

Open Geospatial Consortium Inc.

Date: 2009-11-05

Reference number of this document: OGC 07-063r1

Version: 0.3.3

Category: OGC Best Practice

Editor: Thomas H.G. Lankester

OpenGIS[®] Web Map Services - Profile for EO Products

Copyright © 2009 Open Geospatial Consortium, Inc.

To obtain additional rights of use, visit <http://www.opengeospatial.org/legal/>.

Warning

This document defines an OGC Best Practices on a particular technology or approach related to an OGC standard. This document is not an OGC Standard and may not be referred to as an OGC Standard. It is subject to change without notice. However, this document is an official position of the OGC membership on this particular technology topic.

Document type:	OGC Best Practice
Document subtype:	Profile
Document stage:	Proposed version 0.3.3
Document language:	English

License Agreement

Permission is hereby granted by the Open Geospatial Consortium, ("Licensor"), free of charge and subject to the terms set forth below, to any person obtaining a copy of this Intellectual Property and any associated documentation, to deal in the Intellectual Property without restriction (except as set forth below), including without limitation the rights to implement, use, copy, modify, merge, publish, distribute, and/or sublicense copies of the Intellectual Property, and to permit persons to whom the Intellectual Property is furnished to do so, provided that all copyright notices on the intellectual property are retained intact and that each person to whom the Intellectual Property is furnished agrees to the terms of this Agreement.

If you modify the Intellectual Property, all copies of the modified Intellectual Property must include, in addition to the above copyright notice, a notice that the Intellectual Property includes modifications that have not been approved or adopted by LICENSOR.

THIS LICENSE IS A COPYRIGHT LICENSE ONLY, AND DOES NOT CONVEY ANY RIGHTS UNDER ANY PATENTS THAT MAY BE IN FORCE ANYWHERE IN THE WORLD.

THE INTELLECTUAL PROPERTY IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, AND NON-INFRINGEMENT OF THIRD PARTY RIGHTS. THE COPYRIGHT HOLDER OR HOLDERS INCLUDED IN THIS NOTICE DO NOT WARRANT THAT THE FUNCTIONS CONTAINED IN THE INTELLECTUAL PROPERTY WILL MEET YOUR REQUIREMENTS OR THAT THE OPERATION OF THE INTELLECTUAL PROPERTY WILL BE UNINTERRUPTED OR ERROR FREE. ANY USE OF THE INTELLECTUAL PROPERTY SHALL BE MADE ENTIRELY AT THE USER'S OWN RISK. IN NO EVENT SHALL THE COPYRIGHT HOLDER OR ANY CONTRIBUTOR OF INTELLECTUAL PROPERTY RIGHTS TO THE INTELLECTUAL PROPERTY BE LIABLE FOR ANY CLAIM, OR ANY DIRECT, SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES, OR ANY DAMAGES WHATSOEVER RESULTING FROM ANY ALLEGED INFRINGEMENT OR ANY LOSS OF USE, DATA OR PROFITS, WHETHER IN AN ACTION OF CONTRACT, NEGLIGENCE OR UNDER ANY OTHER LEGAL THEORY, ARISING OUT OF OR IN CONNECTION WITH THE IMPLEMENTATION, USE, COMMERCIALIZATION OR PERFORMANCE OF THIS INTELLECTUAL PROPERTY.

This license is effective until terminated. You may terminate it at any time by destroying the Intellectual Property together with all copies in any form. The license will also terminate if you fail to comply with any term or condition of this Agreement. Except as provided in the following sentence, no such termination of this license shall require the termination of any third party end-user sublicense to the Intellectual Property which is in force as of the date of notice of such termination. In addition, should the Intellectual Property, or the operation of the Intellectual Property, infringe, or in LICENSOR's sole opinion be likely to infringe, any patent, copyright, trademark or other right of a third party, you agree that LICENSOR, in its sole discretion, may terminate this license without any compensation or liability to you, your licensees or any other party. You agree upon termination of any kind to destroy or cause to be destroyed the Intellectual Property together with all copies in any form, whether held by you or by any third party.

Except as contained in this notice, the name of LICENSOR or of any other holder of a copyright in all or part of the Intellectual Property shall not be used in advertising or otherwise to promote the sale, use or other dealings in this Intellectual Property without prior written authorization of LICENSOR or such copyright holder. LICENSOR is and shall at all times be the sole entity that may authorize you or any third party to use certification marks, trademarks or other special designations to indicate compliance with any LICENSOR standards or specifications.

This Agreement is governed by the laws of the Commonwealth of Massachusetts. The application to this Agreement of the United Nations Convention on Contracts for the International Sale of Goods is hereby expressly excluded. In the event any provision of this Agreement shall be deemed unenforceable, void or invalid, such provision shall be modified so as to make it valid and enforceable, and as so modified the entire Agreement shall remain in full force and effect. No decision, action or inaction by LICENSOR shall be construed to be a waiver of any rights or remedies available to it.

None of the Intellectual Property or underlying information or technology may be downloaded or otherwise exported or reexported in violation of U.S. export laws and regulations. In addition, you are responsible for complying with any local laws in your jurisdiction which may impact your right to import, export or use the Intellectual Property, and you represent that you have complied with any regulations or registration procedures required by applicable law to make this license enforceable

Contents		Page
i.	Preface.....	v
ii.	Document terms and definitions	v
iii.	Submitting organizations	v
iv.	Document contributor contact points.....	v
v.	Revision history	vi
vi.	Changes to the OpenGIS® Abstract Specification	vii
vii.	Changes to the OpenGIS® Implementation Standardss	vii
viii.	Future work.....	vii
	Foreword.....	viii
	Introduction.....	ix
1	Scope.....	1
2	Conformance.....	1
3	Normative references	1
4	Terms and definitions	2
4.1	data clearinghouse	2
4.2	data level.....	2
4.3	dataset series.....	2
4.4	Earth Observation Product (EOP)	2
4.5	identifier	2
4.6	layer	2
4.7	map	2
4.8	metadata dataset	2
4.9	metadata entity	2
4.10	metadata schema.....	3
4.11	metadata section	3
4.12	operation.....	3
4.13	parameter	3
4.14	portrayal.....	3
4.15	profile	3
4.16	sample dimension.....	3
4.17	service interface.....	3
4.18	state.....	3
4.19	transfer protocol	4
5	Conventions	4
5.1	Abbreviated terms	4

5.2	Document terms and definitions.....	5
6	Overview and Context	6
6.1	Background	6
6.2	Challenges	7
6.2.1	Discovery	7
6.2.2	Evaluation	7
7	Constraints and Conventions of WMS Usage for EO Products	10
7.1	Approach	10
7.2	Metadata Model.....	10
7.2.1	Mandatory service metadata	11
7.2.2	Coverage outline service metadata	11
7.2.3	Band coverage service metadata.....	12
7.2.4	Geophysical parameter service metadata.....	12
7.2.5	Spatial metadataset (bitmask) service metadata	13
7.3	GetMap Request/Response.....	14
7.3.1	Presentation of default coverage maps	14
7.3.2	Presentation of outline coverage maps	15
7.3.3	Presentation of band coverage maps.....	16
7.3.4	Presentation of geophysical parameter coverage maps	17
7.3.5	Presentation of metadataset coverage (bitmask) maps	17
Annex A	(normative) Abstract Test Suite	18
A.1	Introduction	18
A.1.1	Limitations	18
A.1.2	Source documents	19
A.1.3	Executable test suite.....	19
A.2	WMS-GetCapabilities	19
A.2.1	Purpose.....	19
A.2.2	GetCapabilities Operation Conformance Level 1.....	19
A.2.3	GetCapabilities Operation Conformance Level 2.....	23
A.3	WMS-GetMap	26
A.3.1	Purpose.....	26
A.3.2	GetMap Operation Conformance Level 1.....	26
A.3.3	GetMap Operation Conformance Level 2.....	32
A.4	WMS-GetFeatureInfo.....	41
A.4.1	Purpose.....	41
Annex B	(normative) WSDL Specification (to be completed).....	43
Annex C	(informative) Guidance on integrated discovery and viewing of EO Products (linking the WMS, CS-W and GML EOP extensions).....	44
Bibliography	51

i. Preface

The Open Geospatial Consortium (OGC) is an international industry consortium of more than 375 companies, government agencies, and universities participating in a consensus process to develop publicly available geo-processing standards.

The WMS profile defined in this document began as an initiative funded by the British National Space Agency (BNSC) with ongoing support from the European Space Agency (ESA). This Best Practice defines conventions for the Earth Observation (EO) community to use OGC Web Services. The objective of this work is to define how data providers can apply OGC Web Service standards in a “standard” way to ensure that the inventory level visualisation of EO data is carried out in a truly interoperable way.

ii. Document terms and definitions

This document uses the terms defined in Subclause 5.3 of [OGC 05-008], 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 standard.

iii. Submitting organizations

This profile is being submitted to the OGC by the following organizations:

Infoterra Ltd.

Europa House, The Crescent,
Farnborough, Hampshire,
GU14 0NL
U.K.

iv. Document contributor contact points

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

Thomas H.G. Lankester (Editor)
Infoterra Ltd.
thomas.lankester@infoterra-global.com

Contributors:

Contact	Company
Thomas Lankester	Infoterra Ltd.

v. Revision history

Date	Release	Editor	Primary clauses modified	Description
2006-07-05	0.1.0	Thomas Lankester	All	Initial version submitted and approved for discussion
2007-06-15	0.2.0	Thomas Lankester	7.2, 7.2.1, 7.2.2, 7.3.2, 7.3.3, 7.3.4	Refactored metadata model based on lessons learnt from reference implementation development. Removed requirement for explicit LAYER name suffixes, removed need for explicit default image LAYER and added nested LAYERS for geophysical parameters.
2008-10-29	0.3.0	Thomas Lankester	7.2.1, 7.2.2, 7.3.1, 7.3.2, 7.3.3, 7.3.4, 7.3.5, Annex A	Minor clarifications, addition of subclause on product outline GetMap request and draft Abstract Test Suite (Annex A)
2009-02-17	0.3.1	Thomas Lankester	7.2.1, 7.2.2, 7.3.1, 7.3.2, 7.3.3, 7.3.4, 7.3.5, Annex A	Minor corrections, addition of sub-layer naming conventions, sample dimension properties placed in a dedicated ‘bands’ sub layer, specify XML as the MIME type for a GetFeatureInfo response, remove ‘nearest’ attribute for the TIME dimension, removed bounding box requirement for outlines.
2009-05-22	0.3.2	Thomas Lankester		Minor corrections to Annex A, addition of (informative) Annex C.
2009-6-08	0.3.2	Carl Reed	Various	Preparation for publication as BP replacement
2009-11-09	0.3.3	Thomas Lankester	Annex A: ATC-7, ATC-9	Realigned ATS with specification

vi. Changes to the OpenGIS® Abstract Specification

The OpenGIS® Abstract Specification does not require changes to accommodate the technical contents of this document.

vii. Changes to the OpenGIS® Implementation Standardss

This document defines a Level 1 profile of the OGC Web Map Service (WMS) 1.3 implementation standard and, as such, provides only a specific use case without extensions or changes.

viii. Future work

Improvements in this document are desirable to provide additional examples for Key Value Pair (KVP) and Simple Object Access Protocol (SOAP) bindings.

Foreword

This document describes a profile of the OpenGIS Web Map Service 1.3 Implementation Standard / International Standards Organization (ISO) Web Map server interface Draft International Standard 19128.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. The Open Geospatial Consortium Inc. shall not be held responsible for identifying any or all such patent rights.

Recipients of this document are requested to submit, with their comments, notification of any relevant patent claims or other intellectual property rights of which they may be aware that might be infringed by any implementation of the standard set forth in this document, and to provide supporting documentation.

This document currently includes two annexes. Annex A is normative and Annex C which is informative.

Introduction

The WMS configuration proposed in this profile is intended to support the interactive visualization and evaluation of Earth Observation (EO) data products. The profile describes a consistent Web Map Server (WMS) configuration that can be supported by any content providers (satellite operators, data distributors ...), most of whom have existing (and relatively complex) facilities for the management of these content. In addition, this profile is intended to compliment the EO Products Extension Package for ebRIM Profile of CSW 2.0 (OGC 06-131) by showing how WMS servers may be used to evaluate products identified through catalogue discovery prior to their ordering.

The target audience for this document includes Web map users, client developers, service implementers, and system testers. This Profile encompasses two interrelated views¹ that reflect different viewpoints on a Web map service. Each viewpoint focuses on different areas of concern:

- *Enterprise* – describes the general capabilities of the service in light of functional and nonfunctional requirements (for WMS users and system testers);
- *Information* – defines the kinds of information handled by the map service and the policies to be enforced (for WMS users, developers and testers).

¹ As per the **Reference Model of Open Distributed Processing** (RM-ODP, ISO/IEC 10746)

OpenGIS® Web Map Services – Application Profile for EO Products

1 Scope

This application profile document describes how:

- a) WMS layers, sample dimensions and nested layers can be used to manage the hierarchy of EO product information from the collection level, down through individual products to the sample and quality bitmask dimensions;
- b) The WMS GetMap operation can be used to support interactive browse and the full evaluation of sample coverage and quality information.

This OGC™ document specifies a constrained, consistent interpretation of the WMS standard that is applicable to government, academic and commercial providers of EO products.

2 Conformance

Conformance with this profile shall be checked using all the relevant abstract tests specified in the Abstract Test Suite provided in Annex A of this profile.

3 Normative references

The following normative documents contain provisions that, through reference in this text, constitute provisions of this document. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the normative document referred to applies.

- [1] OGC 06-042, OpenGIS® Web Map Service (WMS) Implementation Standard, version 1.3
- [2] OGC 06-121r3, OGC® Web Service Common Standard, version 1.1.0
- [3] W3C REC-SVG11-20030114, SVG 1.1 recognised colour keywords (<http://www.w3.org/TR/SVG/types.html#ColorKeywords>)
- [4] OGC 06-131r6, OGC® Catalogue Services Standard 2.0 Extension Package for ebRIM Profile: Earth Observation Products, Version 0.2.3

4 Terms and definitions

For the purposes of this profile, the definitions specified in Clause 4 of the OWS Common Implementation Standard [OGC 05-008] shall apply. In addition, the following terms and definitions apply.

4.1 data clearinghouse

collection of institutions providing digital data, which can be searched through a single interface using a common metadata standard [ISO 19115]

4.2 data level

stratum within a set of layered levels in which data is recorded that conforms to definitions of types found at the application model level [ISO 19101]

4.3 dataset series

collection of datasets sharing the same product specification [ISO 19113, ISO 19114, ISO 19115]

4.4 Earth Observation Product (EOP)

an individual dataset, derived from Earth Observation, that conforms to a product specification shard with other datasets in s dataset series

4.5 identifier

a character string that may be composed of numbers and characters that is exchanged between the client and the server with respect to a specific identity of a resource

4.6 layer

basic unit of **geographic information** that may be requested as a **map** from a **server**

4.7 map

portrayal of **geographic information** as a digital image file suitable for display on a computer screen

4.8 metadata dataset

metadata describing a specific dataset [ISO 19101]

4.9 metadata entity

group of metadata elements and other metadata entities describing the same aspect of data

NOTE 1 A metadata entity may contain one or more metadata entities.

NOTE 2 A metadata entity is equivalent to a class in UML terminology [ISO 19115].

4.10 metadata schema

conceptual schema describing metadata

NOTE ISO 19115 describes a standard for a metadata schema. [ISO 19101]

4.11 metadata section

subset of metadata that defines a collection of related metadata entities and elements [ISO 19115]

4.12 operation

specification of a transformation or query that an object may be called to execute [ISO 19119]

4.13 parameter

variable whose name and value are included in an operation **request** or **response**

4.14 portrayal

presentation of information to humans [ISO 19117]

4.15 profile

set of one or more base standards and - where applicable - the identification of chosen clauses, classes, subsets, options and parameters of those base standards that are necessary for accomplishing a particular function [ISO 19101, ISO 19106]

4.16 sample dimension

dimension other than the four space-time dimensions [OGC 06-042]

4.17 service interface

shared boundary between an automated system or human being and another automated system or human being [ISO 19101]

4.18 state

condition that persists for a period

NOTE The value of a particular feature attribute describes a condition of the feature [ISO 19108].

4.19 transfer protocol

common set of rules for defining interactions between distributed systems [ISO 19118]

5 Conventions

5.1 Abbreviated terms

Some frequently used abbreviated terms:

API	Application Program Interface
CEOS	Committee on Earth Observation Satellites
CIM	Core ISO Metadata
CS-W	Catalogue Service Web
EO	Earth Observation
EOP	Earth Observation Product
HTTP	HyperText Transport Protocol
ISO	International Organisation for Standardisation
N/A	Not Applicable
OGC	Open Geospatial Consortium
UML	Unified Modeling Language
URI	Universal Resource Identifier
URL	Universal Resource Locator
W3C	World Wide Web Consortium
WCS	Web Coverage Service
WMC	Web Map Context
WMS	Web Map Service
XML	eXtensible Markup Language

5.2 Document terms and definitions

The following terms and definitions are used in this document:

- a) shall – verb form used to indicate a requirement to be strictly followed to conform to this profile, from which no deviation is permitted
- b) should – verb form used to indicate desirable ability or use, without mentioning or excluding other possibilities
- c) may – verb form used to indicate an action permissible within the limits of this profile
- d) can – verb form used for statements of possibility
- e) informative – a part of a document that is provided for explanation, but is not required
- f) normative – a part of a standards document that is required
- g) annex – an auxiliary part of a document
- h) clause – a major part of a document
- i) subclause – a secondary part of a clause or annex

6 Overview and Context

6.1 Background

The acquisition of EO data is subject to a range of factors which effect the degree to which a product is fit for purpose. For optical EO these factors include cloud cover, snow cover, atmospheric aerosols, low illumination angles, sun glint off the ocean or ice surface and suspended sediment in the water column. For imaging radar the usefulness of products can be affected by wind speed, presence of surfactants and soil moisture. It is therefore important to potential users that they can evaluate EO products prior to ordering and (where applicable) purchase.

A number of WMS features make them a good choice for EO data providers wanting to open up their product inventories for evaluation:

- Open Web service specifications are widely and simply supported using common place Web browsers;
- Web maps provide a geocoded view of data frequently acquired as ungeocoded scan lines;
- The WMS interface supports roam and zoom functionality not available with a simple image thumbnail;
- Use of high levels of image compression reduces bandwidth requirements relative to WCS whilst allowing effective visual inspection;
- The serving of products via highly compressed images ensures that the original data is protected from unauthorised use.

Unfortunately, practical application of WMS technology is hindered by two issues:

1. Inconsistent interpretation of the WMS standard in the context of EO data;
2. Server instances are typically configured to return just a single representation using a sub-set of the dataset. Some or even most, of the dataset is not made available for evaluation.

To illustrate the first point, consider the use of WMS ‘layers’. A layer is defined as the basic unit of geographic information that may be requested as a map from a server. A literal interpretation would be that each individual EO data granule (dataset) should be handled as a WMS layer. With large inventories of EO products (>10,000) this results in bloated responses to GetCapability requests. An alternative interpretation is that a WMS layer should represent a collection of datasets sharing the same product specification (i.e. a dataset series). In this context, individual datasets can be retrieved and presented using their acquisition time.

Whilst both interpretations can be justified, the resulting WMS server configurations are incompatible, seriously hindering the client to server and community wide interoperability.

6.2 Challenges

6.2.1 Discovery

EO data products are usually derived from an instrument onboard a satellite² containing one or more sensors that typically acquire tens of thousands of products during their lifetime. For a user, discovering an appropriate scene via a WMS can be challenging as even a well-constrained search may return a number of overlapping scenes which obscure each other.

6.2.2 Evaluation

Using WMS technology to present EO datasets for evaluation is not straightforward. Data are frequently acquired by sensors simultaneously in several wavebands and/or polarizations of electromagnetic radiation (see Figure 6-1). Higher level products may also contain coverage of bio/geophysical parameters derived from the original sample datasets. Additional background and quality information are commonly stored as bitmasks that are critically important to evaluate the extent of usable data within a product coverage. As a consequence, EO products often contain far more information than can easily be presented in a single, static RGB view.

² The same applies to Remote Sensing instruments used on airborne platforms

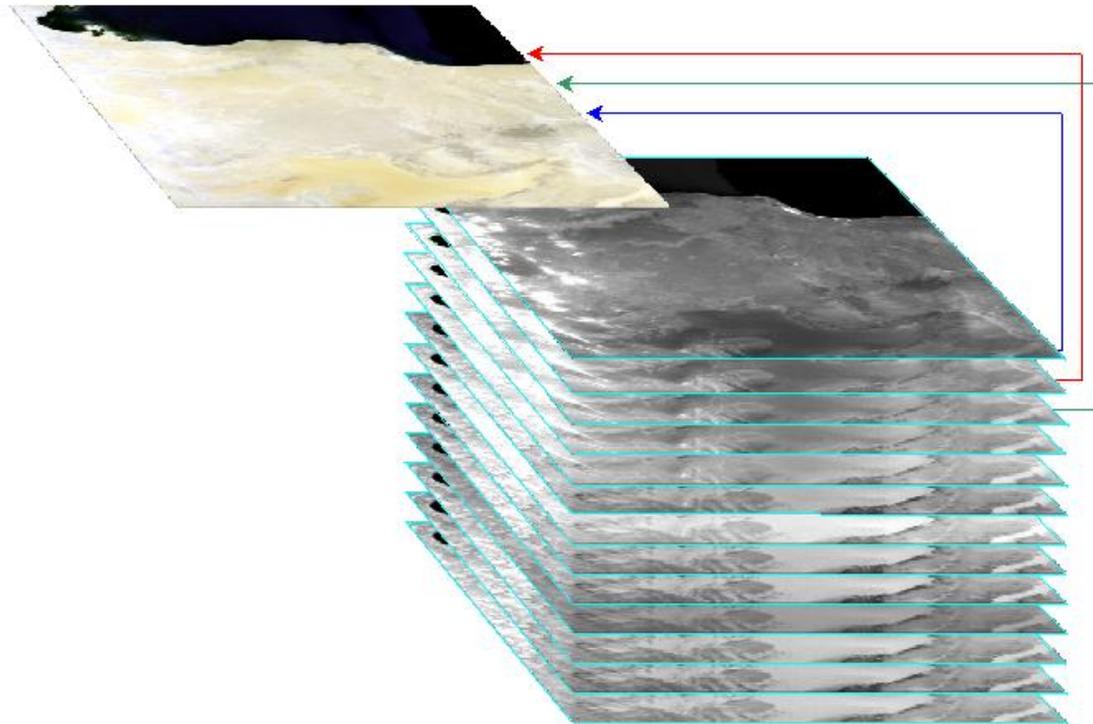


Figure 6-1: Example stack of data coverages in the sample dimension of an EO product.

Note: Only a fraction of the sample information can be visualized using a static RGB image.

The situation is even worse for the spatial metadata held in a parallel stack of bitmasks (see Figure 6-2) because the bitmask information cannot be added to a static RGB image without obscuring data and other bitmask information.

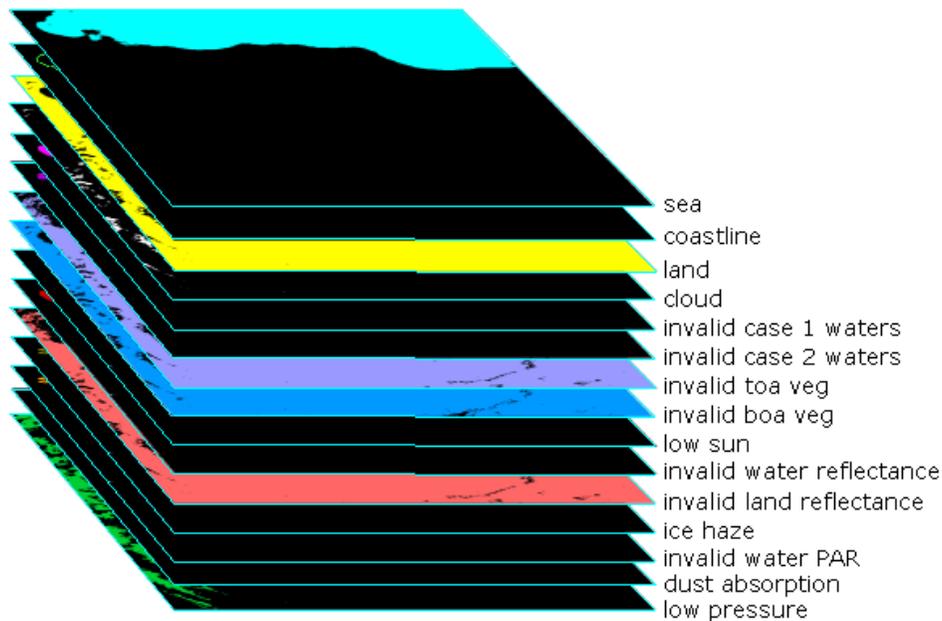


Figure 6-2: Example spatial metadata (bitmask) stack from an EO instrument.

Meeting the twin challenges of true interoperability and the full evaluation of the spatial elements of EO products (interactive browse), requires the definition of a consistent, constrained, interpretation of the WMS standard. This task is carried out in Section 7.

7 Constraints and Conventions of WMS Usage for EO Products

7.1 Approach

The definition of a consistent, constrained, interpretation of the WMS standard has two aspects:

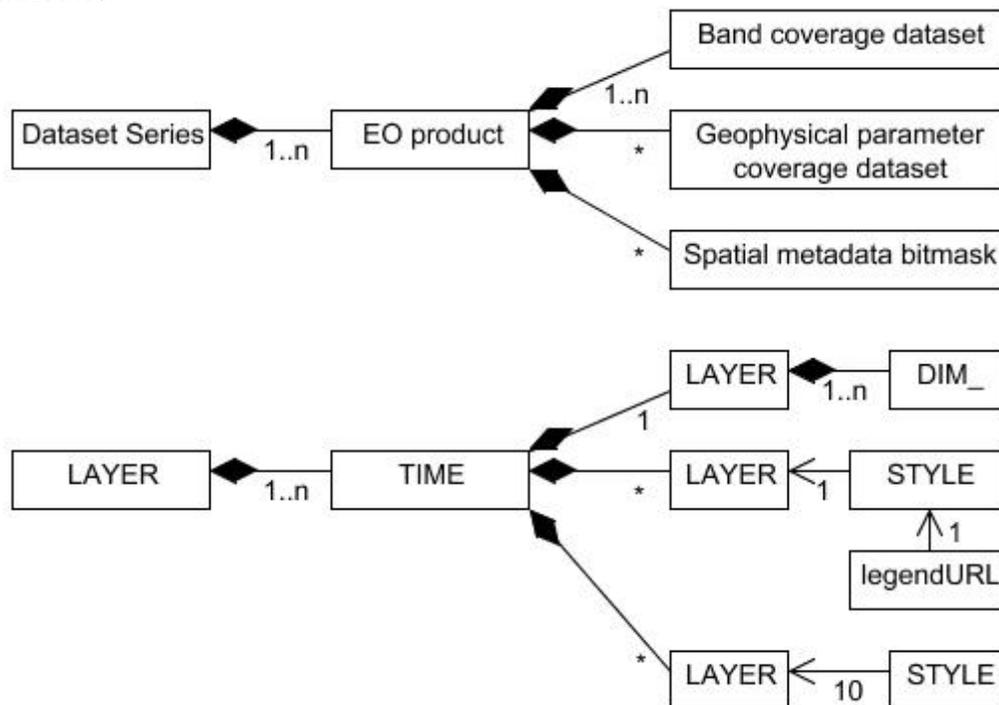
1. A WMS metadata model of the spatial data and metadata structure of EO datasets;
2. A defined set of WMS server responses to GetMap requests.

These aspects are, respectively, addressed in sub-sections 7.2 and 7.3.

Mandatory constructs and behaviour are defined to provide a simple WMS profile that will allow for basic (default) representation of EO products in an interoperable way. Additional, optional, elements of the metadata model and WMS server behaviour are defined to cater for the full interactive browse and evaluation of EO products.

7.2 Metadata Model

The metadata model provides the basic framework, the skeleton, of a WMS instance. Defining a WMS metadata model for EO products is therefore a prerequisite for an application profile that is unambiguous whilst allowing interactive viewing of all of the spatial information within EO products. Figure 7-1 provides a view of how the normal arrangement of EO products can be mirrored using appropriate WMS metadata elements and attributes.



**Figure 7-1: UML class diagrams showing how the organisation of EO spatial information maps to the proposed WMS service metadata model.
Note the use of multiplicity on the class associations.**

The handling of service metadata for EO products defined here is in line with Annex C (Handling multi-dimensional data) of the WMS 1.3 standard (OGC 06-042). The overview for the WMS 1.3 handling of multi-dimensional data concludes:

“The server may declare a single name for the layer and enumerate available times and wavelength bands in its service metadata. A client then adds additional parameters to the GetMap request to request a specific time and band.”

7.2.1 Mandatory service metadata

For EO datasets a LAYER service metadata element shall be used to represent each dataset series / dataset type. For instance, all products of type ‘MERIS instrument, Level 1b, Reduced Resolution’ would be described as a dataset series and represented by a single LAYER element in the service metadata of a WMS instance.

EO WMS instances shall support default maps of a given dataset series. The default image map shall be defined as the mandatory dataset series LAYER e.g.:

```
<Layer>
  <Name>"MER_RR__2P"</Name>
  ...
</Layer>
```

The service metadata shall define a TIME dimension for each LAYER element with a value that defines the individual times or range of the available coverage, e.g.:

```
<Dimension name="time" units="ISO8601">
  2002-05-01/2006-09-17/PT1S
</Dimension>
```

The use of the mandatory TIME dimension to retrieve maps from individual EO products is defined in subclause 7.3.1. Because the specification of a TIME value in a GetMap request is mandatory, the ‘default’ attribute shall not be provided with the TIME dimension service metadata.

The use of other service metadata (nested layers, sample dimensions) in the dataset series LAYER is optional and should be used to support interactive browse of EO products.

7.2.2 Coverage outline service metadata

To support the discovery of EO products, an optional layer may be used to provide outlines of EO products (see Figure 7-5 for example). If such a layer is used then it shall be nested within the dataset series LAYER. When used, a sub-layer of products outlines shall:

1. be queryable;
2. use the parent dataset series LAYER name with the suffix ‘_outlines’.

For example:

```
<Layer queryable="1">
  <Name>MER_FSO_1P_OUTLINES</Name>
  ...
</Layer>
```

Note that the product outlines layer, when used, is queryable in order to support a GetFeatureInfo request. The response to such a request shall include information on any EO products who's shown outline encloses the geographic location selected by the user. The outlines LAYER element shall also contain a STYLE element listing the following 10 predefined colours as per the [SVG 1.1 recognised colour keywords](#) (W3C REC-SVG11-20030114):

```
<Styles=white,yellow,orange,red,magenta,blue,cyan,green,brown,black>
```

7.2.3 Band coverage service metadata

Band coverage datasets refer to a series of coverage datasets that have a common type of measurement such as wavelength or polarisation.

If an EO WMS instance supports the interactive selection and viewing of band coverage datasets then these shall be held in a LAYER nested in the main dataset series (data-type) LAYER. This nested LAYER shall:

1. use the parent dataset series LAYER name with the suffix ‘_bands’;
2. have one (or more) sample dimension shall be defined as properties of this ‘_bands’ layer in the service metadata.

For instance, consider a WMS instance that supports interactive browsing of a series of polarimetric Synthetic Aperture Radar datasets. The sample dimension within the LAYER element of the dataset series might be defined as:

```
<Layer>
  <Name>ASA_APP_1P_BANDS</Name>
  <Dimension name="polarization (intensity)" units=""
    multipleValues="1">
    HH, VV, HV, VH
  </Dimension>
</Layer>
```

Similarly, datasets from a passive sensor that detects upwelling radiance in a number of wavebands might be defined as:

```
<Layer>
  <Name>MODIS_L1B_BANDS</Name>
  <Dimension name="wavelength" units="nano metres" unitSymbol="nm"
    multipleValues="1">
    412.5, 442.5, 490, 510, 560, 620, 665
  </Dimension>
</Layer>
```

7.2.4 Geophysical parameter service metadata

Geophysical parameter datasets differ from band datasets in that each coverage has a distinct unit of measure. Geophysical datasets are typically displayed in pseudo-colour with a colour key relating parameter values to image colour (see Figure 7.2).

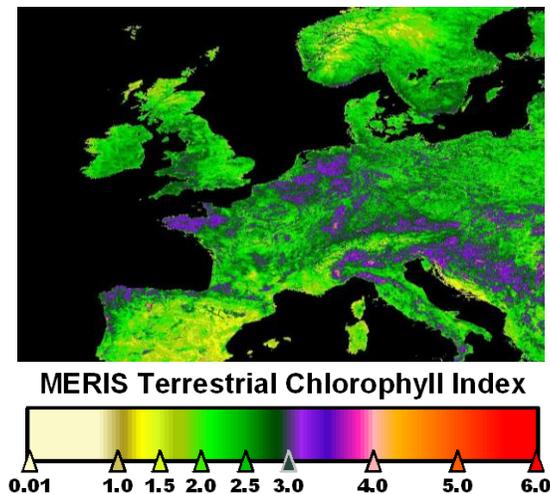


Figure 7-2: Example geophysical parameter map, in pseudo-colour with associated colour legend.

To support interactive browse, the service metadata shall define each geophysical parameter as a LAYER nested in the main dataset series (data-type) LAYER. Geophysical parameter layers shall:

1. use the parent dataset series LAYER name with the suffix ‘_’ and the name of the geophysical parameter ;
2. have an associated style containing a LegendURL element whose value shall link to a graphical colour key.

7.2.5 Spatial metadataset (bitmask) service metadata

Subtle variations in values across coverage datasets can be presented as greyscale or colour image maps in a number of ways (see Section 7.3.3), often through Red Green Blue (RGB) colour combination. Bitmasks, however, represent spatial metadata flags that are either ‘on’ or ‘off’ which can be represented using single colour maps that hide the underlying map of coverage datasets as shown in Figure 7-3 below.

Sample dimensions cannot be used to represent the bitmask stack as the assignment / reassignment of colours to sample dimensions is not supported in WMS 1.3. To provide the required degree of flexibility, each bitmask shall be represented as a nested LAYER element (see Figure 7-1). Each bitmask LAYER shall:

1. use the parent dataset series LAYER name with the suffix ‘_’ and the name of the flag;
2. have an associated STYLE element listing the following 10 predefined colours as per the [SVG 1.1 recognised colour keywords](#) (W3C REC-SVG11-20030114):

```
<Styles=white,yellow,orange,red,magenta,blue,cyan,green,brown,black>
```

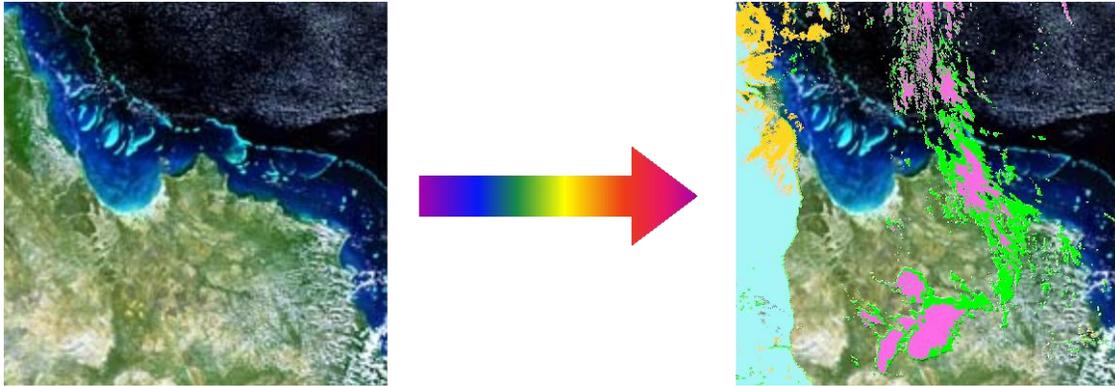


Figure 7-3: Application of four bitmasks to an EO dataset coverage false colour composite map. Note that four contrasting colours have been chosen to represent the bitmasks.

7.3 GetMap Request/Response

Where the service metadata model provides the skeleton for this WMS profile, the definition of the GetMap request/response adds the functional muscle that ultimately delivers the rendered image maps back to the client application of a user. The default behaviour needed to support consistent WMS handling for EO products is defined in subclause 7.3.1. Subclause 7.3.2 describes the response to a GetMap request for product outlines. The behaviour needed to support interactive browse and evaluation of EO products is defined in subclauses 7.3.4, 7.3.5 and 7.2.5.

7.3.1 Presentation of default coverage maps

This subclause covers the client – server handling of the mandatory service elements without reference to specific coverage dataset or spatial metadataset elements. Subclause 7.2.1 defined the use of LAYER elements to identify dataset series with the TIME dimension used to identify individual EO products. An example GetMap request is given below with the mandatory parts of the request shown in bold.

```
http://eoltd.co.uk/mapserver.cgi?VERSION=1.3.0
  &REQUEST=GetMap
  &CRS=CRS:84
  &BBOX=79.105,24.913,91.794,36.358
  &WIDTH=350
  &HEIGHT=350
  &LAYERS=MER_RR_2P&STYLES=&FORMAT=image/png
  &TIME=2002-07-30/2002-07-31/P1D
```

When no coverage dataset sample dimensions, geophysical parameter or bitmask sub-layers are defined in the GetMap request then the WMS server shall respond by returning a default map of the requested EO product(s), as shown in Figure 7-4 below. In other words, no nested layers shall be returned when just the group dataset series / data type layer is defined in the GetMap request.



Figure 7-4: Default server responses to a GetMap request:

- SAR intensity map or panchromatic scene returned as a greyscale image;
- Multi-waveband product map returned as an RGB false colour composite;
- Geophysical parameter map returned as a pseudo-colour image, with colour legend.

Note that when there is no exact match for the requested TIME value, the server response may include a ‘nearest value used’ warning as per subclause C.4.3 of OGC 06-042.

7.3.2 Presentation of outline coverage maps

Where supported (see subclause 7.2.2), an outline view of available EO products may be requested by specifying the name of the queryable outline layer in the GetMap request. The returned map shall support the GetFeatureInfo operation. If a GetFeatureInfo request is made for a location within a product outline, the response shall contain metadata about the acquisition time of the product(s), encoded with an XML MIME type, ideally as GML for EO products (see OGC 06-080). This time metadata can then be used to construct a specific GetMap request for a view of the individual product.

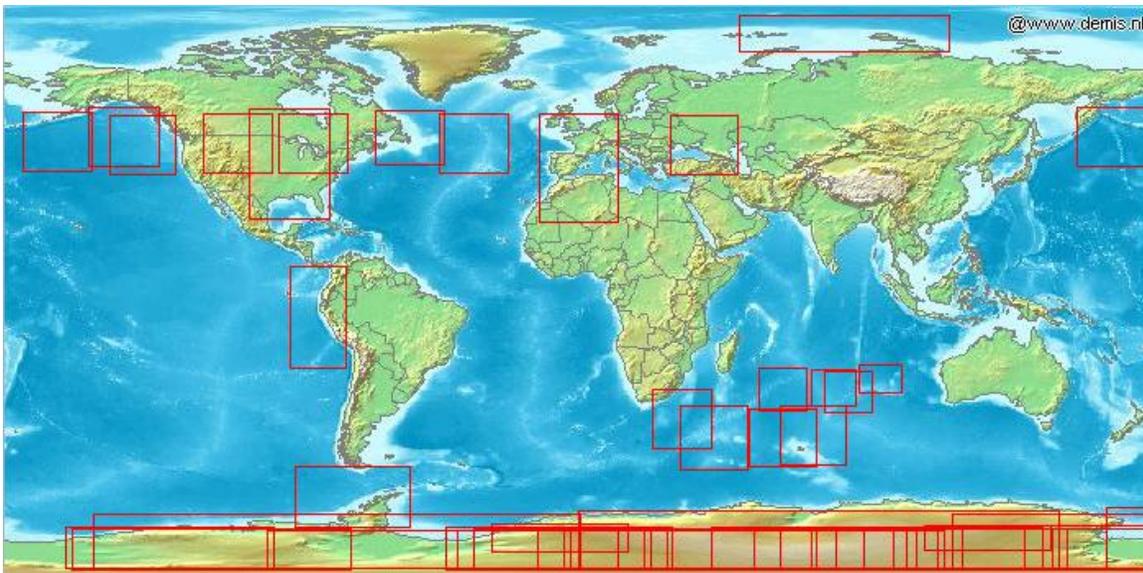


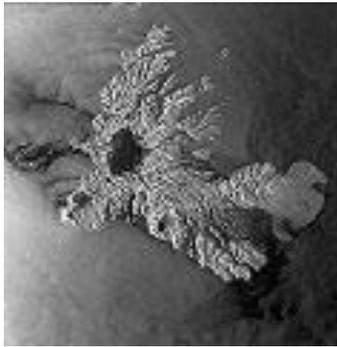
Figure 7-5: Screen shot illustrating the use of an ‘outline’ layer which avoids the obscuration caused by overlapping images of EO products.

7.3.3 Presentation of band coverage maps

The type of rendering of band datasets carried out by the WMS server shall depend on the number of sample dimension values requested. Only one or three sample dimension values may be specified per GetMap request. If any other number of sample dimension values is requested then the server shall issue a service exception (code = InvalidDimensionValue).

A GetMap request for a single dataset in the sample dimension shall be served by a greyscale image as illustrated in Figure 7-6.

```
http://eoltd.co.uk/mapserver.cgi?VERSION=1.3.0
  &REQUEST=GetMap&CRS=CRS:84
  &BBOX=78.105,24.913,94.794,36.358
  &WIDTH=560&HEIGHT=350
  &LAYERS=ASA_IMP_1P_BANDS
  &FORMAT=image/png
  &TIME=2005-10-05T07:25:00
  &DIM_SAR=INTENSITY
```



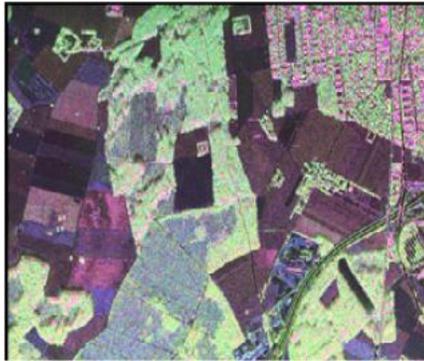
Copyright ESA 2006

Figure 7-6: Example GetMap requests/responses based on specifying a single sample dimension dataset with a SAR intensity map returned as a greyscale image.

A GetMap request for three sample dimension datasets shall be served by a false colour composite with each of the datasets contrast stretched (see Figure 7-7 for examples).

&DIM_POLARISATION=HH-VV,HV+VH,HH+VV

&DIM_WAVELENGTH=665,510,412.5



Copyright DLR 2002



Copyright ESA 2006

Figure 7-7: Example GetMap requests/responses based on specifying a three values from the sample dimension dataset:

- E-SAR L-band polarimetric intensity map returned as an RGB false colour composite;
- MERIS (optical) product map returned as an RGB false colour composite.

7.3.4 Presentation of geophysical parameter coverage maps

A GetMap request for a geophysical parameter LAYER nested in the sample dimension shall be served as a pseudo colour image with a colour legend (see Figure 7-2 for example).

7.3.5 Presentation of metadataset coverage (bitmask) maps

As noted in Section 7.2.5, the spatial metadataset (bitmask) stacks are defined using layers nested within each dataset series layer. This nesting should be reflected in the name of each nested bitmask layer by using the parent layer name to prefix the nested bitmask layer names. For instance, the bitmask CLOUD within the dataset series MER_RR__2P would have the layer name MER_RR__2P_CLOUD.

An example GetMap request is given below:

```
http://eoltd.co.uk/mapserver.cgi?VERSION=1.3.0
  &REQUEST=GetMap&CRS=CRS:84
  &BBOX=78.105,24.913,94.794,36.358
  &WIDTH=560&HEIGHT=350
  &LAYERS=MER_RR__2P,
           MER_RR__2P_CLOUD,
           MER_RR__2P_ABSOA_DUST,
           MER_RR__2P_ICE_HAZE,
           MER_RR__2P_SUSPECT
  &STYLES=,CYAN,ORANGE,MAGENTA,GREEN
  &FORMAT=image/png
  &TIME=2005-10-05T07:25:00
```

Note that the parent dataset series layer is listed with the bitmask layers and that the corresponding styles list has a blank (default) entry for the parent dataset series layer.

Annex A (normative)

Abstract Test Suite

A.1 Introduction

An Abstract Test Suite (ATS), as defined in ISO 19105, is an abstract test module specifying all the requirements to be satisfied for conformance. As such, an ATS provides a basis for developing an executable test suite (ETS) to verify that the implementation under test (IUT) conforms to all relevant functional specifications.

This annex provides a compendium of test assertions applicable to Web Map Server (WMS) implementations of the WMS 1.3 Application Profile for EO Products (OGC 07-063r1). This ATS also covers WMS 1.1.1 servers which conform to the service metadata and GetMap behaviour of the EO Profile.

The abstract test cases (assertions) are organized into classes of conformance that correspond to sets of capabilities. The following classes of conformance are defined:

1. **WMS-Get Capabilities** – GetCapabilities Request and Response
2. **WMS-GetMap** – TIME specification, default map, product outline map, band coverage map, geophysical parameter map and spatial metadata (bitmask) map responses.
3. **WMS-GetFeatureInfo** – product metadata request via product bounding box outline LAYERS.

Two conformance levels are defined:

- *Level 1* – test cases covering all mandatory requirements to be satisfied by a minimally conformant server implementation;
- *Level 2* – test cases addressing desirable, but optional, behaviour requirements.

Note that the use in this document of uppercase to denote elements in XML text has no significance in either Web service requests or responses.

A.1.1 Limitations

There are some limitations and conditions to the ATS:

- Only the WMS server is tested, not the client;
- The test assertions only apply to the specialist constraints and behaviour defined in OGC 07-063r1 (the 'EO profile') and not to the full WMS 1.3 standard.

A.1.2 Source documents

- [OpenGIS® Web Map Services – Application Profile for EO Products \(0.3.0\)](#) (OGC 07-063r1)
- [OpenGIS® Web Map Service \(WMS\) Implementation Specification \(1.3.0\)](#) (OGC 06-042)
- [OpenGIS® Web Service Common Implementation Specification](#) (OGC-06-121r3)
- [SVG 1.1 recognised colour keywords](#) (W3C REC-SVG11-20030114)

A.1.3 Executable test suite

No executable test suite has yet been defined.

A.2 WMS-GetCapabilities**A.2.1 Purpose**

The WMS-GetCapabilities test group includes assertions covering descriptions of conformance *Level 1* and *Level 2* capabilities.

A.2.2 GetCapabilities Operation Conformance Level 1**List of Tables**

1. [Minimal Request](#)
2. [Dataset series LAYER Response](#)
3. [Time DIMENSION Response](#)
4. [Single Time DIMENSION Response](#)
5. [Multiple Time DIMENSION Response](#)
6. [Interval Time DIMENSION Response](#)

ATC 1. GetCapabilities Minimal Request

Test case identifier	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getcapabilities:level-1:minimalrequest
Test purpose (assertion)	Verify that when a GetCapabilities request with only mandatory parameters is submitted, the response is valid XML that validates against the WMS 1.3.0 GetCapabilities schema.

Test method	Submit a request to the server with the following parameters and values:	
	service	WMS
	request	GetCapabilities
	Pass if the result is valid XML and if the result validates against the WMS 1.3.0 GetCapabilities schema (wmsGetCapabilities).	
Reference	<ol style="list-style-type: none"> 1. OGC 06-042 Subclause 7.2 2. OGC 06-121r3 Subclause 7.2.2 	
Test type	Basic	

ATC 2. GetCapabilities Dataset Series LAYER Response

Test case identifier	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getcapabilities:level-1:datasetserieslayer	
Test purpose (assertion)	Verify that when a GetCapabilities request with only mandatory parameters is submitted, the response contains LAYER elements, each with an associated DIMENSION element.	
Test method	Submit a request to the server with the following parameters and values:	
	initial request case	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getcapabilities:level-1:minimalrequest
	extract from response	Layer Variable: Layer
	service	WMS
	request	GetCapabilities
	Pass if the result is valid XML and contains: <ul style="list-style-type: none"> • at least one LAYER element; • each top level (group) LAYER element matches to a dataset series; • each top level (group) LAYER contains one DIMENSION element. 	
Reference	OGC 07_063r1 Subclause 7.2.1	
Test type	Capability	

ATC 3. GetCapabilities 'time' DIMENSION Response

Test case identifier	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getcapabilities:level-1:timedimension
-----------------------------	--

Test purpose (assertion)	Verify that each dataset series LAYER element contains a nested 'time' DIMENSION element.		
Test method	Submit a request to the server with the following parameters and values:		
	initial request case	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getcapabilities:level-1:minimalrequest	
	extract from response	Layer/Dimension	Variable: Dimension Attributes: 'name', 'units'
	service	WMS	
	request	GetCapabilities	
	Pass if the extracted DIMENSION element contains the following attribute values: <ul style="list-style-type: none"> • name="time"; • units="ISO8601". 		
Reference	<ol style="list-style-type: none"> 1. OGC 07 063r1 Subclause 7.2.1 2. OGC 06-042 Subclause C.2 		
Test type	Capability		

ATC 4. GetCapabilities Single Time DIMENSION Response

Test case identifier	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getcapabilities:level-1:singletime		
Test purpose (assertion)	Verify that when a single time value is associated with a dataset series LAYER, the response to a basic GetCapabilities request uses the correct single moment date-time format.		
Test method	Submit a request to the server with the following parameters and values:		
	initial request case	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getcapabilities:level-1:minimalrequest	
	extract from response	Layer/Dimension where attribute name="time"	Variable: Dimension
	service	WMS	
	request	GetCapabilities	
	Pass if the extracted value of the DIMENSION element corresponds to a single time in the date-time format of the Web Map Service profile of ISO 8601.		

Reference	1. OGC 07 063r1 Subclause 7.2.1 2. OGC 06-042 Subclauses D.4 and D.5
Test type	Capability

ATC 5. GetCapabilities Multiple Time DIMENSION Response

Test case identifier	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getcapabilities:level-1:multitime	
Test purpose (assertion)	Verify that when multiple product time values are associated with a dataset series LAYER, the response to a basic GetCapabilities request uses the correct date-time list format.	
Test method	Submit a request to the server with the following parameters and values:	
	initial request case	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getcapabilities:level-1:minimalrequest
	extract from response	Layer/Dimension where attribute name="time" Variable: Dimension
	service	WMS
	request	GetCapabilities
	Pass if the extracted value of the DIMENSION element corresponds to a comma separated list of values in the date-time format of the Web Map Service profile of ISO 8601.	
Reference	1. OGC 07 063r1 Subclause 7.2.1 2. OGC 06-042 Subclauses D.4 and D.5	
Test type	Capability	

ATC 6. GetCapabilities Interval Time DIMENSION Response

Test case identifier	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getcapabilities:level-1:intervaltime	
Test purpose (assertion)	Verify that when an interval of time values are associated with a dataset series LAYER, the response to a basic GetCapabilities request uses the correct date-time list format.	
Test method	Submit a request to the server with the following parameters and values:	
	initial request case	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getcapabilities:level-1:minimalrequest

	extract from response	Layer/Dimension where attribute name="time"	Variable: Dimension
	service	WMS	
	request	GetCapabilities	
	Pass if the extracted value of the DIMENSION element corresponds to a time interval and periodicity/refresh rate in the date-time format of the Web Map Service (extended) profile of ISO 8601 and ISO 19128.		
Reference	<ol style="list-style-type: none"> 1. OGC_07_063r1 Subclause 7.2.1 2. OGC_06-042 Subclauses D.4 (Note) and D.5 		
Test type	Capability		

A.2.3 GetCapabilities Operation Conformance Level 2

List of Tables

7. [Queryable Outlines Response](#)
8. [Band Coverage Response](#)
9. [Geophysical Parameter Response](#)
10. [Spatial Metadata Response](#)

ATC 7. GetCapabilities Queryable Outlines Response

Test case identifier	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getcapabilities:level-2:queryableoutline		
Test purpose (assertion)	Verify that when the WMS server supports bounding box outlines, these are accessed via a queryable LAYER, nested in the dataset series LAYER.		
Test method	Submit a request to the server with the following parameters and values:		
	initial request case	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getcapabilities:level-1:minimalrequest	
	extract from response	Layer/Layer/Name where name ends "_outlines"	Variable: QueryableLayer
	extract from QueryableLayer	Styles	Variable: Styles
	service	WMS	
	request	GetCapabilities	

	Pass if: <ul style="list-style-type: none"> • QueryableLayer corresponds to the parent dataset series LAYER name with the suffix ‘_OUTLINES’; • Styles contains the following 10 STYLE values: white, yellow, orange, red, magenta, blue, cyan, green, brown, black
Reference	<ol style="list-style-type: none"> 1. OGC 07-063r1 Subclause 7.2.2 2. SVG 1.1 recognised colour keywords
Test type	Capability

ATC 8. GetCapabilities Band Coverage Response

Test case identifier	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getcapabilities:level-2:bandcoverage		
Test purpose (assertion)	Verify that when the WMS server supports multiple bands of data in a sample dimension, these bands are listed.		
Test method	Submit a request to the server with the following parameters and values:		
	initial request case	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getcapabilities:level-1:minimalrequest	
	extract from response	Layer/Layer where name element value ends "_bands"	Variable: BandsLayer
	extract from BandsLayer	Sample Dimension	Variable: Dimension Attributes: 'name', 'unit'
	service	WMS	
	request	GetCapabilities	
		Pass if the extracted sample dimension (DIMENSION element) has <ul style="list-style-type: none"> • a 'name' attribute; • a 'unit' attribute; • a list of one or more comma separated (band) values. 	
Reference	<ol style="list-style-type: none"> 1. OGC 07-063r1 Subclause 7.2.3 2. OGC 06-042 Subclauses C.2 		
Test type	Capability		

ATC 9. GetCapabilities Geophysical Parameter Response

Test case identifier	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getcapabilities:level-2:geophysicalparameter	
Test purpose (assertion)	Verify that when the WMS server supports geophysical parameter data, these parameters are listed in the dataset series LAYER as nested LAYER elements.	
Test method	Submit a request to the server with the following parameters and values:	
	initial request case	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getcapabilities:level-1:minimalrequest
	extract from response	Layer/Layer/Name Variable: ParameterName
	extract from response	Layer/Layer/Styles/LegendURL Variable: LegendURL
	service	WMS
	request	GetCapabilities
	Pass if: <ul style="list-style-type: none"> ParameterName corresponds to the parent dataset series LAYER name with the suffix '_' and the name of a geophysical parameter; the value of the OnlineResource href in the LegendURL element is a valid URL that links to an image file containing a colour key. 	
Reference	OGC 07-063r1 Subclause 7.2.4	
Test type	Capability	

ATC 10. GetCapabilities Spatial Metadata Response

Test case identifier	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getcapabilities:level-2:spatialmetadata	
Test purpose (assertion)	Verify that when the WMS server supports spatial metadata bitmasks, these bitmasks are listed in the dataset series LAYER as nested LAYER elements.	
Test method	Submit a request to the server with the following parameters and values:	
	initial request case	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getcapabilities:level-1:minimalrequest

	extract from response	Layer/Layer/Name	Variable: BitmaskName
	extract from response	Layer/Layer/Styles	Variable: Styles
	service	WMS	
	request	GetCapabilities	
	Pass if: <ul style="list-style-type: none"> • BitmaskName corresponds to the bitmask name with the parent (dataset series) layer name as a prefix; • Styles has the following 10 STYLE values: white, yellow, orange, red, magenta, blue, cyan, green, brown, black 		
Reference	<ol style="list-style-type: none"> 1. OGC 07-063r1 Subclause 7.2.5 2. SVG 1.1 recognised colour keywords 		
Test type	Capability		

A.3 WMS-GetMap

A.3.1 Purpose

The WMS-GetMap test group includes assertions covering response behaviour to conformance *Level 1* and *Level 2* map requests.

A.3.2 GetMap Operation Conformance Level 1

List of Tables:

11. [Minimal Request](#)
12. [Missing Time](#)
13. [Default Coverage Single Band Map](#)
14. [Default Coverage Multiple Band Map](#)
15. [Default Coverage Geophysical Parameter Map](#)

ATC 11. GetMap Minimal Request

Test case identifier	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getmap:level-1:minimalrequest
-----------------------------	--

Test purpose (assertion)	Verify that when a GetMap request with only mandatory parameters is submitted, the response is not an exception.	
Test method	Submit two requests to the server with the following parameters and values:	
	initial request case	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getcapabilities:level-1:minimalrequest
	extract from response	Layer/Name Variable: DatasetSeriesName
	extract from response	Layer/BoundingBox Variable: BoundingBox
	extract from response	Layer/Format Variable: Format
	extract from response	Layer/Dimension (where name="time") Variable: Time
	service	WMS
	request	GetMap
	version	"1.3.0" or "1.1.1"
	CRS	"CRS:84" (SRS="EPSG:4326" for WMS 1.1.1 servers)
	bounding box	Variable: BoundingBox
	width	"300"
	height	"300"
	dataset series layer	Variable: DatasetSeriesName
	styles	""
	format	Variable: Format
	time	<ul style="list-style-type: none"> • If Variable: Time returns a single time value or list of time values, one of the specific time values. • If Variable: Time defines a time range, define a time value within this range.
	Pass if the result is multipart MIME for KVP or XML, or SOAP with attachments for SOAP.	
Reference	OGC 07-063r1 Subclause 7.3	
Test type	Basic	

ATC 12. GetMap Missing Time

Test case identifier	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getmap:level-1:missingtime	
Test purpose (assertion)	Verify that when a GetMap request with a missing Time parameter is submitted, the response is valid XML that validates against the OWS Common 1.1.0 ExceptionReport schema.	
Test method	Submit two requests to the server with the following parameters and values:	
	initial request case	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getcapabilities:level-1:minimalrequest
	extract from response	Layer/Name Variable: DatasetSeriesName
	extract from response	Layer/BoundingBox Variable: BoundingBox
	extract from response	Layer/Format Variable: Format
	extract from response	Layer/Dimension (where name="time") Variable: Time
	service	WMS
	request	GetMap
	version	"1.3.0" or "1.1.1"
	CRS	"CRS:84" (SRS="EPSG:4326" for WMS 1.1.1 servers)
	width	"300"
	height	"300"
	bounding box	Variable: BoundingBox
	dataset series layer	Variable: DatasetSeriesName
	styles	""
	format	Variable: Format
	Pass if the response:	
<ul style="list-style-type: none"> • is valid XML • validates against the OWS Common 1.1.0 ExceptionReport schema (owsExceptionReport) • is a service exception with an exception type code of 'MissingParameterValue' and the locator is set to 'time' 		

Reference	1. OGC 07-063r1 Subclause 7.3.1 2. OGC-06-121r3 Subclause 8.5
Test type	Capability

ATC 13. GetMap Default Coverage Single Band Map

Test case identifier	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getmap:level-1:singlebandmap		
Test purpose (assertion)	Verify that when a single band value dataset series is requested, the default response is a grey-scale image.		
Test method	Submit two requests to the server with the following parameters and values:		
	initial request case	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getcapabilities:level-1:minimalrequest	
	extract from response	Layer/Name Variable: DatasetSeriesName	
	extract from response	Layer/BoundingBox Variable: BoundingBox	
	extract from response	Layer/Format Variable: Format	
	extract from response	Layer/Dimension (where name="time") Variable: Time	
	service	WMS	
	request	GetMap	
	version	"1.3.0" or "1.1.1"	
	CRS	"CRS:84" (SRS="EPSG:4326" for WMS 1.1.1 servers)	
	bounding box	Variable: BoundingBox	
	width	"300"	
	height	"300"	
	dataset series layer	Variable: DatasetSeriesName	
styles	""		
format	Variable: Format		

	time	<ul style="list-style-type: none"> • If Variable: Time returns a single value or list of values, one of the specific time values. • If Variable: Time defines a time range, define a time value within this range.
	Pass if a grey-scale image is returned in the response.	
Reference	OGC 07-063r1 Subclause 7.3.1, Figure 7-4	
Test type	Capability	

ATC 14. GetMap Default Coverage Multiple Band Map

Test case identifier	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getmap:level-1:multiplebandmap		
Test purpose (assertion)	Verify that when a multiple band value dataset series is requested, the default response is a false colour composite image.		
Test method	Submit two requests to the server with the following parameters and values:		
	initial request case	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getcapabilities:level-1:minimalrequest	
	extract from response	Layer/Name	Variable: DatasetSeriesName
	extract from response	Layer/BoundingBox	Variable: BoundingBox
	extract from response	Layer/Format	Variable: Format
	extract from response	Layer/Dimension (where name="time")	Variable: Time
	service	WMS	
	request	GetMap	
	version	"1.3.0" or "1.1.1"	
	CRS	"CRS:84" (SRS="EPSG:4326" for WMS 1.1.1 servers)	
	bounding box	Variable: BoundingBox	
	width	"300"	
	height	"300"	
dataset series layer	Variable: DatasetSeriesName		

	styles	“”
	format	Variable: Format
	time	<ul style="list-style-type: none"> • If Variable: Time returns a single value or list of values, one of the specific time values. • If Variable: Time defines a time range, define a time value within this range.
	Pass if a false colour (RGB) composite image is returned in the response.	
Reference	OGC 07-063r1 Subclause 7.3.1, Figure 7-4	
Test type	Capability	

ATC 15. GetMap Default Coverage Geophysical Parameter Map

Test case identifier	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getmap:level-1:geophysicalmap	
Test purpose (assertion)	Verify that when a single geophysical parameter dataset series is requested, the default response is a pseudo-colour image.	
Test method	Submit two requests to the server with the following parameters and values:	
	initial request case	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getcapabilities:level-1:minimalrequest
	extract from response	Layer/Name Variable: DatasetSeriesName
	extract from response	Layer/BoundingBox Variable: BoundingBox
	extract from response	Layer/Format Variable: Format
	extract from response	Layer/Dimension (where name="time") Variable: Time
	service	WMS
	request	GetMap
	version	"1.3.0" or "1.1.1"
	CRS	"CRS:84" (SRS="EPSG:4326" for WMS 1.1.1 servers)
	bounding box	Variable: BoundingBox
width	“300”	

	height	“300”
	dataset series layer	Variable: DatasetSeriesName
	styles	“”
	format	Variable: Format
	time	<ul style="list-style-type: none"> • If Variable: Time returns a single value or list of values, one of the specific time values. • If Variable: Time defines a time range, define a time value within this range.
	Pass if a psuedo-colour image is returned in the response.	
Reference	OGC 07-063r1 Subclause 7.3.1, Figure 7-4	
Test type	Capability	

A.3.3 GetMap Operation Conformance Level 2

List of Tables

16. [Outline Coverage Map](#)
17. [Specified Single Band Coverage Map](#)
18. [Specified Multiple Band Coverage Map](#)
19. [Invalid Band Coverage Request](#)
20. [Specified Geophysical Parameter Coverage Map](#)
21. [Specified Spatial Metadata Coverage Map](#)

ATC 16. GetMap Outline Coverage Map

Test case identifier	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getmap:level-2:outlinemap	
Test purpose (assertion)	Verify that when a queryable outline LAYER is available and requested, a map showing individual product bounding boxes is returned.	
Test method	Submit two requests to the server with the following parameters and values:	
	initial request case	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getcapabilities:level-1:minimalrequest

extract from response	Layer/BoundingBox	Variable: BoundingBox
extract from response	Layer/Format	Variable: Format
extract from response	Layer/Dimension (where name="time")	Variable: Time
extract from response	Layer/Layer/Name where names ends "_outlines"	Variable: QueryableLayer
extract from QueryableLayer	Name	Variable: Name
extract from QueryableLayer	Styles	Variable: Styles
service	WMS	
request	GetMap	
version	"1.3.0" or "1.1.1"	
outline layer	Variable: Name	
styles	"green"	
CRS	"CRS:84" (SRS="EPSG:4326" for WMS 1.1.1 servers)	
bounding box	Variable: BoundingBox	
width	"300"	
height	"300"	
format	Variable: Format	
time	<ul style="list-style-type: none"> • If Variable: Time returns a single value or list of values, one of the specific time values. • If Variable: Time defines a time range, define a time value within this range. 	
	Pass if: <ul style="list-style-type: none"> • variable: Styles contains the following 10 values: white, yellow, orange, red, magenta, blue, cyan, green, brown, black • an image showing one or more product outlines in green is returned in the response 	
Reference	OGC 07-063r1 Subclause 7.3.2	
Test type	Capability	

ATC 17. GetMap Specified Single Band Coverage Map

Test case identifier	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getmap:level-2:singlebandmap		
Test purpose (assertion)	Verify that when a single band dataset is requested, a greyscale map is returned.		
Test method	Submit two requests to the server with the following parameters and values:		
	initial request case	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getcapabilities:level-1:minimalrequest	
	extract from response	Layer/Name Variable: DatasetSeriesName	
	extract from response	Layer/BoundingBox Variable: BoundingBox	
	extract from response	Layer/Format Variable: Format	
	extract from response	Layer/Dimension (where name="time") Variable: Time	
	extract from response	Layer/Layer (where the 'name' element value ends "_bands") Variable: BandsLayer	
	extract from BandsLayer	Name Variable: BandsLayerName	
	extract from BandsLayer	Sample Dimension Variable: SampleDimension	
	extract from SampleDimension	Name Variable: DimName	
	extract from SampleDimension	Values/IndividualValue (single value selected from the Dimension value list) Variable: Band	
	service	WMS	
	request	GetMap	
	version	"1.3.0" or "1.1.1"	
	dataset series layer	Variable: BandsLayerName	
styles	""		

	CRS	"CRS:84" (SRS="EPSG:4326" for WMS 1.1.1 servers)
	bounding box	Variable: BoundingBox
	width	"300"
	height	"300"
	format	Variable: Format
	time	<ul style="list-style-type: none"> • If Variable: Time returns a single value or list of values, one of the specific time values. • If Variable: Time defines a time range, define a time value within this range.
	sample dimension	Variable: DimName with the prefix 'DIM_' and value of Variable: Band
	Pass if a grey-scale image corresponding to the requested band is returned in the response.	
Reference	OGC 07-063r1 Subclause 7.3.3	
Test type	Capability	

ATC 18. GetMap Specified Multiple Band Coverage Map

Test case identifier	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getmap:level-2:multiplebandmap		
Test purpose (assertion)	Verify that when three dataset bands are requested, a corresponding false colour composite map is returned.		
Test method	Submit two requests to the server with the following parameters and values:		
	initial request case	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getcapabilities:level-1:minimalrequest	
	extract from response	Layer/Name	Variable: DatasetSeriesName
	extract from response	Layer/BoundingBox	Variable: BoundingBox
	extract from response	Layer/Format	Variable: Format
	extract from response	Layer/Dimension (where name="time")	Variable: Time

extract from response	Layer/Layer (where the 'name' element value ends "_bands")	Variable: BandsLayer
extract from BandsLayer	Name	Variable: BandsLayerName
extract from BandsLayer	Sample Dimension	Variable: SampleDimension
extract from SampleDimension	Name	Variable: DimName
extract from SampleDimension	Values/ThreeValues (3 values selected from the Dimension value list)	Variable: Bands
service	WMS	
request	GetMap	
version	"1.3.0" or "1.1.1"	
dataset series layer	Variable: BandsLayerName	
styles	""	
CRS	"CRS:84" (SRS="EPSG:4326" for WMS 1.1.1 servers)	
bounding box	Variable: BoundingBox	
width	"300"	
height	"300"	
format	Variable: Format	
time	<ul style="list-style-type: none"> • If Variable: Time returns a single value or list of values, one of the specific time values. • If Variable: Time defines a time range, define a time value within this range. 	
sample dimension	List of three with of the form Variable: DimName with the prefix 'DIM_' and value of Variable: Bands	
	Pass if a false colour composite image is returned in the response with the red, green and blue channels corresponding to the first, second and third values specified in sample dimension .	
Reference	OGC 07-063r1 Subclause 7.3.3	

Test type	Capability
------------------	------------

ATC 19. GetMap Invalid Band Coverage Request

Test case identifier	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getmap:level-2: invalidbandrequest		
Test purpose (assertion)	Verify that when sample dimension (band) request is made with other than 1 or 3 band values specified, the response is valid XML that validates against the OWS Common 1.1.0 ExceptionReport schema.		
Test method	Submit two requests to the server with the following parameters and values:		
	initial request case	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getcapabilities:level-1:minimalrequest	
	extract from response	Layer/Name Variable: DatasetSeriesName	
	extract from response	Layer/BoundingBox Variable: BoundingBox	
	extract from response	Layer/Format Variable: Format	
	extract from response	Layer/Dimension (where name="time") Variable: Time	
	extract from response	Layer/Layer (where the 'name' element value ends "_bands") Variable: BandsLayer	
	extract from BandsLayer	Name Variable: BandsLayerName	
	extract from BandsLayer	Sample Dimension Variable: SampleDimension	
	extract from SampleDimension	Name Variable: DimName	
	extract from SampleDimension	Values (where 0, 2 or more than 3 values are selected from the Dimension value list) Variable: Bands	
	service	WMS	
	request	GetMap	
	version	"1.3.0" or "1.1.1"	

dataset series layer	Variable: DatasetSeriesName
styles	“”
CRS	"CRS:84" (SRS="EPSG:4326" for WMS 1.1.1 servers)
bounding box	Variable: BoundingBox
width	“300”
height	“300”
format	Variable: Format
time	<ul style="list-style-type: none"> • If Variable: Time returns a single value or list of values, one of the specific time values. • If Variable: Time defines a time range, define a time value within this range.
sample dimension	List of 0, 2 or more than 3 with of the form Variable: DimName with the prefix 'DIM_' and value of Variable: Bands
	Pass if the response: <ul style="list-style-type: none"> • is valid XML • validates against the OWS Common 1.1.0 ExceptionReport schema (owsExceptionReport) • is a service exception with an exception type code of 'InvalidDimensionValue'
Reference	OGC 07-063r1 Subclause 7.3.3
Test type	Capability

ATC 20. GetMap Specified Geophysical Coverage Map

Test case identifier	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getmap:level-2:geophysicalmap	
Test purpose (assertion)	Verify that when a geophysical parameter LAYER is requested, the corresponding pseudo-colour map is returned.	
Test method	Submit two requests to the server with the following parameters and values:	
	<table border="1"> <tr> <td>initial request case</td> <td>urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getcapabilities:level-1:minimalrequest</td> </tr> </table>	initial request case
initial request case	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getcapabilities:level-1:minimalrequest	

	extract from response	Layer/BoundingBox	Variable: BoundingBox
	extract from response	Layer/Format	Variable: Format
	extract from response	Layer/Dimension (where name="time")	Variable: Time
	extract from response	Layer/Layer where Layer contains a /Styles/LegendURL element	Variable: GeophysicalLayer
	extract from GeophysicalLayer	Name	Variable: Name
	service	WMS	
	request	GetMap	
	version	"1.3.0" or "1.1.1"	
	geophysical parameter layer	Variable: Name	
	styles	""	
	CRS	"CRS:84" (SRS="EPSG:4326" for WMS 1.1.1 servers)	
	bounding box	Variable: BoundingBox	
	width	"300"	
	height	"300"	
	format	Variable: Format	
	time	<ul style="list-style-type: none"> • If Variable: Time returns a single value or list of values, one of the specific time values. • If Variable: Time defines a time range, define a time value within this range. 	
	Pass if a pseudo-colour image corresponding to the geophysical parameter requested with Variable: Name, is returned in the response		
Reference	OGC 07-063r1 Subclause 7.3.4		
Test type	Capability		

ATC 21. GetMap Spatial Metadata Coverage Map

Test case identifier	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getmap:level-2:bitmaskmap		
Test purpose (assertion)	Verify that when a spatial metadata LAYER is requested, a bitmask map with the requested colour is returned.		
Test method	Submit two requests to the server with the following parameters and values:		
	initial request case	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getcapabilities:level-1:minimalrequest	
	extract from response	Layer/BoundingBox	Variable: BoundingBox
	extract from response	Layer/Format	Variable: Format
	extract from response	Layer/Dimension (where name="time")	Variable: Time
	extract from response	Layer/Layer where the STYLES element contains 10 values and the NAME element value does not end ‘_outlines’	Variable: BitmaskLayer
	extract from BitmaskLayer	Name	Variable: Name
	extract from BitmaskLayer	Styles	Variable: Styles
	service	WMS	
	request	GetMap	
	version	"1.3.0" or "1.1.1"	
	bitmask layer	Variable: Name	
	styles	"green"	
	CRS	"CRS:84" (SRS="EPSG:4326" for WMS 1.1.1 servers)	
	bounding box	Variable: BoundingBox	
	width	"300"	
	height	"300"	
format	Variable: Format		

	time	<ul style="list-style-type: none"> • If Variable: Time returns a single value or list of values, one of the specific time values. • If Variable: Time defines a time range, define a time value within this range.
	Pass if:	<ul style="list-style-type: none"> • Variable Styles: contains the following 10 values: white, yellow, orange, red, magenta, blue, cyan, green, brown, black • a green coloured image bitmask is returned in the response
Reference	OGC 07-063r1 Subclause 7.3.5	
Test type	Capability	

A.4 WMS-GetFeatureInfo

A.4.1 Purpose

The WMS-GetFeatureInfo test group covers Level-2 assertions related to requests for feature information from optional product outline LAYER elements.

List of Tables:

22. [Product Metadata Request](#)

ATC 22. GetFeatureInfo Product Metadata Request

Test case identifier	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo: getfeatureinfo:level-2: productmetadata		
Test purpose (assertion)	Verify that when a product bounding box outline is selected from a queryable outline LAYER, the metadata for an individual product is returned.		
Test method	Submit three requests to the server with the following parameters and values:		
	initial request case	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getcapabilities:level-1:minimalrequest	
	extract from response	Layer/BoundingBox	Variable: BoundingBox
	extract from response	Request/FeatureInfo/Format	Variable: InfoFormat
extract from response	Layer/Layer where attribute queryable="1"	Variable: QueryableLayer	

extract from QueryableLayer	Name	Variable: Name
initial ATC	urn:ogc:cite:ats:wms:1.3.0:07-063r1:eo:getmap:level-2:outlinemap	
select	Select a screen coordinate within at least one of the product bounding box outlines	Variable: ScreenPixelColumn Variable: ScreenPixelRow
service	WMS	
request	GetFeatureInfo	
version	"1.3.0" or "1.1.1"	
outline layer	Variable: Name	
CRS	"CRS:84" (SRS="EPSG:4326" for WMS 1.1.1 servers)	
bounding box	Variable: BoundingBox	
column pixel coordinate	Variable: ScreenPixelColumn	
row pixel coordinate	Variable: ScreenPixelRow	
metadata format	Variable: InfoFormat	
	Pass if the response: <ul style="list-style-type: none"> • has an XML MIME type; • contains ISO 8601 time metadata for one or more products. 	
Reference	OGC 07-063r1 Subclause 7.3.2	
Test type	Capability	

Annex B
(normative)

WSDL Specification (to be completed)

Annex C (informative)

Guidance on integrated discovery and viewing of EO Products (linking the WMS, CS-W and GML EOP extensions)

C.1 Introduction

This annex considers different scenarios for the discovery and viewing of EO products. Based on this context, it provides guidance to facilitate the integration of EOP Catalogue Service Web (CS-W) and Web Map Service instances.

C.2 EOP discovery and viewing scenarios

Three scenarios for the discovery and viewing of EO products are introduced and discussed (see Figure C.1 below).

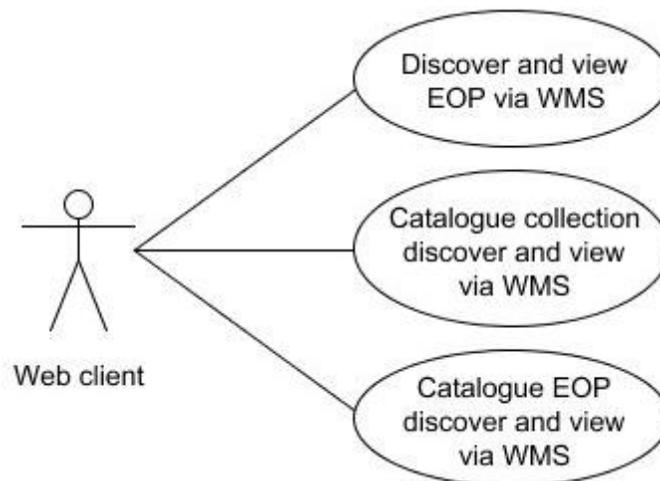


Figure C.1: UML diagram showing three use cases through which a catalogue and WMS client may be used to discover and view EO products

C.2.1 Discovery and viewing via an EOP WMS

This scenario allows the discovery of EO products using only the host Web Map Service however this architectural simplicity is offset by:

1. added WMS client complexity;
2. isolation of each Web Map Service instance from a wider, federated set of geographic Web services.

With reference to Figure C.2 below, it can also be seen that the search procedure is quite iterative, involving four request-response interactions between use (client) and WMS server.

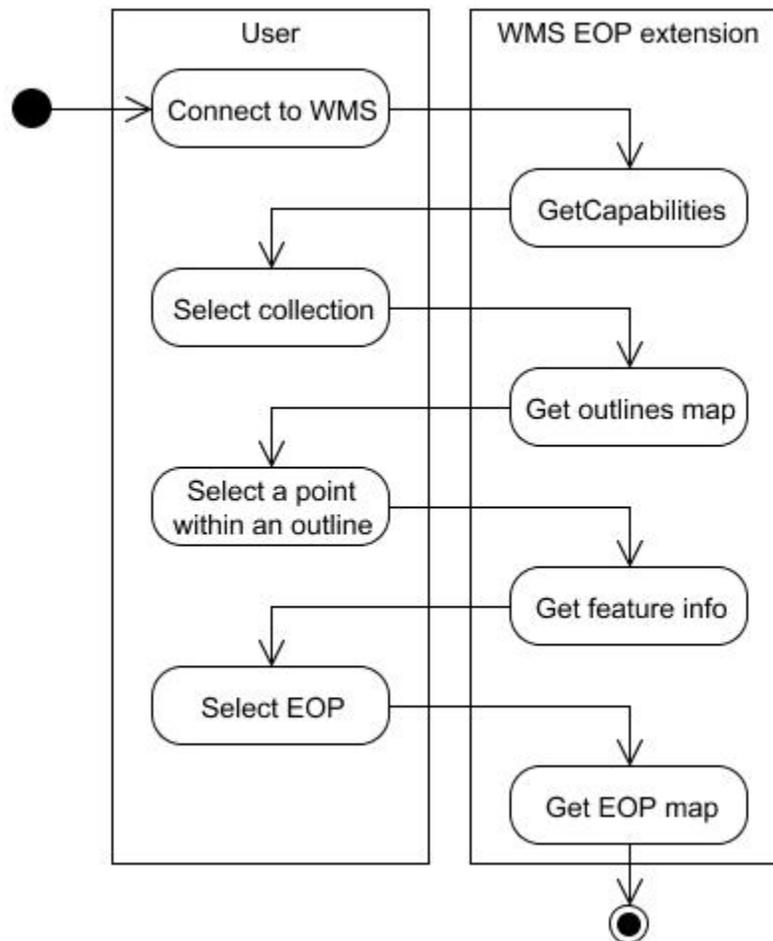


Figure C.2: UML diagram showing the flow of activity between the WMS user and a WMS instance extended for EO product viewing.

C.2.2 Viewing following collection level discovery

In this scenario, a user discovers an EOP collection (dataset series) via a CS-W instance that supports the Core ISO Metadata (CIM) mapping to the eBRIM CS-W profile (OGC 07-038). Comparing Figures C.2 and C.3, this scenario shows the same degree of user – Web service iteration because the user is only using the catalogue to carry out collection (dataset series) level discovery. This scenario does have the following advantages compared to the other scenarios considered:

1. the catalogue search is relatively generic as it does not have a dependency on the EOP CS-W extension (OGC 06-131);
2. a user does not need to know, *a priori*, the location of any instances of the WMS EOP viewing service and is able to search from range of registered collections with associated viewing services.

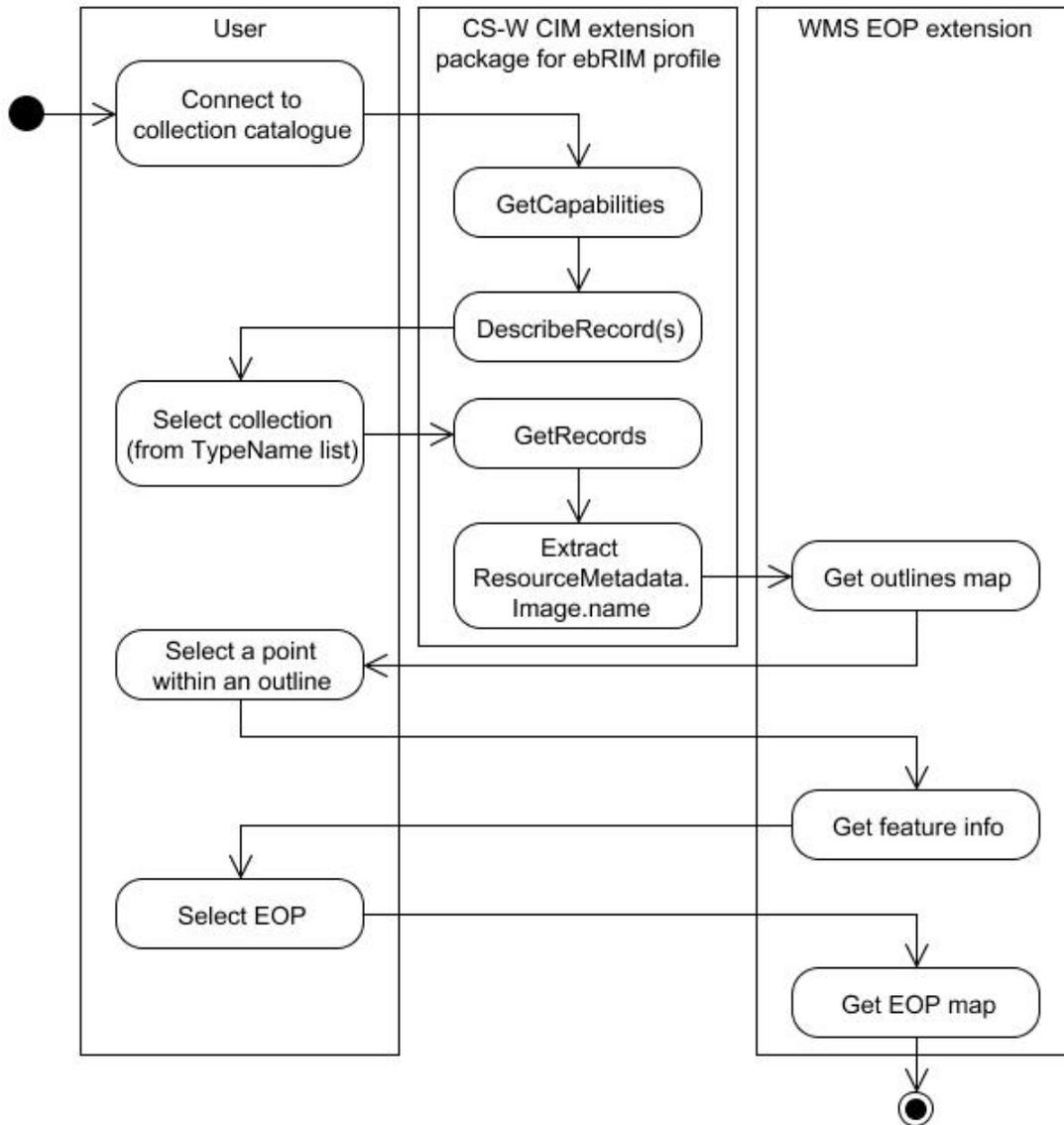


Figure C.3: UML diagram illustrating the flow of activity between a user, dataset series (EOP collection) catalogue and an EOP WMS instance

Note: in this diagram it is assumed that value of the ResourceMetadata.Image.name parameter is a URL containing the GetMap request for the collection outlines map Layer.

C.2.3 Viewing following specific dataset (EOP) discovery

The most user-friendly scenario involves the use of a catalogue service supporting the EO Products extension package for ebRIM [4]. In this use case, a number of distributed EOP collections can be searched by data type, times and spatial areas of interest. Ideally this should allow a user to carry out discovery of a specific EOP then select a 'browse' option and seamlessly be provided with a WMS EOP extension view of the product (See Figure C.4 below).

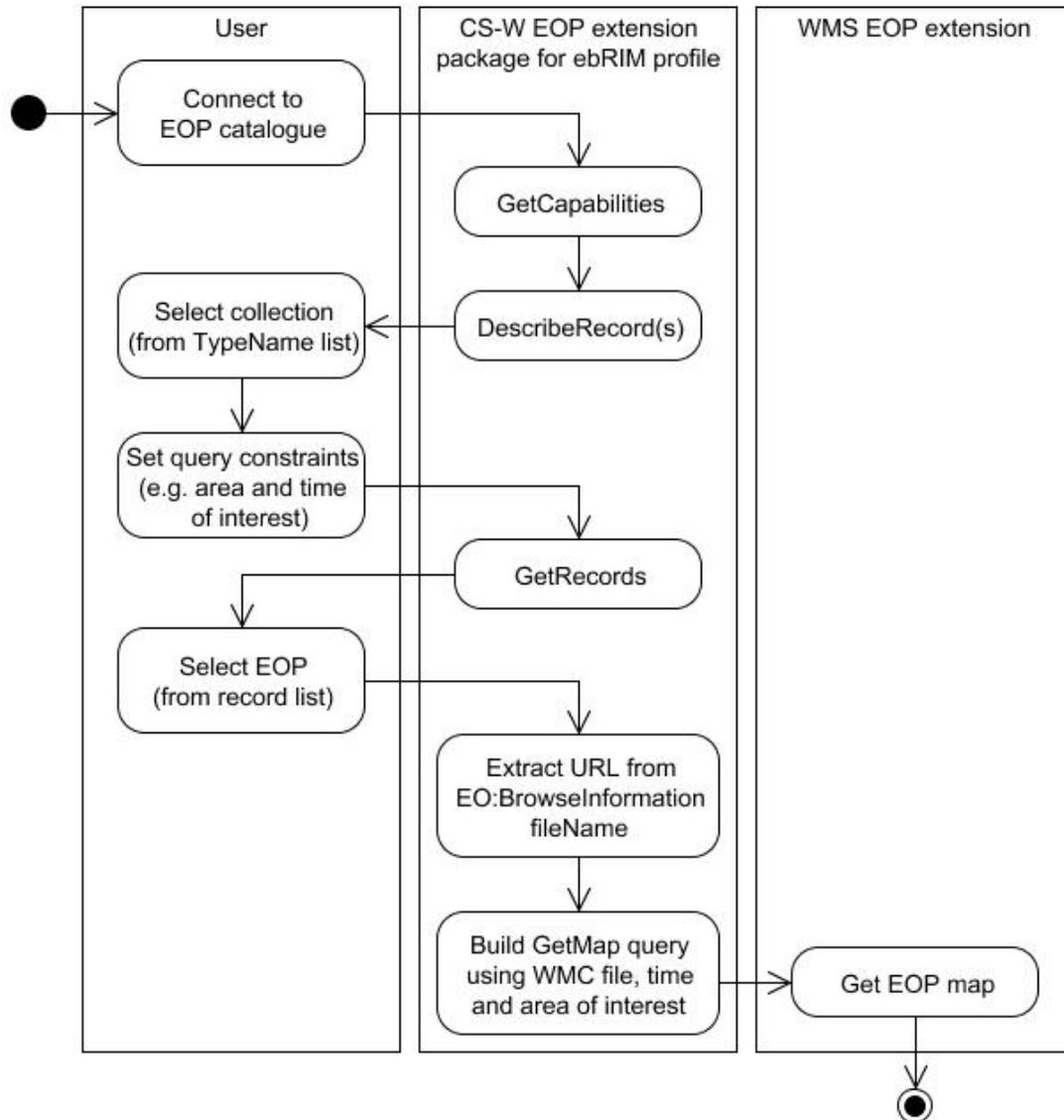


Figure C.4: UML diagram illustrating the flow of activity between a user, EOP extension catalogue and an EOP WMS instance

Note: in this diagram it is assumed that value of the EO:BrowseInformation.fileName parameter contains a URL for a Web Map Context document.

C.3 Guidance on CS-W / WMS EO extension integration

C.3.1 Metadata linkage

The ISO 19115 MD_Metadata.parentIdentifier value for a dataset equates to the parent dataset series i.e. a collection of EO products. The group Layer in the service metadata model of the WMS EO extension also equates to a dataset series and hence, to a collection of EO products. To reflect this equivalence, group Layer names should follow the convention for parentIdentifier naming set out in the EO Products extension to the ebRIM CS Application Profile [4] where the following representation is proposed:

programme.satellite_instrument_processing

Examples of parentIdentifier are:

- urn:ogc:def:EOP:ESA:EECF.ENVISAT_ASA_APx_xS
- urn:ogc:def:EOP:ESA:UK-MM-PAF.ENVISAT_MER_MTCI_FCR_3P

C.3.2 Programmatic linkage

Conceptually, a WMS instance can be thought of as providing either a browse service or a distribution service. In the ISO 19115 metadata model this would equate to either:

- an MD_BrowseGraphic.fileName attribute value
- or an MD_Distribution->transferOptions->MD_DigitalTransferOptions->onLine->CI_OnlineResource definition.

The URI value of an MD_BrowseGraphic.fileName attribute is typically a URL providing the Web address of a browse image, often a thumbnail. A static GetMap request URL may be provided as a MD_BrowseGraphic.fileName attribute value in order to link a CS-W EOP metadata record directly to a WMS EOP view. This direct approach is appropriate for viewing a thumbnail image but it is inflexible as it provides no context about the host WMS service. Figure C.5 shows the use of EOP service metadata context by a how a WMS client to define the GUI controls required for interactive viewing.

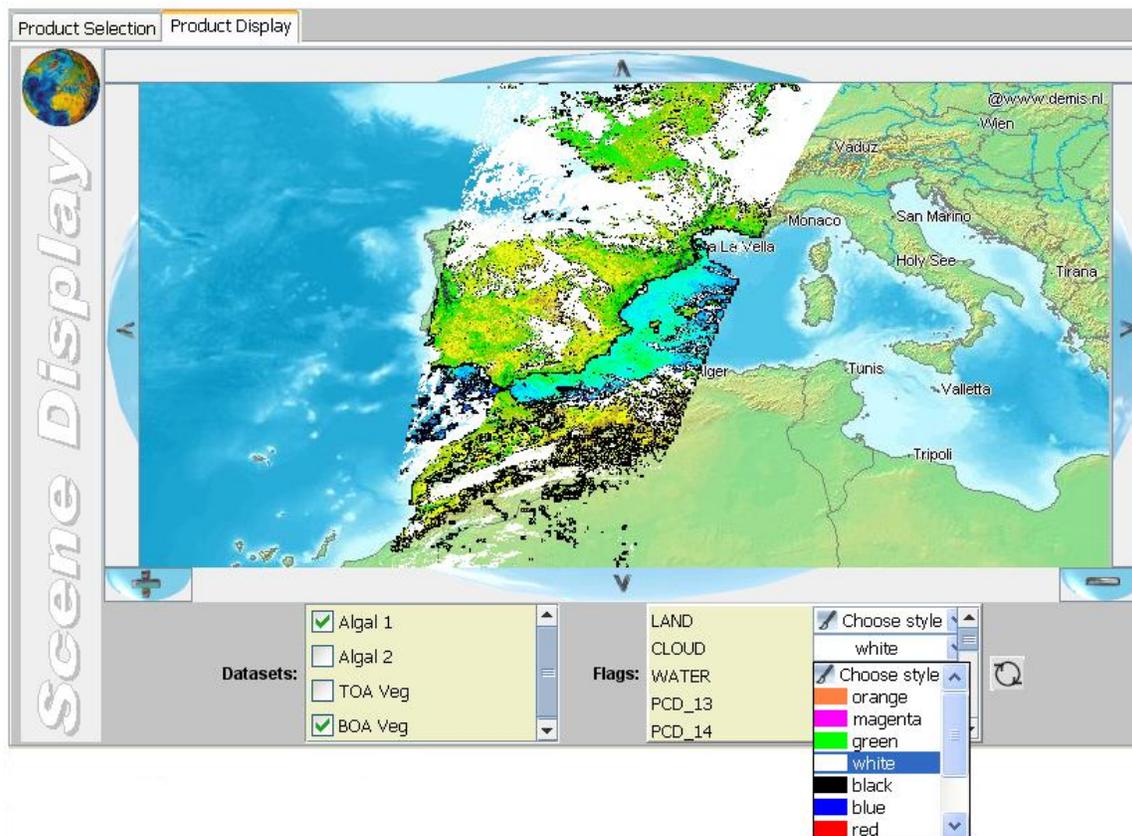


Figure C.5: example of an EOP WMS client configured for the interactive viewing of geophysical parameter and bitmask Layers based on the WMS metadata for a given EO collection

To provide the context necessary to link a catalogue record to a WMS EO extension view, two recommendations are made:

1. Define the WMS EO extension linkage within the ISO 19115 MD_Distribution metadata via the MD_DigitalTransferOptions -> CI_OnlineResource class. The ISO 19115 CI_OnlineResource class augments a URL 'linkage' attribute with optional attributes for service 'protocol' and 'applicationProfile' definition providing a more complete and appropriate way to link a CS-W record to a WMS service (see C.3.2.1 XML snippet for an example).
2. Supply a service description via a Web Map Context (WMC) document. Each WMC document should list the WMS metadata for the parentIdentifier (EO collection) identified via a catalogue search. In this scenario, the owner of a WMS instance would publish a WMC document for each group Layer (EO collection) available. A CS-W server would then point to the appropriate WMC file via a URL given in the MD_DigitalTransferOptions -> CI_OnlineResource.-> description.

Figure C.6 shows how the information obtained from a WMC document could be:

1. used by an EOP WMS client to define the GUI map view selection tools;
2. combined with spatial and temporal catalogue search (or EOP record) parameters to define the GetMap URL needed to request a view of the specific EOP.

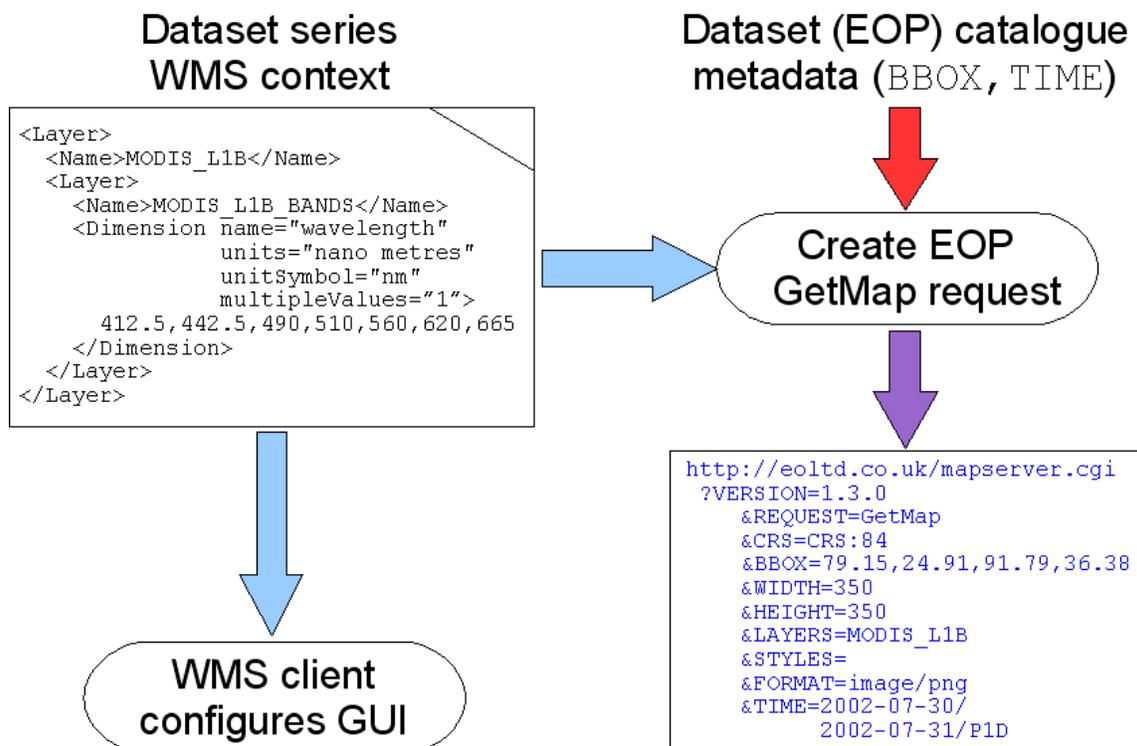


Figure C.6: scenario illustrating the use of a WMC document both to configure a WMS client for interactive browse and to generate the EOP specific GetMap request

Note: this scenario requires the catalogue client to recognise and specifically respond to, a EO:BrowseInformation.fileName URL for a Web Map Context document.

C.3.2.1 Online resource XML example

```

<gmd:distributionInfo>
  <gmd:MD_Distribution>
    <gmd:transferOptions>
      <gmd:MD_DigitalTransferOptions>
        <gmd:onLine>
          <gmd:CI_OnlineResource>
            <gmd:linkage>
              <gmd:URL>
                http://ituk.co.uk /services/ows/wms/?
                  REQUEST=GetMap&
                  SERVICE=WMS&
                  VERSION=1.3.0&
                  LAYERS=UK-PAC.ENVISAT_MER_MTCI_FCR_3P_WMC&
                  SRS=EPSG:4326&
                  BBOX=9.163,54.093,9.713,54.668&
                  WIDTH=400&
                  HEIGHT=420&
                  FORMAT=image/jpeg&
                  STYLES=
              </gmd:URL>
            </gmd:linkage>
            <gmd:protocol>
              <gco:CharacterString>
                OGC:WMS-1.3.0-http-get-map
              </gco:CharacterString>
            </gmd:protocol>
            <gmd:applicationProfile>
              <gco:CharacterString>
                OGC:EOP-profile-0.3.3
              </gco:CharacterString>
            </gmd:applicationProfile>
            <gmd:name>
              <gco:CharacterString>
                urn:ogc:def:EOP:UK-PAC:VAE.ENVISAT_MER_MTCI_FCR_4P
              </gco:CharacterString>
            </gmd:name>
            <gmd:description>
              <gmd:URL>
                http://ituk.co.uk/L4serv.ENVISAT_MER_MTCI_FCR_4P_WMC.xml
              </gmd:URL>
            </gmd:description>
          </gmd:CI_OnlineResource>
        </gmd:onLine>
      </gmd:MD_DigitalTransferOptions>
    </gmd:transferOptions>
  </gmd:MD_Distribution>
</gmd:distributionInfo>

```

Note that this example provides two URL values. The ‘linkage’ URL defines a static GetMap request that can be used by any WMS client. The ‘description’ URL provides the location of the WMC for the parent dataset series.

Bibliography

The following references are informative, not normative.