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DGIWG WMS 1.3 Profile and systems requirements for interoperability for use within a military environment

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DGIWG WMS 1.3 Profile and systems requirements for interoperability for use within a military environment

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i. Preface

The Defence Geospatial Information Working Group (DGIWG) submitted this document to the OGC for consideration as an OGC Best Practice. The OGC Membership approved release of this document as an OGC Best Practice on August 25, 2009.

The document defines a profile of OGC WMS 1.3 implementation specification standard [WMS1.3], a list of normative system requirements and a list of non-normative recommendations.

ii. Submitting organizations

Canada, France, Great Britain, New Zealand, Norway, Sweden.

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iv. Revision history

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06/04/2007	0.1	Cyril Minoux	All	Initial version submitted to nations for review during the April 2007 Technical Panels
20/04/2007	0.2	Cyril Minoux	All	Review of the clauses, discussions and comments at the April 2007 Technical Panels by the S05 meetings participants (CAN, FRA, GER, NOR, NZ, SWE)
13/11/2007	0.3	Cyril Minoux	All	Review of the clauses, discussions and comments at the November 2007 Technical Panels by the S05 meetings participants (CAN, FRA, GER, NZ, SWE, USA)
19/11/2007	0.4	Cyril Minoux	WMS-Cache	Added some references

Date	Release	Editor	Primary clauses modified	Description
10/04/2008	0.5	Cyril Minoux	All	Full restructuring and cleaning of the document ; incorporating all comments gathered from the meetings, and from inputs from Canada (2008-02-01) and from Germany (2008-01-28)
18/04/2008	0.6	Cyril Minoux	All	Update on specific technical elements from FRA inputs.
23/04/2008	0.7	Cyril Minoux	All	Review of the 18/04/2008 updates, discussions and comments at the April 2008 Technical Panels by the S05 meetings participants (CAN, FRA, NOR, NZ, SWE)
09/06/2008	0.8	Cyril Minoux	Portrayal	Integration of S01 / S05 discussions outcome
10/07/2008	0.9	Cyril Minoux	All	Technical finalization of open items to ensure best service and interoperability while taking into account the maturity of the implementations. Provision of analysis for future evolutions of the profile.
16/07/2008	1.0	Cyril Minoux	All	Editing of the document to DGIWG standard layout.
29/10/2008	1.1	Cyril Minoux	All	Processing of comments received from the Letter Ballot
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06/11/2008	1.3	S05 Team	All	Finalization

Date	Release	Editor	Primary clauses modified	Description
01/07/2009	1.3 corrected	Cyril Minoux	3.3.1 3.5.3 4.4.1	Merging of corrigendum (Technical Report TCR-09-206) to produce the body of the OGC Best Practice document
7/9/09	Various	Carl Reed	Various	Ready for posting for e-vote as BP
8/27/09	1.3	Carl Reed	Various	Ready for posting as official BP.

v. Future work

This document provides a number of recommendations and future work directions that can be valuable to take into account by the software industry, the Open Geospatial Consortium, and DGIWG, in order to enhance the quality of the service provided by this technology. Once supported by the wider community, these features could serve as a basis for the next version of the DGIWG WMS Profile.

These include for example the capability of tuning the compression ratio to the requirement of the client, or vector data portrayal specifications. See § 8 Future Work directions.

vi. Forward

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.

1 Executive summary

This document specifies requirements for systems providing maps using OGC Web Map Service. The document defines a profile of OGC WMS 1.3 implementation standard [WMS1.3], a list of normative system requirements and a list of non-normative recommendations. The Defence Geospatial Information Working Group (DGIWG) performed the work as part of through the S05 Web Data Access Service Project of the Services & Interfaces Technical Panel.

This development of this WMS 1.3 profile is in response to a number of requirements expressed by the military geospatial community for disseminating and accessing geospatial data for browsing and visualizing geospatial information (items 8.1, 8.2, 8.6, 12.1, 12.2, 18.1 of the [DGIWG Requirements Matrix]), possibly via a portal (items 8.5, 18.3 of the [DGIWG Requirements Matrix]), and also provide support to overlay data and produce a basic Recognized Environmental Picture (item 11.8 of the [DGIWG Requirements Matrix]).

Web Map Services [WMS1.3] can be used to cover these requirements. They are implemented by a number of vendors, and are more and more involved in a number of initiatives from NATO (CoreGIS) or the European Union (GMES). However, several nations, including Canada, Norway and France, have identified interoperability issues in either experimental or operational environments. Indeed, these specifications have been written to cover a wide range of communities of interest and use-cases. The purpose of this work is to standardize further Web Map Services on a number of items that are important for the military community, in a way that ensures interoperability.

To ensure the ability of implementing this profile, existing constraints among submitting organizations and vendors have been taken into account, in order to distinguish between normative specifications, recommendations and future work directions. Normative specifications include both extensions/restrictions of WMS and system requirements specifications in order to enable interoperability by appropriate configuration of existing software. System requirements specifications are intended to be applied in the design and fielding of systems having services compliant to the profile. They come along with a rationale and conformance tests which provide guidelines for testing compliance of implementations.

Tests are categorized for the convenience of testing organization, so that they can tune the level of testing they perform, depending on the criticality and on the resources and time available for this task. Tests of type 1 consist of checking configuration as declared by the service GetCapabilities response. Tests of type 2 consist of checking that requests do not raise exceptions, and that the response has the awaited characteristics. Tests of type 3 involve human expertise in checking that the response matches a quality level compliant with an operational use of geospatial information.

Recommendations and future work items identify possible enhancements for this technology, which can be reported to the Open Geospatial Consortium and the Software Industry in general, in order to enhance the quality of the service provided by this technology in their future baseline.

2 Introduction

2.1 Scope

This document is a military profile of the OGC Web Map Service 1.3 implementation standard [WMS1.3].

2.2 Structure

The document is structured in four parts:

- A set of normative specifications which comprise an ISO 19106-compliant profile of the OGC Web Map Service Implementation Standard version 1.3.0 [WMS1.3] ;
- A set of system requirements specifications which include content beyond the scope of a profile but relevant to achieving interoperability in an operational context ;
- A set of Recommendations ;
- A set of Future Work directions.

2.3 Delimitation

This document only addresses the Web Map Service and presupposes the existence of web-like connectivity and the ability to use the HTTP protocol. Connectivity issues and standardization is handled by working groups in charge of information systems and security.

2.4 Conformance

Web Map Services conformant to this profile shall be conformant to the OpenGIS® Web Map Service Implementation Standard version 1.3.0 [WMS1.3] and to the normative clauses of section 5 (Web Map Service standards restrictions and extensions (Normative)
of this document. Operational systems conformant to this document shall be conformant to both section 3 and section 6.)

2.5 Intended audience

DGIWG Member Nations and any organization interested in providing / consuming Web Map Services to / from DGIWG Member Nations.

3 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.

Tag	Description
[WMS1.3]	OpenGIS® Web Map Service Implementation Specification – version 1.3.0 – date 2006-03-15 – Ref. 06-042
[DGIWG Requirements Matrix]	"Matrix of Geospatial Activities for Operational Scenarios" *from* "DGIWG Technical Vision & Development Strategy 6.0.3" – IDON – Ref. TVD-Final-06-002-ed6.0.3-TVDS – 05 December 2006
[DGIWG T03]	"T03 DGIWG Portrayal Roadmap" – version 1 – May 2. 2007 - Marlene Meyer, Daniel Gleason, Nicolas Lesage, Brian Parish, Ian Greasley, Marie-Lise Vautier

4 Terms and definitions

Coverage [ISO 19123] Feature that acts as a function to return values from its range for any direct position within its spatial, temporal, or spatiotemporal domain.

4.1 Abbreviations

CRS	Coordinate Reference System
ECWP	ECW streaming protocol
HTTP	Hypertext Transfer Protocol
KVP	Keyword Value Pair
JPIP	JPEG 2000 streaming protocol (Annex 9 of the JPEG 2000 specification)
OGC	Open GIS Consortium, also referred to as OpenGIS®
XML	Extensible Markup Language
WMS	Web Map Service – cf [WMS1.3]

5 Web Map Service standards restrictions and extensions (Normative)

5.1 Service's limits configuration

ID	Normative Clause	Rationale. Conformance testing.
3.1.1	If the WMS Service implements the LayerLimit parameter it should not be less than 20. See [WMS1.3] § 7.2.4.3.	**Operational requirements** : On the provider side, be able to limit the consumption of hardware resources. On the client side, enable the capability of overlaying a sufficient number of layers to set up a useable environmental picture. **Test** type 1 : check that the value of <LayerLimit> in the response to the GetCapabilities request is not less than 20 **Test** type 2 : check that GetMap requests involving <LayerLimit> layers are processed appropriately **Test** type 3: check that any combination of up to <LayerLimit> layers is processed appropriately
3.1.2	The MaxWidth and MaxHeight shall be greater or equal to 800 pixels. See [WMS1.3] § 7.2.4.3.	**Operational requirements** : On the provider side, be able to limit the consumption of hardware and network resources. On the client side, many portals and clients are going to use tiling, hence only small areas (256x256 pixels or so) are going to be updated when the screen is scrolled. Reasons for raising the limit to 800 is to enable simple WMS clients to access a map of sufficient area without tiling (e.g. your client application has crashed and you send an HTTP GetMap request in some web browser). **Test** type 1 : check the value of MaxWidth and MaxHeight in the response to the GetCapabilities request **Test** type 2 : check that GetMap requests involving MaxWidth x MaxHeight output are processed appropriately

5.2 Layers' visibility configuration

ID	Normative Clause	Rationale. Conformance testing.
3.2.1	All layers published by the service shall be subsettable and resizable See [WMS1.3] § 7.2.4.7.5	**Operational requirements** : enables the client to benefit from service-oriented data dissemination. **Test** type 1 : check the value of the <noSubsets> < fixedWidth> <fixedHeight> parameters of each layer declared in the GetCapabilities document. **Test** type 2 : check that GetMap requests involving subsetting and resizing the original data is processed appropriately

5.3 Layer's portrayal

ID	Normative Clause	Rationale. Conformance testing.
3.3.1	The WMS service shall be able to render elevation and bathymetric coverage data in at least the following two styles - "shaded" : shaded terrain rendering - "hypsometric" : hypsometric rendering	**Operational requirements** : Provide the client with common / standard rendering of elevation data **Test** type 1 : check the value of the <style> parameter of each layer declared in the GetCapabilities document **Test** type 2 : access to an elevation or bathymetric layer and test the result of the "style=shaded" and "style=hypsometric" styles.

5.4 Supported Coordinate Reference Systems

ID	Normative Clause	Rationale. Conformance testing.
3.4.1	The service shall support the following Coordinate Reference Systems, and use the following associated keywords 1) to designate them in its responses, and 2) to process the clients' requests **Coordinate Reference System — Keyword** WGS84 geographic longitude, then latitude, expressed in decimal degrees …… CRS:84 WGS84 geographic latitude, then longitude, expressed in decimal degrees…… EPSG:4326 World Mercator projection…… EPSG:3395 See [WMS1.3] Annex B.3 and 6.7.3.3, 7.2.4.6.7	**Operational requirements** : WGS84 and Mercator are the most commonly used CRS which have worldwide validity zone. Mercator used by the Navy. **Test** type 1 : check that these keywords are declared in the GetCapabilities document **Test** type 2 : check that GetMap requests using these keywords on any layers published by the service are processed appropriately
3.4.2	Among the following Coordinate Reference Systems, the service shall support all those which validity zone overlaps data published by the service.. For each of these Coordinate Reference Systems, the following associated keywords shall be used 1) to designate them in its responses, and 2) to process the clients' requests **Coordinate Reference System — Keyword** UTM projections over WGS84 (north zones)… EPSG:32601 to EPSG:32660 UTM projections over WGS84 (south zones)… EPSG:32701 to EPSG:32760 UPS projection over WGS84 (north zone)…… EPSG:32661 UPS projection over WGS84 (south zone)…… EPSG:32761 See [WMS1.3] § 7.2.4.6.7	**Operational requirements** : The UTM projections are the most commonly used CRS which have local validity zone. Used by the Ground forces. **Test** type 1 : check that these keywords are declared in the GetCapabilities document **Test** type 2 : check that GetMap requests using these keywords on any layers published by the service are processed appropriately.

5.5 GetMap supported output formats

ID	Normative Clause	Rationale. Conformance testing.
3.5.1	The service shall support PNG output.	**Operational requirements** : PNG is a compressed format that supports transparency **Test** type 1 : check the value of the <format> parameter of each layer declared in the GetCapabilities document **Test** type 2 : send a GetMap request with "format=image/png" and check that the request is processed appropriately
3.5.2	The service shall not include gamma-correction, color-balance, and colorimetric profile in the PNG output, in order to accommodate the widest range of web browsers.	**Operational requirements** : Some browsers seem to have problems with gamma-correction, color-balance and colorimetric profile options. **Test** type 2 : send a GetMap request with "format=image/png" and check the characteristics of the output
3.5.3	The service shall support JPEG output.	**Operational requirements** : JPEG is a lossy-compression format that provides better compression ratios than PNG on imagery at the expense of non supporting transparency. **Test** type 1 : check the value of the <format> parameter of each layer declared in the GetCapabilities document **Test** type 2 : send a GetMap request with "format=image/jpeg" and check that the request is processed appropriately
3.5.4	The service shall support GIF output.	**Operational requirements** : Support for transparency is key to the interoperability of WMS services ; however, in an early JWID exercise, many clients were using a browser which did not handle PNG transparency properly. The purpose is to account for such limitations. **Test** type 1 : check the value of the <format> parameter of each layer declared in the GetCapabilities document

ID	Normative Clause	Rationale. Conformance testing.
		Test type 2 : send a GetMap request with "format=image/gif" and check that the request is processed appropriately

5.6 Layers' transparency

ID	Normative Clause	Rationale. Conformance testing.
3.6.1	Layers shall be transparent at places where there is no significant data before being rendered into the output image.	**Operational requirements** : Allows to overlay vector data or incomplete raster data on other data, e.g. an image and be able to see this image through it. Allows visibility of underlying data if there are incomplete coverages. **Test** type 1 : check the value of the <opaque> parameter of each layer declared in the GetCapabilities document **Test** type 2 : 1) send a GetMap request at the bounds of existing data on a coverage layer and check that PNG and GIF outputs sets transparent pixels outside of the available data 2) send a GetMap request on a vector layer and check that PNG and GIF outputs sets transparent pixels outside of the features 3) send a GetMap request on a vector layer on top of a coverage layer (imagery, terrain elevation or raster map) and check that the coverage layer is visible.
3.6.2	Whenever the output format enables transparency and the client sets TRANSPARENT=TRUE in the GetMap request, the service shall set the background of its request transparent. See [WMS1.3] § 7.2.4.7.4	**Operational requirements** : While the service won't be able to produce transparent output when the client requests JPEG output, it is expected to do so when the client requests PNG, GIF or JPEG2000 output. **Tests** : see clause 3.6.1

5.7 Multidimensional data

ID	Normative Clause	Rationale. Conformance testing.
3.7.1	Services publishing coverages containing georeferenced data whose values depend not only on a 2D spatial extent but also on other dimensions parameters (for example, date or depth, …) shall allow the user to specify the additional dimension parameters required to produce a 2D still-image in formats compliant with clauses #3.5.x. For dates or periods of time, the TIME parameter shall be used by the service. For depth (in the sea or in the ground) or height (in the atmosphere), the ELEVATION parameter shall be used by the service. See [WMS1.3] § 6.7.5, 6.7.6, 6.7.7	**Operational requirements** : The purpose of this clause is to ask services to provide still-image output even for temporal / multidimensional data. (This does not forbid them to provide also animated GIF or MPEG output). The following initiatives show the interest of using **non-**animated output, but instead issue one request per date of interest ; it enables more control over the temporal dimension ; it simplifies the display of the output ; it avoids video-compression artifacts. http://demo.communitymapbuilder.org/demo/mapbuilder-lib-1.5rc1/examples/timeSeries/index.html http://worldkit.org/wmstimenav/ http://demo.geomatys.fr/seagrid/demo/ifremer/ **Test** type 1 : check that multidimensional data layers are able to output formats as specified in § 5.5 **Test** type 2 : send GetMap request changing dimensional-parameters values, and check that the result is appropriate

5.8 Structure and granularity of the layers

ID	Normative Clause	Rationale. Conformance testing.
3.8.1	Services shall not use hierarchical layers. See [WMS1.3] § 7.2.4.8	**Operational requirements** : Most client and service implementations do not support a hierarchical structure of the layers. Avoid interoperability problems. This capability is not well enough specified in the OGC standard. **Test** type 1 : inspect the GetCapabilities document and check that there are no “child” layers involved.

5.9 Legend support

ID	Normative Clause	Rationale. Conformance testing.
3.9.1	Each vector data layer's style shall have an associated legend, available as an image in one of the following formats : PNG, GIF or JPEG. This legend shall be accessible online at the URL specified by LegendURL. See [WMS1.3] § 7.2.4.6.5	**Operational requirements** : Users need legends in order to understand the content of the map, especially as long as vector data portrayal is not standardized. **Test** type 1 : inspect the GetCapabilities document and check that there is a link to an online available image file containing a legend. **Test** type 2 : browse the layer and check that the legend is consistent with the display

5.10 GetFeatureInfo operation specification

ID	Normative Clause	Rationale. Conformance testing.
3.10.1	All layers publishing vector data shall be queryable See [WMS1.3] § 7.2.4.7.2	**Operational requirements** : WMS would not provide enough service for vector data dissemination if it is not possible for end-users to request attributes of depicted features. **Test** type 1 : check the value of the <queryable> parameter of each layer declared in the GetCapabilities document of services publishing vector data **Test** type 2 : send GetFeatureInfo requests on each layer of services publishing vector data
3.10.2	All layers publishing coverage data shall be queryable See [WMS1.3] § 7.2.4.7.2	**Operational requirements** : WMS would not provide enough service for coverage data dissemination if it is not possible for end-users to request values at a specific point. **Test** type 1 : check the value of the <queryable> parameter of each layer declared in the GetCapabilities document of services publishing coverage data

ID	Normative Clause	Rationale. Conformance testing.
		Test type 2 : send GetFeatureInfo requests on each layer of services publishing coverage data
3.10.3	The service shall support at least one of the following mime-type for the INFO_FORMAT parameter : - text/xml - text/html, - image/png See [WMS1.3] § 7.4.3.5	**Operational requirements** : allows a browser to pop-up a window and display the content of the response **Test** type 1 : check the value of the <Request/FeatureInfo/Format> parameter of each layer declared in the GetCapabilities document **Test** type 2 : check that GetFeatureInfo requests using the declared output format are processed appropriately
3.10.4	The response of the service shall contain : - the attributes of the designated objects in case of a vector layer - the measures at the designated location in case of a coverage layer	**Operational requirements** : provide a level of services similar to the one of GIS readers. **Test** type 2 : check that GetFeatureInfo responses contain appropriate information
3.10.5	If the server implements a limit on the number of features on which information is requested (FEATURE_COUNT parameter of the GetFeatureInfo request) then this limit must be greater than or equal to 100 See [WMS1.3] § 7.4.3.6	**Operational requirements** : On vector layers, there may be several features overlapping or intersecting each-other. If servers only support the default value of FEATURE_COUNT (which is 1) then it might be difficult for a client to retrieve the expected information. **Test** type 2 : check the GetFeatureInfo behavior at a specific location on a test dataset

6 Requirements for systems publishing data as WMS (Normative)

6.1 Layers' visibility configuration

ID	Normative Clause	Rationale. Conformance testing.
4.1.1	The WMS service must be configured to serve requests that range from at least 4x to at least 0.25x the native scale(s) or resolution(s) of the underlying datasets, and match commonly used scales such as [1/5000 1/10k 1/25k 1/50k 1/100k 1/250k 1/500k 1/1M 1/2M 1/4M 1/5M 1/10M] The limits implemented by the service shall be documented using the MinScaleDenominator and MaxScaleDenominator elements of the GetCapabilities document. See [WMS1.3] § 7.2.4.6.9	**Example** a compliant service would serve - VMap0 layers or 1M raster maps from 4M to 250k - VMap1 layers or 250k raster maps from 1M to 50k - VMap2 layers or 50k raster maps from 250k to 10k - 5m imagery or elevation data from 1m pixel-resolution to 20m pixel-resolution **Operational requirements** : enables the client to browse the data comfortably. Enables the provider to put limits on the hardware requirements. Limits matching commonly used scales favors consistent behavior (appearance / disappearance) across national services. Guarantee a visibility window. Outside of that window, data might not be consistent. **Test** type 1 : check the value of the <MinScaleDenominator> <MaxScaleDenominator> parameters of each layer declared in the GetCapabilities document, and compare it with the equivalent scale of the original data as declared by its metadata.

6.2 Layer's portrayal

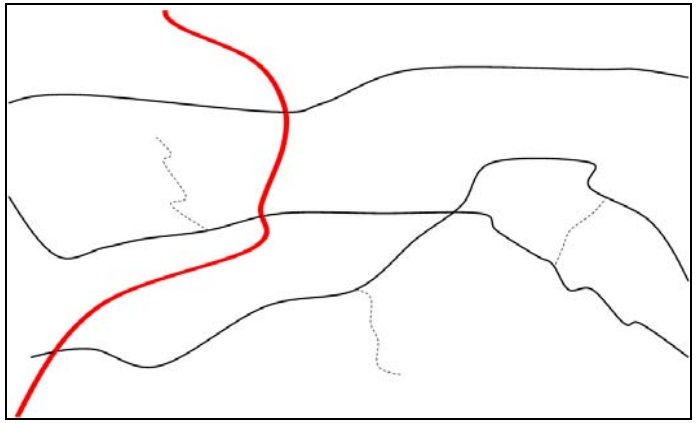
ID	Normative Clause	Rationale. Conformance testing.
4.2.1	The default style for ground terrain elevation data shall be "shaded". The default style for bathymetric data shall be "hypsometric".	**Operational requirements** : Provide the client with common / standard rendering of elevation data **Test** type 2 : access to an elevation or bathymetric layer and test the result of the default style ("style=")

6.3 Structure and granularity of the layers

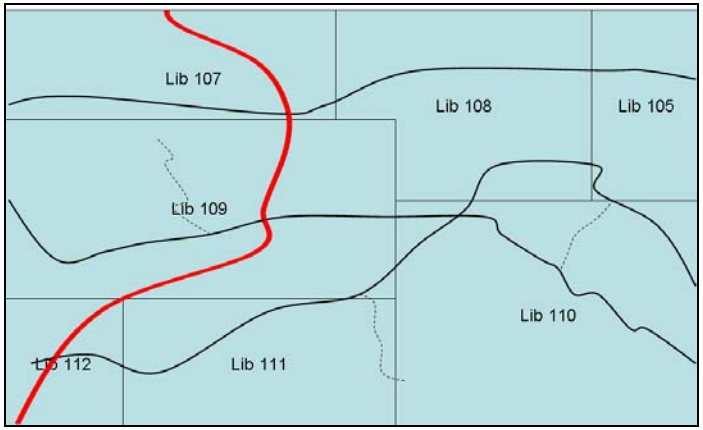
ID	Normative Clause	Rationale. Conformance testing.
4.3.1	WMS services publishing VMap datasets shall use the feature class name (e.g. 'aerofacp') as the WMS-"name" of the layer and the feature class description (e.g. 'Airport Point') as the WMS-"title" of the layer.	**Operational requirements** : avoid disparities across nations. **Test** type 1 : inspect the GetCapabilities document and check that there are one layer per feature class with appropriate naming scheme

6.4 Metadata support

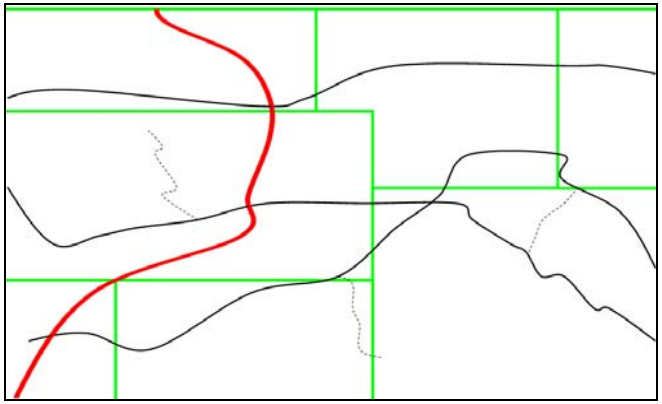
A metadata layer is a WMS layer , which responds to GetMap requests by displaying the extent of each dataset used to constitute the layer ; and which responds to GetFeatureInfo requests by providing the metadata available for the dataset which extent contains the requested I,J point of the GetFeatureInfo request.

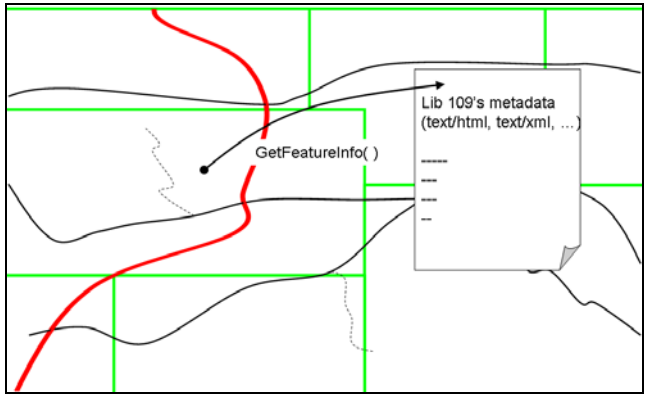


Consider a layer publishing the "roadl" features class, extracted from VMap Type 1 databases.



The libraries used to set up the layer may have been produced at difference times and by different producers, and may have different metadata information. (Note : in the example, we depict an irregular tiling schema).





The metadata layer as defined above would allow the user to extract metadata of the data he currently is viewing on it's screen.

ID	Normative Clause	Rationale. Conformance testing.
4.4.1	Each layer shall have at least one <MetadataURL> that references a WMS layer called "metadata layer" The following convention shall be used : "url-of-the-wms-service#layer-name" (e.g. "http://localhost:8080/cgi-bin/mywms#roadl_metadata"). The type attribute should be set to "WMS". The <Format> child-element should have blank content. See [WMS1.3] § 7.2.4.5	**Operational requirements** : Users may need to know about the date and accuracy of the data that is presented on screen by a particular layer. **Note :** COTS natively support the publication of such information, which is not fundamentally different from publishing vector data. It requires work on the configuration of the service and on the data integration (metadata extraction and publication within a database) **Test** type 1 : inspect the GetCapabilities document and check that there are "metadata" layers along with data layers **Test** type 2 : browse the metadata layer and check that its display and its behaviour regarding GetFeatureInfo is conformant.

6.5 GetMap request responsiveness

ID	Normative Clause	Rationale. Conformance testing.
4.5.1	When requested on the local host machine, the WMS services shall respond to any GetMap request in a manner conformant to this profile within 1 second per layer.	**Operational requirements** : ensure sufficient responsiveness for operational use. **Test** type 2 : connect on localhost, send a hundred GetMap request sequentially on random locations on some layers, and measure the time elapsed between the request and the response.

6.6 GetFeatureInfo operation specification

ID	Normative Clause	Rationale. Conformance testing.
4.6.1	In the case of a vector layer, the response shall produce human-readable output. For example, response to GetFeatureInfo on FACC-based data should use “name” and DFDD-based data should use “short-name” or “name”.	**Operational requirements** : the average end-user is unlikely to be familiar enough with FACC- or DFDD-codes to interpret them without support. **Test** type 2 : check that GetFeatureInfo responses do translate feature-dictionary codes into human-readable descriptions

7 Recommendations

7.1 Web Map Service extension and restriction recommendations

ID	Recommendation	Rationale.
5.1.1	**Output format : PNG** The PNG output should be interlaced	**Operational requirements** : Allows for progressive displaying of the map, which can increase the ease of use of the client software. This clause is not normative at this time, but should be in a subsequent version, as soon as it is supported and implemented by nations' vendors
5.1.2	The service should support the "image/png8" and "image/png24" values for the FORMAT parameter. Upon receiving a request specifying "image/png8", the server should encode the output image as an 8-bit color-indexed RGBA PNG. Upon receiving a request specifying "image/png24", the server should encode the output image as a 32-bit truecolor RGBA PNG.	**Operational requirements** : using color-indexed allows for a smaller output file, but does not cover all the cases (e.g. truecolor imagery data). **Note :** 8-bit color-indexed RGBA PNG output means a color-indexed file using a palette of 256 RGBA colors. (referred to as "PNG alpha-palette image" in http://www.libpng.org/pub/png/pngintro.html) **Test** type 2 : send a GetMap request on an imagery layer / vs a raster map layer, and check asking for PNG output
5.1.3	**Output format : JPEG** The JPEG output should be interlaced	**Operational requirements** : Allows for progressive and display of the map, which can increase the ease of use of the client software. This clause is not normative at this time, but it should be in a subsequent version, as soon as it is supported and implemented by nations' vendors
5.1.4	**Output format : JPEG2000** The service should support JPEG2000 output The service should embed georeferencing in the JPEG2000 output using the GMLJPEG2000 standard	**Operational requirements** : JPEG2000 allows better lossy-compression ratios than JPEG, and also allows lossless-compression. This clause is not normative at this time, but it should be in a

ID	Recommendation	Rationale.
		subsequent version, as soon as it is supported and implemented by nations' vendors
5.1.5	**Output format : JPEG and JPEG2000** The service should allow the client application to specify the compression quality by an optional QUALITY parameter ranging from 0 to 100	**Operational requirements** : enable the client application or a given deployment to tune the quality of the display depending on the network bandwidth in order to make a compromise between quality and responsiveness. This clause is not normative at this time, but it should be in a subsequent version, as soon as it is supported and implemented by nations' vendors
5.1.6	The recommended GetFeatureInfo format is text/xml.	**Operational requirements** : The benefit of providing XML+XSL instead of HTML output is to satisfy the requirements of clients that are processing the XML output in their own way Conformance to this clause is considered an asset for the implementation which supports it. **Test** type 1 : check the value of the <Request/FeatureInfo/Format> parameter of each layer declared in the GetCapabilities document **Test** type 2 : check that GetFeatureInfo requests using the declared output format are processed appropriately

7.2 Recommended systems requirements

ID	Recommendation	Rationale
5.2.1	**Layers' portrayal** When implementing styles that will be used to publish vector and coverage databases as WMS layers in a military environment, vendors should remain as close as possible to existing military conventions.	**Operational requirements** : The closer the software is to portrayal standards already in use, the easier it will be for operational users to read the map. It will also enforce the capability of the implemented styles to depict and make use of the whole information contained in vector or coverage databases.

ID	Recommendation	Rationale
	Examples : layers publishing vector data using the FACC could have a default style named "geosym" implementing MIL-PRF-89045 or MIL-PRF-89045A. Layers publishing S-57 vector data could have a default style named “S52” implementing S-52. A list of existing portrayal standards applicable to military maps are referenced in annex A. Some of them are for hardcopy maps specifically or for specific scales or productions, so all symbols may not be applicable to WMS layers. However they constitute valuable sources for developing styles suitable to a wider range of data layers.	**Test** type 2 : Configure VMap Level 0, 1 or 2 data layers and compare the output of GetMap requests using style=”geosym” on a WMS client with the output on a Command and Control System or a GIS that has been assessed to implement MIL-PRF-89045(A). Configure S-57 data layers and compare the output of GetMap requests using style=”S52” on a WMS client with the output on a system or a GIS that has been assessed to implement S-52.
5.2.2	**Layers’ portrayal : default style** The default style should enable the map to be readable onscreen, and explicit <Name> and <Title> should be associated to the style. Examples : layers publishing vector data using the FACC could have a default style named "geosym" implementing MIL-PRF-89045 or MIL-PRF-89045A. Layers publishing S-57 vector data could have a default style named “S52” implementing S-52.	**Operational requirements** : Clients’ ease of use
5.2.3	The service should configure separate WMS services for : • imagery data • raster map data • terrain elevation data • coverage data other than terrain elevation data • vector data	**Operational requirements** : On the provider side, avoid having as many services as datasets. On the client side, avoid having too long a list of layers within one service, and also too many services. **Test** type 1 : inspect the GetCapabilities document and check that no layer of a given type is published along with other layers of different type.
5.2.4	Datasets and datasets collection containing imagery, raster, terrain, or coverage data that have been produced using consistent production processes (with respect to the targeted audience)	**Operational requirements** : Simplify the end-users’ interaction with the data access services, by abstracting non-significant differences (without hiding them : differences between datasets

ID	Recommendation	Rationale
	should be published through a single layer.	within one layer are still accessible through the metadata layer – see § 5.9). **Examples :** 1) Raster map providers may create two layers, one layer for "legacy raster maps" and one layer for "up-to-date raster maps created from rasterized MGCP data", but they are encouraged to 1) merge all datasets from a series within a single layer 2) merge series that are consistent in terms of accuracy and production date within a single layer 2) Imagery providers who have produced consistent 15m, 5m and 1m imagery within a few months, are allowed to publish them as one single layer, switching from one resolution to another depending on the display-scale of the client. **Test** type 1 : inspect the GetCapabilities document and the metadata of each layer, and check that there are not many small datasets with similar metadata
5.2.5	Vector databases that have been produced using consistent production processes (with respect to the targeted audience) should be published through a single WMS service, publishing one WMS layer per feature class	**Operational requirements** : Enable the end-users' to interact by specifically selecting the layers that meet their requirements. **Examples :** You would, for example, set up two different services for MSD data and VMap data, and for VMap data you would publish one layer for roadl, builtupa, watrcrsl, etc. Also, if you produce VMap1 data from a generalization of VMap2 data, both can be considered as consistent, and you can embed both VMap1 roadl and VMap2 roadl features under the same roadl feature, switching from one source to the other depending on the current display-scale of the client. **Test** type 1 : inspect the GetCapabilities document and check that there are one layer per feature class with appropriate naming scheme + one metadata layer

ID	Recommendation	Rationale
5.2.6	**Additional metadata layers** Additional (more than one) metadata layers may be referenced through the <MetadataURL> element and may be published by the same service, in order to provide color-coded overlays providing quality informations. The following convention should be used : "url-of-the-wms-service#layer-name" (e.g. "http://localhost:8080/cgi-bin/mywms#roadl_horiz_acc").	**Operational requirements** : It could be useful to inform the user on locations where the accuracy is high / ok / or low
5.2.7	The XML response to a GetFeatureInfo request with INFO_FORMAT=text/xml should embed a reference to an online-accessible stylesheet hosted by the service provider, which shall be able to transform the XML output into an HTML webpage.	**Operational requirements** : The benefit of providing XML+XSL instead of HTML output is to satisfy the requirements of both - clients that intend to simply display the content of the response in a web-browser popup window - clients that are processing the XML output in their own way Conformance to this clause is considered an asset for the implementation which supports it. **Test** type 1 : check the value of the <Request/FeatureInfo/Format> parameter of each layer declared in the GetCapabilities document **Test** type 2 : check that GetFeatureInfo requests using the declared output format are processed appropriately
5.2.8	In case the number of features matching a GetFeatureInfo request exceeds the maximum number of features specified by FEATURE_COUNT, the server should print a sentence in the response stating "The number of features you pointed to exceeds <FEATURE_COUNT>. Showing information on the first <FEATURE_COUNT> ones."	**Operational requirement** Without this notification, the end-user has no way of knowing whether there are exactly or more than <FEATURE_COUNT> features where he pointed to

7.3 WMS Client recommendations

ID	Recommendation	Comments
CR1	**Layers' visibility** Client applications should implement appropriate widgets behaviour making use of the Min- and MaxScale of each layer to inform the user what layers are actually involved in the current display of the mapping context	Client behaviour could be specified as follows : "the list of layers shall only contain the layers of the web map context that are currently displayed on screen, based on the Min- and MaxScale associated with each layer" or "In the list of the layers, a different font shall be used for those that are currently displayed on screen and those that are currently not displayed on screen" or "In the list of the layers, those that are currently not displayed on screen shall be stroke"
CR2	**GetMap Output formats** The client application should make use of interlaced output formats in order to increase the GUI responsiveness	
CR3	**GetFeatureInfo specifications** Client applications should be able to issue and support text/xml, text/html, and image/png queries / responses for the GetFeatureInfo operation. In case of a text/xml exchange, the client application should use the referenced stylesheet if it is referenced and accessible	**Operational requirements** : Given the wide range of interpretation among vendors, part of the interoperability issues shall be handled by asking the client to be open to a variety of possible interaction formats. In the meantime, clause #16-4 promotes the transition towards a unique interoperable behaviour that meets several usecases.

8 Future Work directions

ID	Item description
FW1	**Product download** It is suggested that non-subsettable or non-resizable layers should be accessed through another way than WMS. Product download seems to be the most appropriate for accessing such unprocessed data In the case of a product download, a DGIWG-nations' approved standard format should be used, should be packaged as a zip or tar.gz file, and should be accessible at an URL via HTTP and FTP.
FW2	**Include portrayal specifications** based on the output of the DGIWG Portrayal Projects
FW3	**Output format : PNG** Check if any implementation supports the capability to adjust the characteristics of the output PNG format to the strict requirements of the data to be transported. This could be useful to save bandwidth without degrading the information. Specifications could be : “Color-indexed PNG should be generated when all layers returned by the WMS are color-indexed and the union of the colormaps of the layers can fit into a single colormap. Grayscale PNG should be generated when all layers returned by the WMS are grayscale. Truecolor PNG should be generated in any other case. The number of bits per sample or the number of bits of the colormap should be the strict minimum that supports the map's dynamic range.”
FW4	**Output format : PNG** The PNG output should be interlaced This clause is not normative at this time, but it should be in a subsequent version, as soon as it is supported and implemented by nations’ vendors
FW5	The JPEG output should be interlaced This clause is not normative at this time, but it should be in a subsequent version, as soon as it is supported and implemented by nations’ vendors
FW6	**Output format : JPEG2000** The service should support JPEG2000 output The service should embed georeferencing in the JPEG2000 output using the GMLJPEG2000 specification JPEG2000 allows better lossy-compression ratios than JPEG, and also allows lossless-compression. This clause is not normative at this time, but it should be in a subsequent version, as soon as it is supported and implemented by nations’ vendors
FW7	**Output format : JPEG and JPEG2000** The service should allow the client application to specify the compression quality by an optional QUALITY parameter ranging from 0 to 100 Enables the client application or a given deployment to tune the quality of the display depending on the network bandwidth in order to make a compromise between quality and responsiveness. This clause is not normative at this time, but it should be in a subsequent version, as soon as it is supported and implemented by nations’ vendors 1) OGC should consider standardization of an optional compression-quality parameter

ID	Item description
	that could allow the client or the deployment to adjust its requirements to the networks capabilities. e.g. some software allows specification of formats like this in HTTP POST XML requests : <Format>image/jpeg; Quality=50</Format> some other software allows to specify an optional "QUALITY=50" parameter in HTTP GET key-value-pair encoded requests. 2) To address specifically low bandwidth networks, nations may need to consider alternative technologies (JPIP, ECWP), which would then be dealt with in another profile
FW8	**Multidimensional data handling** specify the keywords to use for dimension parameters : e.g. PRESSURE for humidity measures, flight levels… in order to avoid disparities across nations
FW9	**FACC/DFDD-based vector data publication** would it be relevant to merge all feature classes that contain the same information but have different geometries under the same layer ? e.g. have a layer named 'aerofac' and titled as 'Airport', which would contain both aerofacp and aerofaca features.
FW10	**Advanced portrayal features : on-the-fly image equalization** 1) it is interesting for clients that image services perform on-the-fly imagery equalization on the current viewing-area 2) if automatic equalization is performed on the area specified by the BBOX parameter, client applications using tiling (e.g. openlayer-based portals) will join 256x256 tiles that have been equalized independently from each other, which will result in weird transitions between the tiles ➔ automatic equalization performed on the BBOX is not suitable 3) one could think about a specific parameter (EQ_BBOX) through which the client specifies the bounding box on which the equalization should be performed, which can be larger than the BBOX parameter. However this disables the tiled-client's ability to cache its tiles : each time I move, the EQ_BBOX will move, so I cannot reuse the tiles that I have in cache. ➔ on-the-fly equalization does not seem compliant with tiling-client that make use of cache **Conclusion :** 1) on-the-fly service-side equalization can be interesting for non-tiled clients 2) the service should be able to disable this specific feature ➔ a standard parameter to enable / disable this feature is desirable (➔ OGC) 3) tiled-client application should not use this feature, and instead perform radiometric equalization on their own, applying their algorithm on the downloaded tiles if on-the-fly service-side equalization is enabled, it can be performed on the area specified by the BBOX parameter
FW11	**Metadata layers** assess the nations' requirements and level of support and for additional metadata layers publishing quality informations in the form of color-coded overlays
FW12	**Legends** standardize the look-and-feel / graphical chart of the image containing the legend, so that we can dynamically produce a legend corresponding to the current map context of the user, by concatenating all the legend-images in an HTML popup It could be useful to standardize legends for MIL-PRF-89045(A), S-52, Stanag 2525, or S100, S101, S102, and AML in the future.

ID	Item description
FW13	**Service's responsiveness** use interoperability trials (DGIWG, NATO CWID, OGC OWS) in order to evaluate what could be an acceptable normative specification on this matter, for both the providers and the end-users
FW14	**GetFeatureInfo specifications** specify further the desirable output of a GetFeatureInfo on METOC coverages. e.g. if the measure depends on the height in the atmosphere, the output could provide a graphic depicting the values depending on the ELEVATION parameter.
FW15	**GetFeatureInfo specifications** when it is assessed that the support of clause [5.1.5] and [5.2.4] is mature enough, 1) restrict the scope of the profile to save complexity on the client side 2) specify further the XML response
FW16	**GetFeatureInfo : FEATURE_COUNT** the ideal behaviour, which is implemented in standalone GIS, would be to provide information on only one feature at a time, and to highlight the selected feature. One way of providing a similar user-interface would be to require WMS services to provide a SVG along with the features attributes, and to require the WMS clients to make use of this SVG
FW17	**Other output formats** Does the community have requirements to mandate other output formats, like pdf, svg, kml ?

9 Annex A : Portrayal standards references (from [DGIWG T03])

NATO Standardization Agreement (STANAG) 3675, Symbols for Land Maps, Aeronautical Charts, and Special Naval Charts for Joint Operations at Scale 1:250,000
Owner: NATO Inter-Service Geographic Working Party (IGEOWP)
Content: Topographic and aeronautical symbols.
Related standards: Symbols for special naval charts reference IHO INT 1 (see below).

MIL-STD-2402, Mapping, Charting, and Geodesy Symbols for Graphic Products
Owner: US National Geospatial-Intelligence Agency (NGA)
Content: Map/chart symbols for NGA hardcopy products.
Related standards: Hydrographic symbols are based on IHO INT 1 (see below).

MIL-DTL-89045A, Geospatial Symbols for Digital Display (GeoSym) ®
Owner: US National Geospatial-Intelligence Agency (NGA)
Content: Map symbols to portray feature/attribute data contained in NGA standard Vector Product Format (VPF) products. GeoSym v1.0 can be seen as both a register of portrayal catalogues (set or portrayal rules) and a register of symbols involved in those portrayal catalogues. It is sectioned to be dependent on product specifications. The portrayal rules are linked to the data through their feature catalogues, even if this relationship is ensured through FACC codes. GeoSym shares this principle with the ISO 19117 and IHO S-52 standards. GeoSym has dependencies on VPF (contains components to support Geosym) which may not be relevant or present in future standards like GML.
Related standards: Hydrographic symbols are based on IHO S-52 (see below).

MIL-STD-2525B, Common Warfighting Symbology
Owner: US Department of Defense, Symbology Standards Management Committee (SSMC)
Content: Military units, equipment, facilities, battlefield tactical graphics, METOC, Signals Intelli-gence (SIGINT) symbols, and symbols for Military Operations Other Than War (MOOTW).
Related standards: METOC symbols are derived from World Meteorological Organization (WMO) symbols.

NATO Allied Publication APP-6A, Military Symbols for Land Systems
Owner: NATO Joint Symbology Panel
Content: Generally derived from MIL-STD-2552B (see above). For command & control systems, APP 6A is a standard which applies to C2 users. There is rationalisation activity under way in UK.

American National Standards Institute (ANSI-INCITS 415-2006) American National Standard for Information Technology - Homeland Security Mapping Standard – Point Symbology for Emergency Management
Owner: US Federal Geographic Data Committee (FGDC)
Content: Symbols for incidents, natural events, operations, and infrastructure for emergency response.
Related standards: Meteorological natural events symbols are derived from World Meteorological Organization (WMO) symbols.

World Meteorological Organization (WMO) Weather Symbols

Owner: World Meteorological Organization (WMO)
Content: Symbols for weather phenomena.

Special Publication S-52, Colour and Symbol Specification for ECDIS
Owner: International Hydrographic Organization (IHO)
Content: Internationally standardized symbols for Electronic Navigation Charts (ENC) used in Electronic Chart Display and Information System (ECDIS).