

NATO Communications and Information Agency Agence OTAN d'information et de communication

AGENCY TECHNICAL INSTRUCTION

AI TECH 06.02.14

SERVICE INTERFACE PROFILE FOR GEOSPATIAL SERVICES - MAP RENDERING SERVICE

Effective date:	16 September 2016 [precise date as per Approver's e-signature date]
Revision No:	Original

Revision No:

Issued by: Chief, JISR Service Line

Approved by:

Director Service Strategy



Table of Changes and Amendments

Amendment No	Date issued	Remarks

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0 PRELIMINARY INFORMATION ON AGENCY INSTRUCTIONS

0.1 References

- A. NCIA/GM/2012/235; Directive 1 Revision 1; dated 3 May 2013
- B. NCIARECCEN-4-22852 DIRECTIVE 01.01 Agency Policy on Management and Control of Directives, Notices, Processes, Procedures and Instructions, dated 20 May 2014
- C. NCIARECCEN-4-23297, Directive 06.00.01, Management and Control of Directives, Processes, Procedures and Instructions on Service Management, dated 03 June 2014

0.2 Purpose

This Agency Technical Instruction (TI) provides detailed information, guidance, instructions, standards and criteria to be used when planning, programming, and designing Agency products and services. In this specific case the TI defines a Service Interface Profile (SIP) for a specific kind of NATO's Geospatial Services.

TIs are living documents and will be periodically reviewed, updated, and made available to Agency staff as part of the Service Strategy responsibility as Design Authority. Technical content of these instructions is the shared responsibility of SStrat/Service Engineering and Architecture Branch and the Service Line of the discipline involved.

TIs are primarily disseminated electronically¹, and will be announced through Agency Routine Orders. Hard copies or local electronic copies should be checked against the current electronic version prior to use to assure that the latest instructions are used.

0.3 Applicability

This Agency Technical Instruction applies to all elements of the Agency, in particular to all NCI Agency staff involved in development of IT services or software products. It is the responsibility of all NCI Agency Programme, Service, Product and Project Managers to ensure the implementation of this Agency Technical Instruction and to incorporate its content into relevant contractual documentation for external suppliers.

¹ https://servicestrategy.nr.ncia/SitePages/Agency%20Directives%20(Technical).aspx



1 INTRODUCTION

This document gives guidance on the implementation of a Map Rendering Service, being a special kind of a Geospatial Service.

One of the main concepts of the future NATO Network Enabled Capabilities (NNEC) is that of a "network of networks"; that is, instead of a single, all-encompassing global network the NNEC environment will be made up of many NATO and national networks linked together. In order to ensure interoperability between services running in this environment there is a need for a standard (and standards-based) profile, mandatory for all service operations.

This Service Interface Profile (SIP) describes the key elements that make up an NNEC Map Rendering Services. It describes the functionality of such a service, its interfaces, and additional constraints on using and implementing those interfaces.

This SIP aims to remain independent of implementation detail, and thus platform-neutral and technology-agnostic.

1.1 Audience

The target audience for this specification is the broad community of NNEC stakeholders, who are delivering capability in an NNEC environment, or anticipate that their services may be used in this environment.

These may include (but are not limited to):

- Project Managers procuring Bi-SC or NNEC related systems
- The architects and developers of service consumers and providers
- Coalition partners whose services may need to interact with NNEC services
- Systems integrators delivering systems into the NATO environment.

1.2 Goals

This SIP is intended to give directives, along with clarifications and amendments, on the use of mandatory and recommended interfaces to be implemented by the any application, system, or FAS/FS that offers or consumes Map Rendering Services, i.e. a specific kind of Geospatial Services.

1.3 Non-Goals

The following topics are outside the scope of this SIP

- Recommendations for the use of products and platforms to implement this service.
- Instructions and guidance on how to produce and structure the geospatial data that is exposed via the interfaces specified in this SIP.
- Profiling the OGC Web Feature Service (WFS) Interface Standard.
- Service Discovery mechanisms and related standards to discover specific Map Rendering Services that are offered and hosted in an environment.

1.4 Notational Conventions

The following notational conventions apply to this document:



The keywords "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [IETF RFC 2119, 1997].

In summary, this means that

- MUST, in the context of this SIP equivalent to SHALL or REQUIRED, means "that the specified item is an absolute requirement of the specification" [IETF RFC 2119, 1997].
- SHOULD, in the context of this SIP equivalent to RECOMMENDED, means that "there may exist valid reasons in particular circumstances to ignore a particular item, but the full implications must be understood and carefully weighed before choosing a different course" [IETF RFC 2119, 1997].
- MAY, in the context of this SIP equivalent to OPTIONAL, means "that an item is truly optional" [IETF RFC 2119, 1997].

Words in *italics* indicate terms referenced in Section 1.4. Courier font indicates syntax, and names of web service operations.

When specifying the location of certain elements and attributes in an XML structure, XPath [W3C XPath 3.0, 2011] syntax is used.

1.5 Terminology

The following terminology is used in this SIP and its annexes. It bases largely on the terminology used in Section 4 of [OGC WMTS 1.0.0, 2010].

geospatial data	Data used to derive geospatial information, which are facts about the Earth, referenced by geographic position and arranged in a coherent structure. This includes topographic, aeronautical, hydrographic, planimetric, relief, thematic, geodetic, geo-referenced imagery, geophysical products, publications and materials. These are either in analogue or digital formats. (based on MC 0296/2 "NATO Geospatial Policy").
(geospatial) feature	Abstraction of a real world phenomenon.
geospatial information product	Specified data with direct or indirect spatial reference to be consumed by a user, e.g. maps, coverage data, or structured data, that is returned as the result of a geospatial web service call from a producer/server to a client.
layer	Basic unit of geographic information that may be requested as a map from a server
map (digital)	A portrayal of geospatial information in a graphical representation, primarily as a digital image, suitable for display on a computer screen. Formats in which a map is typically rendered by a WMS or WMTS service are for example PNG, GIF, JPEG, or SVG.
portrayal	Graphical presentation of information to humans.



tile	Rectangular unit of a tessellated map. A tile is often part of a set of tiles (see tile matrix), covering a spatially contiguous extent and sharing similar information content and graphical styling. A tile can be uniquely defined by a pair of indices for the column and row along with an identifier for the tile matrix.
tile matrix	A collection of tiles of the same scale to be assembled to a tile of a larger extent.
tile matrix set	A collection of tile matrices defined at different scales.

1.6 Namespaces

The following namespaces are used to qualify XML elements in this document and its annexes:

Namespace Prefix	Namespace	Reference
nwms	nato:ncia:geo:wms	This document
nwmsb	nato:ncia:geo:wms:base	This document
ogc	http://www.opengis.net/ogc	OGC WMS (Annex E2)
ows	http://schemas.opengis.net/ows/2.0	OGC Web Services Common Standard Version 2.0
wms	http://www.opengis.net/wms	OGC WMS Standard Version 1.3.0 (Annex E)
wmts	http://www.opengis.net/wmts/1.0	OGC WMTS Standard Ver. 1.0.0

1.7 Normative References

The following documents have fed into this specification, and are incorporated as normative parts of this SIP. This means that any implementation of the Map Rendering Service uses and bases on the requirements, recommendations and statements specified in these documents, as profiled in this SIP.

Title	Document No	Version
OpenGIS Web Map Server Implementation Specification [OGC WMS 1.3, 2006] (Note that this document is the same as ISO 19128)	OGC 06-042	1.3.0
OpenGIS Web Map Tile Service Implementation Standard [OGC WMTS 1.0.0, 2010]	OGC-07-057r7	1.0.0
OGC Web Services Common Standard [OGC WSCommon 2.0, 2010]	OGC 06-121r9	2.0.0



OGCStyledLayerDescriptor(SLD)ImplementationOGC 02-0701.0.0Specification [OGC 02-070, 2002]



2 SIP FOR THE MAP RENDERING SERVICE

A Map Rendering Service is a special kind of a Geospatial Service that provides geospatial data in form of digital *maps* to its service consumers. This SIP specifies the interface of such a Map Rendering Service by profiling the OGC WMS Standard Version 1.3 [OGC WMS 1.3, 2006], the OGC WMTS standard Version 1.0.0 [OGC WMTS 1.0.0, 2010], OGC Web Services Common Standard Version 2.0.0 [OGC WSCommon 2.0, 2010], and related standards.

NATO Core GIS is one example of a system that provides geospatial data by implementing Map Rendering Services in a way that is conformant to the specification provided in this SIP.

In order to enhance the interoperability between providers and consumers of a Map Rendering Service in an NNEC environment, any NATO Functional Area Service (FAS), Functional Service (FS), or subsystem thereof that offers the functionality described below MUST use the interfaces, standards and methods specified in this SIP. In particular this means that this SIP applies to all services in the NNEC environment that provide (digital) *maps*, or parts of it, to consumers.

In particular, any Map Rendering Service

- MUST support a Web Map Service (WMS) interface, following the profile of the WMS Standard Version 1.3.0 [OGC WMS 1.3, 2006] as specified in Section 3. Here, "to support" means the ability to provide and exchange geospatial data via a WMS interface as specified in Section 3.
- MUST support a Web Map Tile Service (WMTS) interface, following the profile of WMTS Standard Version 1.0.0 [OGC WMTS 1.0.0, 2010] as specified in Section 4. Here, "to support" means the ability to provide and exchange geospatial data via a WMTS interface as specified in Section 4.
- MAY support the Open ESRI Geo Services REST specification Version 1.0 [ESRI REST Spec, 2010, 2010]. It represents a rich interface to the server side GIS capabilities. Systems could take advantage of this interface when implementing a Map Rendering Service.

Note that this means that a system which hosts Map Rendering Services MUST support both interfaces, WMS and WMTS, in parallel, and MUST be able to offer the same geospatial data via both interfaces in parallel. However, this does not mean that necessarily all geospatial data will always be offered via both interfaces, as not every geospatial data is suitable to be cached and offered in a cached form. Reasons for this decision and its implications are discussed in Section 2.2.

The OGC Web Services Common Standard [OGC WSCommon 2.0, 2010] specifies aspects that are common to all OGC Web Service interfaces, including WMS and WMTS. It provides additional details, makes requirements more precise, and represents a refinement of the WMS and WMTS Standards in certain areas, for example bindings, schema definitions, etc.

A Map Rendering Service

• SHOULD implement and comply with the profile of the Web Services Common Standard Version 2.0 [OGC WSCommon 2.0, 2010] specified in Section 5, regarding all aspects that are relevant for the implementation of the WMS and WMTS Standards, such as HTTP bindings and XML encodings.



2.1 Functionality

For the scope of this SIP a Geospatial Service is any functionality that is offered from a server component which is capable of dealing with geospatial data to consumers in the form of web services, providing the consumers with *geospatial information products*.

This is a wide definition, as there are many different kinds of *geospatial information products*, such as:

- *maps*, i.e. geospatial data of a specific geospatial region that is rendered as a raster image or vector graphic following certain *portrayal* rules.
- coverage data, i.e. geospatial data representing continuous phenomena in a discretized manner and in this context in a regular form as grid or raster to be encoded in standard formats either binary or text-based.
- structured geospatial vector data of a specified geospatial area adhering to an application schema as *geospatial features*. This includes structured data that is produced by Gazetteer services.
- structured analysis result created on demand by processing specific geospatial queries or complex analyses and addressing specific questions that have to be computed from geospatial as well as other domain specific data.

In order to separate between different kinds of Geospatial Services we group the Geospatial Services according to the *information product* which they provide.

The scope of this SIP is limited to Geospatial Services that offer the first *information product* from the previous list, i.e. Geospatial Services that return *maps*, primarily as images², portraying a specific geospatial region. We call such services *Map Rendering Services*. The remaining classes of Geospatial Services, offering *information products* other than *maps*, are not in the scope of this SIP, and will be specified if required in consecutive documents.

The functionality provided by a Map Rendering Service as it is specified in this SIP comprises:

- serving user-specific digital *maps*, i.e. *portrayals* of a specific geospatial region (e.g. formatted as media types image/jpeg, image/gif, or image/svg+xml). The geospatial extent that the *map* should cover, the corresponding coordinate reference system (CRS), the geospatial objects that appear on the *map*, the way these objects are rendered, and properties of the produced *map* such as file format and image size can be defined in the service call by the service consumer.
- providing service metadata as a machine readable description (e.g. formatted as media type text/xml) of the information content provided by the service, and the corresponding request parameter
- providing responses (e.g. formatted as media type text/xml, application/xml, etc.) to queries for information about *features* shown on a *map*.

2.2 WMS vs. WMTS

Both interfaces, WMS and WMTS, are mandatory for any NATO FAS/FS or subsystem thereof that offers Map Rendering Services.

² Examples of digital *maps* are provided in APPENDIX A.



The reason for this is that – although both service interfaces, WMS and WMTS, offer similar functionality with respect to retrieving *maps* from a GIS – they cover different usage scenarios and differ in the way *maps* are requested.

It is RECOMMENDED that clients consume a WMTS (with the appropriate settings and parameters) in situations where performance and service response times are essential requirements.

For the current NATO system landscape this means that most of the FASes, FSs and consumers of simple *maps* will consume WMTS from the future NATO datacentres or similar central sites.

However, this recommendation does not mean to replace WMS by WMTS. WMS covers a different use case where performance advantage is traded with more flexibility and control in the WMS request, allowing the user to specify more precisely the resulting *map*. While for some FASes/FSs and users this is an overhead that requires additional knowledge, some use cases with NATO require this freedom and have less strict response time limitations.

Together this means that both WMTS and WMS will coexist as service interfaces in the future NATO system landscape, where the consumers have to decide which interfaces fits their requirements better.

Depending on the nature of geospatial data it does not always make sense to cache data and offer it in a cached form, for example in the case of fast changing data, in particular vector data. The decision if geospatial data is offered via the WMS or WMTS interface, or via both interfaces, depends on the geospatial data and should be taken by a geospatial expert.

A brief overview of the functionality of WMS and WMTS is given in the remainder of this section in order to better describe their difference and ease the selection between both interface standards.

2.2.1 Characteristics of WMS³

The WMS Standard [OGC WMS 1.3, 2006] focuses on flexibility in the client request enabling clients to obtain exactly the final image they want. A WMS client can request that the server creates a *map* by overlaying an arbitrary number of the *map layers* offered by the server, over an arbitrary geographic extent, with an arbitrary background color at an arbitrary scale within a suitable range of scales, in any supported coordinate reference system. The client may also request that the *map layers* be rendered using a specific server advertised style or even use a style provided by the client when the WMS server implements the OGC Styled Layers Descriptor (SLD) standard. However, all this flexibility comes at a price: server image processing must scale with the number of connected clients and there is only limited potential to cache images between the server and client since each different WMS request leads to a different image.

2.2.2 Characteristics of WMTS³

As web service clients have become computationally more powerful, an alternative strategy where image overlays are performed on the client side can be considered. More specifically a client requests *map* tile images which are fully or partially overlapping the requested area of interest, combines the *tiles* obtained from the server, and clips the mosaic to the *map* image of interest. In such a scenario the act of creating a map image by combining several tiles is performed by the client and no longer by a server. For a server this means that it can pre-render some or all of their map images and no longer needs to create the images on the fly when requested. This allows for servers

³ Note, that the main parts of this section are excerpts taken from the WMS [OGC WMS 1.3, 2006] and [OGC WMTS 1.0.0, 2010] standard documents.



to be scaled based on communication processing abilities rather than image processing abilities. Exchanging a fixed set of images also enables network providers to cache images between the client and the server, reducing latency and bandwidth use.

Such performance oriented considerations are implemented in the Web Map Tile Service (WMTS) Standard [OGC WMTS 1.0.0, 2010]. The WMTS standard complements the existing Web Map Service (WMS) standard of the OGC, targeting to improve the response time of a server by trading in the flexibility in the request, and shifting some of the functionality to the client.

The Web Map Tile Service (WMTS) Implementation Standard provides a standard based solution to serve digital *maps* using predefined image *tiles*.

In each request the WMTS serves a single *tile* of a single *layer* of a *map*. Unlike WMS, there is no specified way to request a server to combine and return a *tile* with information coming from more than one *layer* in a single fetching process. WMTS clients that want to show a combination of *layers* must make independent requests for the *layer tiles* and then combine or overlay the responses. Also bounding boxes and scales of these WMTS tiles are constrained to a discrete set of values. It is therefore the responsibility of the service owner to create pre-configured tiles that satisfy the users' requirements.

The goal of providing a WMTS enabled service is performance orientation and scalability. Therefore, servers must be able to return tiles quickly. A good way to achieve that is to use locally stored and indexed pre-rendered tiles that will not require any image manipulation or geo-processing. Server developers will decide if pre-rendered tiles will be generated in a previous tile-preparation process or generated on the fly utilizing a mechanism to build up caches on demand over time with the number of request.



3 WMS INTERFACE

This section contains a profile of the Web Map Service (WMS) standard Version 1.3.0 [OGC WMS 1.3, 2006]. The profile consists of amendments, restrictions, and exceptions that further refine the WMS Standard, in order to meet the specific needs of a Map Rendering Service within the NNEC environment.

Any Map Rendering Service MUST implement the profile of the WMS Standard Version 1.3.0 [OGC WMS 1.3, 2006] specified in this SIP. In particular this means that any Map Rendering Service MUST offer a WMS interface as specified by this SIP.

Regarding the aspects that are not explicitly profiled in this SIP, a Map Rendering Service MUST follow and implement the original requirements specified in the WMS Standard Version 1.3.0 [OGC WMS 1.3, 2006]. It SHOULD also implement the corresponding requirements specified in the Web Services Common Standard Version 2.0.0 [OGC WSCommon 2.0, 2010] unless they are in contradiction with the WMTS Standard or the specifications in this SIP.

Note, that when using the term "WMS Standard" in the following, this SIP refers to the WMS Standard Version 1.3.0 [OGC WMS 1.3, 2006].

3.1 WMS Conformance Classes

The WMS Standard defines two conformance classes:

- a *Basic WMS*, which specifies aspects that are independent of particular operations, as well as the two mandatory operations GetCapabilities and GetMap.
- a *Queryable WMS*, which extends the Basic WMS class with the additional mandatory operation GetFeatureInfo.

A Map Rendering Service MUST implement the Basic WMS interface of the WMS Standard, and comply with all aspects specified by the Basic WMS interface. This means that a Map Rendering Service MUST offer the two operations GetCapabilities and GetMap. This allows for example that Map Rendering Services which are only published to serve imagery data do not have to support the GetFeatureInfo operation.

Besides, a Map Rendering Service MAY implement the Queryable WMS interface, and thus MAY provide the GetFeatureInfo operation, depending on the use cases.

3.2 Operations

The WMS interface of a Map Rendering Service covers the operations GetCapabilities, GetMap, and GetFeatureInfo. The status of each operation, i.e. whether an operation is mandatory or optional, is defined in the previous Section 3.1.

3.2.1 Operation GetCapabilities

The purpose of the GetCapabilities operation is to obtain service metadata and value ranges for request parameters.

The GetCapabilities operation request MUST follow the requirements specified in Section 7.2 of the WMS Standard [OGC WMS 1.3, 2006]. In particular, this means that the operation MUST support the parameters version, format, service, and updateSequence, according to their definitions in the WMS Standard.



In order to be in line with the general design of a generic OGC web service, the parameters introduced for a generic OWS as defined in Section 7.2 of the OGC Web Services Common Standard [OGC WSCommon 2.0, 2010] MAY be supported. The parameters AcceptVersions, Sections, AcceptFormats, and AcceptLanguages, SHALL be used as specified in Section 7.3 of [OGC WSCommon 2.0, 2010]. However, if parameters serve the same purpose the representation and semantics of the WMS Standard SHALL take precedence.

If an XML encoding is used for the request message it SHOULD comply with the XML schema specified in Appendix A.1. The values of the schemalocation attributes of the import element MAY be changed accordingly to a local reference or a URL reference to the file. Note that the parameters defined by the WMS Standard are represented as XML attributes of the GetCapabilities element, while the parameters defined in WS Commons Standard are represented as sibling elements under the GetCapabilities element.

With respect to bindings, a GetCapabilities request MUST follow the requirements specified in Section 3.3 of this SIP.

The response to a GetCapabilities request MUST be a WMS_Capabilities element that complies with the specification of the WMS Standard [OGC WMS 1.3, 2006] and that MUST be valid with respect to the XML schema provided in Appendix E.1 of the WMS Standard.

3.2.2 Operation GetMap

The purpose of the GetMap operation is to return a *map* of the spatially referenced information *layer* requested, in the desired style, and having the specified coordinate reference system, bounding box, size, format and transparency.

The GetMap operation request MUST follow the requirements specified in Section 7.3 of the WMS Standard [OGC WMS 1.3, 2006].

If an XML encoding is used for the request message it SHOULD comply with the XML schema specified in Appendix A.3. The XML schema follows the guidance for OWS services and uses syntactical constructs from the WS Commons Standards schemas, however, the meaning of the parameters SHALL be as defined in Section 7.3 of the WMS Standard [OGC WMS 1.3, 2006].

With respect to bindings, a GetMap request MUST follow the requirements specified in Section 3.3.

The response to a GetMap request is a *map* (image). It MUST comply with the specification in Section 7.3.4 of the WMS Standard [OGC WMS 1.3, 2006].

3.2.3 Operation GetFeatureInfo

The purpose of the GetFeatureInfo operation is to provide clients that use the WMS interface with more information about *features* in the *map* that were returned by previous GetMap requests.

If a Map Rendering Service offers the GetFeatureInfo operation it has to comply with Section 7.4 of the WMS Standard [OGC WMS 1.3, 2006].

If an XML encoding is used for the request message it SHOULD comply with the XML schema specified in Appendix A.4. The XML schema follows the guidance for OWS services and uses syntactical constructs from the WS Commons Standards schemas, however, the meaning of the parameters SHALL be as defined in Section 7.4 of the WMS Standard [OGC WMS 1.3, 2006].

With respect to bindings, a GetFeatureInfo request MUST follow the requirements specified in Section 3.3.



The response to a GetFeature request is information about *features* at the selected point on the *map* in the requested format. A GetMap response MUST comply with the specification in Section 7.4.4 of the WMS Standard [OGC WMS 1.3, 2006].

3.3 Bindings

The operations defined in the WMS interface can be invoked in different ways, regarding their bindings to transport protocols and the corresponding ways how parameters are encoded.

A Map Rendering Service SHOULD specify relevant information about the operations of its WMS interface, including operation names, operation invocation, bindings, and parameter encodings, in the OperationsMetadata section of the service metadata document (currently represented by the Capabilities XML element which is returned by the GetCapabilities operation), as specified in Section 7.4.6 of the Web Services Common Standard [OGC WSCommon 2.0, 2010].

Regarding operation invocation a Map Rendering Service extends and profiles the WMS Standard in the following way. A Map Rendering Service

- MUST support the HTTP GET/KVP binding as specified in the WMS Standard [OGC WMS 1.3, 2006] (For a summary of the WMS HTTP/KVP see Appendix C.1)
- MAY support the HTTP POST/XML binding. If it supports this binding, it SHOULD follow the corresponding guidance and requirements for the XML encoding that are provided for the various operations in Section 3.2. It is RECOMMENDED that the XML encodings for the parameters and requests are compliant to the XML schemas specified in APPENDIX A.
- MAY support SOAP bindings and offer its functionality via SOAP interfaces. If a Map Rendering Service offers its functionality via the SOAP protocol, it MUST do so in compliance with the Messaging Service SIP [NCIA TR/2012/SPW008000/30, 2012] which defines general requirements that apply to all services in the NNEC environment that make use of SOAP. It is RECOMMENDED that the XML encodings for the parameters and requests are compliant to the XML schemas specified in APPENDIX A.
- SHOULD NOT use a HTTP GET/XML binding, where the parameters are encoded as XML in the body of the GET request. The reason is that a payload within a GET request message has no defined semantics [IETF RFC 7231, 2014], and sending a payload body on a GET request might cause some existing implementations to reject the request [IETF RFC 7231, 2014].

Note that the WMS Standard defines the URL prefix in accordance to IETF RFC2396. However, RFC2396 is obsolete, and has been superseded by IETF RFC3986. The implementation of a Map Rendering Service MAY follow the superseding standard IETF RFC3986 for the specification of the URL prefix.

3.4 Additional Exceptions

In addition to the exceptions specified in the WMS Standard a Map Rendering Service MAY support more exceptions. These are listed in the remainder of this section.

3.4.1 Duplicated Parameters in a Request

In contrast to the WMS Standard, when parameters of a WMS request are duplicated with conflicting values, a Map Rendering Service MAY respond with an exception.

If the exception is encoded as XML, it



- SHALL be valid according to the schema provided in Appendix E.2 of the WMS Standard [OGC WMS 1.3, 2006], and SHALL use the exception code "DuplicatedParameterInRequest" as value of the attribute /ogc:ServiceExceptionReport/ogc:ServiceException/@code
- SHALL contain the information that the cause for raising this exception is the existence of duplicated parameters in the operation request. The content of the element /ogc:ServiceExceptionReport/ogc:ServiceException SHALL be used for this purpose.
- SHALL contain the name and the conflicting values of the duplicated parameters in the value of the attribute

/ogc:ServiceExceptionReport/ogc:ServiceException/@locator

If the exception is reported in a different format than XML, e.g. as part of the *map*, it

- SHOULD contain the information that the cause for raising this exception is the existence of duplicated and conflicting parameters in the operation request in an applicable form.
- SHOULD provide sufficient information about the name and the conflicting values of the duplicated parameters.

3.5 Map Image Formats

The WMS Standard does not require the use of specific formats, but does suggest that a server should offer at least one format that supports transparency, and one format that can be displayed on common web browsers without additional software. Based on these considerations the WMS Standard suggests that a server SHOULD at least offer the PNG format (Media type image/png).

In addition to the suggestions of the WMS Standard, it is RECOMMENDED that any server in an NNEC environment providing a WMS also supports the JPG format for images (Media type image/jpeg). The reason behind this recommendation is that rendering *maps* in JPG format reduces the processing time of a server, and allows faster response times for GetMap requests.

3.6 Coordinate Reference Systems

With Coordinate Reference System (CRS) this SIP refers to the coordinate system used for the geographic information that serves as the source for a *map*, not to the coordinate system used for the map image.

This SIP uses the term *bounding box* to refer to a real geographic extent expressed in the CRS. The bounding box is represented by the BBOX parameter in the WMS GetMap operation.

In line with the WMS Standard this SIP does not mandate support for any particular CRS.

However, following [DGIWG WMS Profile, 2009], it is RECOMMENDED that a Map Rendering Service supports at least the following geocentric coordinate systems (as defined in the WMS Standard):

- CRS:84 WGS84 geographic longitude, then latitude, expressed in decimal degrees
- EPSG:4326 WGS84 geographic latitude, then longitude, expressed in decimal degrees
- EPSG:3395 World Mercator projection

Besides these basic CRSs, usually further CRSs are applicable for a certain area of interest or area of operation. A Map Rendering Service SHOULD support all CRSs that a required for a certain area of interest or area of operation.

Regarding the announcement of supported CRSs, a Map Rendering Service SHOULD provide an exhaustive list of the CRSs suitable and available for a particular service, and SHOULD announce all supported CRSs in the GetCapabilities XML response.



3.7 Bounding Boxes

The WMS service metadata declares (directly or inherited from a parent *layer*) for each *layer* at least one bounding box, which is represented for example in a GetCapabilities response directly under each layer element by the element /wms:WMS_Capabilities//wms:Layer/wms:BoundingBox

In addition to the requirements for a bounding box in the WMS Standard, a Map Rendering Service MUST also implement the requirements for bounding boxes specified in Section 10.2 of the OGC WS Common Standard [OGC WSCommon 2.0, 2010].

According to the WMS Standard the "<BoundingBox> metadata element specifies the coordinate range for the layer as a whole". However, the bounding box can be redefined in child layers, and the WMS Standard does not specify how the bounding box value of a parent layer is related to the bounding box values defined by child layers.

For a Map Rendering Service it is RECOMMENDED that the bounding box element of any *layer* is always equivalent to the Minimum Bounding Rectangle (MBR) of all its child-*layers*.

While this recommendation does not prohibit that the geospatial information that is represented by a (parent) *layer* is actually defined (and can be rendered) for the entire area specified by its bounding box, it guarantees at least that the bounding box of a child *layer* does not lie outside the bounding box of its parent *layer*.

According to the WMS Standard a wms:Layer element shall not contain more than one wms:BoundingBox elements for the same CRS. In the case where a *layer* specifies a disjoint area, the WMS suggest two possible solutions: Either define several *layers*, each one for a connected area, or extend the bounding box to cover the entire disjoint area.

In the case where a *layer* covers disjoint areas it is RECOMMENDED for a Map Rendering Service to follow the first approach and specify each part of the disjoint area by a separate *layer*.

The reason for this recommendation is to prevent any misinterpretation of the meaning of a bounding box, as bounding boxes do not get extended to an area for which no information might be available, suggesting to the user the opposite, i.e. that information would be defined and that no *geospatial features* exist in this area, otherwise.

3.8 Rendering and Portrayal Styles

The Map Rendering Service SHALL publish its *maps* with a default styling. The default styling SHOULD be created by the service management which is usually in the responsibility of a geo officer or other geo expert, following best knowledge and best practise. The default styling SHOULD be sufficient to render *maps* properly, in the sense that a client does not have to provide further *portrayal* rules in a request for a *map*.

The WMS Standard [OGC WMS 1.3, 2006] supports basic styling and *portrayal* options for its data sets by means of specifying the styles in which *layers* should be portrayed in a GetMap request. However, the standard WMS interface does not give a consumer the ability to provide own styling rules.

A Map Rendering Service addresses this situation by supporting a styling language to specify userdefined styling and *portrayal* rules, and the mechanism to combine such styles with a WMS request.

A Map Rendering Service SHOULD provide the capability to use external *portrayal* rules and symbology. For this purpose a Map Rendering Service



• SHOULD implement the OGC Styled Layer Descriptor (SLD) Implementation Specification, Version 1.0.0 [OGC 02-070, 2002]. This means that a Map Rendering Service SHOULD accept user-defined XML encodings of *layer* styles by means of implementing the extensions and changes in its WMS interface as described in [OGC 02-070, 2002].

Note that according to OGC the Styled Layer Descriptor Implementation Specification 1.0.0 [OGC 02-070, 2002] is a deprecated implementation specification. It has been superseded by the Styled Layer Descriptor (SLD) Profile for WMS Version 1.1.0 together with the Symbology Encoding Implementation Specification Version 1.1.0.

Regarding the follow up standards, a Map Rendering Service

- MAY implement the OGC Styled Layer Descriptor Profile of the Web Map Service Implementation Specification Version 1.1.0 [OGC 05-078r4, 2007]. This means that a Map Rendering Service MAY accept user-defined XML encodings of *layer* styles by means of implementing the extensions and changes in its WMS interface as described in [OGC 05-078r4, 2007].
- MAY support the OpenGIS Symbology Encoding Implementation Specification Version 1.1.0 [OGC 05-077r4, 2007]. This means that a Map Rendering Service MAY implement and understand the format of the map-styling language defined in [OGC 05-077r4, 2007] for producing georeferenced *maps* with user-defined styling.



4 WMTS INTERFACE

This section contains a profile of the Web Map Tile Service (WMS) standard Version 1.0.0 [OGC WMTS 1.0.0, 2010]. The profile consists of amendments, restrictions, and exceptions that further refine the WMTS standard, in order to meet the specific needs of a Map Rendering Service within the NNEC environment.

Any Map Rendering Service MUST implement the profile of the WMTS standard Version 1.0.0 [OGC WMTS 1.0.0, 2010] specified in the following. In particular this means that any Map Rendering Service MUST offer a WMTS interface.

Regarding the aspects that are not explicitly profiled in this SIP, a Map Rendering Service MUST follow and implement the requirements specified in the original WMTS Standard Version 1.0.0 [OGC WMTS 1.0.0, 2010].

Many of the aspects of the WMTS interface that are shared in common with other OGC Web Services are included normatively in the WMTS Standard by reference to the Web Services Common Standard Version 2.0.0 [OGC WSCommon 2.0, 2010]. To this extent, the WMTS Standard already implements the corresponding requirements specified in the Web Services Common Standard Version 2.0.0 [OGC WSCommon 2.0, 2010].

Note, that when using the term "WMTS Standard" in the following, this SIP refers to the WMTS Standard Version 1.0.0 [OGC WMTS 1.0.0, 2010].

4.1 Operations

The WMTS interface of a Map Rendering Service covers the operations GetCapabilities, GetTile, and GetFeatureInfo.

A Map Rendering Service

- MUST offer the GetCapabilities operation
- MUST offer the GetTile operation
- MAY offer the GetFeatureInfo operation

4.1.1 Operation GetCapabilities

The GetCapabilities operation is used to retrieve service metadata which describe the abilities and information holdings of the specific Map Rendering Service implementation.

The GetCapabilities operation request MUST follow the specification given in Section 7.1.2 of the WMTS Standard.

If an XML encoding is used for the request message it SHOULD be based on the XML schema specified in the file wmtsGetCapabilities_request.xsd. This schema MAY be extended following the requirements and guidance specified in the OGC Web Services Common Standard [OGC WSCommon 2.0, 2010]. If it is extended the XML artefacts specified in the file wmtsKVP.xsd SHOULD be used. These schemas – together with other official schemas – are part of the WMTS Standard. For details, e.g. where to obtain the schemas, refer to Annex B of the WMTS Standard.

With respect to bindings, a GetCapabilities request MUST follow the requirements specified in Section 4.2 of this SIP.



The response to a GetCapabilities request MUST be a service metadata document that complies with the specification provided in Section 7.1.1 of the WMTS Standard. For a Map Rendering Service it MUST be encoded as XML and MUST be valid with respect to the XML schema provided in Section 7.1.1.2 and Annex B of the WMTS Standard.

4.1.2 Operation GetTile

The GetTile operation is used to retrieve a *tile* resource which shows a fragment of the *map* representation of a *layer*.

The ${\tt GetTile}$ operation request MUST follow the specification given in Section 7.2.2 of the WMTS Standard.

If an XML encoding is used for the request message it SHOULD be based on the XML schema specified in the file wmtsGetTile_request.xsd. This schema MAY be extended following the requirements and guidance specified in the OGC Web Services Common Standard [OGC WSCommon 2.0, 2010]. For details, e.g. where to obtain the schemas, refer to Annex B of the WMTS Standard.

With respect to bindings, a GetTile request MUST follow the requirements specified in Section 4.2 of this SIP.

The response to a GetTile request MUST be a *tile* image that complies with the requested parameters and that fulfils the requirements as described in Section 7.2.1 of the WMTS Standard. The image MAY be returned as part of an SOAP/XML message or directly in the HTTP response. In the case of SOAP/XML the image and the response message SHOULD comply the requirements in Section 9.2.3 of the WMTS Standard. In the case of a direct HTTP response the *tile* resource representation SHALL be returned in the format specified in the request.

4.1.3 Operation GetFeatureInfo

The GetFeatureInfo operation is used to retrieve a FeatureInfo resource which provides information about the *geospatial features* located at a particular pixel of a *tile map*, similar to the WMS GetFeatureInfo operation.

The <code>GetFeatureInfo</code> operation request MUST follow the specification given in Section 7.3.2 of the WMTS Standard.

If an XML encoding is used for the request message it SHOULD be based on the XML schema specified in the file wmtsGetFeatureInfo_request.xsd. This schema MAY be extended following the requirements and guidance specified in the OGC Web Services Common Standard [OGC WSCommon 2.0, 2010]. For details, e.g. where to obtain the schemas, refer to Annex B of the WMTS Standard.

With respect to bindings, a GetFeatureInfo request MUST follow the requirements specified in Section 4.2 of this SIP.

The response to a GetFeatureInfo request MUST be FeatureInfo document as described in Section 7.3.1 of the WMTS Standard. For a Map Rendering Service it MAY be encoded as XML. If so it SHOULD be valid with respect to the XML schema provided in wmtsGetFeatureInfo request.xsd, as described Annex B of the WMTS Standard.

4.2 Bindings

The operations defined in the WMTS interface can be invoked in different ways, regarding their bindings to transport protocols and the corresponding ways how parameters are encoded.



A Map Rendering Service SHOULD specify relevant information about the operations of its WMTS interface, including operation names, operation invocation, bindings, and parameter encodings, in the OperationsMetadata section of the service metadata document (currently represented by the Capabilities XML element which is returned by the GetCapabilities operation), as specified in Section 7.4.6 of the Web Services Common Standard [OGC WSCommon 2.0, 2010].

Regarding operation invocation a Map Rendering Service extends and profiles the WMTS Standard in the following way. A Map Rendering Service

- SHOULD support service requests over the HTTP GET and POST methods using KVP parameter encoding. If supported the HTTP KVP bindings for HTTP GET and POST requests MUST comply with the specification given in Section 8 of the WMTS Standard.
- MAY support the HTTP POST/XML binding. If it supports this binding it is RECOMMENDED that the XML encodings for the parameters and requests are compliant to the corresponding XML schemas listed in Annex B of the WMTS Standard.
- MAY support SOAP bindings and offer its functionality via SOAP interfaces. If a Map Rendering Service offers its functionality via the SOAP protocol, it
 - MUST do so in compliance with the Messaging Service SIP [NCIA TR/2012/SPW008000/30, 2012] which defines general requirements that apply to all services in the NNEC environment that make use of SOAP.
 - MUST do so in compliance with Section 9 of the WMTS Standard.
- SHOULD NOT use a HTTP GET/XML binding, where the parameters are encoded as XML in the body of the HTTP GET request. The reason is that a payload within a HTTP GET request message has no defined semantics [IETF RFC 7231, 2014], and sending a payload body on a GET request might cause some existing implementations to reject the request [IETF RFC 7231, 2014].
- MAY implement HTTP RESTful interaction according to Section 10 of the WMTS Standard.

4.3 Tile Image Formats

Following the recommendations in Section 11.2 of the WMTS Standard, a server that offers a Map Rendering Service SHOULD at least offer the *tiles* in PNG format (Media type image/png), and JPG format (Media type image/jpeg).

4.4 Caching Strategies

The goal of providing a WMTS enabled service is to be performance oriented and scalable. WMTS aims to improve the response times of web service calls by using pre-rendered *tiles*. Since *tiles* are pre-rendered and not uniquely generated for each client request (like the *maps* returned by a WMS GetMap request), the same *tile* is very likely to be requested by many clients. This fact is the basis for establishing *tile* caches that reside anywhere between a WMTS server and its clients.

A (*tile*) cache is a local store of response messages and the subsystem that controls storage, retrieval, and deletion of messages in it. We separate between different types of caches, private and shared caches, based on their location: A shared cache is a cache that stores responses to be reused by more than one user; shared caches are usually (but not always) deployed as a part of an intermediary. A private cache, in contrast, is dedicated to a single user; often, they are deployed as a component of a user agent, i.e. the *map* client [IETF RFC 7234, 2014].



It is RECOMMENDED that both of these *tile* caching strategies, private and shared *tile* caching, are implemented: Clients as well as the intermediate network infrastructure should cache *tiles* when using a WMTS interface. Only then can a WTMS provide the performance gain compared to equivalent WMS calls.

For all caching strategies it is RECOMMENDED that the server that implements a Map Rendering Service assigns expiration times to the *tiles*, to indicate how long a version of a *tile* should be valid in a cache. The guidance provided in the RFC "Hypertext Transfer Protocol (HTTP/1.1): Caching" [IETF RFC 7234, 2014] MAY be used to implement caching for HTTP.



5 WEB SERVICES COMMON ASPECTS

The OGC Web Services Common Standard [OGC WSCommon 2.0, 2010] tries to complement and amend existing standards for OGC Web Services by specifying aspects that are common to many OGC Web Service interfaces such as WMS, WFS, and WMTS. It provides more details and clarification regarding common aspects of OGC web services, addressing aspects such as bindings, parameter encodings, etc.

It is RECOMMENDED that any implementation of a Map Rendering Service considers the WS Common Standard and takes the guidance into account unless explicitly stated differently by this SIP.

Note, that when using the term "WS Common Standard" this SIP refers to the OGC Web Services Common Standard Version 2.0 [OGC WSCommon 2.0, 2010].

5.1 Operation GetResourceByID

The Web Services Common Standard [OGC WSCommon 2.0, 2010] specifies the operation GetResourceByID that allows clients to retrieve one or more identified resources, including datasets and resources that describe datasets or parameters.

A Map Rendering Service MAY offer the GetResourceByID operation. If it offers such an GetResourceByID operation it MUST comply with Section 9.3 the Web Services Common Standard [OGC WSCommon 2.0, 2010].

5.2 Key-Value Pair (KVP) Encoding

Where a KVP encoding is used, it SHOULD comply with the specification provided in Section 11.5 of Web Services Common Standard [OGC WSCommon 2.0, 2010].

5.3 XML Encoding

The Web Services Common Standard [OGC WSCommon 2.0, 2010] does not mandate complete XML schemas for any OGC Web Service like WMS or WMTS, but rather provides a set of XML elements together with guidance and requirements on how to use these XML elements, and how to create a complete XML schema for the specification and validation of XML encoded requests.

Where an XML encoding is used, e.g. for parameters in a HTTP POST or SOAP request, it is RECOMMENDED that the encoding is in line with the specification and guidance provided in Section 11.6 of Web Services Common Standard [OGC WSCommon 2.0, 2010].

Note that

- the XML schemas listed in APPENDIX A take these guidance into account.
- the XML schemas of the WMTS Standard already base on the guidance and the schemas of the Web Services Common Standard.

5.4 Long URLs

It is RECOMMENDED to use HTTP POST (with either KVP or XML encoding) for calling operations of a Map Rendering Service where (due to too many parameters) the entire query string becomes too long to be executed as an HTTP GET/KVP request.



6 **REFERENCES**

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7 ABBREVIATIONS

For definitions of the abbreviations see Section 1.5.

BBOX	Bounding Box
CES	Core Enterprise Services
CRS	Coordinate Reference System
EPSG	European Petroleum Survey Group
FAS	Functional Area System
FS	Functional Service
GIS	Geographic Information System
нттр	Hypertext Transfer Protocol
IETF	Internet Engineering Task Force
MIME	Multipurpose Internet Mail Extensions
OGC	Open Geospatial Consortium
OWS	OGC Web Service, or Open Web Service
REST	Representational State Transfer
RFC	Request for Comments
SE	Symbology Encoding
SIP	Service Interface Profile
SLD	Styled Layer Descriptor
SOAP	Simple object access protocol
URI	Unified resource identifier
WGS	World Geodetic System
WMS	Web Map Service
WMTS	Web Map Tile Service
XML	Extensible Mark-up Language
XSD	XML schema definition





APPENDIX A—XML SCHEMAS FOR WMS REQUESTS (NORMATIVE)

The XML schemas specified in this section are normative.

For all schemas, the values of the schemaLocation attributes of the import element MAY be changed accordingly to a local reference or a URL reference to the file.

A.1 XML Schema for WMS GetCapabilities Requests

The imported XML schemas are online available on the OGC website under http://schemas.opengis.net/ows/2.0/

<pre><schema <="" pre="" xmlns="http://www.w3.org/2001/XMLSchema" xmlns:ows="http://www.opengis.net/ows/2.0"></schema></pre>
xmlns:nyms="nato:ncia:geo:wms" targetNamespace=" nato:ncia:geo:wms">
<annotation></annotation>
<appinfo>wmsGetCapabilities_request</appinfo>
< documentation>
This XML Schema Document defines the XML encoding of a WMS GetCapabilities request
Requirements are based on the WMS Standard 1.3.0 however, the schema design also takes
guidance from the WS common Standard into account. Since the WMS 1.3.0 Standard does not
specify this schema, it is specified that NCI Agency under the nato namesnace
<pre>cimpot informations</pre>
schemal ocation="http://www.opengis.net/ows/2.0/owsAll vsd"/>
<pre>celement name_/SetCanaphilities"></pre>
WMS CotCanabilities aparties request
complex contents
<pre>cextension base= www.Getcapabilities Type * cextension base= www.Getcapabilities * cextension base= wwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwwww</pre>
calificate name - service type use required fixed - who >
Mandatory accounter relacting the convice type
for which the operation has to be to be involved
dependent in operation has to be invoked.
<attribute name="version" type="" use="optional"></attribute>
<pre><aniotation> <documentation> Optional varian parameter as defined in Section 6.2 of the WMS 1.2.0 standard</documentation></aniotation></pre>
descent descent descent as defined in Section 6.2 of the Wivis 1.3.0 standard.
<attribute name="format" type="" use="optional"></attribute>
canobalicons-documentations
The optional format parameter states the desired format of the service metadata,
as defined in Section 7.2.3.1 of the OGC WINS 1.3.0 standard.



A.2 XML Base Type Schema for WMS Requests

The following XML schema specifies the base type from which the encoding schemas for all WMS operations except for GetCapabilities are derived. The schemas follow the OGC Web Services Common Standard [OGC WSCommon 2.0, 2010] and extend the type RequestBaseType that is defined in Section 9.2.3 of [OGC WSCommon 2.0, 2010].

This schemas is imported and extended by the other schemas that are specified in the remaining subsections of this appendix.

<schema <="" th="" xmlns="http://www.w3.org/2001/XMLSchema" xmlns:nwmsb="nato:ncia:geo:wms:base"></schema>
targetNamespace="nato:ncia:geo:wms:base">
<complextype name="RequestBaseType"></complextype>
<annotation> <documentation></documentation></annotation>
XML encoded operation request base, for all operations except Get Capabilities.
In this XML encoding, no "request" parameter is included, since the final element
name will specify the specific operation.
<attribute fixed="WMS" name="service" type="string" use="required"></attribute>
<annotation> <documentation></documentation></annotation>
Service type identifier, where the string
value is the OWS type abbreviation, such as "WMS" or "WFS".
<attribute fixed="1.3.0" name="version" type="string" use="required"></attribute>
<annotation> <documentation></documentation></annotation>
Specification version for OWS version and operation.
<simpletype name="WMSExceptionsType"></simpletype>
<restriction base="string"></restriction>
<pre><enumeration value="XML"></enumeration></pre>
<pre><enumeration value="INIMAGE"></enumeration></pre>
<enumeration value="BLANK"></enumeration>
sattribute name. "Accord anguages" tune. "atting"

List of language lags (NFC 4040 language cours of β of the human-readable text (e.e. "en-CA en-US en fr")
decumentation
Nonoma



A.3 XML Schema for WMS GetMap Requests

This schema is normative. It imports and extends the schema specified in Appendix A.2.

<schema <br="" xmlns="http://www.w3.org/2001/XMLSchema" xmlns:ows="http://www.opengis.net/ows/2.0">xmlns:wms="http://www.opengis.net/wms" xmlns:nwmsb="nato:ncia:geo:wms:base" xmlns:nwms="nato:ncia:geo:wms" targetNamespace="nato:ncia:geo:wms"> <import namespace="nato:ncia:geo:wms" targetnamespace="nato:ncia:geo:wms"> <import namespace="nato:ncia:geo:wms" targetnamespace="nato:ncia:geo:wms"> <import <br="" namespace="nato:ncia:geo:wms"><import <br="" namespace="http://www.opengis.net/ows/2.0">schemaLocation="http://schemas.opengis.net/ows/2.0/owsAll.xsd"/> <import <br="" namespace="nato:ncia:geo:wms">schemaLocation="http://schemas.opengis.net/wms" <schemalocation="http: schemas.opengis.net="" wms"<br=""><import namespace="nato:ncia:geo:wms:base" schemalocation="owsRequestBaseType_for_WMS.xsd"></import> <element name="GetMap"></element></schemalocation="http:></import></import></import></import></import></schema>
<complextype></complextype>
<annotation></annotation>
<pre><gocumentation> This XML Schema Decument defines the XML encoding of a</gocumentation></pre>
WMS GetMan request Requiremens are based on the
WMS Standard 1.3.0 however the schema design also takes
guidance from the WS Common Standard into account. Since
the WMS 1.3.0 Standard does not specify this schema, it is
specified by NCI Agency under the nato namespace.
<complexcontent></complexcontent>
<extension base="nwmsb:RequestBaseType"></extension>
<pre><element maxoccurs="1" minoccurs="1" name="Layers" type="string"></element> <element maxoccurs="1" minoccurs="1" name="Styles" type="string"></element></pre>
<pre><element maxoccurs="1" minoccurs="1" name="Crs" type="string"></element></pre>
<pre><element minoccurs="1" name="Bbox" type="string"></element></pre>
<element minoccurs="1" name="Width" type="nonNegativeInteger"></element>
<pre><element minoccurs="1" name="Height" type="nonNegativeInteger"></element></pre>
<element minoccurs="1" name="Format" type="ows:MimeType"></element>
<element maxoccurs="1" minoccurs="0" name="Transparent" type="boolean"></element>
<element maxoccurs="1" minoccurs="0" name="Bgcolor" type="string"></element>
<pre><element <="" minoccurs="0" name="Exceptions" pre="" type="nwmsb:WMSExceptionsType"></element></pre>
maxOccurs="1"/>
<element maxoccurs="1" minoccurs="0" name="I ime" type="string"></element>
<pre><element 1="" name="Elevation_type=" string_minoccurs="0_maxOccurs="></element> <element mexoccurs='1"/' minoccurs="0" ref_"ume:dimension"=""></element></pre>



A.4 XML Schema for WMS GetFeatureInfo Requests

This schema is normative. It imports and extends the schema specified in Appendix A.2.

<pre><schema <="" pre="" xmlns="http://www.w3.org/2001/XMLSchema" xmlns:nwms="nato:ncia:geo:wms" xmlns:nwmsb="nato:ncia:geo:wms:base" xmlns:ows="http://www.opengis.net/ows/2.0"></schema></pre>
targetNamespace="nato:ncia:geo:wms">
<import <="" namespace="http://www.opengis.net/ows/2.0" td=""></import>
schemaLocation="http://schemas.opengis.net/ows/2.0/owsAll.xsd"/>
<pre><import namespace="nato:ncia:geo:wms:base" schemalocation="owsReguestBaseType for WMS.xsd"></import></pre>
<pre><element name="GetFeatureInfo"></element></pre>
<complextype></complextype>
<pre><annotation></annotation></pre>
<documentation></documentation>
This XML Schema Document defines the XML encoding of a
WMS GetFeatureInfo request. Requiremens are based on the
WMS Standard 1.3.0, however, the schema design also takes
guidance from the WS Common Standard into account. Since
the WMS 1.3.0 Standard does not specify this schema, it is
specified by NCI Agency under the nato namespace.
<complexcontent></complexcontent>
<pre><extension base="nwmsb:RequestBaseType"></extension></pre>
<all></all>
<element maxoccurs="1" minoccurs="1" name="MapRequestParts"></element>
<complextype mixed="true"></complextype>
<sequence></sequence>
<any <="" minoccurs="0" namespace="##any" processcontents="lax" td=""></any>
maxOccurs="unbounded"/>
<element maxoccurs="1" minoccurs="1" name="QueryLayers" type="string"></element>
<element <="" minoccurs="1" name="InfoFormat" td="" type="ows:MimeType"></element>
maxOccurs="1"/>
<element maxoccurs="1" minoccurs="0" name="FeatureCount" type="integer"></element>
<element maxoccurs="1" minoccurs="1" name="l" type="nonNegativeInteger"></element>
<element maxoccurs="1" minoccurs="1" name="J" type="nonNegativeInteger"></element>
<pre><element <="" name="Exceptions" pre="" type="nwmsb:WMSExceptionsType"></element></pre>
minOccurs="0" maxOccurs="1"/>



APPENDIX B- EXAMPLES OF MAP IMAGES (INFORMATIVE)

This section contains examples of *maps* that have been retrieved via WMS and WMTS interfaces. The examples presented here are only informative, with the intension to describe and visualize the differences between WMS and WMTS using real data.

B.1 Map Images Retrieved via WMS

Figure 1 shows a *map* that was retrieved via a WMS service interface. It covers the area in Papua New Guinea between the two geographic coordinates 145.551° N, 8.222° W and 155.551° N, 2.721° W, spanning the geographic extent of 10° in west-east direction, and 5.5° in north-south direction. The image is a raster image in JPG format and has originally a size of 1024x512 pixels.



Figure 1 A JPG image as the result of a WMS request

B.2 Map Images Retrieved via WMTS

The same geographic extent that is shown in Figure 1 can be covered with *tiles* from different *tile matrices* in different scale levels using a WMTS service. Figure 2 and Figure 3 show *maps* that have been requested as *tiles* from a WMTS service. The *map tiles* are part of different *tile matrices*, providing different levels of detail. Each *tile* is in JPG format and has the size of 256 x 256 pixels.



Figure 2 Map images retrieved as WMTS *tiles* (matrix *tile* id 5) covering the geographic extent (red rectangle) as specified by the corresponding WMS *map* shown in Figure 1







Figure 3 Map images retrieved as WMTS *tiles* (matrix *tile* id 6) covering the geographic extent (red rectangle) as specified by the corresponding WMS *map* shown in Figure 1

When using WMTS, in order to obtain an image that is identical to an image retrieved via WMS, e.g. an image as shown in Figure 1, a client at first has to make consecutive requests to retrieve the corresponding *map tiles* in the appropriate level of detail (i.e. from the appropriate *tile matrix* and *tile matrix set*), Then the client constructs the final map by combining the appropriate parts from the relevant *tiles*.



APPENDIX C- ORIGINAL BINDING AND PARAMETER ENCODING REQUIREMENTS FOR WMS AND WMTS (INFORMATIVE)

This section is informative only. All normative requirements regarding the binding and parameter encoding for a Map Rendering Service are listed in the main body of this SIP.

In order to clearly and quickly identify the derivations and amendments between the binding requirements in this SIP and the original OGC WMS Standard [OGC WMS 1.3, 2006] we summarize the original requirements defined in the standard in the following.

C.1 WMS

The WMS Standard [OGC WMS 1.3, 2006] defines the implementation of a WMS only for platforms that support HTTP. Other platforms are not addressed in the WMS Standard.

On HTTP platforms each WMS operation is represented as an HTTP URL following IETF RFC2616 [IETF RFC 2616, 1999]. The WMS Standard [OGC WMS 1.3, 2006] does not specify further bindings, such as a SOAP binding.

For platforms that support HTTP, the WMS Standard specifies that a WMS shall support the HTTP GET method as a mandatory way of transmitting a request to the server, and receiving a response. Optionally, the HTTP POST method may be used to submit requests. Both methods differ in the way how parameters are encoded, and how the entire HTTP URL is formed.

When using the HTTP GET method, the WMS Standard specifies that parameters to a WMS operation shall be encoded in the query part of the HTTP URL in form of Key/Value pairs (KVP) as defined in the WMS Standard (Section 6.3.3). The WMS Standard makes no further statement about using an XML encoding in combination with the GET method.

When using the HTTP POST method, the WMS Standard (Section 6.3.4) specifies that parameters to a WMS operation are transmitted in the HTTP message body, formulated as XML. While the WMS Standard does not provide any further details on the XML structure, the Web Services Common Standard refines this requirement by providing guidance and requirements about how to define an XML schema, together with some XML artifacts that can be used and imported. However, a complete schema that specifies how parameters are encoded as XML is not defined in the Web Services Common Standard either.

According to the WMS Standard the response to both HTTP methods shall eventually (modulo HTTP redirects) be either an exception, or depending on the WMS operation

- in the case of a GetCapabilities operation a XML document that follows the XML schemas as defined in the WMS Standard.
- in the case of a GetMap operation a map of the spatially referenced information layer requested, in the desired style and with the specified properties and document media type (MIME).
- in the case of a GetFeatureInfo operation a response according to the requested format.