirement 2: /req/mf-collection/collections-post Requirement 3: /req/mf-collection/collections-get-success Requirement 4: /req/mf-collection/collections-post-success Requirement 5: /req/mf-collection/mandatory-collection Requirement 6: /req/mf-collection/collection-get Requirement 7: /req/mf-collection/collection-put Requirement 8: /req/mf-collection/collection-delete Requirement 9: /req/mf-collection/collection-get-success Requirement 10: /req/mf-collection/collection-put-success Requirement 11: /req/mf-collection/collection-delete-success |

The Moving Feature Collection Catalog requirements class defines the requirements for a moving feature collection. A moving feature collection is an object that provides information about and access to a set of related Moving Features.

7.2. Information Resources

The two resources defined in this Requirement Class are summarized in Table 5.

Table 5 – Moving Feature Collection Catalog Resources

| RESOURCE | URI | HTTP METHOD | DESCRIPTION |
|-------------|-----------------------------------|----------------------|---|
| Collections | {root}/collections | GET | Get information which describes the set of available Collections resource |
| | | POST | Add a new resource (Collection) instance to a Collections resource |
| Collection | {root}/collections/{collectionId} | GET PUT DELETE | Get information about a specific Collection resource ({collectionId}) of geospatial data Update information about a specific Collection resource ({collectionId}) Delete a specific Collection resource ({collectionId}) |

7.3. Resource Collections

7.3.1. Overview

The **Collections** resource supports retrieving and creating operations via GET and POST HTTP methods respectively.

1. A retrieve operation returns a set of metadata which describes the collections available from this API.
2. A create operation posts a new **Collection** resource instance to the collections with this API.

7.3.2. Operation

7.3.2.1. Retrieve

The retrieve operation is defined in the [Collections](#) conformance class of OGC API – Common. No modifications are needed to support **MovingFeature** resources.

1. Issue a GET request on {root}/collections path

Support for the HTTP GET method on the {root}/collections path is specified as a requirement in OGC API – Common.

REQUIREMENT 1

IDENTIFIER /req/mf-collection/collections-get

INCLUDED IN Requirements class 1: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/>
req/mf-collection

A An implementation of the OGC API – MF SHALL comply with the OGC API – Common **Collections** operation requirement [/req/collections/rc-md-op](#).

7.3.2.1.1. Create

The create operation is defined in the [CREATE](#) conformance class of OGC API – Features. This operation targeted **Collection** resource.

1. Issue a POST request on {root}/collections path

Support for the HTTP POST method is specified as a requirement in OGC API – Features.

REQUIREMENT 2

IDENTIFIER /req/mf-collection/collections-post

INCLUDED IN Requirements class 1: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/req/>
mf-collection

A An implementation of the OGC API – MF SHALL comply with the OGC API – Feature CREATE operation requirement [/req/create-replace-delete/insert-post-op](#).

B An implementation of the OGC API – MF SHALL comply with the OGC API – Feature CREATE request body requirements [/req/create-replace-delete/insert-body](#) and [/req/create-replace-delete/insert-content-type](#).

C The content of the request body SHALL be based upon the **Collection** request body schema.

```
type: object
required:
  - itemType
properties:
  title:
    description: human readable title of the collection
    type: string
  updateFrequency:
    description: a time interval of sampling location. The unit is millisecond.
    type: number
  description:
    description: any description
    type: string
  itemType:
```

```
    description: indicator about the type of the items in the moving features  
collection (the default value is 'movingfeature').  
    type: string  
    default: "movingfeature"
```

Figure 2 – Collection Request Body Schema:

The following example adds a new feature (collection information object) to the feature collections. The feature is encoded as JSON. A pseudo-sequence diagram notation is used to illustrate the details of the HTTP communication between the client and the server.



Figure 3 – An Example of Creating a New Collection:

7.3.3. Response

7.3.3.1. Retrieve

A successful response to the **Collections** GET operation is a document that contains summary metadata for each collection accessible through an instance of an API implementation. In a typical deployment of the OGF API – MF, the **Collections** GET response will list collections of all offered resource types. The collections where the value of the itemType property is **MovingFeature** are collections of moving features.

REQUIREMENT 3

IDENTIFIER /req/mf-collection/collections-get-success

INCLUDED IN Requirements class 1: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/req/mf-collection>

A An implementation of the OGC API – MF SHALL comply with the OGC API – Common **Collections** response requirement [/req/collections/rc-md-success](#).

B The content of that response SHALL be based upon the **Collections** response schema.

REQUIREMENT 3

C The itemType property of the response schema SHALL be **MovingFeature**.

NOTE: The usage of the itemType property is referred from the OGC API – Common item Type section.

```
type: object
required:
  - collections
  - links
properties:
  collections:
    type: array
    items:
      $ref: 'collection.yaml'
  links:
    type: array
    items:
      $ref: 'https://schemas.opengis.net/ogcapi/features/part1/1.0/openapi/schemas/link.yaml'
```

Figure 4 – Collections GET Response Schema (collections.yaml):

The following JSON payload is an example of a response to an OGC API – Moving Features Collections GET operation.

```
{
  "collections": [
    {
      "id": "mfc-1",
      "title": "MovingFeatureCollection_1",
      "description": "a collection of moving features to manage data in a distinct (physical or logical) space",
      "itemType": "movingfeature",
      "updateFrequency": 1000,
      "extent": {
        "spatial": {
          "bbox": [
            -180, -90, 190, 90
          ],
          "crs": "http://www.opengis.net/def/crs/OGC/1.3/CRS84"
        },
        "temporal": {
          "interval": [
            "2011-11-11T12:22:11Z", "2012-11-24T12:32:43Z"
          ],
          "trs": "http://www.opengis.net/def/uom/ISO-8601/0/Gregorian"
        }
      },
      "links": [
        {
          "href": "https://data.example.org/collections/mfc-1",
          "rel": "self",
          "type": "application/json"
        }
      ]
    }
  ]
```

```

"links": [
  {
    "href": "https://data.example.org/collections",
    "rel": "self",
    "type": "application/json"
  }
]
}

```

Figure 5 – An Example of Collections JSON Payload:

7.3.3.1.1. Create

A successful response to the **Collections POST** operation is an HTTP status code.

REQUIREMENT 4

IDENTIFIER /req/mf-collection/collections-post-success

INCLUDED IN Requirements class 1: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/req/mf-collection>

A An implementation of the OGC API – MF SHALL comply with the OGC API – Features CREATE response requirement [/req/create-replace-delete/insert-response](#) and [/req/create-replace-delete/insert-response-rid](#).

7.3.4. Error situations

General guidance on HTTP status codes and how they should be handled is provided in Clause 9.2.

7.4. Resource Collection

7.4.1. Overview

A **Collection** information object is the set of metadata that describes a single collection. An abbreviated copy of this information is returned for each **Collection** in the {root}/collections GET response.

The schema for the collection information object presented in this clause is an extension of the collection schema defined in [OGC API – Common](#) and [OGC API – Features](#).

Table 6 defines the set of properties that may be used to describe a collection.

Table 6 – Table of collection properties

| PROPERTY | REQUIREMENT | DESCRIPTION |
|------------------------|-------------|--|
| <i>id</i> | M | A unique identifier to the collection. |
| <i>title</i> | O | A human-readable name given to the collection. |
| <i>description</i> | O | A free-text description of the collection. |
| <i>links</i> | M | A list of links for navigating the API (e.g. link to previous or next pages; links to alternative representations, etc.) |
| <i>extent</i> | O | The spatiotemporal coverage of the collection. |
| <i>itemType</i> | M | Fixed to the value “movingfeature”. |
| <i>updateFrequency</i> | O | A time interval of sampling location. The time unit of this property is millisecond. |

NOTE 1: The *id*, *title*, *description*, *links*, *extent*, and *itemType* properties were inherited from [OGC API – Common](#) and [OGC API – Features](#).

NOTE 2: An update frequency is one of the most important properties of moving feature collection. The update frequency can be used to handle the continuity of the moving feature’s trajectory.

REQUIREMENT 5

| | |
|-------------|--|
| IDENTIFIER | /req/mf-collection/mandatory-collection |
| INCLUDED IN | Requirements class 1: http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/ req/mf-collection |
| A | A collection object SHALL contain all the mandatory properties listed in Table 6. |

7.4.2. Operation

7.4.2.1. Retrieve

The retrieve operation is defined in the OGC API – Common [Collection](#) conformance class. No modifications are required to support **MovingFeature** resources.

1. Issue a GET request on the {root}/collections/{collectionId} path

The {collectionId} path parameter is the unique identifier for a single collection offered by an API implementation instance. The list of valid values for {collectionId} is provided in the /collections response.

Support for the {root}/collections/{collectionId} path is required by OGC API – Common.

REQUIREMENT 6

IDENTIFIER /req/mf-collection/collection-get

| | |
|--------------------|--|
| INCLUDED IN | Requirements class 1: http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/ /req/mf-collection |
| A | An implementation of OGC API – MF SHALL comply with the OGC API – Common Collection operation requirement https://docs.ogc.org/DRAFTS/20-024.html#_operation_2 . |

7.4.2.2. Replace

The replace operation is defined in the REPLACE conformance class of OGC API – Features. This operation targeted **Collection** resource.

1. Issue a PUT request on {root}/collections/{collectionId} path

Support for the HTTP PUT method is specified as a requirement in OGC API – Features.

REQUIREMENT 7

IDENTIFIER /req/mf-collection/collection-put

| | |
|--------------------|---|
| INCLUDED IN | Requirements class 1: http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/ /req/mf-collection |
| A | An implementation of the OGC API – MF SHALL comply with the OGC API – Feature PUT operation requirement /req/create-replace-delete/update-put-op . |
| B | An implementation of the OGC API – MF SHALL comply with the OGC API – Feature PUT request body requirements /req/create-replace-delete/update-put-body and /req/create-replace-delete/update-put-content-type . |
| C | The content of the request body SHALL be based upon the Collection request body schema, except updateFrequency. If the updateFrequency is included in the request body, the server SHALL ignore it. |

NOTE: Once set, the update frequency cannot be changed.

The following example replaces the feature created by the Create Example with a new feature (collection metadata without an update frequency). Once again, the replacement feature is

represented as a JSON payload. A pseudo-sequence diagram notation is used to illustrate the details of the HTTP communication between the client and the server.



Figure 6 – An Example of Replacing an Existing Collection:

7.4.2.3. Delete

The delete operation is defined in the [DELETE](#) conformance class of OGC API – Features.

1. Issue a DELETE request on {root}/collections/{collectionId} path

Support for the HTTP DELETE method is specified as a requirement in OGC API – Features.

REQUIREMENT 8

IDENTIFIER /req/mf-collection/collection-delete

INCLUDED IN Requirements class 1: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/>
req/mf-collection

A An implementation of the OGC API – MF SHALL comply with the OGC API – Feature DELETE operation requirement [/req/create-replace-delete/delete/delete-op](#).

The following example deletes the feature created by the Create Example and replaced with a new feature in the Replace Example. A pseudo-sequence diagram notation is used to illustrate the details of the HTTP communication between the client and the server.



Figure 7 – An Example of Deleting an Existing Collection:

7.4.3. Response

7.4.3.1. Retrieve

A successful response to the **Collection** GET operation is a set of metadata that describes the collection identified by the {collectionId} parameter.

REQUIREMENT 9

IDENTIFIER /req/mf-collection/collection-get-success

INCLUDED IN Requirements class 1: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/>
req/mf-collection

A An implementation of the OGC API – MF SHALL comply with the OGC API – Common **Collection** response requirement [/req/collections](#).

B The response SHALL only include collection metadata selected by the request.

C The content of that response SHALL be based upon the **Collection** response schema.

D The itemType property of the response schema SHALL be ‘movingfeature’.

```
type: object
required:
  - id
  - links
  - itemType
properties:
  id:
    description: identifier of the collection used, for example, in URIs
    type: string
    example: 'address'
  title:
    description: human readable title of the collection
    type: string
    example: 'address'
  description:
    description: a description of the features in the collection
    type: string
    example: 'An address.'
  links:
    type: array
    items:
      $ref: 'https://schemas.opengis.net/ogcapi/features/part1/1.0/openapi/
schemas/link.yaml'
    example:
      - href: https://data.example.com/buildings
        rel: item
      - href: https://example.com/concepts/buildings.html
        rel: describedby'
```

```

    type: text/html
extent:
  $ref: 'https://schemas.opengis.net/ogcapi/features/part1/1.0/openapi/
schemas/extent.yaml'
itemType:
  description: indicator about the type of the items in the collection
  type: string
  default: 'movingfeature'
crs:
  description: the list of coordinate reference systems supported by the
service
  type: array
  items:
    type: string
  default:
    - 'https://www.opengis.net/def/crs/OGC/1.3/CRS84'
example:
  - 'https://www.opengis.net/def/crs/OGC/1.3/CRS84'
  - 'https://www.opengis.net/def/crs/EPSG/0/4326'
updateFrequency:
  description: a time interval of sampling location. The unit is millisecond.
  type: number

```

Figure 8 – Collection GET Response Schema (collection.yaml)

The following JSON payload is an example of a response to an OGC API – Moving Features **Collection GET** operation.

```
{
  "id": "mfc-1",
  "title": "moving_feature_collection_sample",
  "itemType": "movingfeature",
  "updateFrequency": 1000,
  "extent": {
    "spatial": {
      "bbox": [
        -180, -90, 190, 90
      ],
      "crs": [
        "http://www.opengis.net/def/crs/OGC/1.3/CRS84"
      ]
    },
    "temporal": {
      "interval": [
        "2011-11-11T12:22:11Z", "2012-11-24T12:32:43Z"
      ],
      "trs": [
        "http://www.opengis.net/def/uom/ISO-8601/0/Gregorian"
      ]
    }
  },
  "links": [
    {
      "href": "https://data.example.org/collections/mfc-1",
      "rel": "self",
      "type": "application/json"
    }
  ]
}
```

Figure 9 – An Example of Collection GET Operation:

7.4.3.2. Replace

A successful response to the **Collection** PUT operation is an HTTP status code.

REQUIREMENT 10

IDENTIFIER /req/mf-collection/collection-put-success

INCLUDED IN Requirements class 1: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/>
req/mf-collection

- A** An implementation of the OGC API – MF SHALL comply with the OGC API – Feature PUT response requirement [/req/create-replace-delete/update-put-response](#).
- B** An implementation of the OGC API – MF SHALL comply with the OGC API – Feature PUT exception requirement [/req/create-replace-delete/update-put-rid-exception](#).

7.4.3.3. Delete

A successful response to the **Collection** DELETE operation is an HTTP status code.

REQUIREMENT 11

IDENTIFIER /req/mf-collection/collection-delete-success

INCLUDED IN Requirements class 1: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/>
req/mf-collection

- A** An implementation of the OGC API – MF SHALL comply with the OGC API – Feature DELETE response requirement [/req/create-replace-delete/delete/response](#).
- B** If no resource with the identifier exists in the collection, the server SHALL respond with a not-found exception (404).

7.4.4. Error situations

General guidance on HTTP status codes and how they should be handled is provided in Clause 9.2.

8

REQUIREMENTS CLASS “MOVING FEATURES”

REQUIREMENTS CLASS “MOVING FEATURES”

8.1. Overview

REQUIREMENTS CLASS 2: MOVING FEATURES

| | |
|----------------------|---|
| IDENTIFIER | http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/req/movingfeatures |
| TARGET TYPE | Web API |
| CONFORMANCE CLASS | Conformance class A.2: http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/conf/movingfeatures |
| PREREQUISITES | http://www.opengis.net/spec/ogcapi-common-1/1.0/req/core http://www.opengis.net/spec/ogcapi-features-1/1.0/req/core http://www.opengis.net/spec/ogcapi-features-4/1.0/req/create-replace-delete http://www.opengis.net/spec/movingfeatures/json/1.0/req/trajectory http://www.opengis.net/spec/movingfeatures/json/1.0/req/prism |
| NORMATIVE STATEMENTS | Requirement 12: /req/movingfeatures/param-subtrajectory-definition Requirement 13: /req/movingfeatures/param-subtrajectory-response Requirement 14: /req/movingfeatures/features-get Requirement 15: /req/movingfeatures/features-post Requirement 16: /req/movingfeatures/features-get-success Requirement 17: /req/movingfeatures/features-post-success Requirement 18: /req/movingfeatures/mf-mandatory Requirement 19: /req/movingfeatures/mf-get Requirement 20: /req/movingfeatures/mf-delete Requirement 21: /req/movingfeatures/mf-get-success Requirement 22: /req/movingfeatures/mf-delete-success Requirement 23: /req/movingfeatures/param-leaf-definition Requirement 24: /req/movingfeatures/param-leaf-response Requirement 25: /req/movingfeatures/tgsequence-get Requirement 26: /req/movingfeatures/tgsequence-post Requirement 27: /req/movingfeatures/tgsequence-get-success Requirement 28: /req/movingfeatures/tgsequence-post-success Requirement 29: /req/movingfeatures/tpgeometry-mandatory Requirement 30: /req/movingfeatures/tpgeometry-delete Requirement 31: /req/movingfeatures/tpgeometry-delete-success Requirement 32: /req/movingfeatures/tpgeometry-query Requirement 33: /req/movingfeatures/tpgeometry-query-success Requirement 34: /req/movingfeatures/param-subtemporalvalue-definition |

REQUIREMENTS CLASS 2: MOVING FEATURES

Requirement 35: /req/movingfeatures/param-subtemporalvalue-response
Requirement 36: /req/movingfeatures/tproperties-get
Requirement 37: /req/movingfeatures/tproperties-post
Requirement 38: /req/movingfeatures/tproperties-get-success
Requirement 39: /req/movingfeatures/tproperties-post-success
Requirement 40: /req/movingfeatures/tproperty-mandatory
Requirement 41: /req/movingfeatures/tproperty-get
Requirement 42: /req/movingfeatures/tproperty-post
Requirement 43: /req/movingfeatures/tproperty-delete
Requirement 44: /req/movingfeatures/tproperty-get-success
Requirement 45: /req/movingfeatures/tproperty-post-success
Requirement 46: /req/movingfeatures/tproperty-delete-success

The **MovingFeatures** requirements class defines the requirements for a moving feature. A moving feature is an object that provides information about and access to **TemporalGeometry** and **TemporalProperties**.

8.2. Information Resources

The seven resources defined in this Requirement Class are summarized in Table 7.

Table 7 – MovingFeatures Resources

| RESOURCE | URI | HTTP METHOD |
|---------------------------|---|-------------|
| MovingFeatures | {root}/collections/{collectionId}/items | GET, POST |
| MovingFeature | {root}/collections/{collectionId}/items/{mfeatureId} | GET, DELETE |
| TemporalGeometry | {root}/collections/{collectionId}/items/{mFeatureId}/tgsequence | GET, POST |
| TemporalPrimitiveGeometry | {root}/collections/{collectionId}/items/{mFeatureId}/tgsequence/{tGeometryId} | DELETE |
| TemporalGeometry Query | {root}/collections/{collectionId}/items/{mFeatureId}/tgsequence/{tGeometryId}/{queryType} | GET |

| RESOURCE | URI | HTTP METHOD |
|--------------------|--|-------------|
| TemporalProperties | {root}/collections/ {collectionId}/items/ {mFeatureId}/tproperties | GET, POST |
| TemporalProperty | {root}/collections/ {collectionId}/items/ {mFeatureId}/tproperties/ {tPropertiesName} | GET, POST |

8.3. Resource MovingFeatures

8.3.1. Overview

The **MovingFeatures** resource supports retrieving and creating operations via GET and POST HTTP methods respectively.

1. A retrieve operation returns a set of features which describes the moving feature available from this API.
2. A create operation posts a new **MovingFeature** resource instance to a specific **Collection** (specified by {collectionId} with this API.

The OGC API – MF Items query is an OGC API – Features endpoint that may be used to catalog pre-existing moving features. If a {mFeatureID} is not specified, the query will return a list of the available moving features. The list of moving features returned to the response can be limited using the bbox, datetime, limit, and subTrajectory query parameters. This behavior and query parameters for use with the Items query are specified in OGC API – Features and OGC API – Common, except subTrajectory parameter.

8.3.2. Query Parameters

Query parameters are used in URLs to define the resources which are returned on a GET request.

The query parameters bbox, datetime, and limit are inherited from OGC API – Common.

8.3.2.1. Parameter subTrajectory

The subTrajectory query parameter is defined as follows:

REQUIREMENT 12

| | |
|-------------|---|
| IDENTIFIER | /req/movingfeatures/param-subtrajectory-definition |
| INCLUDED IN | Requirements class 2: http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/ /req/movingfeatures |
| STATEMENT | <p>The operation SHALL support a query parameter <code>subTrajectory</code> with the following characteristics (using an OpenAPI Specification 3.0 fragment):</p> <pre>name: subTrajectory in: query required: false schema: type: boolean style: form explode: false</pre> |
| A | The <code>subTrajectory</code> parameter SHALL be used with <code>datetime</code> parameter. |
| B | If the <code>subTrajectory</code> parameter is “true”, the <code>datetime</code> parameter SHALL be a bounded interval, not half-bounded intervals or a date-time. |

REQUIREMENT 13

| | |
|-------------|---|
| IDENTIFIER | /req/movingfeatures/param-subtrajectory-response |
| INCLUDED IN | Requirements class 2: http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/req/ /req/movingfeatures |
| A | The endpoint SHALL return only a subsequence of the trajectory derived from temporal primitive geometry by the <code>subTrajectory</code> operation at a time interval (new start time and new end time) included in the <code>datetime</code> parameter, using interpolated trajectory according to the <code>interpolation</code> property in <code>TemporalPrimitiveGeometry</code> (Clause 8.6), if the <code>subTrajectory</code> parameter is “true”. |
| B | If the <code>subTrajectory</code> parameter is “true”, the <code>datetime</code> parameter SHALL match all temporal primitive geometry objects in the moving feature or moving feature collection. |
| C | If the <code>subTrajectory</code> parameter is “true”, the <code>interpolation</code> property in the response SHALL be the same as the temporal primitive geometry’s <code>interpolation</code> property value. |
| D | Apply <code>subTrajectory</code> only to resources that intersect a <code>bbox</code> parameter, if the <code>subTrajectory</code> parameter is provided with a <code>bbox</code> parameter. |
| E | The <code>subTrajectory</code> parameter SHALL not be used with the <code>leaf</code> (Clause 8.5.2.1) parameter. |

The `subTrajectory` query parameter is used to select a subsequence of `TemporalGeometrySequence` for the specified time interval. Each `MovingFeature` in the `MovingFeatures` has `TemporalGeometrySequence`. The `subTrajectory` parameter is used to implement the `subTrajectory` operation, which is defined in the [OGC Moving Feature Access Standard](#). This operation required two timestamps (`newStartTime` and `newEndTime`) to represent a

specified time interval. The time interval for the subTrajectory operation is taken from `datetime` parameter.

If the `subTrajectory` parameter is provided by the client, the endpoint SHALL return only a subset of the trajectory derived from temporal primitive geometry by the operation at time (`newStartTime` and `newEndTime`) included in the `subTrajectory` parameter, using interpolated trajectory according to the `interpolation` property in **TemporalPrimitiveGeometry**. The `interpolation` property in the response shall be the same as the original temporal primitive geometry.



Figure 11 – Example of a response result with `subTrajectory` parameter

8.3.3. Operation

8.3.3.1. Retrieve

The retrieve operation is defined in the Features conformance class of OGC API – Features. Additional support for query parameter `subTrajectory` is needed to support **MovingFeatures** resource.

1. Issue a GET request on `{root}/collections/{collectionID}/items` path

Support for GET on the `{root}/collections/{collectionID}/items` path is required by OGC API – Features.

REQUIREMENT 14

IDENTIFIER /req/movingfeatures/features-get

INCLUDED Requirements class 2: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/>
IN req/movingfeatures

REQUIREMENT 14

- A An implementation of the OGC API – MF SHALL comply with the OGC API – Features Features operation requirement [/req/core/fc-op](#).

8.3.3.1.1. Create

The create operation is defined in the [CREATE](#) conformance class of OGC API – Features. This operation targeted **MovingFeature** resource.

1. Issue a POST request on {root}/collections/{collectionID}/items path

Support for the HTTP POST method is specified as a requirement in OGC API – Features.

REQUIREMENT 15

IDENTIFIER /req/movingfeatures/features-post

- INCLUDED Requirements class 2: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/req/movingfeatures>
- A An implementation of the OGC API – MF SHALL comply with the OGC API – Feature CREATE operation requirement [/req/create-replace-delete/insert-post-op](#).
- B An implementation of the OGC API – MF SHALL comply with the OGC API – Feature CREATE request body requirements [/req/create-replace-delete/insert-body](#) and [/req/create-replace-delete/insert-content-type](#).
- C The content of the request body SHALL be based upon the [MovingFeature object](#) and [MovingFeature Collection object](#) in OGC Moving Features JSON Encoding Standard.

The following example adds a new feature ([MovingFeature object](#) in MF-JSON) to the specific **Collection**. The feature is represented as **MovingFeature** object (or **MovingFeatureCollection** object) in MF-JSON. A pseudo-sequence diagram notation is used to illustrate the details of the HTTP communication between the client and the server.



```

    "properties": {
      "name": "urn:ogc:def:crs:OGC:1.3:CRS84"
    }
  },
  "trs": {
    "type": "Link",
    "properties": {
      "type": "ogcdef",
      "href": "http://www.opengis.net/def/uom/ISO-8601/0/Gregorian"
    }
  },
  "temporalGeometry": {
    "type": "MovingPoint",
    "datetimes": [
      "2011-07-14T22:01:01.000Z",
      "2011-07-14T22:01:02.000Z",
      "2011-07-14T22:01:03.000Z",
      "2011-07-14T22:01:04.000Z",
      "2011-07-14T22:01:05.000Z"
    ],
    "coordinates": [
      [139.757083,35.627701,0.5],
      [139.757399,35.627701,2.0],
      [139.757555,35.627688,4.0],
      [139.757651,35.627596,4.0],
      [139.757716,35.627483,4.0]
    ],
    "interpolation": "Linear",
    "base": {
      "type": "glTF",
      "href": "http://.../example/car3dmodel.gltf"
    },
    "orientations": [
      {"scales": [1,1,1], "angles": [0,0,0]},
      {"scales": [1,1,1], "angles": [0,355,0]},
      {"scales": [1,1,1], "angles": [0,0,330]},
      {"scales": [1,1,1], "angles": [0,0,300]},
      {"scales": [1,1,1], "angles": [0,0,270]}
    ]
  },
  "temporalProperties": [
    {
      "datetimes": [
        "2011-07-14T22:01:01.450Z",
        "2011-07-14T23:01:01.450Z",
        "2011-07-15T00:01:01.450Z"
      ],
      "length": {
        "type": "Measure",
        "form": "http://www.qudt.org/qudt/owl/1.0.0/quantity/Length",
        "values": [1,2.4,1],
        "interpolation": "Linear",
        "description": "description1"
      },
      "discharge": {
        "type": "Measure",
        "form": "MQS",
        "values": [3,4,5],
        "interpolation": "Step"
      }
    },
    {
      "datetimes": [

```

```

        "2011-07-15T23:01:01.450Z",
        "2011-07-16T00:01:01.450Z"
    ],
    "camera": {
        "type": "Image",
        "values": [
            "http://.../example/image1",
            "VBORw0KGgoAAAANSUhEU...."
        ],
        "interpolation": "Discrete"
    },
    "labels": {
        "type": "Text",
        "values": ["car", "human"],
        "interpolation": "Discrete"
    }
}
]
}

----->
HTTP/1.1 201 Created
Location: /collections/mfc_1/items/mf_1
<-----

```

Figure 12 – An Example of Creating a New MovingFeature Object:

8.3.4. Response

8.3.4.1. Retrieve

A successful response to the **MovingFeatures** GET operation is a document that contains the static data for a set of moving features.

If the value of the `subTrajectory` query parameter is provided, the value of the corresponding `temporalGeometry` property of each moving feature is calculated using the `subTrajectory` parameter value and included in the result, i.e., a **MovingFeatureCollection** object of MF-JSON.

In a typical deployment of the OGF API – MF, the **MovingFeatures** GET response will list **MovingFeature** resource.

REQUIREMENT 16

IDENTIFIER /req/movingfeatures/features-get-success

INCLUDED IN Requirements class 2: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/>
`req/movingfeatures`

A An implementation of the OGC API – MF SHALL comply with the OGC API – Features Features response requirement [/req/core/fc-response](#).

B The response SHALL only include moving features selected by the request with `limit`, `bbox`, `datetime`, and `subTrajectory` parameters.

REQUIREMENT 16

C Each moving feature in the response SHALL include the mandatory properties listed in Table 8.

```
type: object
required:
  - type
  - features
properties:
  type:
    type: string
    enum:
      - 'FeatureCollection'
  features:
    type: array
    nullable: true
    items:
      $ref: 'movingFeature.yaml'
  crs:
    $ref: "https://schemas.opengis.net/movingfeatures/1.0/MF-JSON_Prism.schema.json#/definitions/crs"
  trs:
    $ref: "https://schemas.opengis.net/movingfeatures/1.0/MF-JSON_Prism.schema.json#/definitions/trs"
  bbox:
    $ref: "https://schemas.opengis.net/movingfeatures/1.0/MF-JSON_Prism.schema.json#/definitions/bbox"
  time:
    $ref: "https://schemas.opengis.net/movingfeatures/1.0/MF-JSON_Prism.schema.json#/definitions/time"
  links:
    type: array
    items:
      $ref: 'https://schemas.opengis.net/ogcapi/features/part1/1.0/openapi/schemas/link.yaml'
  timeStamp:
    type: string
    format: date-time
  numberMatched:
    type: integer
    minimum: 0
  numberReturned:
    type: integer
    minimum: 0
```

Figure 13 – MovingFeatures GET Response Schema (movingFeatureCollection.yaml):

The following JSON payload is an example of a response to an OGC API – Moving Features **MovingFeatures** GET operation.

```
{
  "type": "FeatureCollection",
  "features": [
    {
      "id": "mf-1",
      "type": "Feature",
      "geometry": {
        "type": "LineString",
        "coordinates": [
          [139.757083, 35.627701, 0.5],
          [139.757083, 35.627701, 0.5]
        ]
      }
    }
  ]
}
```

```

        [139.757399, 35.627701, 2.0],
        [139.757555, 35.627688, 4.0],
        [139.757651, 35.627596, 4.0],
        [139.757716, 35.627483, 4.0]
    ],
},
"properties": {
    "label": "car",
    "state": "test1",
    "video": "http://www.opengis.net/spec/movingfeatures/json/1.0/prism/
example/video.mpeg"
},
"bbox": [
    139.757083, 35.627483, 0.0,
    139.757716, 35.627701, 4.5
],
"time": [
    "2011-07-14T22:01:01Z",
    "2011-07-15T01:11:22Z"
],
"crs": {
    "type": "Name",
    "properties": "urn:ogc:def:crs:OGC:1.3:CRS84"
},
"trs": {
    "type": "Name",
    "properties": "urn:ogc:data:time:iso8601"
}
],
"crs": {
    "type": "Name",
    "properties": "urn:ogc:def:crs:OGC:1.3:CRS84"
},
"trs": {
    "type": "Name",
    "properties": "urn:ogc:data:time:iso8601"
},
"links": [
{
    "href": "https://data.example.org/collections/mfc-1/items",
    "rel": "self",
    "type": "application/geo+json"
},
{
    "href": "https://data.example.org/collections/mfc-1/items&offset=1&limit=
1",
    "rel": "next",
    "type": "application/geo+json"
}
],
"timeStamp": "2020-01-01T12:00:00Z",
"numberMatched": 100,
"numberReturned": 1
}

```

Figure 14 – An Example of a MovingFeatures GET Operation:

8.3.4.1.1. Create

A successful response to the **MovingFeatures** POST operation is an HTTP status code.

REQUIREMENT 17

IDENTIFIER /req/movingfeatures/features-post-success

INCLUDED IN Requirements class 2: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/req/movingfeatures>

A An implementation of the OGC API – MF SHALL comply with the OGC API – Feature CREATE response requirement [/req/create-replace-delete/insert-response](#) and [/req/create-replace-delete/insert-response-rid](#).

8.3.5. Error situations

General guidance on HTTP status codes and how they should be handled is provided in Clause 9.2.

8.4. Resource MovingFeature

8.4.1. Overview

A **MovingFeature** object consists of the set of static information that describes a single moving feature and the set of temporal object, such as temporal geometry and temporal properties. An abbreviated copy of this information is returned for each **MovingFeature** in the {root}/collections/{collectionId}/items GET response.

Table 8 defines the set of properties that may be used to describe a moving feature. The schema for the moving feature object presented in this clause is an extension of the **GeoJSON Feature Object** defined in GeoJSON. By default, the properties defined in Table 8 are the same as the **MovingFeature Object** in OGC MF-JSON. The semantics of each property are also the same as those defined in MF-JSON.

However, depending on where this schema is used (i.e., depending on which resource produces results with which query parameter), there are differences in requirements from the schema defined in MF-JSON; as sometimes it only needs to have static information, and sometimes it also has a **temporalGeometry**. For example, in MF-JSON, type and temporalGeometry are mandatory, but in this API, id and type are mandatory. This is why the defined schema is represented in GeoJSON, not MF-JSON.

Table 8 – Table of the properties related to the moving feature

| PROPERTY | REQUIREMENT | DESCRIPTION |
|---------------------------|-------------|---|
| <i>id</i> | M | A unique identifier to the moving feature. |
| <i>type</i> | M | The GeoJSON feature type (i.e., one of ‘Feature’ or ‘FeatureCollection’). |
| <i>geometry</i> | O | Projective geometry of the moving feature. |
| <i>properties</i> | O | A set of properties of GeoJSON. |
| <i>bbox</i> | O | Bounding box information for the moving feature. |
| <i>time</i> | O | Life span information for the moving feature. |
| <i>crs</i> | O | Coordinate reference system (CRS) information for the moving feature. |
| <i>trs</i> | O | Temporal reference system information for the moving feature. |
| <i>temporalGeometry</i> | O | A sequence of TemporalPrimitiveGeometry for the moving feature. |
| <i>temporalProperties</i> | O | A set of TemporalProperty of the moving feature. |

NOTE 1: The properties *id*, *type*, *geometry*, *properties*, and *bbox* were inherited from [GeoJSON](#).

NOTE 2: The properties *time*, *crs*, *trs*, *temporalGeometry*, and *temporalProperties* were inherited from [OGC MF-JSON](#)

REQUIREMENT 18

IDENTIFIER /req/movingfeatures/mf-mandatory

INCLUDED IN Requirements class 2: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/req/movingfeatures>

A A moving feature object SHALL contain all the mandatory properties listed in Table 8.

8.4.2. Operation

8.4.2.1. Retrieve

The retrieve operation is defined in the Feature conformance class of OGC API – Features. No modifications are needed to support **MovingFeature** resources.

1. Issue a GET request on the `{root}/collections/{collectionId}/items/{mFeatureId}` path

The `{mFeatureId}` path parameter is the unique identifier for a single moving feature offered by the API. The list of valid values for `{mFeatureId}` is provided in the `{root}/collections/{collectionId}/items` GET response.

Support for GET on the `{root}/collections/{collectionID}/items/{mFeatureId}` path is required by OGC API – Features.

REQUIREMENT 19

IDENTIFIER /req/movingfeatures/mf-get

INCLUDED IN Requirements class 2: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/req/movingfeatures>

A An implementation of the OGC API – MF SHALL comply with the OGC API – Features Feature operation requirement [/req/core/f-op](#).

B For every moving feature in a moving feature collection (path `{root}/collections/{collectionId}`), the server SHALL support the HTTP GET operation at the path `{root}/collections/{collectionId}/items/{mFeatureId}`

C The path parameter `collectionId` is each `id` property in the **Collection** GET operation response where the value of the `itemType` property is specified as **MovingFeature**. The path parameter `mFeatureId` is an `id` property of the moving feature.

8.4.2.2. Delete

The delete operation is defined in the DELETE conformance class of OGC API – Features.

1. Issue a DELETE request on `{root}/collections/{collectionId}/items/{mFeatureId}` path

Support for the HTTP DELETE method is required by OGC API – Features.

REQUIREMENT 20

IDENTIFIER /req/movingfeatures/mf-delete

INCLUDED IN Requirements class 2: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/req/movingfeatures>

A An implementation of the OGC API – MF SHALL comply with the OGC API – Feature DELETE operation requirement [req/create-replace-delete/delete/delete-op](#).

B For every moving feature in a moving feature collection (path {root}/collections/{collectionId}), the server SHALL support the HTTP DELETE operation at the path {root}/collections/{collectionId}/items/{mFeatureId}

C The path parameter collectionId is each id property in the **Collection** GET operation response where the value of the itemType property is specified as **MovingFeature**. The path parameter mFeatureId is an id property of the moving feature.

8.4.3. Response

8.4.3.1. Retrieve

A successful response to the **MovingFeature** GET operation is a set of metadata that describes the moving feature identified by the {mFeatureId} parameter. This response does not include a set of temporal object information. The temporal object information may be accessed using **TemporalGeometry** and **TemporalProperties** operations.

REQUIREMENT 21

IDENTIFIER /req/movingfeatures/mf-get-success

INCLUDED IN Requirements class 2: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/req/movingfeatures>

A A successful execution of the operation SHALL be reported as a response with an HTTP status code 200.

B The content of that response SHALL include the set of moving feature's metadata that defined in the response schema.

```
type: object
required:
  - id
  - type
properties:
  type:
    type: string
    enum:
      - 'Feature'
temporalGeometry:
```

```

$ref: "https://schemas.opengis.net/movingfeatures/1.0/MF-JSON_Prism.schema.json#/definitions/temporalGeometry"
temporalProperties:
  $ref: "https://schemas.opengis.net/movingfeatures/1.0/MF-JSON_Prism.schema.json#/definitions/temporalProperties"
crs:
  $ref: "https://schemas.opengis.net/movingfeatures/1.0/MF-JSON_Prism.schema.json#/definitions/crs"
trs:
  $ref: "https://schemas.opengis.net/movingfeatures/1.0/MF-JSON_Prism.schema.json#/definitions/trs"
bbox:
  $ref: "https://schemas.opengis.net/movingfeatures/1.0/MF-JSON_Prism.schema.json#/definitions/bbox"
time:
  $ref: "https://schemas.opengis.net/movingfeatures/1.0/MF-JSON_Prism.schema.json#/definitions/time"
geometry:
  $ref: 'https://schemas.opengis.net/ogcapi/features/part1/1.0/openapi/schemas/geometryGeoJSON.yaml'
properties:
  type: object
  nullable: true
id:
  description: 'An identifier for the feature'
  oneOf:
    - type: string
    - type: integer
links:
  type: array
  items:
    $ref: 'https://schemas.opengis.net/ogcapi/features/part1/1.0/openapi/schemas/link.yaml'

```

Figure 15 – MovingFeature GET Response Schema (movingFeature.yaml):

The time property of the **MovingFeature** response represents a particular period of moving feature existence.

The following JSON payload is an example of a response to an OGC API – Moving Features **MovingFeature** operation.

```
{
  "id": "mf-1",
  "type": "Feature",
  "geometry": {
    "type": "LineString",
    "coordinates": [
      [139.757083, 35.627701, 0.5],
      [139.757399, 35.627701, 2.0],
      [139.757555, 35.627688, 4.0],
      [139.757651, 35.627596, 4.0],
      [139.757716, 35.627483, 4.0]
    ]
  },
  "properties": {
    "name": "car1",
    "state": "test1",
    "video": "http://www.opengis.net/spec/movingfeatures/json/1.0/prism/example/video.mpeg"
  },
  "bbox": [

```

```

        139.757083, 35.627483, 0.0,
        139.757716, 35.627701, 4.5
    ],
    "time": [
        "2011-07-14T22:01:01Z",
        "2011-07-15T01:11:22Z"
    ],
    "crs": {
        "type": "Name",
        "properties": "urn:ogc:def:crs:OGC:1.3:CRS84"
    },
    "trs": {
        "type": "Name",
        "properties": "urn:ogc:data:time:iso8601"
    }
}

```

Figure 16 – An Example of a MovingFeature JSON Payload:

8.4.3.2. Delete

A successful response to the **Collection DELETE** operation is an HTTP status code.

REQUIREMENT 22

IDENTIFIER /req/movingfeatures/mf-delete-success

INCLUDED Requirements class 2: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/>
IN req/movingfeatures

A An implementation of the OGC API – MF SHALL comply with the OGC API – Features DELETE response requirement [/req/create-replace-delete/delete/response](#).

B If no resource with the identifier exists in the collection, the server SHALL respond with a not-found exception (404).

8.4.4. Error situations

General guidance on HTTP status codes and how they should be handled is provided in Clause 9.2.

8.5. Resource TemporalGeometrySequence

8.5.1. Overview

The **TemporalGeometrySequence** resource supports retrieving and creating operations via GET and POST HTTP methods respectively.

1. A retrieve operation returns a sequence of **TemporalPrimitiveGeometry** object which is included in the **MovingFeature** that specified by {mFeatureId}. The sequence of **TemporalPrimitiveGeometry** object returned to the response can be limited using the query parameters `limit`, `bbox`, `datetime`, and `leaf` (or `subTrajectory`).
2. A create operation posts a new **TemporalPrimitiveGeometry** resource to the **MovingFeature** that specified by {mFeatureId}.

8.5.2. Query Parameters

Query parameters are used in URLs to define the resources which are returned on a GET request.

The query parameters `bbox`, `datetime`, and `limit` are inherited from OGC API – Common.

The `subTrajectory` query parameter is defined in the **MovingFeatures** clause.

8.5.2.1. Parameter leaf

The `leaf` query parameter is defined as follows:

REQUIREMENT 23

IDENTIFIER /req/movingfeatures/param-leaf-definition

INCLUDED IN Requirements class 2: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/req/movingfeatures>

STATEMENT The operation SHALL support a query parameter `leaf` with the following characteristics (using an OpenAPI Specification 3.0 fragment):

```
name: leaf
in: query
required: false
schema:
  type: array
  uniqueItems: true
  minItems: 1
```

REQUIREMENT 23

```
items:  
  type: string  
  format: date-time  
style: form  
explode: false
```

- A The leaf parameter SHALL be a sequence of monotonic increasing instants with date-time strings.
- B The syntax of date-time is specified by [RFC 3339, 5.6](#).

REQUIREMENT 24

IDENTIFIER /req/movingfeatures/param-leaf-response

INCLUDED IN Requirements class 2: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/req/movingfeatures>

- A The leaf parameter SHALL match all resources in the moving feature that are associated with temporal information.
- B If the leaf parameter is provided by the client, the endpoint SHALL return only temporal geometry coordinate (or temporal property value) with the **pointAtTime** operation at each date-time included in the leaf parameter, using interpolated trajectory according to the interpolation property.
- C If the leaf parameter is provided by the client, the interpolation property in the response SHALL be 'Discrete'.
- D Apply leaf only to resources that intersect a bbox or (and) a datetime parameter, if the leaf parameter is provided with a bbox or (and) a datetime parameter.
- E The leaf parameter SHALL not be used with the subTrajectory(Clause 8.3.2.1) parameter.

The leaf parameter is a sequence of monotonic increasing instants represented by date-time strings (ex. "2018-02-12T23:20:50Z") whose structure adheres to [IETF RFC3339](#). The leaf parameter consists of a list of the date-time format strings, different from datetime parameter. The list does not allow the same element value. Figure 18 shows valid expression examples of the leaf parameter.

- (O) "2018-02-12T23:20:50Z"
- (O) "2018-02-12T23:20:50Z", "2018-02-12T23:30:50Z"
- (O) "2018-02-12T23:20:50Z", "2018-02-12T23:30:50Z", "2018-02-12T23:40:50Z"
- (X) "2018-02-12T23:20:50Z", "2018-02-12T23:20:50Z"
- (X) "2018-02-12T23:20:50Z", "2018-02-12T22:40:50Z"

Figure 18 – leaf parameter valid (and invalid) Examples

If the `leaf` parameter is provided by the client, the endpoint returns only temporal geometry coordinate (or temporal property value) with the leaf query at each time included in the `leaf` parameter, similar to `pointAtTime` operation in the [OGC Moving Feature Access Standard](#). The interpolation property in the response shall be "Discrete".



Figure 19 – Example of a response result with leaf parameter

8.5.3. Operation

8.5.3.1. Retrieve

- Issue a GET request on the `{root}/collections/{collectionId}/items/{mFeatureId}/tgsequence` path

REQUIREMENT 25

IDENTIFIER /req/movingfeatures/tgsequence-get

INCLUDED IN Requirements class 2: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/req/movingfeatures>

A For every moving feature identified in the **MovingFeatures**(Clause 8.3) GET response (path `{root}/collections/{collectionId}/items`), the server SHALL support the HTTP GET operation at the path `{root}/collections/{collectionId}/items/{mFeatureId}/tgsequence`

B The path parameter `collectionId` is each `id` property in the **Collection**(Clause 7.4) GET response where the value of the `itemType` property is specified as **MovingFeature**. The path parameter `mFeatureId` is each `id` property in the **MovingFeatures**(Clause 8.3) GET response.

8.5.3.1.1. Create

The create operation is defined in the [CREATE](#) conformance class of OGC API – Features. This operation targeted **TemporalPrimitiveGeometry** resource.

1. Issue a POST request on `{root}/collections/{collectionId}/items/{mFeatureId}/tgsequence` path

Support for the HTTP POST method is specified as a requirement in OGC API – Features.

REQUIREMENT 26

IDENTIFIER /req/movingfeatures/tgsequence-post

INCLUDED IN Requirements class 2: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/req/movingfeatures>

A An implementation of the OGC API – MF SHALL comply with the OGC API – Feature CREATE operation requirement [/req/create-replace-delete/insert-post-op](#).

B An implementation of the OGC API – MF SHALL comply with the OGC API – Feature CREATE request body requirements [/req/create-replace-delete/insert-body](#) and [/req/create-replace-delete/insert-content-type](#).

C The content of the request body SHALL be based upon the [TemporalPrimitiveGeometry object](#) in OGC Moving Features JSON Encoding Standard schema.

D The ending date-time instance (`t_end`) in the temporal geometry object in **MovingFeature**(Clause 8.4), determined by `mFeatureId`, SHALL be earlier than the beginning date-time instance (`t_new`) in the temporal geometry object in the request body, i.e., $t_end < t_new$.

The following example adds a new feature ([TemporalPrimitiveGeometry object](#) in MF-JSON) to the feature created by the Creation a MovingFeature Example. The feature is represented as **TemporalPrimitiveGeometry** object in MF-JSON, which is an extension of the JSON. A pseudo-sequence diagram notation is used to illustrate the details of the HTTP communication between the client and the server.

Client

```
POST /collections/mfc_1/items/mf_1/tgsequence HTTP/1.1
Content-Type: application/json

{
  "id": "tg_1",
  "type": "MovingPoint",
  "datetimes": [
    "2011-07-14T22:01:06.000Z",
    "2011-07-14T22:01:07.000Z",
    "2011-07-14T22:01:08.000Z"
  ],
  "coordinates": [
```

Server

```

        [139.757716,35.627483,4.0],
        [139.757782,35.627483,4.0],
        [139.757843,35.627483,4.0]
    ],
    "interpolation": "Linear",
    "base": {
        "type": "glTF",
        "href": "http://.../example/car3dmodel.gltf"
    },
    "orientations": [
        {"scales": [1,1,1],"angles": [0,0,270]},
        {"scales": [1,1,1],"angles": [0,0,270]},
        {"scales": [1,1,1],"angles": [0,0,270]}
    ]
}
----->
HTTP/1.1 201 Created
Location: /collections/mfc_1/items/mf_1/tgsequence/tg_1
<-----

```

Figure 20 – An Example of Creating a New TemporalPrimitiveGeometry Object:

8.5.4. Response

8.5.4.1. Retrieve

A successful response to the **TemporalGeometrySequence** GET operation is a document that contains the set of temporal geometry of the moving feature identified by the {mFeatureId} parameter.

REQUIREMENT 27

IDENTIFIER /req/movingfeatures/tgsequence-get-success

INCLUDED IN Requirements class 2: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/>
req/movingfeatures

A An implementation of the OGC API – MF SHALL comply with the OGC API – Feature Features response requirement [/req/core/fc-response](#).

B The response SHALL only include temporal primitive geometry selected by request with limit, bbox, datetime, and leaf (or subTrajectory) parameters.

C Each temporal primitive geometry in the response SHALL include the mandatory properties listed in Table 9.

```

type: object
required:
  - type
  - geometrySequence
properties:
  type:
    type: string

```

```

enum:
  - "TemporalGeometrySequence"
geometrySequence:
  type: array
  items:
    $ref: 'https://schemas.opengis.net/movingfeatures/1.0/MF-JSON_Prism.
schema.json#/definitions/temporalPrimitiveGeometry'
links:
  type: array
  items:
    $ref: 'https://schemas.opengis.net/ogcapi/features/part1/1.0/openapi/
schemas/link.yaml'
timeStamp:
  type: string
  format: date-time
numberMatched:
  type: integer
  minimum: 0
numberReturned:
  type: integer
  minimum: 0

```

Figure 21 – TemporalGeometrySequence GET Response Schema (temporalGeometrySequence.yaml):

The following JSON payload is an example of a response to an OGC API – Moving Features TemporalGeometrySequence GET operation.

```
{
  "type": "TemporalGeometrySequence",
  "geometrySequence": [
    {
      "id": "tg-1",
      "type": "MovingPoint",
      "datetimes": [
        "2011-07-14T22:01:02Z",
        "2011-07-14T22:01:03Z",
        "2011-07-14T22:01:04Z"
      ],
      "coordinates": [
        [139.757399, 35.627701, 2.0],
        [139.757555, 35.627688, 4.0],
        [139.757651, 35.627596, 4.0]
      ],
      "interpolation": "Linear",
      "base": {
        "type": "glTF",
        "href": "https://www.opengis.net/spec/movingfeatures/json/1.0/prism/
example/car3dmodel.gltf"
      },
      "orientations": [
        {
          "scales": [1,1,1],
          "angles": [0,355,0]
        },
        {
          "scales": [1,1,1],
          "angles": [0,0,330]
        },
        {
          "scales": [1,1,1],
          "angles": [0,0,300]
        }
      ]
    }
  ]
}
```

```

        }
    ],
    "crs": {
        "type": "Name",
        "properties": "urn:ogc:def:crs:OGC:1.3:CRS84"
    },
    "trs": {
        "type": "Name",
        "properties": "urn:ogc:data:time:iso8601"
    }
}
],
"links": [
{
    "href": "https://data.example.org/collections/mfc-1/items/mf-1/tgsequence",
    "rel": "self",
    "type": "application/json"
},
{
    "href": "https://data.example.org/collections/mfc-1/items/mf-1/tgsequence&offset=10&limit=1",
    "rel": "next",
    "type": "application/json"
}
],
"timeStamp": "2021-09-01T12:00:00Z",
"numberMatched": 100,
"numberReturned": 1
}

```

Figure 22 – An Example of a TemporalGeometrySequence GET operation:

8.5.4.1.1. Create

A successful response to the **TemporalGeometrySequence** POST operation is an HTTP status code.

REQUIREMENT 28

IDENTIFIER /req/movingfeatures/tgsequence-post-success

INCLUDED IN Requirements class 2: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/req/movingfeatures>

A An implementation of the OGC API – MF SHALL comply with the OGC API – Feature CREATE response requirement [/req/create-replace-delete/insert-response_and /req/create-replace-delete/insert-response-rid](#).

8.5.5. Error situations

General guidance on HTTP status codes and how they should be handled is provided in Clause 9.2.

8.6. Resource TemporalPrimitiveGeometry

8.6.1. Overview

A **TemporalPrimitiveGeometry** resource represents the movement of a moving feature with various types of moving geometry, i.e., `MovingPoint`, `MovingLineString`, `MovingPolygon`, and `MovingPointCloud`. It can also represent the movement of a 3D object with its orientation.

The schema for the **TemporalPrimitiveGeometry** presented in this clause is the same as the **TemporalPrimitiveGeometry** object defined in MF-JSON. Table 9 defines the set of properties that may be used to describe a **TemporalPrimitiveGeometry**.

Table 9 – Table of the properties related to the **TemporalPrimitiveGeometry**

| PROPERTY | REQUIREMENT | DESCRIPTION |
|----------------------------|-------------|--|
| <code>id</code> | M | A unique identifier to the temporal primitive geometry. |
| <code>type</code> | M | A primitive geometry type of MF-JSON (i.e., one of ‘MovingPoint’, ‘MovingLineString’, ‘MovingPolygon’, or ‘MovingPointCloud’). |
| <code>datetimes</code> | M | A sequence of monotonically increasing instants. |
| <code>coordinates</code> | M | A sequence of leaf geometries of a temporal geometry, having the same number of elements as “datetimes”. |
| <code>interpolation</code> | M | A predefined type of motion curve (i.e., one of ‘Discrete’, ‘Step’, ‘Linear’, ‘Quadratic’ or ‘Cubic’). |
| <code>base</code> | O | type: A type of 3D file format, such as ‘STL’, ‘OBJ’, ‘PLY’, and ‘glTF’. href: A URL to address a 3D model data which represents a base geometry of a 3D shape. |
| <code>orientations</code> | O | scales: An array value of numbers along the x, y, and z axis in order as three scale factors. |

| PROPERTY | REQUIREMENT DESCRIPTION |
|----------|--|
| | <i>angles</i> : An array value of numbers along the x, y, and z axis in order as Euler angles in degree. |

NOTE: The detailed information and requirements for each property are described in the OGC Moving Feature JSON Encoding Standard.

REQUIREMENT 29

| | |
|-------------|---|
| IDENTIFIER | /req/movingfeatures/tpgeometry-mandatory |
| INCLUDED IN | Requirements class 2: http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/ req/movingfeatures |
| A | TemporalPrimitiveGeometry object SHALL contain all the mandatory properties listed in Table 9. |

8.6.2. Operation

8.6.2.1. Delete

The delete operation is defined in the DELETE conformance class of API – Features.

1. Issue a DELETE request on {root}/collections/{collectionId}/items/{mFeatureId}/tgsequence/{tGeometryId} path

The {tGeometryId} parameter is the unique identifier for a TemporalPrimitiveGeometry object offered by the API. The list of valid values for {tGeometryId} is provided in the {root}/collections/{collectionId}/items/{mFeatureId}/tgsequence GET response.

Support for the HTTP DELETE method is specified as a requirement in OGC API – Features.

REQUIREMENT 30

| | |
|-------------|---|
| IDENTIFIER | /req/movingfeatures/tpgeometry-delete |
| INCLUDED IN | Requirements class 2: http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/ req/movingfeatures |
| A | An implementation of the OGC API – MF SHALL comply with the OGC API – Feature DELETE operation requirement /req/create-replace-delete/delete/delete-op . |

REQUIREMENT 30

- B For every temporal geometry in a moving feature (path {root}/collections/{collectionId}/items/{mFeatureId}), the server SHALL support the HTTP DELETE operation at the path {root}/collections/{collectionId}/items/{mFeatureId}/tgsequence/{tGeometryId}
- C The path parameter collectionId is each id property in the **Collection** GET operation response where the value of the itemType property is specified as **MovingFeature**.
The path parameter mFeatureId is an id property of the moving feature.
The path parameter tGeometryId is an id property of the temporal geometry.

8.6.3. Response

8.6.3.1. Delete

A successful response to the **TemporalPrimitiveGeometry** DELETE operation is an HTTP status code.

REQUIREMENT 31

IDENTIFIER /req/movingfeatures/tpgeometry-delete-success

- INCLUDED IN** Requirements class 2: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/>
A An implementation of the OGC API – MF SHALL comply with the OGC API – Feature DELETE response requirement [/req/create-replace-delete/delete/response](#).
B If no resource with the identifier exists in the collection, the server SHALL respond with a not-found exception (404).

8.6.4. Error situations

General guidance on HTTP status codes and how they should be handled is provided in Clause 9.2.

8.7. TemporalGeometry Query Resources

8.7.1. Overview

TemporalGeometry Query resources are spatiotemporal queries that support operations for accessing TemporalPrimitiveGeometry resources. The OGC API – MF Standard identifies an initial set of common query types to implement. These are described in this clause. This list may change as the Standard is used and experience is gained.

Query resources related to the TemporalPrimitiveGeometry resource can be exposed using the path templates:

- `{root}/collections/{collectionId}/items/{mFeatureId}/tgsequence/{tGeometryId}/{queryType}`

Where:

- `{root}` = Base URI for the API server
- `{collectionId}` = An identifier for a specific **Collection** of data
- `{mFeatureId}` = An identifier for a specific **MovingFeature** of a specific **Collection** of data
- `{tGeometryId}` = An identifier for a specific **TemporalPrimitiveGeometry** of a specific **MovingFeature** of data
- `{queryType}` = An identifier for the query pattern performed by an implementation instance of the OGC API – MF.

Table 10 provides a mapping of the initial query types proposed for the OGC API – MF.

Table 10 – Table of the query resources

| PATH TEMPLATE | QUERY TYPE | DESCRIPTION |
|---|--------------|--|
| <code>{root}/collections/{collectionId}/items/{mFeatureId}/tgsequence/{tGeometryId}/distance</code> | Distance | Return a graph of the time to distance function as a form of the TemporalProperty . |
| <code>{root}/collections/{collectionId}/items/{mFeatureId}/tgsequence/{tGeometryId}/velocity</code> | Velocity | Return a graph of the time to velocity function as a form of the TemporalProperty . |
| <code>{root}/collections/{collectionId}/items/{mFeatureId}/tgsequence/{tGeometryId}/acceleration</code> | Acceleration | Return a graph of the time to acceleration function as a form of the TemporalProperty . |

8.7.2. Query parameters

Query parameters are used in URLs to define the resources which are returned on a GET request. The query parameters datetime is inherited from OGC API – Common.

8.7.3. Distance Query

The Distance query returns a time-to-distance curve of the **TemporalPrimitiveGeometry** object as a form of the **TemporalProperty**. Figure 23 shows an example of the time-to-distance curve.



Figure 23 – Example of time-to-distance curve [OGC 16-120r3, OGC Moving Features Access]

The filter constraints are defined by the following query parameter:

8.7.3.1. Parameter **datetime**

The **datetime** parameter defines the specified date and time to return the distance value from the time-to-distance curve. If the **datetime** is provided, the **datetime** must be a date-time, not a half-bounded interval or bounded interval. When the **datetime** is not specified, an implementation instance (endpoint) of the API returns data from all available times of the specified **TemporalPrimitiveGeometry** resource.

8.7.4. Velocity Query

The Velocity query returns a time-to-velocity curve of the **TemporalPrimitiveGeometry** object as a form of the **TemporalProperty**.

The filter constraints are defined by the following query parameter:

8.7.4.1. Parameter `datetime`

The `datetime` parameter defines the specified date and time to return the velocity value from the time-to-velocity graph. If the `datetime` is provided, the `datetime` must be a date-time, not a half-bounded interval or bounded interval. When the `datetime` is not specified, an implementation instance (endpoint) of the API returns data from all available times of the specified **TemporalPrimitiveGeometry** resource.

8.7.5. Acceleration Query

The Acceleration query returns a time-to-acceleration curve of the **TemporalPrimitiveGeometry** object as a form of the **TemporalProperty**.

The filter constraints are defined by the following query parameter:

8.7.5.1. Parameter `datetime`

The `datetime` parameter defines the specified date and time to return the acceleration value from the time-to-acceleration curve. If the `datetime` is provided, the `datetime` must be a date-time, not a half-bounded interval or bounded interval. When the `datetime` is not specified, an implementation instance (endpoint) of the API returns data from all available times of the specified **TemporalPrimitiveGeometry** resource.

8.7.6. Operation Requirements

REQUIREMENT 32

IDENTIFIER /req/movingfeatures/tpgeometry-query

INCLUDED IN Requirements class 2: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/req/movingfeatures>

A For every **TemporalPrimitiveGeometry** identified in the **TemporalGeometrySequence**(Clause 8.5) GET response (path `{root}/collections/{collectionId}/items/{mFeatureId}/tgsequence`), the server SHALL support the HTTP GET operation at the path `{root}/collections/{collectionId}/items/{mFeatureId}/tgsequence/{tGeometryId}/{queryType}`

B The path parameter `collectionId` is each `id` property in the **Collection** GET operation response where the value of the `itemType` property is specified as **MovingFeature**.
The path parameter `mFeatureId` is an `id` property of the moving feature.
The path parameter `tGeometryId` is an `id` property of the temporal geometry.

C The path parameter `queryType` SHALL be one of the predefined query type (**distance**, **velocity**, and **acceleration**)

REQUIREMENT 32

- D If the datetime parameter is provided, the datetime SHALL be a date-time, not a half-bounded interval or bounded interval.

PERMISSION 1

IDENTIFIER /per/movingfeatures/tpgeometry-query

A A distance query GET operation MAY include a datetime query parameter.

B A velocity query GET operation MAY include a datetime query parameter.

C An acceleration query GET operation MAY include a datetime query parameter.

8.7.7. Response Requirements

REQUIREMENT 33

IDENTIFIER /req/movingfeatures/tpgeometry-query-success

INCLUDED IN Requirements class 2: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/>
req/movingfeatures

A A successful execution of the distance, velocity, and acceleration query GET operation SHALL be reported as a response with an HTTP status code 200.

B The content of that response SHALL include the parametric value that is defined in the response schema.

C The type property SHALL be “TReal”

8.8. Resource TemporalProperties

8.8.1. Overview

A **TemporalProperties** object consists of the set of **TemporalProperty** which is included in the **MovingFeature** that is specified by {mFeatureId}. The **TemporalProperties** resource supports the retrieve and create operations via the HTTP GET and POST methods respectively.

1. A retrieve operation returns a list of the available abbreviated copy of **TemporalProperty** object in the specified moving feature. The **TemporalProperties** resource returned to the response can be limited using the query parameters `limit`, `datetime`, and `subTemporalValue`.
2. A create operation posts a new **TemporalProperty** object to the **MovingFeature** that is specified by `{mFeatureId}`.

8.8.2. Query Parameters

Query parameters are used in URLs to define the resources which are returned on a GET request.

The query parameters `datetime` and `limit` are inherited from OGC API – Common.

8.8.2.1. Parameter subTemporalValue

The `subTemporalValue` query parameter is defined as follows:

REQUIREMENT 34

IDENTIFIER /req/movingfeatures/param-subtemporalvalue-definition

INCLUDED IN Requirements class 2: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/>
req/movingfeatures

STATEMENT The operation SHALL support a query parameter `subTemporalValue` with the following characteristics (using an OpenAPI Specification 3.0 fragment):

```
name: subTemporalValue
in: query
required: false
schema:
  type: boolean
  style: form
  explode: false
```

A The `subTemporalValue` parameter SHALL be used with `datetime` parameter.

B If the `subTemporalValue` parameter is “true”, the `datetime` parameter SHALL be a bounded interval, not half-bounded intervals or a date-time.

REQUIREMENT 35

IDENTIFIER /req/movingfeatures/param-subtemporalvalue-response

REQUIREMENT 35

| | |
|-------------|--|
| INCLUDED IN | Requirements class 2: http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/req/movingfeatures |
| A | The endpoint SHALL return only a subsequence of the temporal primitive values derived from temporal property for a specified time interval (new start time and new end time) included in the datetime parameter, using interpolated temporal property values according to the interpolation property in TemporalProperty (Clause 8.9), if the subTemporalValue parameter is “true”. |
| B | If the subTemporalValue parameter is “true”, the datetime parameter SHALL match all temporal property objects in the moving feature. |
| C | If the subTemporalValue parameter is “true”, the interpolation property in the response SHALL be the same as the temporal property’s interpolation property value. |
| D | The subTemporalValue parameter SHALL not be used with the leaf(Clause 8.5.2.1) parameter. |

The subTemporalValue query parameter is used to select a subset of **TemporalProperty** for the specified time interval. Each **TemporalProperty** in the **TemporalProperties** has a sequence of **TemporalPrimitiveValue**. The subTemporalValue parameter behaves functionally the same as the subTrajectory parameter. The difference is that subTrajectory is associated with temporal geometry, while subTemporalValue is associated with temporal properties.

8.8.3. Operation

8.8.3.1. Retrieve

1. Issue a GET request on the {root}/collections/{collectionId}/items/{mFeatureId}/tproperties path

REQUIREMENT 36

IDENTIFIER /req/movingfeatures/tproperties-get

| | |
|-------------|---|
| INCLUDED IN | Requirements class 2: http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/req/movingfeatures |
| A | For every moving feature identified in the MovingFeatures (Clause 8.3) GET response (path {root}/collections/{collectionId}/items), the server SHALL support the HTTP GET operation at the path {root}/collections/{collectionId}/items/{mFeatureId}/tproperties |
| B | The path parameter collectionId is each id property in the Collection (Clause 7.4) GET response where the value of the itemType property is specified as MovingFeature . The path parameter mFeatureId is each id property in the MovingFeatures (Clause 8.3) GET response. |

8.8.3.1.1. Create

The create operation is defined in the [CREATE](#) conformance class in the OGC API – Features. This operation targeted **TemporalProperty** resource.

1. Issue a POST request on `{root}/collections/{collectionId}/items/{mFeatureId}/tproperties` path

Support for the HTTP POST method is specified as a requirement in OGC API – Features.

REQUIREMENT 37

IDENTIFIER /req/movingfeatures/tproperties-post

INCLUDED IN Requirements class 2: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/req/movingfeatures>

A An implementation of the OGC API – MF SHALL comply with the OGC API – Feature CREATE operation requirement [/req/create-replace-delete/insert-post-op](#).

B An implementation of the OGC API – MF SHALL comply with the OGC API – Feature CREATE request body requirements [/req/create-replace-delete/insert-body](#) and [/req/create-replace-delete/insert-content-type](#).

C The content of the request body SHALL be based upon a TemporalProperty defined in this API or a [ParametricValues object](#) defined in OGC Moving Features JSON Encoding Standard.

```
type: object
required:
  - name
  - type
properties:
  name:
    type: string
  type:
    type: string
    enum:
      - 'TBoolean'
      - 'TText'
      - 'TInteger'
      - 'TReal'
      - 'TImage'
  form:
    oneOf:
      - type: string
        format: uri
      - type: string
        minLength: 3
        maxLength: 3
  valueSequence:
    type: array
    uniqueItems: true
    items:
```

```
        $ref: 'temporalPrimitiveValue.yaml'  
description:  
  type: string  
links:  
  type: array  
  items:  
    $ref: 'https://schemas.opengis.net/ogcapi/features/part1/1.0/openapi/  
schemas/link.yaml'
```

Figure 25 – TemporalProperties Request Body Schema (temporalProperty.yaml):

The following example adds a new feature (**TemporalProperty Object** and **ParametricValues Object** in MF-JSON) to the feature created by the Creation a MovingFeature Example. The feature is represented as a JSON payload. A pseudo-sequence diagram notation is used to illustrate the details of the HTTP communication between the client and the server.



Figure 26 – An Example of Creating a New TemporalProperty Object:



|<-----|

Figure 27 – An Example of Creating a New TemporalProperty Object with *ParametricValues* as a MF-JSON encoding:

8.8.4. Response

8.8.4.1. Retrieve

A successful response to the **TemporalProperties** GET operation is a document that contains the set of metadata (and static data) of **TemporalProperty** in the moving feature identified by the {mFeatureId} parameter. The response result does not include dynamic (and temporal information).

If the value of the subTemporalValue query parameter is provided, the temporal value of the corresponding **temporalProperties** property of the moving feature is calculated using the subTemporalValue parameter value and included in the result.

REQUIREMENT 38

IDENTIFIER /req/movingfeatures/tproperties-get-success

INCLUDED IN Requirements class 2: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/>
req/movingfeatures

A An implementation of the OGC API – MF SHALL comply with the OGC API – Feature Features response requirement [/req/core/fc-response](#).

B The response SHALL only include moving features selected by the request with limit, datetime, and subTemporalValue parameters.

C Each temporal property object in the response SHALL include the mandatory properties listed in Table 11.

```
type: object
required:
  - temporalProperties
properties:
  temporalProperties:
    oneOf:
      - $ref: "https://schemas.opengis.net/movingfeatures/1.0/MF-JSON_Prism.schema.json#/definitions/temporalProperties"
        - type: array
          items:
            $ref: "temporalProperty.yaml"
  links:
    type: array
    items:
      $ref: 'https://schemas.opengis.net/ogcapi/features/part1/1.0/openapi/schemas/link.yaml'
  timeStamp:
    type: string
```

```

    format: date-time
numberMatched:
  type: integer
  minimum: 0
numberReturned:
  type: integer
  minimum: 0

```

Figure 28 – TemporalProperties GET Response Schema (TemporalProperties.yaml):

The following JSON payload is an example of a response to an OGC API – Moving Features **TemporalProperties** GET operation.

```
{
  "temporalProperties": [
    {
      "name": "length",
      "type": "TReal",
      "form": "http://www.qudt.org/qudt/owl/1.0.0/quantity/Length"
    },
    {
      "name": "speed",
      "type": "TReal",
      "form": "KMH"
    }
  ],
  "links": [
    {
      "href": "https://data.example.org/collections/mfc-1/items/mf-1/
tproperties",
      "rel": "self",
      "type": "application/json"
    },
    {
      "href": "https://data.example.org/collections/mfc-1/items/mf-1/
tproperties&offset=2&limit=2",
      "rel": "next",
      "type": "application/json"
    }
  ],
  "timeStamp": "2021-09-01T12:00:00Z",
  "numberMatched": 10,
  "numberReturned": 2
}
```

Figure 29 – An Example of a TemporalProperties GET Operation:

The following JSON payload is an example of a response to an OGC API – Moving Features **TemporalProperties** GET operation with query parameter subTemporalValue.

```
{
  "temporalProperties": [
    {
      "datetimes": ["2011-07-14T22:01:06.000Z", "2011-07-14T22:01:07.000Z",
"2011-07-14T22:01:08.000Z"],
      "length": {
        "type": "Measure",
        "form": "http://www.qudt.org/qudt/owl/1.0.0/quantity/Length",
        "values": [1.0, 2.4, 1.0],
        "interpolation": "Linear"
      }
    }
  ]
}
```

```

        },
        "speed" : {
            "type" : "Measure",
            "form" : "KMH",
            "values" : [65.0, 70.0, 80.0],
            "interpolation": "Linear"
        }
    }
],
"links": [
{
    "href": "https://data.example.org/collections/mfc-1/items/mf-1/tproperties",
    "rel": "self",
    "type": "application/json"
},
{
    "href": "https://data.example.org/collections/mfc-1/items/mf-1/tproperties&offset=2&limit=2",
    "rel": "next",
    "type": "application/json"
}
],
"timeStamp": "2021-09-01T12:00:00Z",
"numberMatched": 10,
"numberReturned": 2
}

```

Figure 30 – An Example of a TemporalProperties GET Operation with subTemporalValue:

8.8.4.1.1. Create

A successful response to the **TemporalProperties** POST operation is an HTTP status code.

REQUIREMENT 39

IDENTIFIER /req/movingfeatures/tproperties-post-success

INCLUDED IN Requirements class 2: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/req/movingfeatures>

A An implementation of the OGC API – MF SHALL comply with the OGC API – Feature CREATE response requirement [/req/create-replace-delete/insert-response](#) and [/req/create-replace-delete/insert-response-rid](#).

8.8.5. Error situations

General guidance on HTTP status codes and how they should be handled is provided in Clause 9.2.

8.9. Resource TemporalProperty

8.9.1. Overview

The **TemporalProperty** resource supports the retrieve and create operations via the HTTP GET and POST methods respectively.

1. A retrieve operation returns a **TemporalProperty** resource which is included in the **TemporalProperties** that specified by {tPropertyName}. The **TemporalProperty** resource returned to the response can be limited using the parameters `datetime`, `leaf` and `subTemporalValue`.
2. A create operation posts a new temporal primitive value object to the **TemporalProperties** that specified by {tPropertyName}.

A temporal property object is a collection of dynamic non-spatial attributes and their temporal values with time. An abbreviated copy of this information is returned for each **TemporalProperty** in the `{root}/collections/{collectionId}/items/{mFeatureId}/tproperties` response.

The schema for the temporal property object presented in this clause is an extension of the [ParametricValues Object](#) defined in MF-JSON. Table 11 defines the set of property that may be used to describe a temporal property.

Table 11 – Table of the properties related to the temporal property

| PROPERTY | REQUIREMENT | DESCRIPTION |
|----------------------------|-------------|--|
| <code>name</code> | M | An identifier for the resource assigned by an external entity. |
| <code>type</code> | M | A predefined temporal property type (i.e., one of 'TBoolean', 'TText', 'TInteger', 'TReal', and 'TImage'). |
| <code>valueSequence</code> | M | A sequence of temporal primitive value |
| <code>form</code> | O | A unit of measure. |
| <code>description</code> | O | A short description. |

Table 12 – Table of the properties related to the temporal primitive value

| PROPERTY | REQUIREMENT | DESCRIPTION |
|------------------------|-------------|--|
| <code>datetimes</code> | M | A sequence of monotonic increasing instants. |

| PROPERTY | REQUIREMENT DESCRIPTION |
|----------------------|---|
| <i>values</i> | M A sequence of dynamic values having the same number of elements as "datetimes". |
| <i>interpolation</i> | M A predefined type for a dynamic value (i.e., one of 'Discrete', 'Step', 'Linear', or 'Regression'). |

NOTE: The detailed information and requirements for each property are described in the OGC Moving Feature JSON Encoding Standard.

REQUIREMENT 40

| | |
|-------------|--|
| IDENTIFIER | /req/movingfeatures/tproperty-mandatory |
| INCLUDED IN | Requirements class 2: http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/ req/movingfeatures |
| A | A temporal property object SHALL contain all the mandatory properties listed in Table 11 and Table 12. |

8.9.2. Query Parameters

Query parameters are used in URLs to define the resources which are returned on a GET request.

The query parameter [datetime](#) is inherited from OGC API – Common.

The leaf query parameter is defined in the **TemporalGeometrySequence** clause.

The subTemporalValue query parameter is defined in the **TemporalProperties** clause.

8.9.3. Operation

8.9.3.1. Retrieve

1. Issue a GET request on the {root}/collections/{collectionId}/items/{mFeatureId}/tproperties/{tPropertyName} path

The {tPropertyName} parameter is the unique identifier for a single temporal property value offered by an implementation instance (endpoint) of the OGC API – MF. The list of valid values for {tPropertyName} is provided in the {root}/collections/{collectionId}/items/{mFeatureId}/tproperties GET response.

REQUIREMENT 41

IDENTIFIER /req/movingfeatures/tproperty-get

INCLUDED IN Requirements class 2: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/req/movingfeatures>

A For every temporal property in a moving feature (path {root}/collections/{collectionId}/items/{mFeatureId}/tproperties), the server SHALL support the HTTP GET operation at the path {root}/collections/{collectionId}/items/{mFeatureId}/tproperties/{tPropertyName}

The path parameter collectionId is each id property in the **Collection**(Clause 7.4) GET response where the value of the itemType property is specified as **MovingFeature**.

B The path parameter mFeatureId is each id property in the **MovingFeatures**(Clause 8.3) GET response.

tPropertyName is a local identifier of the temporal property.

8.9.3.1.1. Create

The create operation is defined in the CREATE conformance class in the OGC API – Features. This operation targeted the new temporal primitive value object defined in Table 12.

1. Issue a POST request on {root}/collections/{collectionId}/items/{mFeatureId}/tproperties/{tPropertyName} path

Support for the HTTP POST method is specified as a requirement in OGC API – Features.

REQUIREMENT 42

IDENTIFIER /req/movingfeatures/tproperty-post

INCLUDED IN Requirements class 2: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/req/movingfeatures>

A An implementation of the OGC API – MF SHALL comply with the OGC API – Feature CREATE operation requirement [/req/create-replace-delete/insert-post-op](#).

B An implementation of the OGC API – MF SHALL comply with the OGC API – Feature CREATE request body requirements [/req/create-replace-delete/insert-body](#) and [/req/create-replace-delete/insert-content-type](#).

C The content of the request body SHALL be based upon the TemporalPrimitiveValue schema.

D The ending date-time instance (**t_end**) in the temporal value object in **TemporalProperty**(Clause 8.9), determined by tPropertyName, SHALL be earlier than the beginning date-time instance (**t_new**) in the temporal value object in the request body, i.e., **t_end < t_new**.

type: **object**

```
required:
  - datetimes
  - values
  - interpolation
properties:
  datetimes:
    type: array
    uniqueItems: true
    minItems: 2
    items:
      type: string
      format: date-time
  values:
    oneOf:
      - type: number
      - type: string
      - type: boolean
  interpolation:
    type: string
    enum:
      - 'Discrete'
      - 'Step'
      - 'Linear'
      - 'Regression'
```

Figure 31 — TemporalProperty Request Body Schema (TemporalPrimitiveValue.yaml):

The following example adds a new feature (TemporalPrimitiveValue object) to the feature created by Creating a New TemporalPrimitiveValue Object Example. The feature is represented as a JSON payload. A pseudo-sequence diagram notation is used to illustrate the details of the HTTP communication between the client and the server.



Figure 32 – An Example of Creating a New TemporalPrimitiveValue Object:

8.9.3.2. Delete

The delete operation is defined in the DELETE conformance class of API – Features.

- Issue a DELETE request on `{root}/collections/{collectionId}/items/{mFeatureId}/tproperties/{tPropertyName}` path

Support for the HTTP DELETE method is specified as a requirement in OGC API – Features.

REQUIREMENT 43

IDENTIFIER /req/movingfeatures/tproperty-delete

| | |
|--------------------|---|
| INCLUDED IN | Requirements class 2: http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/req/movingfeatures |
| A | An implementation of the OGC API – MF SHALL comply with the OGC API – Feature DELETE operation requirement /req/create-replace-delete/delete/delete-op . |
| B | For every temporal property in a moving feature (path <code>{root}/collections/{collectionId}/items/{mFeatureId}</code>), the server SHALL support the HTTP DELETE operation at the path <code>{root}/collections/{collectionId}/items/{mFeatureId}/tproperties/{tPropertyName}</code> |
| C | <p>The path parameter <code>collectionId</code> is each <code>id</code> property in the Collection GET operation response where the value of the <code>itemType</code> property is specified as MovingFeature.</p> <p>The path parameter <code>mFeatureId</code> is an <code>id</code> property of the moving feature.</p> <p>The path parameter <code>tPropertyName</code> is a local identifier of the temporal property.</p> |

8.9.4. Response

8.9.4.1. Retrieve

A successful response to the **TemporalProperty** GET operation is a temporal property identified by the `{tPropertyName}` parameter.

REQUIREMENT 44

IDENTIFIER /req/movingfeatures/tproperty-get-success

| | |
|--------------------|---|
| INCLUDED IN | Requirements class 2: http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/req/movingfeatures |
| A | A successful execution of the operation SHALL be reported as a response with an HTTP status code 200. |
| B | The response SHALL only include temporal properties selected by the request with <code>leaf</code> and <code>subTemporalValue</code> parameters. |

C The content of that response SHALL include the parametric value that is defined in the response schema.

The following JSON payload is an example of a response to an OGC API – Moving Features TemporalProperty GET operation.

```
{  
  "temporalProperties": [  
    {  
      "datetimes": [  
        "2011-07-14T22:01:02Z",  
        "2011-07-14T22:01:03Z",  
        "2011-07-14T22:01:04Z"  
      ],  
      "values": [  
        65.0,  
        70.0,  
        80.0  
      ],  
      "interpolation": "Linear"  
    },  
    {  
      "datetimes": [  
        "2011-07-15T08:00:00Z",  
        "2011-07-15T08:00:01Z",  
        "2011-07-15T08:00:02Z"  
      ],  
      "values": [  
        0.0,  
        20.0,  
        50.0  
      ],  
      "interpolation": "Linear"  
    }  
  ],  
  "links": [  
    {  
      "href": "https://data.example.org/collections/mfc-1/items/mf-1/tproperties/speed",  
      "rel": "self",  
      "type": "application/json"  
    }  
  ]  
}
```

Figure 33 – An Example of TemporalProperty GET Operation:

8.9.4.1.1. Create

A successful response to the TemporalProperty POST operation is an HTTP status code.

REQUIREMENT 45

IDENTIFIER /req/movingfeatures/tproperty-post-success

INCLUDED Requirements class 2: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/req/movingfeatures>

REQUIREMENT 45

- A An implementation of the OGC API – MF SHALL comply with the OGC API – Feature CREATE response requirement [/req/create-replace-delete/insert-response](#) and [/req/create-replace-delete/insert-response-rid](#).

8.9.4.2. Delete

A successful response to the **TemporalProperty** DELETE operation is an HTTP status code.

REQUIREMENT 46

IDENTIFIER /req/movingfeatures/tproperty-delete-success

INCLUDED IN Requirements class 2: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/req/movingfeatures>

A An implementation of the OGC API – MF SHALL comply with the OGC API – Feature DELETE response requirement [/req/create-replace-delete/delete/response](#).

B If no resource with the identifier exists in the collection, the server SHALL respond with a not-found exception (404).

8.9.5. Error situations

General guidance on HTTP status codes and how they should be handled is provided in Clause 9.2.

9

COMMON REQUIREMENTS

COMMON REQUIREMENTS

REQUIREMENTS CLASS 3: MOVING FEATURES – COMMON

| | |
|----------------------|--|
| IDENTIFIER | http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/req/common |
| TARGET TYPE | Web API |
| PREREQUISITES | http://www.opengis.net/spec/ogcapi-features-1/1.0/req/core http://www.opengis.net/spec/ogcapi-common-1/1.0/req/core |
| NORMATIVE STATEMENTS | Requirement 47: /req/common/param-limit Requirement 48: /req/common/param-bbox Requirement 49: /req/common/param-datetime |

The following common requirements apply to all OGC APIs.

9.1. Parameters

The query parameters `bbox`, `datetime`, and `limit` are inherited from OGC API – Common. All requirements and recommendations in API – Common regarding these parameters also apply to OGC API – MF. No modifications are required.

9.1.1. Parameter limit

REQUIREMENT 47

IDENTIFIER /req/common/param-limit

INCLUDED IN Requirements class 3: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/req/common>

A An implementation instance of the OGC API – MF SHALL support the Limit parameter for the operation.

B Requests which include the Limit parameter SHALL comply with OGC API – Common requirement [/req/collections/rc-limit-definition](#).

C Responses to Limit requests SHALL comply with OGC API – Common requirements [/req/collections/rc-limit-response](#)

9.1.2. Parameter bbox

REQUIREMENT 48

IDENTIFIER /req/common/param-bbox

INCLUDED IN Requirements class 3: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/> req/common

A An implementation instance of the OGC API – MF SHALL support the Bounding Box (bbox) parameter for the operation.

B Requests which include the Bounding Box parameter SHALL comply with OGC API – Common requirement [/req/collections/rc-bbox-definition](#).

C Responses to Bounding Box requests SHALL comply with OGC API – Common requirement [/req/collections/rc-bbox-response](#).

9.1.3. Parameter datetime

REQUIREMENT 49

IDENTIFIER /req/common/param-datetime

INCLUDED IN Requirements class 3: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/> req/common

A An implementation instance of the OGC API – MF SHALL support the DateTime (datetime) parameter for the operation.

B Requests which include the DateTime parameter SHALL comply with OGC API – Common requirement [/req/collections/rc-time-definition](#).

C Responses to DateTime requests SHALL comply with OGC API – Common requirement [/req/collections/rc-time-response](#).

9.2. HTTP Status Codes

Table 13 lists the main HTTP status codes that clients should be prepared to receive. This includes support for specific security schemes or URI redirection. In addition, other error situations may occur in the transport layer outside of the server.

Table 13 – Typical HTTP status codes

| STATUS CODE | DESCRIPTION |
|-------------|---|
| 200 | A successful request. |
| 201 | The server has been fulfilled the operation and a new resource has been created. |
| 202 | A successful request, but the response is still being generated. The response will include a <code>Retry-After</code> header field giving a recommendation in seconds for the client to retry. |
| 204 | A successful request, but the resource has no data resulting from the request. No additional content or message body is provided. |
| 304 | An entity tag was provided in the request and the resource has not been changed since the previous request. |
| 308 | The server cannot process the data through a synchronous request. The response includes a <code>Location</code> header field which contains the URI of the location the result will be available at once the query is complete Asynchronous queries. |
| 400 | The server cannot or will not process the request due to an apparent client error. For example, a query parameter had an incorrect value. |
| 401 | The request requires user authentication. The response includes a <code>WWW-Authenticate</code> header field containing a challenge applicable to the requested resource. |
| 403 | The server understood the request, but is refusing to fulfill it. While status code 401 indicates missing or bad authentication, status code 403 indicates that authentication is not the issue, but the client is not authorized to perform the requested operation on the resource. |
| 404 | The requested resource does not exist on the server. For example, a path parameter had an incorrect value. |
| 405 | The request method is not supported. For example, a POST request was submitted, but the resource only supports GET requests. |
| 406 | Content negotiation failed. For example, the <code>Accept</code> header submitted in the request did not support any of the media types supported by the server for the requested resource. |
| 413 | Request entity too large. For example the query would involve returning more data than the server is capable of processing, the implementation should return a message explaining the query limits imposed by the server implementation. |
| 500 | An internal error occurred in the server. |

The status codes described in Table 13 do not cover all possible conditions. See IETF RFC 7231 for a complete list of HTTP status codes. When a server encounters an error in the processing of a request, the server may wish to include information in addition to the status code in the response. Since Web API interactions are often machine-to-machine, a machine-readable report would be preferred. IETF RFC 7807 addresses this need by providing “Problem Details” response schemas for both JSON and XML.



A

ANNEX A (NORMATIVE) CONFORMANCE CLASS ABSTRACT TEST SUITE

ANNEX A (NORMATIVE)

CONFORMANCE CLASS ABSTRACT TEST SUITE

A.1. Introduction

The Abstract Test Suite (ATS) is a compendium of test assertions applicable to implementations of the OGC API – MF. An ATS provides a basis for developing an Executable Test Suite to verify that the implementation under test conforms to all the relevant functional specifications.

The abstract test cases (assertions) are organized into test groups that correspond to distinct conformance test classes defined in the OGC API – MF Standard.

Implementations of OGC API Standards are not Web Services in the traditional sense. Rather, they define the behavior and content of a set of Resources exposed through a Web Application Programming Interface (Web API). Therefore, an API may expose resources in addition to those defined by the standard. A test engine shall traverse the API, identify and validate test points, and ignore resource paths which are not to be tested.

The Conformance Classes addressed by this Abstract Test Suite are the:

- MovingFeature Collection Catalog Conformance Class
- MovingFeature Conformance Class

A.2. Conformance Class MovingFeature Collection Catalog

CONFORMANCE CLASS A.1

IDENTIFIER

<http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/conf/mf-collection>

CONFORMANCE CLASS A.1

| | |
|--------------------|---|
| REQUIREMENTS CLASS | Requirements class 1: http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/req/mf-collection |
| TARGET TYPE | Web API |
| DEPENDENCY | http://www.opengis.net/spec/ogcapi-common-1/1.0/conf/html http://www.opengis.net/spec/ogcapi-common-1/1.0/conf/json http://www.opengis.net/spec/ogcapi-common-2/1.0/conf/collections http://www.opengis.net/spec/ogcapi-features-4/1.0/conf/create-replace-delete |
| CONFORMANCE TESTS | Abstract test A.1: /conf/mf-collection/collections-get Abstract test A.2: /conf/mf-collection/collections-get-success Abstract test A.3: /conf/mf-collection/collections-post Abstract test A.4: /conf/mf-collection/collections-post-success Abstract test A.5: /conf/mf-collection/collection-get Abstract test A.6: /conf/mf-collection/collection-get-success Abstract test A.7: /conf/mf-collection/collection-put Abstract test A.8: /conf/mf-collection/collections-put-success Abstract test A.9: /conf/mf-collection/collection-delete Abstract test A.10: /conf/mf-collection/collections-delete-success |

A.2.1. MovingFeature Collections

A.2.1.1. HTTP GET Operation

ABSTRACT TEST A.1

| | |
|--------------|---|
| IDENTIFIER | /conf/mf-collection/collections-get |
| REQUIREMENTS | Requirement 1: /req/mf-collection/collections-get Requirement 3: /req/mf-collection/collections-get-success |
| TEST PURPOSE | Validate that the MovingFeature Collections can be retrieved from the expected location. |
| TEST METHOD | <ol style="list-style-type: none"> 1. Issue an HTTP GET request to the URL {root}/collections 2. Validate that a document was returned with a status code 200 3. Validate the contents of the returned document using Abstract test A.2: /conf/mf-collection/collections-get-success |

ABSTRACT TEST A.2

IDENTIFIER /conf/mf-collection/collections-get-success

REQUIREMENT Requirement 3: /req/mf-collection/collections-get-success

TEST PURPOSE Validate that the **MovingFeature Collections** complies with the required structure and contents.

1. Validate that all response documents comply with OGC API – Common [/conf/collections/_rc-md-success](#)

TEST METHOD 2. Validate the **Collections** resource for all supported media types using the resources and tests identified in Table A.1

3. Verify that the response document contains a itemType property and its value is 'movingfeature'

The **Collections** content may be retrieved in a number of different formats. The following table identifies the applicable schema document for each format and the test to be used to validate the against that schema. All supported formats should be exercised.

Table A.1 – Schema and Tests for MovingFeature Collections content

| FORMAT | SCHEMA DOCUMENT | TEST ID |
|--------|------------------|------------------------------------|
| HTML | collections.yaml | /conf/html/content |
| JSON | collections.yaml | /conf/json/content |

A.2.1.2. HTTP POST Operation

ABSTRACT TEST A.3

IDENTIFIER /conf/mf-collection/collections-post

REQUIREMENTS Requirement 2: /req/mf-collection/collections-post
Requirement 4: /req/mf-collection/collections-post-success

TEST PURPOSE Validate that the **MovingFeature Collections** can be created at the expected location.

1. Validate that the server complies with OGC API – Features [POST operation requirements](#)
2. Validate that a body of a POST request using for all supported media types using the resources and tests identified in Table A.2
3. Validate that the request body complies OGC API – Features [POST request body requirements](#)

ABSTRACT TEST A.3

4. Issue an HTTP POST request to the URL {root}/collections
5. Validate the contents of the response using Abstract test A.4: /conf/mf-collection/collections-post-success

Table A.2 – Schema and Tests for Request Body of {root}/collections POST

| FORMAT | SCHEMA DOCUMENT | TEST ID |
|--------|-----------------------------|--------------------|
| HTML | collection_requestbody.yaml | /conf/html/content |
| JSON | collection_requestbody.yaml | /conf/json/content |

ABSTRACT TEST A.4

IDENTIFIER /conf/mf-collection/collections-post-success

REQUIREMENT Requirement 4: /req/mf-collection/collections-post-success

TEST PURPOSE Validate that the response of {root}/collections POST request complies with the required structure and contents.

- TEST METHOD**
1. Validate that a document was returned with a status code 201 or 202
 2. Validate that all response documents comply with OGC API – Features – Part 4 [POST response requirements](#)

A.2.2. MovingFeature Collection

A.2.2.1. HTTP GET Operation

ABSTRACT TEST A.5

IDENTIFIER /conf/mf-collection/collection-get

REQUIREMENTS Requirement 6: /req/mf-collection/collection-get

Requirement 9: /req/mf-collection/collection-get-success

TEST PURPOSE Validate that the **MovingFeature Collection** can be retrieved from the expected location.

ABSTRACT TEST A.5

TEST METHOD

For every **Collection** described in the **Collections** content, issue an HTTP GET request to the URL `{root}/collections/{collectionId}` where `{collectionId}` is the id property for the collection

1. Validate that a **Collection** was returned with a status code 200
2. Validate the contents of the returned document using Abstract test A.6: `/conf/mf-collection/collection-get-success`

ABSTRACT TEST A.6

IDENTIFIER

`/conf/mf-collection/collection-get-success`

REQUIREMENTS

Requirement 5: `/req/mf-collection/mandatory-collection`
Requirement 9: `/req/mf-collection/collection-get-success`

TEST PURPOSE

Validate that the **MovingFeature Collection** complies with the required structure and contents.

TEST METHOD

1. Validate that all response documents comply with OGC API – Common [`/conf/collections/src-md-success`](#)
2. Validate the **Collection** resource for all supported media types using the resources and tests identified in Table A.3 and Table 6

Table A.3 – Schema and Tests for MovingFeature Collection content

| FORMAT | SCHEMA DOCUMENT | TEST ID |
|--------|-----------------|---|
| HTML | collection.yaml | <code>/conf/html/content</code> |
| JSON | collection.yaml | <code>/conf/json/content</code> |

A.2.2.2. HTTP PUT Operation

ABSTRACT TEST A.7

IDENTIFIER

`/conf/mf-collection/collection-put`

REQUIREMENTS

Requirement 7: `/req/mf-collection/collection-put`
Requirement 10: `/req/mf-collection/collection-put-success`

TEST PURPOSE

Validate that the **MovingFeature Collection** can be replaced at the expected location.

ABSTRACT TEST A.7

| | |
|-------------|---|
| | <ol style="list-style-type: none">1. Validate that the server complies with OGC API – Features – Part 4 <u>PUT operation requirements</u>2. Validate that a body of a PUT request using for all supported media types using the resources and tests identified in Table A.2 |
| TEST METHOD | <ol style="list-style-type: none">3. Validate that the request body complies OGC API – Features – Part 4 <u>PUT request body requirements</u>4. Issue an HTTP PUT request to the URL {root}/collections/{collectionId}5. Validate the contents of the response using Abstract test A.8: /conf/mf-collection/collections-put-success |

ABSTRACT TEST A.8

IDENTIFIER /conf/mf-collection/collections-put-success

REQUIREMENT Requirement 10: /req/mf-collection/collection-put-success

TEST PURPOSE Validate that the response of {root}/collections/{collectionId} PUT request complies with the required structure and contents.

| | |
|-------------|--|
| TEST METHOD | <ol style="list-style-type: none">1. Validate that a document was returned with a status code 200, 202, or 2042. Validate that all response documents comply with OGC API – Features <u>PUT response requirements</u> |
|-------------|--|

A.2.2.3. HTTP DELETE Operation

ABSTRACT TEST A.9

IDENTIFIER /conf/mf-collection/collection-delete

REQUIREMENTS Requirement 8: /req/mf-collection/collection-delete
Requirement 11: /req/mf-collection/collection-delete-success

TEST PURPOSE Validate that the **MovingFeature Collection** can be deleted at the expected location.

| | |
|--|---|
| | <ol style="list-style-type: none">1. Validate that the server complies with OGC API – Features – Part 4 <u>DELETE operation requirements</u>2. Issue an HTTP DELETE request to the URL {root}/collections/{collectionId}3. Validate the contents of the response using Abstract test A.10: /conf/mf-collection/collections-delete-success |
|--|---|

ABSTRACT TEST A.10

IDENTIFIER /conf/mf-collection/collections-delete-success

REQUIREMENT Requirement 11: /req/mf-collection/collection-delete-success

TEST PURPOSE Validate that the response of {root}/collections/{collectionId} DELETE request complies with the required structure and contents.

1. Validate that a document was returned with a status code 200, 202, or 204

TEST METHOD 2. Validate that all response documents comply with OGC API – Features – Part 4 DELETE response requirements

A.3. Conformance Class MovingFeatures

CONFORMANCE CLASS A.2

IDENTIFIER <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/conf/movingfeatures>

REQUIREMENTS CLASS Requirements class 2: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/req/movingfeatures>

CLASS Requirements class 3: <http://www.opengis.net/spec/ogcapi-movingfeatures-1/1.0/req/common>

TARGET TYPE Web API

<http://www.opengis.net/spec/ogcapi-common-1/1.0/conf/html>

<http://www.opengis.net/spec/ogcapi-common-1/1.0/conf/json>

<http://www.opengis.net/spec/ogcapi-common-2/1.0/conf/collections>

<http://www.opengis.net/spec/ogcapi-common-2/1.0/conf/simple-query>

<http://www.opengis.net/spec/ogcapi-features-1/1.0/conf/core>

<http://www.opengis.net/spec/ogcapi-features-1/1.0/conf/geojson>

<http://www.opengis.net/spec/ogcapi-features-4/1.0/conf/create-replace-delete>

Abstract test A.11: /conf/movingfeatures/features-get

Abstract test A.12: /conf/movingfeatures/features-get-success

Abstract test A.13: /conf/movingfeatures/features-post

Abstract test A.14: /conf/movingfeatures/features-post-success

Abstract test A.15: /conf/movingfeatures/mf-get

Abstract test A.16: /conf/movingfeatures/mf-get-success

Abstract test A.17: /conf/movingfeatures/mf-delete

Abstract test A.18: /conf/movingfeatures/mf-delete-success

Abstract test A.19: /conf/movingfeatures/tgsequence-get

Abstract test A.20: /conf/movingfeatures/tgsequence-get-success

Abstract test A.21: /conf/movingfeatures/tgsequence-post

CONFORMANCE CLASS A.2

Abstract test A.22: /conf/movingfeatures/tgsequence-post-success
Abstract test A.23: /conf/movingfeatures/tpgeometry-delete
Abstract test A.24: /conf/movingfeatures/tpgeometry-delete-success
Abstract test A.25: /conf/movingfeatures/tpgeometry-query-distance
Abstract test A.26: /conf/movingfeatures/tpgeometry-query-velocity
Abstract test A.27: /conf/movingfeatures/tpgeometry-query-acceleration
Abstract test A.28: /conf/movingfeatures/tproperties-get
Abstract test A.29: /conf/movingfeatures/tproperties-get-success
Abstract test A.30: /conf/movingfeatures/tproperties-post
Abstract test A.31: /conf/movingfeatures/tproperties-post-success
Abstract test A.32: /conf/movingfeatures/tproperty-get
Abstract test A.33: /conf/movingfeatures/tproperty-get-success
Abstract test A.34: /conf/movingfeatures/tproperty-post
Abstract test A.35: /conf/movingfeatures/tproperty-post-success
Abstract test A.36: /conf/movingfeatures/tproperty-delete
Abstract test A.37: /conf/movingfeatures/tproperty-delete-success
Abstract test A.38: /conf/movingfeatures/param-leaf-definition
Abstract test A.39: /conf/movingfeatures/param-leaf-response
Abstract test A.40: /conf/movingfeatures/param-subtrajectory-definition
Abstract test A.41: /conf/movingfeatures/param-subtrajectory-response
Abstract test A.42: /conf/movingfeatures/param-subtemporalvalue-definition
Abstract test A.43: /conf/movingfeatures/param-subtemporalvalue-response

A.3.1. MovingFeatures

A.3.1.1. HTTP GET Operation

ABSTRACT TEST A.11

| | |
|--------------|---|
| IDENTIFIER | /conf/movingfeatures/features-get |
| REQUIREMENTS | Requirement 14: /req/movingfeatures/features-get Requirement 16: /req/movingfeatures/features-get-success Requirement 47: /req/common/param-limit Requirement 48: /req/common/param-bbox Requirement 49: /req/common/param-datetime |
| TEST PURPOSE | Validate that MovingFeatures can be identified and extracted from a MovingFeature Collection using query parameters. |
| TEST METHOD | For every MovingFeature Collection identified in MovingFeature Collections , issue an HTTP GET request to the URL {root}/collections/{collectionId}/items where {collectionId} is the id property for a MovingFeature Collection described in the MovingFeature Collections content |

ABSTRACT TEST A.11

1. Validate that a document was returned with a status code 200
2. Validate the contents of the returned document using Abstract test A.12: /conf/movingfeatures/features-get-success

Repeat these tests using the following parameter tests that are defined in the OGC API – Common and OGC API – MF:

- Limit: [Limit Tests](#)
- Bounding Box: [Bounding Box Tests](#)
- Date-Time: [Date-Time Tests](#)

- SubTrajectory: SubTrajectory Definition Test and SubTrajectory Response Test

Execute requests with combinations of the "bbox", "datetime", and "subTrajectory" query parameters and verify that only features are returned that match both selection criteria.

ABSTRACT TEST A.12

IDENTIFIER /conf/movingfeatures/features-get-success

REQUIREMENT Requirement 16: /req/movingfeatures/features-get-success

TEST PURPOSE Validate that the **MovingFeatures** complies with the required structure and contents.

- | | |
|--------------------|--|
| TEST METHOD | <ol style="list-style-type: none">1. Validate that all response documents comply with OGC API – Features /conf/core/fc-response2. Validate the Collections resource for all supported media types using the resources and tests identified in Table A.4 |
|--------------------|--|

The **MovingFeatures** content may be retrieved in a number of different formats. The following table identifies the applicable schema document for each format and the test to be used to validate the against that schema. All supported formats should be exercised.

Table A.4 – Schema and Tests for MovingFeatures content

| FORMAT | SCHEMA DOCUMENT | TEST ID |
|---------|------------------------------|---------------------------------------|
| HTML | movingFeatureCollection.yaml | /conf/html/content |
| GeoJSON | movingFeatureCollection.yaml | /conf/geojson/content |

A.3.1.2. HTTP POST Operation

ABSTRACT TEST A.13

| | |
|--------------|--|
| IDENTIFIER | /conf/movingfeatures/features-post |
| REQUIREMENTS | Requirement 15: /req/movingfeatures/features-post Requirement 17: /req/movingfeatures/features-post-success Requirement 18: /req/movingfeatures/mf-mandatory |
| TEST PURPOSE | Validate that the MovingFeature can be created at the expected location. |
| TEST METHOD | <ol style="list-style-type: none">1. Validate that the server complies with OGC API – Features POST operation requirements2. Validate that a body of a POST request using for all supported media types using the resources and tests identified in Table A.5 and Table 83. Validate that the request body complies OGC API – Features POST request body requirements4. Issue an HTTP POST request to the URL {root}/collections/{collectionId}/items5. Validate the contents of the response using Abstract test A.14: /conf/movingfeatures/features-post-success |

Table A.5 – Schema and Tests for Request Body of {root}/collections/{collectionId}/items POST

| FORMAT | SCHEMA DOCUMENT | TEST ID |
|--------|---|------------------------------------|
| JSON | MF-JSON Prism.schema.json | /conf/json/content |

ABSTRACT TEST A.14

| | |
|--------------|--|
| IDENTIFIER | /conf/movingfeatures/features-post-success |
| REQUIREMENT | Requirement 17: /req/movingfeatures/features-post-success |
| TEST PURPOSE | Validate that the response of {root}/collections/{collectionId}/items POST request complies with the required structure and contents. |
| TEST METHOD | <ol style="list-style-type: none">1. Validate that a document was returned with a status code 201 or 2022. Validate that all response documents comply with OGC API – Features POST response requirements |

A.3.2. MovingFeature

A.3.2.1. HTTP GET Operation

| ABSTRACT TEST A.15 | |
|--------------------|---|
| IDENTIFIER | /conf/movingfeatures/mf-get |
| REQUIREMENTS | Requirement 19: /req/movingfeatures/mf-get Requirement 21: /req/movingfeatures/mf-get-success |
| TEST PURPOSE | Validate that the MovingFeature can be retrieved from the expected location. |
| TEST METHOD | <p>For every MovingFeature identified in MovingFeature Collection, issue an HTTP GET request to the URL {root}/collections/{collectionId}/items/{mFeaturesId} where {collectionId} is the id property for a MovingFeature Collection described in the Moving Feature Collections content and {mFeatureId} is the id property for the MovingFeature</p> <ol style="list-style-type: none">1. Validate that a document was returned with a status code 2002. Validate the contents of the returned document using Abstract test A.16: /conf/movingfeatures/mf-get-success |

| ABSTRACT TEST A.16 | |
|--------------------|--|
| IDENTIFIER | /conf/movingfeatures/mf-get-success |
| REQUIREMENT | Requirement 21: /req/movingfeatures/mf-get-success |
| TEST PURPOSE | Validate that the MovingFeature complies with the required structure and contents. |
| TEST METHOD | <ol style="list-style-type: none">1. Validate that all response documents comply with OGC API – Features /conf/core/f-success2. Validate the Collections resource for all supported media types using the resources and tests identified in Table A.6 |

The **MovingFeature** content may be retrieved in a number of different formats. The following table identifies the applicable schema document for each format and the test to be used to validate the against that schema. All supported formats should be exercised.

Table A.6 – Schema and Tests for MovingFeature content

| FORMAT | SCHEMA DOCUMENT | TEST ID |
|---------|--------------------|---------------------------------------|
| HTML | movingFeature.yaml | /conf/html/content |
| GeoJSON | movingFeature.yaml | /conf/geojson/content |

A.3.2.2. HTTP DELETE Operation

ABSTRACT TEST A.17

| | |
|--------------|--|
| IDENTIFIER | /conf/movingfeatures/mf-delete |
| REQUIREMENTS | Requirement 20: /req/movingfeatures/mf-delete Requirement 22: /req/movingfeatures/mf-delete-success |
| TEST PURPOSE | Validate that the MovingFeature can be deleted at the expected location. <ol style="list-style-type: none"> 1. Validate that the server complies with OGC API – Features DELETE operation requirements |
| TEST METHOD | 2. Issue an HTTP DELETE request to the URL {root}/collections/{collectionId}/items/{mFeatureId} 3. Validate the contents of the response using Abstract test A.18: /conf/movingfeatures/mf-delete-success |

ABSTRACT TEST A.18

| | |
|--------------|---|
| IDENTIFIER | /conf/movingfeatures/mf-delete-success |
| REQUIREMENT | Requirement 22: /req/movingfeatures/mf-delete-success |
| TEST PURPOSE | Validate that the response of {root}/collections/{collectionId}/items/{mFeatureId} DELETE request complies with the required structure and contents. <ol style="list-style-type: none"> 1. Validate that a document was returned with a status code 200, 202, or 204 |
| TEST METHOD | 2. Validate that all response documents comply with OGC API – Features DELETE response requirements |

A.3.3. TemporalGeometrySequence

A.3.3.1. HTTP GET Operation

| ABSTRACT TEST A.19 | |
|--------------------|---|
| IDENTIFIER | /conf/movingfeatures/tgsequence-get |
| REQUIREMENTS | Requirement 25: /req/movingfeatures/tgsequence-get Requirement 27: /req/movingfeatures/tgsequence-get-success Requirement 47: /req/common/param-limit Requirement 48: /req/common/param-bbox Requirement 49: /req/common/param-datetime |
| TEST PURPOSE | <p>Validate that the TemporalGeometrySequence can be identified and extracted from a Moving Feature object using query parameters.</p> <p>For every TemporalGeometrySequence identified in MovingFeature, issue an HTTP GET request to the URL <code>{root}/collections/{collectionId}/items/{mFeatureId}/tgsequence</code> where <code>{collectionId}</code> is the id property for a MovingFeature Collection described in the MovingFeature Collection content and <code>{mFeatureId}</code> is the id property for the MovingFeature</p> <ol style="list-style-type: none">1. Validate that a document was returned with a status code 2002. Validate the contents of the returned document using Abstract test A.20: /conf/movingfeatures/tgsequence-get-success |
| TEST METHOD | <p>Repeat these tests using the following parameter tests that defined in the OGC API – Common and OGC API – MF:</p> <ul style="list-style-type: none">- Limit: Limit Tests- Bounding Box: Bounding Box Tests- Date-Time: Date-Time Tests- Leaf: Leaf Definition Test and Leaf Response Test- SubTrajectory: SubTrajectory Definition Test and SubTrajectory Response Test <p>Execute requests with combinations of the "bbox", "datetime", and "leaf" (or "subTrajectory") query parameters and verify that only features are returned that match both selection criteria.</p> |

ABSTRACT TEST A.20

| | |
|-------------|--|
| IDENTIFIER | /conf/movingfeatures/tgsequence-get-success |
| REQUIREMENT | Requirement 27: /req/movingfeatures/tgsequence-get-success |

ABSTRACT TEST A.20

TEST PURPOSE Validate that the **TemporalGeometrySequence** complies with the required structure and contents.

1. Validate that the type property is present and has a value of **MovingGeometryCollection**
2. Validate the prism property is present and that it is populated with an array of **TemporalPrimitiveGeometry** items
3. Validate that only **TemporalPrimitiveGeometry** which match the selection criteria are included in the **MovingFeature**
4. If the links property is present, validate that all entries comply with OGC API – Features [/conf/core/fc-links](#)
5. If the timeStamp property is present, validate that it complies with OGC API – Features [/conf/core/fc-timeStamp](#)
6. If the numberMatched property is present, validate that it complies with OGC API – Features [/conf/core/fc-numberMatched](#)
7. If the numberReturned property is present, validate that it complies with OGC API – Features [/conf/core/fc-numberReturned](#)
8. Validate the TemporalGeometry resource for all supported media types using the resources and tests identified in Table A.7

The **TemporalPrimitiveGeometry** content may be retrieved in a number of different formats. The following table identifies the applicable schema document for each format and the test to be used to validate the against that schema. All supported formats should be exercised.

Table A.7 – Schema and Tests for TemporalGeometrySequence content

| FORMAT | SCHEMA DOCUMENT | TEST ID |
|--------|-------------------------------|---|
| HTML | temporalGeometrySequence.yaml | <u>/conf/html/content</u> |
| JSON | temporalGeometrySequence.yaml | <u>/conf/json/content</u> |

A.3.3.2. HTTP POST Operation

ABSTRACT TEST A.21

IDENTIFIER [/conf/movingfeatures/tgsequence-post](#)

Requirement 26: [/req/movingfeatures/tgsequence-post](#)

REQUIREMENTS Requirement 28: [/req/movingfeatures/tgsequence-post-success](#)

Requirement 29: [/req/movingfeatures/tpgeometry-mandatory](#)

ABSTRACT TEST A.21

TEST PURPOSE Validate that the **TemporalPrimitiveGeometry** can be created at the expected location.

- | | |
|--------------------|--|
| TEST METHOD | <ol style="list-style-type: none">1. Validate that the server complies with OGC API – Features POST operation requirements2. Validate that a body of a POST request using for all supported media types using the resources and tests identified in Table A.8 and Table 93. Validate that the request body complies OGC API – Features POST request body requirements4. Issue an HTTP POST request to the URL {root}/collections/{collectionId}/items/{mFeatureId}/tgsequence5. Validate the contents of the response using Abstract test A.22: /conf/movingfeatures/tgsequence-post-success |
|--------------------|--|

Table A.8 – Schema and Tests for Request Body of {root}/collections/{collectionId}/items/{mFeatureId}/tgsequence POST

| FORMAT | SCHEMA DOCUMENT | TEST ID |
|--------|---|------------------------------------|
| JSON | MF-JSON_Prism.schema.json | /conf/json/content |

ABSTRACT TEST A.22

IDENTIFIER /conf/movingfeatures/tgsequence-post-success

REQUIREMENT Requirement 28: /req/movingfeatures/tgsequence-post-success

TEST PURPOSE Validate that the response of {root}/collections/{collectionId}/items/{mFeatureId}/tgsequence POST request complies with the required structure and contents.

- | | |
|--------------------|--|
| TEST METHOD | <ol style="list-style-type: none">1. Validate that a document was returned with a status code 201 or 2022. Validate that all response documents comply with OGC API – Features POST response requirements |
|--------------------|--|

A.3.4. TemporalPrimitiveGeometry

A.3.4.1. HTTP DELETE Operation

ABSTRACT TEST A.23

| | |
|--------------|---|
| IDENTIFIER | /conf/movingfeatures/tpgeometry-delete |
| REQUIREMENTS | Requirement 30: /req/movingfeatures/tpgeometry-delete Requirement 31: /req/movingfeatures/tpgeometry-delete-success |
| TEST PURPOSE | Validate that the TemporalPrimitiveGeometry can be deleted at the expected location. |
| TEST METHOD | <ol style="list-style-type: none">1. Validate that the server complies with OGC API – Features DELETE operation requirements2. Issue an HTTP DELETE request to the URL {root}/collections/{collectionId}/items/{mFeatureId}/tgsequence/{tgeometryId}3. Validate the contents of the response using Abstract test A.24: /conf/movingfeatures/tpgeometry-delete-success |

ABSTRACT TEST A.24

| | |
|--------------|--|
| IDENTIFIER | /conf/movingfeatures/tpgeometry-delete-success |
| REQUIREMENT | Requirement 31: /req/movingfeatures/tpgeometry-delete-success |
| TEST PURPOSE | Validate that the response of {root}/collections/{collectionId}/items/{mFeatureId}/tgsequence/{tGeometryId} DELETE request complies with the required structure and contents. |
| TEST METHOD | <ol style="list-style-type: none">1. Validate that a document was returned with a status code 200, 202, or 2042. Validate that all response documents comply with OGC API – Features DELETE response requirements |

A.3.5. TemporalGeometry Query

A.3.5.1. HTTP GET Operation

ABSTRACT TEST A.25

| | |
|--------------|--|
| IDENTIFIER | /conf/movingfeatures/tpgeometry-query-distance |
| REQUIREMENTS | Permission 1: /per/movingfeatures/tpgeometry-query Requirement 32: /req/movingfeatures/tpgeometry-query Requirement 33: /req/movingfeatures/tpgeometry-query-success Requirement 49: /req/common/param-datetime |

ABSTRACT TEST A.25

| | |
|---------------------|--|
| TEST PURPOSE | Validate that resources can be identified and extracted from a TemporalPrimitiveGeometry with a Distance query using query parameters. |
| TEST METHOD | <p>IF a query parameter datetime is not empty, validate that the query parameter datetime with the following parameter tests that defined in the OGC API – Common:</p> <p>- Date-Time: Date-Time Tests</p> <ol style="list-style-type: none">1. Issue an HTTP GET request to the URL <code>{root}/collections/{collectionId}/items/ {mFeatureId}/tgsequence/{tGeometryId}/distance</code>2. Validate that a document was returned with a status code 2003. Verify the type is "TReal" <p>IF a query parameter datetime is not empty: Execute requests with datetime query parameter and verify the correctly calculated value is returned.</p> <p>IF a query parameter datetime is empty: Verify that a time-to-distance curve is correctly returned according to the specified TemporalPrimitiveGeometry resource by <code>{tGeometryId}</code>.</p> |

ABSTRACT TEST A.26

| | |
|---------------------|--|
| IDENTIFIER | /conf/movingfeatures/tpgeometry-query-velocity |
| REQUIREMENTS | Permission 1: /per/movingfeatures/tpgeometry-query Requirement 32: /req/movingfeatures/tpgeometry-query Requirement 33: /req/movingfeatures/tpgeometry-query-success Requirement 49: /req/common/param-datetime |
| TEST PURPOSE | Validate that resources can be identified and extracted from a TemporalPrimitiveGeometry with a Velocity query using query parameters. |
| TEST METHOD | <p>IF a query parameter datetime is not empty, validate that the query parameter datetime with the following parameter tests that defined in the OGC API – Common:</p> <p>- Date-Time: Date-Time Tests</p> <ol style="list-style-type: none">1. Issue an HTTP GET request to the URL <code>{root}/collections/{collectionId}/items/ {mFeatureId}/tgsequence/{tGeometryId}/velocity</code>2. Validate that a document was returned with a status code 2003. Verify the type is "TReal" <p>IF a query parameter datetime is not empty: Execute requests with datetime query parameter and verify the correctly calculated value is returned.</p> <p>IF a query parameter datetime is empty: Verify that a time-to-velocity curve is correctly returned according to the specified TemporalPrimitiveGeometry resource by <code>{tGeometryId}</code>.</p> |

ABSTRACT TEST A.27

| | |
|--------------|---|
| IDENTIFIER | /conf/movingfeatures/tpgeometry-query-acceleration |
| REQUIREMENTS | Permission 1: /per/movingfeatures/tpgeometry-query Requirement 32: /req/movingfeatures/tpgeometry-query Requirement 33: /req/movingfeatures/tpgeometry-query-success Requirement 49: /req/common/param-datetime |
| TEST PURPOSE | <p>Validate that resources can be identified and extracted from a TemporalPrimitiveGeometry with a Acceleration query using query parameters.</p> <p>If a query parameter datetime is not empty, validate that the query parameter datetime with the following parameter tests that defined in the OGC API – Common:</p> <ul style="list-style-type: none">- Date-Time: Date-Time Tests<ol style="list-style-type: none">Issue an HTTP GET request to the URL {root}/collections/{collectionId}/items/ {mFeatureId}/tgsequence/{tGeometryId}/accelerationValidate that a document was returned with a status code 200Verify the type is "TReal" |
| TEST METHOD | <p>If a query parameter datetime is not empty: Execute requests with datetime query parameter and verify the correctly calculated value is returned.</p> <p>If a query parameter datetime is empty: Verify that a time-to-acceleration curve is correctly returned according to the specified TemporalPrimitiveGeometry resource by {tGeometryId}.</p> |

A.3.6. TemporalProperties

A.3.6.1. HTTP GET Operation

ABSTRACT TEST A.28

| | |
|--------------|---|
| IDENTIFIER | /conf/movingfeatures/tproperties-get |
| REQUIREMENTS | Requirement 36: /req/movingfeatures/tproperties-get Requirement 38: /req/movingfeatures/tproperties-get-success Requirement 47: /req/common/param-limit Requirement 49: /req/common/param-datetime |
| TEST PURPOSE | Validate that the TemporalProperties can be identified and extracted from a MovingFeature object using query parameters. |
| TEST METHOD | For every TemporalProperty identified in MovingFeature , issue an HTTP GET request to the URL {root}/collections/{collectionId}/items/{mFeatureId}/tproperties where {collectionId} is the id property for a MovingFeature Collection described in the Moving Feature Collection content and {mFeatureId} is the id property for the MovingFeature |

ABSTRACT TEST A.28

1. Validate that a document was returned with a status code 200
2. Validate the contents of the returned document using Abstract test A.29: /conf/movingfeatures/tproperties-get-success

Repeat these tests using the following parameter tests that are defined in the OGC API – Common and OGC API – MF:

- Limit: [Limit Tests](#)
 - Date-Time: [Date-Time Tests](#)
 - SubTemporalValue: SubTemporalValue Definition Test and SubTemporalValue Response Test
- Execute requests with combinations of the "datetime" and "subTemporalValue" query parameters and verify that only features are returned that match both selection criteria.

ABSTRACT TEST A.29

IDENTIFIER /conf/movingfeatures/tproperties-get-success

REQUIREMENT Requirement 38: /req/movingfeatures/tproperties-get-success

TEST PURPOSE Validate that the **TemporalProperties** complies with the required structure and contents.

1. Validate the **TemporalProperties** property is present and that it is populated with an array of TemporalProperty items
2. Validate that the name and type property is present
3. Validate the type property is present and its value is one of the predefined values (i.e., one of 'TBoolean', 'TText', 'TInteger', 'TReal', and 'TImage')
4. If the links property is present, validate that all entries comply with OGC API – Features /conf/core/fc-links

TEST METHOD

5. If the timeStamp property is present, validate that it complies with OGC API – Features /conf/core/fc-timeStamp
6. If the numberMatched property is present, validate that it complies with OGC API – Features /conf/core/fc-numberMatched
7. If the numberReturned property is present, validate that it complies with OGC API – Features /conf/core/fc-numberReturned
8. Validate the **TemporalProperties** resource for all supported media types using the resources and tests identified in Table A.9

The **TemporalProperties** content may be retrieved in a number of different formats. The following table identifies the applicable schema document for each format and the test to be used to validate the against that schema. All supported formats should be exercised.

Table A.9 – Schema and Tests for TemporalProperties content

| FORMAT | SCHEMA DOCUMENT | TEST ID |
|--------|---------------------------------|------------------------------------|
| HTML | temporalPropertyCollection.yaml | /conf/html/content |
| JSON | temporalPropertyCollection.yaml | /conf/json/content |

A.3.6.2. HTTP POST Operation

| ABSTRACT TEST A.30 | |
|--------------------|--|
| IDENTIFIER | /conf/movingfeatures/tproperties-post |
| REQUIREMENTS | <p>Requirement 37: /req/movingfeatures/tproperties-post</p> <p>Requirement 39: /req/movingfeatures/tproperties-post-success</p> <p>Requirement 40: /req/movingfeatures/tproperty-mandatory</p> |
| TEST PURPOSE | Validate that the TemporalProperty can be created at the expected location. |
| TEST METHOD | <ol style="list-style-type: none"> 1. Validate that the server complies with OGC API – Features POST operation requirements 2. Validate that a body of a POST request using for all supported media types using the resources and tests identified in Table A.10 and Table 11 3. Validate that the request body complies OGC API – Features POST request body requirements 4. Issue an HTTP POST request to the URL {root}/collections/{collectionId}/items/{mFeatureId}/tproperties 5. Validate the contents of the response using Abstract test A.31: /conf/movingfeatures/tproperties-post-success |

Table A.10 – Schema and Tests for Request Body of {root}/collections/{collectionId}/items/{mFeatureId}/tproperties POST

| FORMAT | SCHEMA DOCUMENT | TEST ID |
|--------|---|------------------------------------|
| HTML | tproperty_requestbody.yaml | /conf/html/content |
| JSON | tproperty_requestbody.yaml | /conf/json/content |
| JSON | MF-JSON_Prism.schema.json | /conf/json/content |

ABSTRACT TEST A.31

IDENTIFIER /conf/movingfeatures/tproperties-post-success

REQUIREMENT Requirement 39: /req/movingfeatures/tproperties-post-success

TEST PURPOSE Validate that the response of {root}/collections/{collectionId}/items/{mFeatureId}/tproperties POST request complies with the required structure and contents.

1. Validate that a document was returned with a status code 201 or 202

TEST METHOD 2. Validate that all response documents comply with OGC API – Features [POST response requirements](#)

A.3.7. TemporalProperty

A.3.7.1. HTTP GET Operation

ABSTRACT TEST A.32

IDENTIFIER /conf/movingfeatures/tproperty-get

Requirement 41: /req/movingfeatures/tproperty-get

Requirement 44: /req/movingfeatures/tproperty-get-success

Requirement 47: /req/common/param-limit

Requirement 49: /req/common/param-datetime

TEST PURPOSE Validate that the **TemporalProperty** can be identified and extracted from a **TemporalProperties** using query parameters.

For every **TemporalProperty** identified in **MovingFeature**, issue an HTTP GET request to the URL {root}/collections/{collectionId}/items/{mFeatureId}/tproperties/{tPropertyName} where {collectionId} is the id property for a **MovingFeature Collection** described in the **MovingFeature Collections** content, {mFeatureId} is the id property for the **MovingFeature**, {tPropertyName} is the name property for the **TemporalProperty**

1. Validate that a document was returned with a status code 200

TEST METHOD 2. Validate the contents of the returned document using Abstract test A.33: /conf/movingfeatures/tproperty-get-success

Repeat these tests using the following parameter tests that defined in the OGC API – Common and OGC API – MF:

- Date-Time: [Date-Time Tests](#)

- Leaf: Leaf Definition Test and Leaf Response Test

- SubTemporalValue: SubTemporalValue Definition Test and SubTemporalValue Response Test

ABSTRACT TEST A.32

Execute requests with combinations of the "datetime" and "leaf" (or "subTemporalValue") query parameters and verify that only features are returned that match both selection criteria.

ABSTRACT TEST A.33

IDENTIFIER /conf/movingfeatures/tproperty-get-success

REQUIREMENT Requirement 44: /req/movingfeatures/tproperty-get-success

TEST PURPOSE Validate that the **TemporalProperty** complies with the required structure and contents.

1. Validate the **TemporalProperties** property is present and that it is populated with an array of TemporalPrimitiveValue items
2. If the links property is present, validate that all entries comply with OGC API – Features /[conf/core/fc-links](#)
3. If the timeStamp property is present, validate that it complies with OGC API – Features /[conf/core/fc-timeStamp](#)
4. If the numberMatched property is present, validate that it complies with OGC API – Features /[conf/core/fc-numberMatched](#)
5. If the numberReturned property is present, validate that it complies with OGC API – Features /[conf/core/fc-numberReturned](#)
6. Validate the **TemporalProperty** resource for all supported media types using the resources and tests identified in Table A.11

The **TemporalProperty** content may be retrieved in a number of different formats. The following table identifies the applicable schema document for each format and the test to be used to validate the against that schema. All supported formats should be exercised.

Table A.11 – Schema and Tests for TemporalProperty content

| FORMAT | SCHEMA DOCUMENT | TEST ID |
|--------|-----------------------|------------------------------------|
| HTML | temporalProperty.yaml | /conf/html/content |
| JSON | temporalProperty.yaml | /conf/json/content |

A.3.7.2. HTTP POST Operation

ABSTRACT TEST A.34

| | |
|--------------|--|
| IDENTIFIER | /conf/movingfeatures/tproperty-post |
| REQUIREMENTS | Requirement 40: /req/movingfeatures/tproperty-mandatory Requirement 42: /req/movingfeatures/tproperty-post Requirement 45: /req/movingfeatures/tproperty-post-success |
| TEST PURPOSE | Validate that the TemporalPrimitiveValue can be created at the expected location. |
| TEST METHOD | <ol style="list-style-type: none">1. Validate that the server complies with OGC API – Features POST operation requirements2. Validate that a body of a POST request using for all supported media types using the resources and tests identified in Table A.12 and Table 123. Validate that the request body complies OGC API – Features POST request body requirements4. Issue an HTTP POST request to the URL {root}/collections/{collectionId}/items/{mFeatureId}/tproperties/{tPropertyName}5. Validate the contents of the response using Abstract test A.35: /conf/movingfeatures/tproperty-post-success |

Table A.12 – Schema and Tests for Request Body of {root}/collections/{collectionId}/items/{mFeatureId}/tproperties/{tPropertyName} POST

| FORMAT | SCHEMA DOCUMENT | TEST ID |
|--------|-------------------------|------------------------------------|
| HTML | tvalue_requestbody.yaml | /conf/html/content |
| JSON | tvalue_requestbody.yaml | /conf/json/content |

ABSTRACT TEST A.35

| | |
|--------------|--|
| IDENTIFIER | /conf/movingfeatures/tproperty-post-success |
| REQUIREMENT | Requirement 45: /req/movingfeatures/tproperty-post-success |
| TEST PURPOSE | Validate that the response of {root}/collections/{collectionId}/items/{mFeatureId}/tproperties/{tPropertyName} POST request complies with the required structure and contents. |
| TEST METHOD | <ol style="list-style-type: none">1. Validate that a document was returned with a status code 201 or 2022. Validate that all response documents comply with OGC API – Features POST response requirements |

A.3.7.3. HTTP DELETE Operation

ABSTRACT TEST A.36

| | |
|--------------|---|
| IDENTIFIER | /conf/movingfeatures/tproperty-delete |
| REQUIREMENTS | Requirement 43: /req/movingfeatures/tproperty-delete Requirement 46: /req/movingfeatures/tproperty-delete-success |
| TEST PURPOSE | Validate that the TemporalProperty can be deleted at the expected location. |
| TEST METHOD | <ol style="list-style-type: none">1. Validate that the server complies with OGC API – Features DELETE operation requirements2. Issue an HTTP DELETE request to the URL {root}/collections/{collectionId}/items/{mFeatureId}/tproperties/{tpropertyName}3. Validate the contents of the response using Abstract test A.37: /conf/movingfeatures/tproperty-delete-success |

ABSTRACT TEST A.37

| | |
|--------------|--|
| IDENTIFIER | /conf/movingfeatures/tproperty-delete-success |
| REQUIREMENT | Requirement 46: /req/movingfeatures/tproperty-delete-success |
| TEST PURPOSE | Validate that the response of {root}/collections/{collectionId}/items/{mFeatureId}/tproperties/{tpropertyName} DELETE request complies with the required structure and contents. |
| TEST METHOD | <ol style="list-style-type: none">1. Validate that a document was returned with a status code 200, 202, or 2042. Validate that all response documents comply with OGC API – Features DELETE response requirements |

A.3.8. Parameters

A.3.8.1. Parameter Leaf

ABSTRACT TEST A.38

| | |
|------------|--|
| IDENTIFIER | /conf/movingfeatures/param-leaf-definition |
|------------|--|

ABSTRACT TEST A.38

REQUIREMENT Requirement 23: /req/movingfeatures/param-leaf-definition

TEST PURPOSE Validate that the leaf query parameter is constructed correctly.

TEST METHOD Verify that the leaf query parameter complies with the definition (using an OpenAPI Specification 3.0 fragment)

ABSTRACT TEST A.39

IDENTIFIER /conf/movingfeatures/param-leaf-response

REQUIREMENTS Requirement 23: /req/movingfeatures/param-leaf-definition
Requirement 24: /req/movingfeatures/param-leaf-response

TEST PURPOSE Validate that the leaf query parameter is processed correctly.

DO FOR each Resource which have datetimes property:

1. Calculate a temporal geometry coordinate (or temporal property value) with the **point AtTime** query at each time included in the leaf parameter, using interpolated trajectory according to the interpolation property
2. Verify that the temporal geometry coordinate (or temporal property value) intersects the interpolated trajectory according to the interpolation property, using datetime value defined by the leaf parameter

A.3.8.2. Parameter SubTrajectory

ABSTRACT TEST A.40

IDENTIFIER /conf/movingfeatures/param-subtrajectory-definition

REQUIREMENT Requirement 12: /req/movingfeatures/param-subtrajectory-definition

TEST PURPOSE Validate that the subTrajectory query parameter is constructed correctly.

- Verify that the subTrajectory query parameter complies with the definition (using an OpenAPI Specification 3.0 fragment)

TEST METHOD

- If the subTrajectory parameter is “true”:
 1. Verify that the datetime parameter is a bounded interval with a start time and end time.
 2. Verify that the leaf parameter is not used if it can be used.

ABSTRACT TEST A.41

| | |
|--------------|--|
| IDENTIFIER | /conf/movingfeatures/param-subtrajectory-response |
| REQUIREMENTS | Requirement 12: /req/movingfeatures/param-subtrajectory-definition Requirement 13: /req/movingfeatures/param-subtrajectory-response |
| TEST PURPOSE | Validate that the subTrajectory query parameter is processed correctly. |
| TEST METHOD | If the subTrajectory parameter is “true”, DO FOR each temporal primitive geometry resource: <ol style="list-style-type: none">Calculate a temporal geometry coordinate with the subTrajectory query at a time interval (new start time and new end time) included in the datetime parameter, using interpolated trajectory according to the interpolation propertyVerify that the calculated temporal geometry coordinate intersects the interpolated trajectory according to the interpolation property, using the time interval value defined by the datetime parameterIf the bbox parameter is not empty, verify that the calculated temporal geometry coordinate intersects the bounding box with the bbox parameter |

A.3.8.3. Parameter SubTemporalValue

ABSTRACT TEST A.42

| | |
|--------------|--|
| IDENTIFIER | /conf/movingfeatures/param-subtemporalvalue-definition |
| REQUIREMENT | Requirement 34: /req/movingfeatures/param-subtemporalvalue-definition |
| TEST PURPOSE | Validate that the subTemporalValue query parameter is constructed correctly. <ul style="list-style-type: none">Verify that the subTemporalValue query parameter complies with the definition (using an OpenAPI Specification 3.0 fragment) |
| TEST METHOD | <ul style="list-style-type: none">If the subTemporalValue parameter is “true”:<ol style="list-style-type: none">Verify that the datetime parameter is a bounded interval with a start time and end time.Verify that the leaf parameter is not used if it can be used. |

ABSTRACT TEST A.43

| | |
|--------------|--|
| IDENTIFIER | /conf/movingfeatures/param-subtemporalvalue-response |
| REQUIREMENTS | Requirement 34: /req/movingfeatures/param-subtemporalvalue-definition Requirement 35: /req/movingfeatures/param-subtemporalvalue-response |
| TEST PURPOSE | Validate that the subTemporalValue query parameter is processed correctly. |

ABSTRACT TEST A.43

TEST METHOD

If the `subTemporalValue` parameter is “true”, DO FOR each temporal property resource:

1. Calculate a temporal property value with the `subTrajectory` query at a time interval (new start time and new end time) included in the `datetime` parameter, using interpolated trajectory according to the `interpolation` property
2. Verify that the calculated temporal property value intersects the interpolated trajectory according to the `interpolation` property, using the time interval value defined by the `datetime` parameter



B

ANNEX B (INFORMATIVE) RELATIONSHIP WITH OTHER OGC/ISO STANDARDS

ANNEX B (INFORMATIVE)

RELATIONSHIP WITH OTHER OGC/ISO STANDARDS

This specification is built upon the following OGC/ISO Standards. The geometry concept is presented first, followed by the feature concept. Note that a feature is *not* a geometry. However, a feature often contains a geometry as one of its attributes. However, it is legal to build features without a geometry attribute, or with more than one geometry attributes.

B.1. Static geometries, features and accesses

The following standards define static objects, without time-varying properties.

B.1.1. Geometry (ISO 19107)

The ISO 19107, *Geographic information – Spatial schema* standard defines a GM_Object base type which is the root of all geometric objects. Some examples of GM_Object subtypes are GM_Point, GM_Curve, GM_Surface and GM_Solid. A GM_Object instance can be regarded as an infinite set of points in a particular coordinate reference system. The standard provides a GM_CurveInterpolation code list to identify how those points are computed from a finite set of points. Some interpolation methods listed by ISO 19107 are presented in Table B.1.

Table B.1 – A non-exhaustive list of interpolation methods listed by ISO 19107

| TERM | DEFINITION |
|--------------------|--|
| linear | Positions on a straight line between each consecutive pair of control points. |
| geodesic | Positions on a geodesic curve between each consecutive pair of control points. A geodesic curve is a curve of shortest length. The geodesic shall be determined in the coordinate reference system of the curve. |
| circularArc3Points | For each set of three consecutive control points, a circular arc passing from the first point through the middle point to the third point. Note 1: if the three points are co-linear, the circular arc becomes a straight line. |

| TERM | DEFINITION |
|-------------|--|
| elliptical | <p>For each set of four consecutive control points, an elliptical arc passing from the first point through the middle points in order to the fourth point.</p> <p>Note 1: If the four points are co-linear, the arc becomes a straight line.</p> <p>Note 2: If the four points are on the same circle, the arc becomes a circular one.</p> |
| cubicSpline | The control points are interpolated using initial tangents and cubic polynomials, a form of degree 3 polynomial spline. |

The UML below shows the GM_Object base type with its operations (e.g. distance(...)) for computing the distance between two geometries). GM_Curve (not shown in this UML) is a subtype of GM_Primitive. All operations assume static objects, without time-varying coordinates or attributes.



Figure B.1 – GM_Object from ISO 19107:2003 figure 6

Geometry, topology and temporal-objects (GM_Object, TP_Object, TM_Object) are not abstractions of real-world phenomena. These types can provide types for feature properties as described in the next section but cannot be specialized to features.

B.1.2. Features (ISO 19109)

The ISO 19109, *Geographic information – Rules for application schema* standard defines types for the definition of features. A feature is an abstraction of a real-world phenomena. The terms “feature type” and “feature instance” are used to separate the following concepts of “feature”:

| | |
|-------------------------|--|
| Feature type | The whole collection of real-world phenomena classified in a concept. For example the “bridge” feature type is the abstraction of the collection of all real-world phenomena that is classified into the concept behind the term “bridge”. |
| Feature instance | A certain occurrence of a feature type. For example “Tower Bridge” feature instance is the abstraction of a certain real-world bridge in London. |

In object-oriented modelling, feature types are equivalent to classes and feature instances are equivalent to objects,

The UML below shows the General Feature Model. FeatureType is a metaclass that is instantiated as classes that represent individual feature types. A FeatureType instance contains the list of properties (attributes, associations and operations) that feature instances of that type can contain. Geometries are properties like any other, without any special treatment. All properties are static, without time-varying values.



Figure B.2 – General Feature Model from ISO 19109:2009 figure 5

B.1.3. Simple Features SQL

The Simple Feature Access — Part 2: SQL Option Standard describes a feature access implementation in SQL based on a profile of ISO 19107. This standard defines *feature table* as a table where the columns represent feature attributes, and the rows represent feature instances. The geometry of a feature is one of its feature attributes.

B.1.4. Filter Encoding (ISO 19143)

The ISO 19143, *Geographic information – Filter encoding* standard (also OGC Standard) provides types for constructing queries. These objects can be transformed into a SQL “SELECT ... FROM ... WHERE ... ORDER BY ...” statement to fetch data stored in a SQL-based relational database. Similarly, the same objects can be transformed into a XQuery expression in order to retrieve

data from XML document. The UML below shows the objects used for querying a subset based on spatial operations such as “contains” or “intersects”.



Figure B.3 – Spatial operators from ISO 19143 figure 6

B.1.5. Features web API

The [OGC 17-069, Features – Part 1: Core](#) Standard specifies the fundamental building blocks for interacting with features using a Web API pattern. This Standard defines how to get all features available on a server, or to get feature instances by their identifier.

B.1.6. Features Filtering web API

The draft [OGC TBD, Features – Part 3: Filtering and the Common Query Language \(CQL\)](#) standard extends the Feature web API with capabilities to encode more sophisticated queries. The conceptual model is close to ISO 19143.

B.2. Temporal Geometries and Moving Features

B.2.1. Moving Features (ISO 19141)

The ISO 19141, *Geographic information – Schema for moving features* standard extends the ISO 19107 spatial schema for addressing features whose locations change over time. Despite the “Moving Features” name, that standard is more about “Moving geometries”. The UML below shows how the MF_Trajectory type extends the “static” types from ISO 19107.



Figure B.4 – Trajectory type from ISO 19141 figure 3

Trajectory inherits operations shown below. Those operations are in addition to the operations inherited from GM_Object. For example the distance(...) operation from ISO 19107 is now completed by a nearestApproach(...) operation.



Figure B.5 – Temporal geometry from ISO 19141 figure 6

B.2.2. Moving Features XML encoding (OGC 18-075)

The [OGC 18-075 Moving Features Encoding Part I: XML Core Standard](#) takes a subset of the ISO 19141 Standard and defines an XML encoding. That standard also completes ISO 19141 by allowing to specify attributes whose value change over time. This extension to the above *General Feature Model* is shown below:



Figure B.6 – Dynamic attribute from OGC 18-075 figure 3

B.2.3. Moving Features JSON encoding (OGC 19-045)

The [OGC 19-045 Moving Features Encoding – JSON](#) Standard takes a subset of the ISO 19141 Standard and defines a JSON encoding. The Standard provides various UML diagrams summarizing ISO 19141.

C

ANNEX C (INFORMATIVE) REVISION HISTORY

ANNEX C

(INFORMATIVE)

REVISION HISTORY

Table C.1 — Revision history

| DATE | RELEASE | EDITOR | PRIMARY CLAUSES MODIFIED | DESCRIPTION |
|------------|-----------|---|--------------------------|--|
| 2021-09-14 | 0.1 | Taehoon Kim, Kyoung-Sook Kim, and Martin Desruisseaux | all | first draft version |
| 2022-03-01 | 0.2 | Taehoon Kim, Kyoung-Sook Kim | all | revised sections related to resources to add CRUD operations |
| 2022-10-09 | 0.3 | Taehoon Kim, Kyoung-Sook Kim | all | added TemporalGeometry Query resources |
| 2023-02-21 | 0.9 | Taehoon Kim, Kyoung-Sook Kim, Mahmoud, and Esteban | all | finalize draft version |
| 2023-05-19 | 0.9.9 | Taehoon Kim, Kyoung-Sook Kim, Mahmoud, and Esteban | all | finalize draft version |
| 2023-07-10 | 1.0.draft | Taehoon Kim, Kyoung-Sook Kim | all | finalize draft version |
| 2024-02-14 | 1.0.draft | Taehoon Kim, Kyoung-Sook Kim | all | apply public comments |



BIBLIOGRAPHY



BIBLIOGRAPHY

- [1] OGC: OGC API – Common website, <https://ogcapi.ogc.org/common/>
- [2] OGC: OGC API – Features website, <https://ogcapi.ogc.org/features/>
- [3] OGC: OGC API website, <https://ogcapi.ogc.org/>
- [4] OpenAPI initiative website, <https://www.openapis.org/>
- [5] OGC: OGC API – Features – Part 4: Create, Replace, Update and Delete candidate Standard. (2020). <https://docs.ogc.org/DRAFTS/20-002.html>