TECHNICAL SPECIFICATION

ISO/TS 19163-2

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Geographic information — Content components and encoding rules for imagery and gridded data —

Part 2:
Implementation schema

Information géographique — Composantes de contenu et règles de codage pour l'imagerie et les données maillées —

Partie 2: Schéma d'implémentation

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 211, *Geographic information/Geomatics*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Geographic imagery and gridded thematic data are widely used in the geospatial community and related fields. Over the past two decades, several standards of geographic images have been developed by ISO/TC 211. ISO 19123 defines a conceptual schema for the spatial characteristics of coverages and defines the relationship between the domain of coverages and an associated attribute range. Multiple types of coverages are defined in ISO 19123, including raster, triangulated irregular network, point, curve and polygon coverages.

Although ISO/TS 19163-1 specifies logical data structures and the rules for encoding the content components in the structures, it is not an implementation schema. Without a concrete implementation structure, the specified UML cannot be mapped to the encodings used in various data formats, such as JPEG2000, GeoTIFF, NetCDF, and GMLJP2.

This part of ISO 19163 proposes a GML-based implementation schema of ISO/TS 19163-1 as a binding between the content components and specific encoding formats.

This document conforms to the coverage structure defined in ISO 19123-2.

Geographic information — Content components and encoding rules for imagery and gridded data —

Part 2:
Implementation schema

1 Scope

This document specifies an implementation schema based on the content models for geographic imagery and gridded thematic data defined in the ISO/TS 19163-1.

This document defines a structure that is suitable for binding content components and specific encoding formats. It also provides an implementation schema for binding a concrete, implementable, conformance-testable coverage structure as defined in ISO 19123-2.

2 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.

ISO/TS 19163-1:2016, *Geographic information — Content components and encoding rules for imagery and gridded data — Part 1: Content model*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
binding
specification of a mapping relating the information defined in a content model (data and metadata) to the data format that carries that information

[SOURCE: ISO/TS 19163-1:2016, 4.2]

3.2
conversion rule
rule for converting instances in the input data structure to instances in the output data structure

[SOURCE: ISO 19118:2011, 4.7]

3.3
document
<XML> well-formed data object

3.4
encoding rule
identifiable collection of *conversion rules* (3.2) that define the encoding for a particular data structure

EXAMPLE   XML, ISO 10303-21, ISO/IEC 8211.

Note 1 to entry: An encoding rule specifies the types of data to be converted as well as the syntax, structure and codes used in the resulting data structure.

[SOURCE: ISO 19118:2011, 4.14]

3.5
grid
network composed of two or more sets of curves in which the members of each set intersect the members of the other sets in an algorithmic way

[SOURCE: ISO 19123:2005, 4.1.23]

3.6
gridded data
data whose attribute values are associated with positions on a *grid* (3.5) coordinate system

[SOURCE: ISO 19115-2:2019, 3.16, modified — Note 1 to entry has been removed.]

3.7
imagery
representation of phenomena as images produced by electronic and/or optical techniques

Note 1 to entry: The term imagery is often used colloquially with various meanings in different contexts. It is often used to describe any set of gridded, point set or other form of coverage data that can be portrayed.

[SOURCE: ISO 19101-2:2018, 3.14, modified — Note 1 to entry has been added.]

3.8
namespace
collection of names, identified by a URI reference, which are used in *XML documents* (3.3) as element names and attribute names

[SOURCE: W3C XML]

3.9
schema document
<XML Schema> *XML document* (3.3) containing schema component definitions and declarations

Note 1 to entry: The W3C XML Schema provides an XML interchange format for schema information. A single schema document provides descriptions of components associated with a single XML *namespace* (3.8), but several documents may describe components in the same schema, i.e. the same target namespace.

[SOURCE: ISO 19136-1:2020, 3.1.54]

4   Symbols and abbreviated terms

4.1   Abbreviations

CIS   Coverage Implementation Schema

CRS   Coordinate Reference System

GML   Geography Markup Language

GMLCOV   GML Application Schema for Coverages

SWE   Sensor Web Enablement

UML   Unified Modeling Language

URI   Unique Resource Identifier

XML   eXtensible Markup Language

XSD   XML Schema Definition

5 Conformance

This document defines two classes of conformance: schema implementation and binding rules. Any product claiming conformance with one of these classes shall pass all the requirements described in the corresponding abstract test suite in Annex A.

Requirements and conformance test URIs defined in this document are relative to https://standards .isotc211.org/iso19163/-2/1

6 XML Schema requirements class

6.1 Introduction

The normative parts of this document use the W3C XML Schema language to describe the grammar of conformant XML data instances. XML Schema is a rich language with many capabilities and subtleties. While a reader who is unfamiliar with XML Schema may be able to follow the description in a general fashion, this document is not intended to serve as an introduction to XML Schema. In order to have a full understanding of this document, it is necessary for the reader to have a reasonable knowledge of XML Schema.

This XML Schema implementation of ISO/TS 19163-1 follows the general rules defined in ISO 19118 and ISO/TS 19139-1 for transforming UML models to XML Schema. ISO 19118 specifies conversion rules for transforming data from an input data structure to an output data structure. ISO/TS 19139-1 provides the details on how to convert UML classes, attributes, associations, aggregations and compositions into XML elements.

6.2 XML namespaces

UML diagrams and XML code fragments adhere to the namespace conventions shown in Table 1. The namespace prefixes used in this document are not normative and are merely chosen for convenience. They may appear in examples without being formally declared and have no semantic significance. The namespaces to which the prefixes correspond are normative.

All components defined or declared in this document use the same target namespace of https://www .isotc211.org/xsd/gmi.

Table 1 — Namespace mapping conventions

Prefix	Namespace URI	Description
gmi	https://www.isotc211.org/2005/gmi	Geographic Metadata for imagery and gridded data
gmd	https://www.isotc211.org/2005/gmd	Geographic MetaData extensible markup language
gco	https://www.isotc211.org/2005/gco	Geographic Common extensible markup language

Table 1 *(continued)*

Prefix	Namespace URI	Description
gmx	https://www.isotc211.org/2005/gmx	Geographic Metadata XML Schema
gss	https://www.isotc211.org/2005/gss	Geographic Spatial Schema extensible markup language
gsr	https://www.isotc211.org/2005/gsr	Geographic Spatial Referencing extensible markup
gts	https://www.isotc211.org/2005/gts	Geographic Temporal Schema extensible markup
gml	http://www.opengis.net/gml/3.2	GML 3.2.1
swe	http://www.opengis.net/swe/2.0	SWE Common 2.0
gmlcov	http://www.opengis.net/gmlcov/1.0	GML Application Schema for Coverages 1.0
gmlcovrgrid	http://schemas.opengis.net/gmlcov/gmlcovrgrid/1.0/	ReferenceableGridCoverage Extension 1.0
cis	http://www.opengis.net/cis/1.0	Coverage Implementation Schema 1.0

NOTE 1   CIS 1.0 is a derived work based on OGC GMLCOV 1.0. The two documents are functionally equivalent.

NOTE 2   ReferenceableGridCoverage Extension provides a set of referenceable grid elements for use as sub-elements of ReferenceableGridCoverage, via an extension GMLCOVRGRID of GMLCOV 1.0.

6.3   UML and XML Schema mapping

This XML Schema document shall implement the UML conceptual schema defined in ISO/TS 19163-1. The schema mapping between UML and XML is listed in Table 2.

Table 2 — UML and XML Schema mapping

XML Schema	UML conceptual schema
ImageandGriddedData.xsd	IE_ImageryAndGriddedData
	IE_Georectified
	IE_Georeferenceable
ThematicGriddedData.xsd	IE_ThematicGriddedData
	IE_CategoricalGriddedData
	IE_NumericalGriddedData
Imagery.xsd	IE_Imagery
	IE_SyntheticImage
	IE_FusedImage
	IE_SimulatedImage
	IE_OpticalImage
	IE_MicrowaveData
	IE_ActiveMWData
	IE_SARData
	IE_PassiveMWData
	IE_RadiometerData

6.4 Encoding rules

6.4.1 ImageryandGriddedData

Requirement 1 /req/gmi/ImageandGriddedData: An `ImageandGriddedData` shall be an implementation of ISO/TS 19163-1 `IE_ImageryAndGriddedData`, including either `IE_Georectified` or `IE_Georeferenceable`.

IE_ImageryAndGriddedData is the topmost class defined in ISO/TS 19163-1, which is a subclass of CV_Coverage defined in ISO/TS 19123.

NOTE   More than one subtype of ImageryandGriddedData can be added to the xsd in the same mechanism if it conforms to ISO/TS 19163-1.

Requirement 2 /req/gmi/Georectified: A `Georectified` shall be an implementation of ISO/TS 19163-1 `IE_Georectified`.

IE_Georectified specifies the source of geolocations and the model used for geometric correction. The attribute *checkPoints* specifies the format and source of ground control points used as check points in a georectified image. More spatial attributes about the check points and other attributes are inherited from MD_Georectified as defined in ISO 19115-1.

Requirement 3 /req/gmi/Georeferenceable: A `Georeferenceable` shall be an implementation of ISO/TS 19163-1 `IE_Georeferenceable` associated to `SD_SensorModel`.

Dependency: `SD_SensorModel` class defined in ISO/TS 19130-3[1].

Geolocation information of georeferenceable data defines the geometric correction models. More spatial attributes about georeferenceable data are inherited from MD_Georeferenceable as defined in ISO 19115-1.

6.4.2 ThematicGriddedData

Requirement 4 /req/gmi/ThematicGriddedData: A `ThematicGriddedData` shall be an implementation of ISO/TS 19163-1 `IE_ThematicGriddedData` that is a subtype of `IE_ImageryAndGriddedData`.

IE_ThematicGriddedData contains the common characteristics of thematic gridded data. There are two sub-types of thematic gridded data, categorical and numerical, which are specified with IE_CategoricalGriddedData class and IE_NumericalGriddedData class.

Requirement 5 /req/gmi/CategoricalGriddedData: A `CategoricalGriddedData` shall be an implementation of ISO/TS 19163-1 `IE_CategoricalGriddedData` that is a subtype of `IE_ThematicGriddedData`.

IE_CategoricalGriddedData specifies the number of categories of a categorical data layer, the description on the classification to produce the categorical data, and the number of bits for recording each value.

Requirement 6 /req/gmi/NumericalGriddedData: A `NumericalGriddedData` shall be an implementation of ISO/TS 19163-1 `IE_NumericalGriddedData` that is a subtype of `IE_ThematicGriddedData`.

IE_NumericalGriddedData specifies the meaning of the numerical gridded data with the attribute *valueDescription* and inherits the information about the maximum and minimum value, units, bitsPerValue and so on.

6.4.3 Imagery

Requirement 7 /req/gmi/Imagery: An `Imagery` shall be an implementation of ISO/TS 19163-1 `IE_Imagery` that is a subtype of `IE_ImageryAndGriddedData`.

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1)   Under preparation. Stage at the time of publication: ISO/CD TS 19130-3:2020.

Imagery is a kind of coverage whose attribute values are numerical representations of the physical parameters (e.g., radiance) measured by imagery sensors. IE_Imagery defines the following required information: acquisition time, image parameters, number of bands, platform, sensor, processing action, calibration and validation of sensor.

NOTE   The supported data types of Imagery were defined in ISO/TS 19163-1:2016, 7.2.

Requirement 8 /req/gmi/SyntheticImage: A `SyntheticImage` shall be an implementation of ISO/TS 19163-1 `IE_SyntheticImage` that is a subtype of `IE_Imagery`.

IE_SyntheticImage defines the intended usage of the imagery and it has two subclasses, IE_FusedImage and IE_SimulatedImage.

Requirement 9 /req/gmi/FusedImage: A `FusedImage` shall be an implementation of ISO/TS 19163-1 `IE_FusedImage` that is a subtype of `IE_SyntheticImage`.

The image fusion techniques allow the integration of images from different sources. The fused image can have complementary multisource characteristics. The class IE_FusedImage describes the number of source images and the processing steps used to produce a fused image.

Requirement 10 /req/gmi/SimulatedImage: A `SimulatedImage` shall be an implementation of ISO/TS 19163-1 `IE_SimulatedImage` that is a subtype of `IE_SyntheticImage`.

Simulated images are used to evaluate the characteristics of a sensor system and validate the retrieval algorithms prior to the system being put into the operational environment. The class IE_SimulatedImage describes the method for simulating an image and its provenance.

Requirement 11 /req/gmi/OpticalImage: An `OpticalImage` shall be an implementation of ISO/TS 19163-1 `IE_OpticalImage` that is a subtype of `IE_Imagery`.

Optical images are acquired from visible and infrared sensors by detecting the radiation reflected or emitted from target objects [ISO 19101-2]. The class IE_OpticalImage contains the information specific to images acquired by optical sensors.

Requirement 12 /req/gmi/MicrowaveData: A `MicrowaveData` shall be an implementation of ISO/TS 19163-1 `IE_MicrowaveData` that is a subtype of `IE_Imagery`.

Microwave data are classified into active and passive microwave data corresponding to active and passive microwave sensors.

There is more than one type of active and passive microwave data, but as defined in ISO/TS 19163-1, it only specifies the contents of data from SAR (IE_SARData) and microwave radiometers (IE_RadiometerData). The class IE_MicrowaveData has two subclasses, which are IE_ActiveMWData and IE_PassiveMWData.

Requirement 13 /req/gmi/ActiveMWData: An `ActiveMWData` shall be an implementation of ISO/TS 19163-1 `IE_ActiveMWData` that is a subtype of `IE_MicrowaveData`.

Requirement 14 /req/gmi/PassiveMWData: A `PassiveMWData` shall be an implementation of ISO/TS 19163-1 `IE_PassiveMWData` that is a subtype of `IE_MicrowaveData`.

Requirement 15 /req/gmi/SARData: A `SARData` shall be an implementation of ISO/TS 19163-1 `IE_SARData` that is a subtype of `IE_PassiveMWData`.

The class IE_SARData includes the basic information on the system's wavelength, incidence angle, SAR imaging mode and sensor.

Requirement 16 /req/gmi/RadiometerData: A `RadiometerData` shall be an implementation of ISO/TS 19163-1 `IE_RadiometerData` that is a subtype of `IE_ActiveMWData`.

The class IE_RadiometerData specifies the attributes of data acquired from a microwave imaging radiometer.

6.5   Binding rules

Requirement 17 /req/gmi/coverageType: A `ImageryAndGriddedData` coverage instance shall be of type `gmlcov:GridCoverage`, `gmlcov:RectifiedGridCoverage`, or `gmlcovrgrid:ReferenceableGridCoverage`, or a subtype thereof.

NOTE   A `RectifiedGridCoverage` is a discrete point coverage based on a rectified grid. It is similar to the grid coverage except that the points of the grid are geometrically referenced.

NOTE   A `ReferenceableGridCoverage` can be used for both discrete and continuous coverages.

Requirement 18 /req/gmi/multipart: In a `ImageryAndGriddedData` coverage instance encoded in a multipart message, the coverage representation shall conform with GMLCOV.

Dependency: http://www.opengis.net/gmlcov/1.0

A coverage can be represented as a multipart/related message document consisting of a GML-encoded part containing the coverage data minus its range set followed by a second part containing an encoding of the coverage range set in some standard encoding format.

6.6   Model coherence

Both imagery and gridded data contain location and categories or band information corresponding to GMLCOV elements. Hence, consistency must be enforced among them. The pertaining requirements are listed in this Subclause.

Requirement 19 /req/gmi/GeorectifiedCoherence: A `ThematicGriddedData` used `IE_Georectified` to specify the source of geolocations and the model used for geometric correction shall be implemented `gmlcov:RectifiedGridCoverage`.

Requirement 20 /req/gmi/GeoreferenceableCoherence: A `ThematicGriddedData` used `IE_Georerenceable` to specify the source of geolocations and the model used for geometric correction shall be implemented `gmlcovrgrid:ReferenceableGridCoverage`.

NOTE   OGC 16-083r3 is developed as an extension of GMLCOV to make use of ReferenceableGridCoverage. The ReferenceableGridCoverage Extension specifies instantiable referenceable grid elements supportive of GMLCOV::ReferenceableGridCoverage with the namespace of gmlcovrgrid.

Requirement 21 /req/gmi/CRSCoherence: The CRS used by `Georectified` or `Georeferenceable` shall be identical with the srsName attribute of the `gml:Envelope` element of the `gml:boundedBy` element of a GMLCOV encoded coverage instance.

Requirement 22 /req/gmi/locationCoherence: The location information used to geolocate a `ImageryAndGriddedData` coverage instance shall respect the `gml:boundedBy` of the GMLCOV domain description.

Requirement 23 /req/gmi/rangeCoherence: A `ImageryAndGriddedData` coverage with more than one categories or bands shall have the components identical with the coverage's rangeType in the same order as given in the `gml:rangeType` element's document order.

Annex A
(normative)

Abstract Test Suite

A.1 Introduction

This annex specifies an abstract test suite which shall be passed in completeness by any implementation claiming conformance with this document. The corresponding XML document shall be "well-formed" and shall be valid with respect to the types and definitions of a conformant XML Schema implementation of the ISO/TS 19163-1.

A.2 Imagery and gridded data

Test id: **/req/gmi/ImageandGriddedData**

Test purpose: Requirement 1: /req/gmi/ImageandGriddedData: An ImageandGriddedData is an implementation of ISO/TS 19163-1 IE_ImageryAndGriddedData, including either IE_Georectified or IE_Georeferenceable.

Test method: Inspect the instance document under test and verify that the document has the element <IE_ImageryAndGriddedData>, test pass if the instance document validated by schema of IE_ImageryAndGriddedData (B.3).

Test passes if all checks pass.

A.3 Georectified data

Test id: **/req/gmi/Georectified**

Test purpose: Requirement 2: /req/gmi/Georectified: A Georectified is an implementation of ISO/TS 19163-1 IE_Georectified.

Test method: Inspect the instance document under test and verify that the document has the element <IE_Georectified>, test pass if the instance document validated by schema of IE_ImageryAndGriddedData (B.3).

Test passes if all checks pass.

A.4 Georeferenceable data

Test id: **/req/gmi/Georeferenceable**

Test purpose: Requirement 3: /req/gmi/Georeferenceable: A Georeferenceable is an implementation of ISO/TS 19163-1 IE_Georeferenceable that associated to SD_SensorModel.

Test method: Inspect the instance document under test and verify that the document has the element *<IE_Georeferenceable>*, test pass if the instance document validated by schema of IE_ImageryAndGriddedData (B.3).

Test passes if all checks pass.

A.5 Thematic gridded data

Test id: **/req/gmi/ThematicGriddedData**

Test purpose: Requirement 4: /req/gmi/ThematicGriddedData: A ThematicGriddedData is an implementation of ISO/TS 19163-1 IE_ThematicGriddedData that is a subtype of IE_ImageryAndGriddedData.

Test method: Inspect the instance document under test and verify that the document has the element *<IE_ThematicGriddedData >*, test pass if the instance document validated by schema of IE_ThematicGriddedData (B.4).

Test passes if all checks pass.

A.6 Categorical gridded data

Test id: **/req/gmi/CategoricalGriddedData**

Test purpose: Requirement 5: /req/gmi/CategoricalGriddedData: A CategoricalGriddedData is an implementation of ISO/TS 19163-1 IE_CategoricalGriddedData that is a subtype of IE_ThematicGriddedData.

Test method: Inspect the instance document under test and verify that the document has the element <IE_CategoricalGriddedData>, test pass if the instance document validated by schema of IE_ThematicGriddedData (B.4).

Test passes if all checks pass.

A.7 Numerical gridded data

Test id: **/req/gmi/NumericalGriddedData**

Test purpose: Requirement 6: /req/gmi/NumericalGriddedData: A NumericalGriddedData is an implementation of ISO/TS 19163-1 IE_NumericalGriddedData that is a subtype of IE_ThematicGriddedData.

Test method: Inspect the instance document under test and verify that the document has the element *<IE_NumericalGriddedData>*, test pass if the instance document validated by schema of IE_ThematicGriddedData (B.4).

Test passes if all checks pass.

A.8 Imagery

Test id: **/req/gmi/Imagery**

Test purpose: Requirement 7: /req/gmi/Imagery: An Imagery is an implementation of ISO/TS 19163-1 IE_Imagery that is a subtype of IE_ImageryAndGriddedData.

Test method: Inspect the instance document under test and verify that the document has the element *<IE_Imagery>*, test pass if the instance document validated by schema of IE_Imagery (B.2).

Test passes if all checks pass.

A.9 Synthetic image

Test id: **/req/gmi/SyntheticImage**

Test purpose: Requirement 8: /req/gmi/SyntheticImage: A SyntheticImage is an implementation of ISO/TS 19163-1 IE_SyntheticImage that is a subtype of IE_Imagery.

Test method: Inspect the instance document under test and verify that the document has the element *<IE_SyntheticImage>*, test pass if the instance document validated by schema of IE_Imagery (B.2).

Test passes if all checks pass.

A.10 Fused image

Test id: **/req/gmi/FusedImage**

Test purpose: Requirement 9: /req/gmi/FusedImage: A FusedImage is an implementation of ISO/TS 19163-1 IE_FusedImage that is a subtype of IE_SyntheticImage.

Test method: Inspect the instance document under test and verify that the document has the element *<IE_FusedImage>*, test pass if the instance document validated by schema of IE_Imagery (B.2).

Test passes if all checks pass.

A.11 Simulated image

Test id: **/req/gmi/SimulatedImage**

Test purpose: Requirement 10: /req/gmi/SimulatedImage: A SimulatedImage is an implementation of ISO/TS 19163-1 IE_SimulatedImage that is a subtype of IE_SyntheticImage.

Test method: Inspect the instance document under test and verify that the document has the element *<IE_SimulatedImage>*, test pass if the instance document validated by schema of IE_Imagery (B.2).

Test passes if all checks pass.

A.12 Optical image

Test id: **/req/gmi/OpticalImage**

Test purpose: Requirement 11: /req/gmi/OpticalImage: An OpticalImage is an implementation of ISO/TS 19163-1 IE_OpticalImage that is a subtype of IE_Imagery.

Test method: Inspect the instance document under test and verify that the document has the element *<IE_OpticalImage>*, test pass if the instance document validated by schema of IE_Imagery (B.2).

Test passes if all checks pass.

A.13 Microwave data

Test id: **/req/gmi/MicrowaveData**

Test purpose: Requirement 12: /req/gmi/MicrowaveData: A MicrowaveData is an implementation of ISO/TS 19163-1 IE_MicrowaveData that is a subtype of IE_Imagery.

Test method: Inspect the instance document under test and verify that the document has the element *<IE_MicrowaveData>*, test pass if the instance document validated by schema of IE_Imagery (B.2).

Test passes if all checks pass.

A.14 Active microwave data

Test id: **/req/gmi/ActiveMWData**

Test purpose: Requirement 13: /req/gmi/ActiveMWData: An ActiveMWData is an implementation of ISO/TS 19163-1 IE_ActiveMWData that is a subtype of IE_MicrowaveData.

Test method: Inspect the instance document under test and verify that the document has the element *<IE_ActiveMWData>*, test pass if the instance document validated by schema of IE_Imagery (B.2).

Test passes if all checks pass.

A.15 Passive microwave data

Test id: **/req/gmi/PassiveMWData**

Test purpose: Requirement 14: /req/gmi/PassiveMWData: A PassiveMWData is an implementation of ISO/TS 19163-1 IE_PassiveMWData that is a subtype of IE_MicrowaveData.

Test method: Inspect the instance document under test and verify that the document has the element *<IE_PassiveMWData>*, test pass if the instance document validated by schema of IE_Imagery (B.2).

Test passes if all checks pass.