



DGIWG 908

DGIWG PORTRAYAL ROADMAP

Document type:	Enterprise
Document date:	26 July 2019
Edition:	3.0.0
Responsible Party:	Defence Geospatial Information Working Group
Audience:	This document is approved for public release and is available on the DGIWG website, http://www.dgiwg.org/dgiwg/
Abstract:	<p>The activities defined in this document are intended to serve as a guide to facilitate program/project management undertaken by the DGIWG in response to future state needs. The document places special emphasis on portrayal activities that promote interoperability of geospatial data, products and services.</p> <p>The document is reviewed annually and is subject to change without notice.</p>
Copyright:	© Copyright DGIWG. Licensed under the terms in CC BY 4.0.

Table of Contents

1.	Scope	1
2.	Purpose	1
3.	Reference documents	1
3.1.	Open Geospatial Consortium (OGC)	1
3.2.	Defence Geospatial Information Working Group (DGIWG)	2
3.3.	North Atlantic Treaty Organization (NATO)	2
3.4.	International Organization for Standardization (ISO)	2
3.5.	World Wide Web Consortium (W3C)	2
3.6.	International Hydrographic Organization (IHO)	2
3.7.	International Civil Aviation Organization (ICAO)	3
4.	Terms and Definitions	3
5.	Geospatial Information – present state	5
5.1.	Geospatial Content	5
5.1.1	Data Models	5
5.1.2	Symbol Sets and Portrayal Rules	6
5.1.3	Static Portrayal Products.....	6
5.1.4	Dynamic Portrayal Procedures	6
5.2.	Geospatial Services	6
5.3.	Standards Assessment	7
5.3.1	Civil Standards	7
5.3.2	Defence Standards	13
6.	Technology Considerations.....	19
6.1.	Existing.....	19
6.1.1	Hardcopy Data Products	19
6.1.2	Computing and Display Environment.....	19
6.1.3	Web Services for Geospatial Display.....	20
6.1.4	Proliferation of Open Source Data	20
6.1.5	Disconnected / Intermittent / Limited Bandwidth (DIL) Users	20
6.2.	Emerging	20
6.2.1	Bundling Data and Delivery Containers, GeoPackage and OGC Web Service Context.....	20
6.2.2	Vector Tiling	21
6.2.3	Geospatial Analytics.....	21
6.2.4	Plug and Play, Code Reuse and Modular Design	21
6.2.5	Chained Services	21
6.2.6	3D Portrayal	21
6.2.7	Semantics, Ontologies and Linked Data.....	22
6.2.8	Cloud Computing	22
7.	Geospatial Information - Future State.....	23
7.1.	Target Objectives	23
7.1.1	Symbology for Common Operational Picture	23
7.1.2	Dynamic Vector Portrayal	24
7.1.3	Common Portrayal Content	25
7.1.4	Portrayal Register and DGIWG Registry	26
7.1.5	Feature Portrayal Service	28
7.1.6	3D Portrayal	28
7.1.7	Tailored Portrayal.....	28
7.2.	Geospatial Content	29
7.2.1	Vector Datasets.....	29
7.2.2	Symbol Sets and Portrayal Rules	30
7.2.3	Hardcopy and Raster Portrayal Products	30
7.2.4	Vector Portrayal Procedures.....	30

7.3.	Geospatial Services	30
7.4.	Standardisation Initiatives	31
7.4.1	Civil Standards	31
7.4.2	Defence Standards	32
8.	Program Plan	33
8.1.	Portrayal Technical Panel (P4)	33
8.2.	Current Projects	33
8.2.1.	P4.01: Symbology for Web Service Environment	33
8.2.2.	P1.03: City Map Hardcopy DPS.....	34
8.2.3.	P1.05: DJOG(A) DPS.....	34
8.2.4.	P4.05: Portrayal Repository/Database.....	34
8.3.	Envisioned Projects.....	34
8.3.1.	P4.03: DGIWG Implementation Guide for General Symbology Encoding.....	34
8.3.2.	Portrayal Register	35
8.3.3.	Dynamic Portrayal Specification	36
9.	Dependencies	37
	Annex A – Acronyms and Abbreviations.....	38
	Annex B - Summary of activities	42

List of Figures

Figure 1	Joint Military Symbology Document Structure	16
Figure 2	Dynamic Vector-Based Map Portrayal	24
Figure 3	Feature Portrayal Service	28

Introduction

The Portrayal Roadmap facilitates current and future planning of the DGIWG Portrayal Technical Panel (PTP) activities. DGIWG requires a roadmap that looks four years into the future from the 2019 approved roadmap completion (2019-2023) for current standards and six years into the future to track industry research and development of emerging standards.

This roadmap provides DGIWG Management with a strategy to manage portrayal symbology, encoding and labelling definitions that synchronise efforts with all DGIWG Technical Panels and Data Product Specifications (DPS) development. DGIWG, its Member Organisations and Associates, prioritises requirements to ensure interoperability milestones are achieved. The DGIWG Plenary will review and approve the initial Portrayal Roadmap followed by annual reviews by the PTP project team. Annual Portrayal Roadmap updates shall be submitted to the Plenary for assessment and approval.

i. Contributing participants

Nation	Parent organisation
Czech Republic	Military Geographic and Hydrometeorologic Office (MGHMO)
France	Institut national de l'information géographique et forestière (IGN) Institut Geographique National (IGN)
United Kingdom	MoD - JFC C4ISR JtUser
United States	National Geospatial-Intelligence Agency (NGA) US Army Geospatial Center (AGC)

ii. Document points of contact

All questions regarding this document shall be directed to the secretariat@dgiwg.org

iii. Revision history

Date	Edition number	Primary clauses Modified	Description
2018	3.0 (draft)	All	Creation (on basis of previous Portrayal roadmap version 2.0 02 Aug 2010) using a new template

1. Scope

DGIWG is the Multi-National body responsible to Member Nation Defence Organisations for coordinating, advising and providing Policy recommendations on Geospatial Standardisation issues. The Portrayal Roadmap serves as a strategy and planning tool for DGIWG, its Member Organisations and Associates. It provides a baseline for standardisation advancements and identifies deficiencies in portrayal. This document describes the present state of geospatial interoperability across the Civil and Defence user communities. It establishes the future state goals and objectives upon which associated standardisation activities are based. Key factors used for this roadmap include: user requirements, relevant standards (published or in work) and emerging technologies.

2. Purpose

The Portrayal Roadmap is a planning tool for DGIWG. The guidance within the document highlights portrayal efforts to support software and capability development and advances interoperability within the civil and defence user communities.

The DGIWG portrayal work focuses on symbology, labelling definition and ruleset creation together with their maintenance, encoding and distribution. The PTP supports geospatial production, data product specifications development and web services implementation.

3. Reference documents

3.1. Open Geospatial Consortium (OGC)

- OGC 06-042 OpenGIS Web Map Service (WMS) Implementation Specification, Version 1.3, 15 March 2006,
http://portal.opengeospatial.org/files/?artifact_id=14416
- OGC 07-057r7, Web Map Tile Service Implementation Standard, v1.0.0, 2010-04-06,
http://portal.opengeospatial.org/files/?artifact_id=35326
- OGC 09-025r2, Web Feature Service, 2.0, 6 December 2010 (in DISR as ISO 19142:2010),
<http://docs.opengeospatial.org/is/09-025r2/09-025r2.html>
- OGC 09-110r4, Web Coverage Service (WCS) 2.0 Interface Standard- Core (incorporating Corrigendum), Version 2.0.1, 2012-07-12,
<https://portal.opengeospatial.org/files/09-110r4>
- OGC 12-168r6, Catalogue Services 3.0,
<http://docs.opengeospatial.org/is/12-168r6/12-168r6.html>
- OGC 12-128r15, OGC Geopackage Encoding Standard 1.2.1, 2018-09-06,
<https://portal.opengeospatial.org/files/12-128r15>
- OGC 07-036r1, OpenGIS® Geography Markup Language (GML) Encoding Standard 3.2.2, 2016-12-05,
https://portal.opengeospatial.org/files/?artifact_id=74183&version=2
- OGC 05-078r4, OGC OpenGIS Styled Layer Descriptor Profile of the Web Map Service Implementation Specification,
http://portal.opengeospatial.org/files/?artifact_id=22364

- OGC 05-077r4, OGC Symbology Encoding Specification, http://portal.opengeospatial.org/files/?artifact_id=16700
- OGC 12-007r2, KML 2.3 <http://docs.opengeospatial.org/is/12-007r2/12-007r2.html>
- OGC 15-001r4, 3D Portrayal Service 1.013 Sep 2017, <http://docs.opengeospatial.org/is/15-001r4/15-001r4.html>

3.2. Defence Geospatial Information Working Group (DGIWG)

- DGIWG 112: DGIWG Web Map Service (WMS) 1.3 Profile – Revision, 2017-11-28, https://portal.dgiwg.org/files/?artifact_id=68226&format=pdf
- DGIWG 122: DGIWG Web Feature Service (WFS) 2.0 Profile, 2017-11-28, https://portal.dgiwg.org/files/?artifact_id=68228&format=pdf
- DGIWG 119: DGIWG Web Coverage Service (WCS) 2.0 Profile, 2017-11-28, https://portal.dgiwg.org/files/?artifact_id=68227&format=pdf
- DGIWG 125: DGIWG Catalogue Service for the Web 2.0 Profile, 2018-03-01, https://portal.dgiwg.org/files/?artifact_id=68270&format=pdf
- DGIWG 118: DGIWG Portrayal Registry Service Interface Specification
- DGIWG 904: Defence Geospatial Standards Baseline (DGSB)

3.3. North Atlantic Treaty Organization (NATO)

- STANAG 3675 Ed 2 Symbols on land maps, aeronautical and special naval charts
- STANAG 3676 Ed 3 Marginal information on land maps, aeronautical charts and photomaps
- STANAG 3833 Ed 4 Symbols for use on maps of training areas for land forces
- STANAG 7170 Ed 3 Additional Military Layers (AML)
- STANAG 2019 Ed 7 (RD) NATO Joint Military Symbology – APP-6D, FD
- STANAG 2592 Ed 2 NATO Geospatial Information Framework (NGIF)

3.4. International Organization for Standardization (ISO)

- ISO 19117: 2012, Geographic Information – Portrayal

3.5. World Wide Web Consortium (W3C)

- Scalable Vector Graphics (SVG) 1.1 (Second Edition) <http://www.w3.org/TR/SVG11/>
- Cascading Style Sheets (CSS) Basic User Interface Module Level 3 (CSS3 UI), W3C Proposed Recommendation, 14 December 2017 <https://www.w3.org/TR/2017/PR-css-ui-3-20171214/>

3.6. International Hydrographic Organization (IHO)

- IHO Publication S-52, Specifications for Chart Content and Display Aspects of ECDIS, Ed. 6.1(.1) - October 2014 - With Clarifications up to June 2015,

https://www.iho.int/iho_pubs/standard/S-52/S-52%20Edition%206.1.1%20-%20June%202015.pdf

- IHO Publication S-100, IHO Universal Hydrographic Data Model (April 2017), https://www.iho.int/iho_pubs/standard/S-100/S-100_Ed_3/S-100_Edition_3.0.0.pdf
- IHO Geospatial Registry, <http://registry.iho.int/>

3.7. International Civil Aviation Organization (ICAO)

- ICAO Doc 8126 Aeronautical Information Services Manual

4. Terms and Definitions

- **Annotation**

any marking on illustrative material for the purpose of clarification

[SOURCE: ISO 19117:2012]

- **Data**

facts and statistics collected together for reference or analysis

[Oxford English Dictionary]

- **Data Product Specification**

detailed description of a dataset or dataset series together with additional information that will enable it to be created, supplied to and used by another party

[SOURCE: ISO 19131:2007]

- **Dynamic Vector Portrayal**

digital representation of geospatial features rendered directly from vector data, with symbols, line weights and area patterns that change to appropriate size, density and geometry for different scales according to (pre-) defined rules

- **Globe**

a three-dimensional scale model of Earth (terrestrial globe or geographical globe) or other celestial body such as a planet or moon

[SOURCE: OGC Glossary of Terms]

- **Map**

a two-dimensional visual portrayal of geospatial data.

[SOURCE: OGC Glossary of Terms]

NOTE: A map is not the data itself.

- **Portrayal**

presentation of information to humans

[SOURCE: ISO 19117: 2012]

NOTE: The use of the term portrayal is restricted to the portrayal of geographic information.

- **Portrayal Service**

generic interface used to portray features

[SOURCE: ISO 19117: 2012]

- **Data Product**

a dataset or dataset series that conforms to a product specification.

[SOURCE: derived from ISO 19131: 2007]

- **Raster**

the representation of spatial data as a matrix of valued cells

[OGC Glossary of Terms]

- **Digital Raster Map**

a map or globe product in raster format conformant with a Data Product Specification suitable for digital or hard copy use.

- **Register**

set of files containing identifiers assigned to items with descriptions of the associated items

[SOURCE: ISO 19135-1:2015]

NOTE: A register in its simplest form can be a list.

- **Registry**

information system on which a register is maintained

[SOURCE: ISO 19135-1:2015].

- **Style**

the mapping from feature types and feature properties and constraints to parameterised symbols used in drawing maps

[SOURCE: OGC Glossary of Terms]

- **Symbol Portrayal**

primitive that can be graphic, audible, or tactile in nature, or a combination of these

[SOURCE: ISO 19117:2012]

- **Symbology**

methodology for describing symbols and mapping of the schema to an application schema

[SOURCE: OGC Glossary of Terms]

NOTE: Portrayal requires symbology

- **Vector**

a representation of the spatial extent of geographic features using geometric elements (such as point, curve and surface) in a coordinate space

[SOURCE: OGC Glossary of Terms]

5. Geospatial Information – present state

In the past, the DGIWG developed standards addressing the production, cartographic finishing and printing/rasterising of hardcopy maps. Hardcopy and digital raster map production is mature with common practices to provide common static raster map backgrounds.

However, the DGIWG does not have a common mechanism to portray their maps on a Common Operational Picture (COP) display. The primary reason is a lack of a standard specification for dynamic vector-based maps that include symbology, registries and rendering rules. Additionally, numerous proprietary commercial map display capabilities are in use by DGIWG Nations that yield differences in symbols, formats and services. These differences exacerbate the problem, leading to inconsistent portrayal solutions.

Standards for portrayal of dynamic vector-based maps are less mature primarily because of the technical complexity of the subject. The community relies on commercial vendors with unique and often proprietary map display solutions that are not easily translatable across nations or beyond vendor-specific applications. Recent technology improvements support rendering and display of dynamic vector-based maps in an acceptable amount of time and with suitable visual quality. The lack of regional/global coverage of topographic vector data in a consistent data schema at tactically significant scales (urban, 1:50,000 and 1:100,000 scales) compounds the symbolisation interoperability problem.

5.1. Geospatial Content

The main task for the Portrayal Panel is to develop symbol sets for vector data that provide clear and unambiguous information to the map user. Therefore, collaboration between the Vector Model and Schema Team (VMST) and the PTP is essential as the VMST defines the geospatial concepts required by military users.

Portrayal consists of the symbol sets and portrayal rules describing how geospatial features contained in the vector datasets are displayed.

Portrayal of geospatial content requires standardisation and governance. This standardisation must address both international standards which define interfaces, exchanges and general structure as well as Community of Interest (COI) specifications and profiles which apply the general standards within the community for the data, symbols, rules and products under its governance.

5.1.1 Data Models

The VMST provides governance of vector data models for DGIWG. Several formats and schemas such as Defence Geospatial Information Framework (DGIF) and Multinational Geospatial Co-Production Program (MGCP) are recognised and/or managed by DGIWG. Additionally, national formats and schemas as well as commercial/open source datasets are used when required or when they are the best available source. The capability to translate data between schemas and apply common symbology and portrayal rules to different datasets is not uniformly implemented. Data is often created and maintained by geospatial organisations at the national or unit level or by individual commercial entities for internal use.

5.1.2 Symbol Sets and Portrayal Rules

Portrayal of any vector dataset is performed based on associated symbology and portrayal rules. These symbol sets and portrayal rules are currently only published for hardcopy products and associated raster representation. To portray vector data, individual organisations and vendors create and maintain unique symbol sets and rules that often have minor variations and system-specific constraints that prevent sharing across vendors or organisations. Given the diversity of vector datasets and lack of common symbols and rules, consistent portrayal is challenging to achieve between different systems and organisations. Often the resulting portrayal is not sharable across the community but only within a very limited set of users.

5.1.3 Static Portrayal Products

Static portrayal products include hardcopy and associated raster representation. These map products are generated in accordance with documented data product specifications (DPS). DGIWG and other organisations adopt consistent symbology and portrayal rules for hardcopy and associated raster representation such as the Topographic Maps (TM) and Joint Operations Graphics (JOG). Minor variations exist as DPS for similar products are established by collaborating organisations (e.g. MGCP).

5.1.4 Dynamic Portrayal Procedures

Specifications for static portrayal products do not exist for the dynamic vector rendering required to support web services and handheld devices. Dynamic portrayal procedures are required to access vector data and apply symbology, portrayal rules and rendering logic. As many of the component parts are subject to change as content evolves, a more agile and responsive specification and governance process is required. The growing availability of web services and handheld devices requires standardisation of dynamic portrayal across civil and military user communities.

5.2. Geospatial Services

Direct users of portrayal capabilities are map producers, web service creators and application developers. The portrayal rules and symbols are used to create products and services, harmonise symbology and create applications that support the war-fighter. Common OGC web services are used to provide raster representation of static products and dynamic map products. These services include; WMS, WFS and Web Map Tile Service (WMTS). DGIWG portrayal will comply with these standards and DGIWG profiles and additionally, will utilise OGC portrayal standards such as Symbology Encoding (SE) and Styled Layer Descriptor (SLD) Profile of WMS or other adopted formats and encodings.

These services, particularly WMS, are widely used in industry and within member nations, primarily to share and portray geospatial content. Use of OGC web services to display vector data requires use of SE and SLD which presents interoperability challenges from the lack of consistent and shared symbol sets and portrayal rules.

Future portrayal web service and registry capabilities will utilise the OGC Catalogue Service for the Web (CSW) and registry models such as ebXML Registry Information Model (ebRIM) that will be web-enabled using OGC Web Processing Services (WPS). These models and service capabilities show great promise, although the work is conceptual with limited operational implementations.

Within DGIWG, the Web Service Technical Panel (WSTP) is responsible for the development of DGIWG WMS, WMTS and WFS implementation profiles. The PTP provides the symbol set and labelling rules that are used in the WSTP profiled web services. A detailed discussion of geospatial service standards and DGIWG implementation profiles is provided in the WSTP Roadmap.

5.3. Standards Assessment

5.3.1 Civil Standards

5.3.1.1 Civil Geospatial Standards Development Organisations

Several international standards organisations provide key standards addressing portrayal to include standards for data, formats, services and graphics. Key organisations and their portrayal related standards are included here. This is not an exhaustive list of standards or organisations. Primary organisations are listed below:

- **Open Geospatial Consortium**

The Open Geospatial Consortium (OGC) is an international industry-oriented consortium of more than 300 companies, government agencies, research organisations and universities participating in a consensus process to develop publicly available interface specifications.

OGC's portrayal activities mainly involve the development of portrayal data exchange formats and service specifications for Web rendering of distributed feature and coverage data. Some basic management aspects of portrayal catalogues are also being considered, but with no emphasis on the organisational and versioning management processes of registration. These activities currently take place in the OGC innovation initiative such as testbeds, plug-fests and interoperability experiments in the Defence and Intelligence (D&I) and Portrayal Domain Working Groups and in various standards working groups (SWGs) dealing with the development and revision of OGC standards.

- **International Standards Organization Technical Committee 211**

The International Standards Organization Technical Committee 211 (ISO/TC 211) is a committee established under the International Organisation for Standardization (ISO) to develop international standards for geospatial information. Several of these standards are of special interest in the portrayal of geographical information.

- **International Hydrographic Organization**

The International Hydrographic Organization (IHO) ensures that all the world's seas, oceans and navigable waters are surveyed and charted. The mission of the IHO is to create a global environment in which States provide adequate and timely hydrographic data, products and services and ensure their widest possible use. The vision of the IHO is to be the authoritative worldwide hydrographic body which actively engages all coastal and interested States to advance maritime safety and efficiency and which supports the protection and sustainable use of the marine environment. Digital Information Portrayal Working Group (DIPWG) is the IHO technical body, responsible for IHO specifications for colours, symbols and display rules.

- **International Civil Aviation Organization**

The International Civil Aviation Organization (ICAO) is a UN specialised agency, established in 1944 to manage the administration and governance of the Convention on International Civil Aviation (Chicago Convention). ICAO works with the Convention's 192 Member States and industry groups to reach consensus on international civil aviation Standards and Recommended Practices (SARPs) and policies in support of a safe, efficient, secure, economically sustainable and environmentally responsible civil aviation sector. These SARPs and policies are used by ICAO Member States to ensure that their local civil aviation operations and regulations conform to global norms, which in turn permits more than 100,000 daily flights in aviation's global network to operate safely and reliably in every region of the world.

- **World Wide Web Consortium**

The World Wide Web Consortium (W3C) is an international community where Member organisations, a full-time staff and the public work together to develop Web standards. Led by Web inventor and Director Tim Berners-Lee and CEO Jeffrey Jaffe, W3C's mission is to lead the Web to its full potential. W3C standards define an Open Web Platform for application development that has the unprecedented potential to enable developers to build rich interactive experiences, powered by vast data stores that are available on any device. Although the boundaries of the platform continue to evolve, industry leaders speak almost in unison about how Hypertext Markup Language 5 (HTML5) will be the cornerstone for this platform. The full strength of the platform relies on many more technologies that W3C and its partners are creating, including Cascading Style Sheets (CSS), Scalable Vector Graphics (SVG), the Semantic Web stack, eXtensible Markup Language (XML) and a variety of Application Programming Interfaces (APIs). Contact W3C for more information.

5.3.1.2 Civil Geospatial Content Standards

- **ISO 19117, Geographic Information – Portrayal**

This standard is part of the 191xx series of standards that are being promulgated by ISO/TC 211. This international standard is an abstract document and is not intended for direct implementation. It gives general guidelines to the application developers about the mechanism that will be used to portray feature instances of a dataset. The portrayal mechanism described in ISO 19117 separates the geospatial data from the portrayal of the data. This makes it possible to portray the same data in different ways depending on the needs of the user community. Portrayal rules establish a relationship between a geospatial feature and a particular symbol. Portrayal rule sets are collections of portrayal rules that in aggregate define a portrayal for each possible feature type defined in the application schema of a geospatial data set. Different portrayal rule sets can be used to create different portrayals of the same data set. This International Standard includes a mechanism for declaring portrayal attributes as part of the portrayal specification. The standard defines the concepts of portrayal specifications, portrayal catalogues and how they relate to geospatial datasets.

The second edition of ISO 19117 was published in 2012. A revision of ISO 19117:2012 is currently underway to improve the structure and content of this standard. The rules that define relationships of symbols to other symbols are not defined in ISO 19117.

These product finishing rules (de-confliction, displacement, thinning, etc.) could be the subject of future work in TC 211 or DGIWG.

5.3.1.3 Civil Geospatial Service Standards

In DGIWG, the Web Services Technical Panel (WSTP) is the primary organisation managing civil and defence geospatial services standards. See the WSTP Roadmap for detailed information of services available.

- **OGC Web Map Service**

The OGC Web Map Service (WMS) generates a dynamic image from geospatial data using a simple request string which includes, at minimum, the requested layers and the bounding box of the required area. Additional parameters may include; time, depth, transparency and other optional dimensions such as spectral bands from satellite images or filtering parameters.

DGIWG has published a WMS 1.3 Profile which has been adopted by the OGC as a best practice document. WMS is a DGIWG Core Service.

- **OGC Styled Layer Descriptor**

The OGC Styled Layer Descriptor (SLD-WMS) specification is a profile of the WMS Encoding Standard that defines an encoding that extends the WMS standard to allow user-defined symbolisation and colouring of geographic feature and coverage data. SLD addresses the need for users and software to be able to control the visual portrayal of the geospatial data. The ability to define styling rules requires a styling language that the client and server can both understand. The OGC Symbology Encoding Standard (SE) provides this language, while the SLD profile of WMS enables the application of SE to WMS layers using extensions of WMS operations. Additionally, SLD defines an operation for standardised access to legend symbols.

SLD allows users to utilise their own symbology and rule sets to portray geospatial data in accordance with their individual needs. SLD provides the capability for users to include or reference their own SLD file for published data layers or geospatial data accessible via WFS or WCS services. These services may be loosely coupled component servers which can symbolise feature/coverage data from any WFS/WCS to which it is directed and also Geography Markup Language (GML) data that is provided inline as Feature Portrayal Services (FPS) or Coverage Portrayal Services (CPS). These services may also be integrated servers that are closely coupled and can only work in particular configurations and with specified data sources.

DGIWG submitted a Change Request to SLD WMS (CR 117) to OGC to improve support of such portrayal registries as sources for symbology. OGC is developing the open portrayal framework which should improve the SLD-WMS.

- **OGC Web Map Tile Service**

The OGC Web Map Tile Service (WMTS) Implementation Standard provides a standards-based solution to serve digital maps using tile images with predefined content, extent and resolution. WMTS provides a complementary approach to WMS for tiling maps. WMS focuses on rendering custom maps and is a good solution for dynamic data or custom styled maps (combined with the OGC Style Layer Descriptor (SLD) standard).

WMTS trades the flexibility of custom map rendering for the scalability possible by serving of static data (base maps) where the bounding box and scales have been constrained to discrete tiles. The fixed set of tiles allows for the implementation of a WMTS service using a web server that simply returns existing files. The fixed set of tiles also enables the use of standard network mechanisms for scalability such as distributed cache systems.

- **OGC Web Feature Service**

The OGC Web Feature Service (WFS) specification provides a service interface for accessing and writing geospatial data that is usually delivered in GML format. Features normally have unique identifiers and can be accessed in groups using relationships e.g. all roads within a national boundary.

DGIWG has defined two WFS 2.0 profiles: One for Basic WFS responding to basic requirements such as access to vector data and one for Transactional WFS allowing both access and update of vector data. WFS 2.0 is a DGIWG Core Service.

- **OGC Web Coverage Service**

The OGC Web Coverage Service (WCS) Implementation Specification provides interfaces to access geospatial data as coverages, i.e. Digital Geospatial Information representing space-time multidimensional varying phenomena. Typical examples are; aerial, satellite images and meteorological and oceanographic (METOC) data.

The standard WCS 2.0 consists of a core definition and extensions, some of which are community based, thus DGIWG will be monitoring and contributing to these extensions when deemed relevant to the military use case. DGIWG has developed a WCS 2.0 profile for GEO requirements. WCS is a DGIWG Core Service.

- **OGC Catalogue Service for the Web**

The OGC Catalogue Service for the Web (CSW) defines common interfaces to discover, browse and query metadata about data, services and other potential resources.

The OGC catalogue standards break down into a number of components. For example, the base standard which defines an abstract search interface. This currently supports two information models for catalogues (Application Profiles) which are the CSW-ISO profile and the CSW-ebRIM profile providing simple but limited and more advanced cataloguing options respectively. CSW-ISO supports only two artifacts: Dataset and Service. CSW-ebRIM is able to catalogue a wider range of artifacts and has an extensible model. There are arguments for the use of either, or both of these application profiles depending on the requirements and use cases. In both cases (and particularly in the case of ebRIM) the need for a DGIWG profile is likely to be significant if real interoperability is to be achieved between nations.

OGC has published Catalogue Services 3.0. DGIWG WSTP has published a profile for the CSW-ISO Application Profile based on Catalogue Service 2.0.

- **OGC 3D Portrayal Service**

The 3D Portrayal Service (3DPS) is a Geospatial Three-Dimensional (3D) content delivery implementation specification. It focuses on what is to be delivered, and in which manner, to enable interoperable 3D portrayal. It does not define or endorse particular

content transmission formats, but specifies how geospatial 3D content is described, selected and delivered. It does not prescribe how aforementioned content is to be organised and represented but provides a framework to determine whether 3D content is interoperable at the content representation level.

5.3.1.4 Civil Graphics and Encoding Standards

The portrayal of geographic information is achieved by applying pre-determined symbols to the feature geometry and rendering the data to visually display information or form a recognisable map or chart. Symbols may be represented either as raster (also known as “bitmaps”) or vector format.

While many graphic-employed encoding standards are proprietary and software specific, the majority of raster formats are open and available for general use. The most common lossy compression graphics standard is Joint Photographic Experts Group (JPEG) format. The lossless graphics standards include Bitmap (BMP), Graphics Interchange Format (GIF), Portable Network Graphics (PNG) and X Pixmap (XPM). There are standards that work as lossless or lossy, such as JPEG 2000 and Tagged Image File Format (TIFF). Vector graphics standards include Computer Graphic Metafile (CGM) and SVG. Some standards combine both raster and vector data, for example Encapsulated PostScript (EPS) and Portable Document Format (PDF).

Some of these standards have been adapted specifically for Geographic Information such as Geospatial Tagged Image File Format (GeoTIFF) or Geospatial Portable Document Format (GeoPDF). This document does not provide an exhaustive list of encoding formats nor makes any recommendations as to which format to use. The formats discussed below provide a selective overview of which ones are commonly used for portrayal in a web service context.

- **International Hydrographic Organization (IHO) Publication S-52**

IHO Publication S-52 provides specifications for colours, symbols and display rules along with its accompanying Presentation Library and the portrayal elements of IHO Publications S-100 and S-101, as well as the Portrayal Register of the Geospatial Information Infrastructure. S-52 is the symbology for Electronic Navigational Chart (ENC).

- **International Civil Aviation Organization (ICAO) Doc 8126 Aeronautical Information Services Manual**

Doc 8126 is a guidance material on aspects of the Aeronautical Information Service (AIS), explaining the basic functions of an AIS and the basic type of organisation required to assist member states in implementing the Standards and Recommended Practices of Annex 15 — Aeronautical Information Services. Key documents include: Annex 4 — Aeronautical Charts, Annex 15 — Aeronautical Information Services and Doc 8697 — Aeronautical Chart Manual.

- **OGC Symbology Encoding**

OGC Symbology Encoding (SE) defines the XML language for styling information that can be applied to digital Feature and Coverage data. This document, together with the SLD Profile (for the WMS Implementation Specification), is the direct follow-up of SLD Implementation Specification 1.0.0. The old specification document was split into two

documents to allow the parts that are not specific to WMS to be reused by other service specifications.

SE is undergoing an update in OGC to address design and symbolisation shortfalls by creating a modular specification. This specification will include a conceptual model that is independent and provide more open encoding alternatives to improve interoperability and exchange outside of vendor specific extensions.

- **Geography Markup Language**

Geography Markup Language (GML) is an XML grammar for the description of application schemas as well as the transport and storage of geographic information.

The aim of GML is to provide a standardised encoding (i.e. a standardised implementation in XML) of conceptual models specified by the International Standards for Geographic Information provided by ISO Technical Committee 211 (Geographic Information/Geomatics) (ISO/TC211). If every application schema was encoded independently and the encoding process included the types from, for example, ISO 19108, then without unambiguous and completely fixed encoding rules, the XML encodings would be different. Additionally, since every implementation platform has specific strengths and weaknesses, it is helpful to standardise XML encodings for core Geographic Information concepts modelled in the ISO 19100 series of international standards and commonly used in application schemas. Work is underway in the DGIWG DGIF project to create GML 3.2.1 application schemas for DGIF data.

- **Keyhole Markup Language**

Keyhole Markup Language (KML) is an XML grammar used to encode and transport representations of geographic data for display in an earth browser, such as a three-dimensional (3D) virtual globe, two-dimensional (2D) web browser application, or 2D mobile application. KML Application Profiles that support extensions for symbology encoding, symbol graphics and regular polygon geometry for certain symbol sets (e.g. MIL-STD-2525) need to be agreed on and supported by KML clients.

- **Scalable Vector Graphics**

Scalable Vector Graphics (SVG) is an XML-based vector image format for two-dimensional graphics that has support for interactivity and animation. The SVG specification is an open standard developed by the W3C since 1999. SVG is used in Geographic Information Systems both as an encoding for symbols and as a format for rendering maps.

- **Cascading Style Sheets**

Cascading Style Sheets (CSS) is a language for describing the rendering of structured documents (such as HTML and XML) on screen, on paper, in speech, etc. The CSS specification describes user interface related properties and values that are proposed for CSS level 3 to style HTML and XML (including XHTML). It uses various properties and values to style basic user interface elements in a document.

The CSS specification is an open standard developed by the W3C. Geospatial derivatives such as CartoCSS and GeoCSS are openly available.

- **JavaScript Object Notation**

JavaScript Object Notation (JSON) is an open standard format that uses human-readable text to transmit data objects consisting of key value pairs. It is used primarily to transmit data between a server and web application as an alternative to XML. An advantage of JSON over XML is that it is a more lightweight format as it does not have the XML overhead of, for example, start- and end-tags. The disadvantage of JSON is the lack of the schema representation found in XML as a Mark-Up language. JSON is an alternative to XML where there are no requirements for sophisticated schemas or specific data types.

- **Geospatial JavaScript Object Notation**

Geospatial JavaScript Object Notation (GeoJSON) is an open standard format for encoding collections of simple geographical features along with their non-spatial attributes using JSON. GeoJSON supports the following geometry types: Point, LineString, Polygon, MultiPoint, MultiLineString, MultiPolygon and GeometryCollection. Features in GeoJSON contain a geometry object and additional properties and a feature collection represents a list of features. GeoJSON offers an efficient method to parse data in a browser, i.e. it can be faster to deliver and parse WFS as GeoJSON compared to GML.

- **OGC GeoPackage**

OGC GeoPackage provides a flexible, interoperable solution for providing geospatial content that can be exchanged and shared across different mobile devices, applications and web services. GeoPackage currently allows users to store, view, edit and update feature data, tiled imagery and raster maps. It features 22 standard zoom levels that allow the user to zoom in and out across multiple scales and resolution data in a similar way to Google maps. Additionally, GeoPackage enables users to include maps and images in an open format. A GeoPackage file is a single SQLite container for the storage, dissemination and direct-use of vector features, tile matrix sets and metadata on a variety of computing platforms.

GeoPackage is intended to provide a light-weight interoperable solution use case for many defence users. It provides the ability to load data on to a handheld device for use in situations where continuous connection to a web service is impractical due to limited bandwidth, radio silence/covertness, or potential denial of communications. Currently GeoPackage may contain: Vector Feature User Data Tables and Tile Matrix Set User Data Tables (PNG and JPEG Tiles). OGC has ongoing work to standardise how to include symbology and rules in GeoPackage. It is possible that this, and future work will lead to a DGIWG GeoPackage Profile.

5.3.2 Defence Standards

5.3.2.1 Defence Standards Development Organisations

- **Defence Geospatial Information Working Group**

DGIWG is the Multi-National body responsible for Geospatial Standardisation for the Defence Organisations of Member Nations. DGIWG Geospatial Standards are built upon the generic and abstract standards for geographic information defined by ISO TC/211

and the service specifications endorsed by the OGC. DGIWG defines information components for use in the development of product specifications and application schemas for military geospatial data. DGIWG also establishes service specifications, encoding formats and testing methodologies to meet military geospatial information requirements.

- **NATO Working Groups**

- **Joint Geospatial Standards Working Group**

The role of the Joint Geospatial Standards Working Group (JGSWG) is to progress standardisation and/or interoperability in military geospatial matters in order to improve the effectiveness of NATO forces. JGSWG oversees Geospatial Standardization Agreements (STANAGs). JGSWG is the main point of contact between DGIWG and NATO Core Geographic Information Systems (GIS) and other NATO initiatives related to Geospatial Information. The JGSWG transforms the geospatial requirements from NATO into an unclassified JGSWG Program of Work.

DGIWG and JGSWG have established a close relationship around which future cooperation will be developed. This is the framework to provide NATO geospatial requirements to DGIWG. Currently JGSWG and DGIWG are working on DGIF/NGIF, services and interfaces and the involvement of civil geospatial standards within NATO. NATO Core GIS is currently one of the main focuses of both organisations.

- **Joint Symbology Panel**

The Joint Symbology Panel (JSP) is a panel of the Information Exchange Requirements Harmonization Working Group (IERHWG). JSP ensures that the requirements for joint symbology are correctly represented in Allied Procedural Publication 6 (APP-6). The Panel also ensures that joint symbols remain harmonised with NATO doctrine, terminology and information exchange requirements.

- **Geospatial Maritime Working Group**

The Geospatial Maritime Working Group (GMWG) is responsible for the Additional Military Layers initiative to add supplementary information to nautical charts. For NATO Geospatial Standardisation, the GMWG is directed and supported by the JGSWG. GMWG also reports annually to the NATO Geospatial Board (NGB). For NATO Operational Geospatial Requirements, the GMWG is directed and supported by the Geospatial Requirements Working Group (GRWG). For Oceanographic and Meteorological contents, GMWG will liaise with the Military Committee Meteorology and Oceanography Group (MC METOC Group).

- **Geospatial Aeronautical Working Group**

In 2018 the NATO Geospatial Board agreed to give the Geospatial Aeronautical Working Group (GAWG) permanent status as a NATO working group. The role of the GAWG is to provide the NATO Command and Force Structure with Aeronautical Geospatial Standards, governance of Production and Co-production, Operational Support and provision of Aeronautical Geospatial Information in close consultation with, and as directed by, the GRWG and the JGSWG.

5.3.2.2 Defence Vector Data Standards

The development of standards and specifications supporting the collection, management, production and provision of geospatial information as vector data is a task of the Vector Modelling Standards Team (VMST).

NATO and DGIWG started the NATO Geospatial Information Framework/Defence Geospatial Information Framework (NGIF/DGIF) based on the US Geospatial Intelligence (GEOINT) Structure Implementation Profile (GSIP) 5.0 in order to solve the issues of inhomogeneous, isolated and partly outdated specifications for Geospatial Information in the Military Environment.

The first step was the creation of an information model for vector data called NATO/Defence Geospatial Information Model (NGIM/DGIM) accompanied by the NATO/Defence Geospatial Feature Concept Dictionary (NGFCD/DGFCD) and the NATO/Defence Geospatial Real-World Object Index (NGRWI/DGRWI). These three standardisation documents were adopted for use by NATO Nations and NATO in 2014 with the ratification and promulgation of STANAG 2592 and AGeoP-11. They create a foundation for any future specification for Geospatial Information Exchange and Geospatial Products based on vector data.

The terms DGIF 1.0 and NGIF 1.0 are interchangeable as they have the exact same content. In future this may vary, as NGIF may only be a sub set of the DGIF suite of standards and specifications. For the purposes of this document the term DGIF will be used.

DGIWG has published edition 2.0 of the DGIF specifications comprising of content changes to reflect NATO and Nations' requirements. DGIWG is currently developing product specifications for a 50k topographic map and additional specifications for the encoding of Geospatial Information for exchange.

Review the VMST Roadmap for a detailed discussion of Defence Geospatial Vector Data standards.

5.3.2.3 Defence Symbology and Portrayal Rules Standards

- **STANAG 3675 Ed 2 Symbols on Land Maps, Aeronautical and Special Naval Charts**

This JGSWG agreement standardises the basic symbols used on topographical land maps, aeronautical charts and special naval charts for use by NATO Armed Forces. These symbols are recommended for portrayal of communication network features. These include, at the very least, roads, railroads, built-up areas (populated places), power transmission lines (high tension), aeronautical data and hydrography where applicable.

NOTE: Edition 3 shall align symbology for global, regional, local and urban/specialised topographical land maps. It may be addressed under STANAG 2592.

- **STANAG 3676 Ed 3 Marginal Information on Land Maps, Aeronautical Charts and Photomaps**

This JGSWG agreement standardises the presentation of marginal data on land maps, aeronautical charts and photomaps.

- **STANAG 3833 Ed 4 Symbols for use on Maps of Training Areas for Land Forces**

This JGSWG agreement standardises the basic production procedures and the basic symbolisation of training facilities that are shown on the maps of training areas.

- **STANAG 2019 Ed 7 NATO Joint Military Symbolology – APP-6D**

This Joint Service Publication (JSP) provides a standardised, structured set of graphical symbols for the display of information in military systems and applications. The purpose of this publication is to establish a common standard for the design, development and use of symbols depicting joint military activities. The publication aims to enable a standard visual portrayal for all Command and Control (C2) symbols and Control Measures symbols. APP-6 applies to both electronic/automated and hand-drawn graphic displays, both multi-coloured and monochrome. It shall be applicable to mapping/charting as well as to engineering and design of system symbols. APP-6 shall be used by all NATO forces involved in operations, system development and training. It aims to serve as the basic standard building set for current and future NATO implementations of symbol sets used in manual applications and electronic display systems.

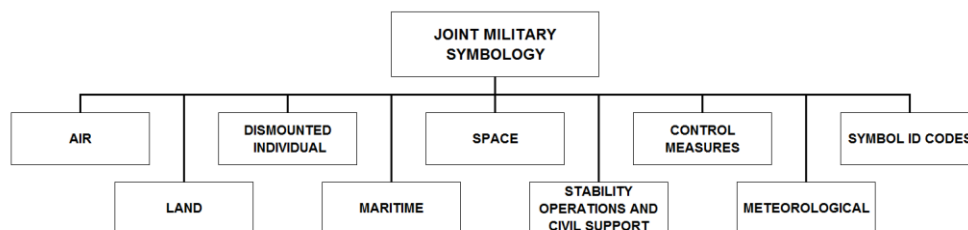


Figure 1 Joint Military Symbolology Document Structure

- **STANAG 7170 Ed 3 Additional Military Layers**

Additional Military Layers (AML) is a unified range of digital geospatial data products designed to satisfy the totality of NATO non-navigational maritime defence requirements from the GMWG. This agreement does not mandate the use of any particular symbolisation standard for AML Products. However, to support consistent display in Warship Electronic Chart Display and Information Systems (WECDIS), portrayal guidance has been developed using APP-06(C) and IHO S-52. The GMWG should be contacted to obtain the latest information.

- **STANAG 2592 Ed 2 NATO Geospatial Information Framework**

The NATO JGSWG, in close corporation with the DGIWG, has developed and approved the NATO Geospatial Information Framework (NGIF). The NGIF is a set of core artifacts that define feature concepts and associated relationships, as expressed in a common data model. The application and use of these core artifacts will enable the interoperability of geospatial information, products and services. The artifacts provide the basis for the development of a common product line. NGIF aims at supporting all operational domains (Land, Maritime and Air) that require geospatial information.

5.3.2.4 Defence Data Product Specifications

Hardcopy maps and associated raster representations are produced at various scales using vector data sources (from MGCP, NAS/Topographic Data Store (TDS), GGDM, etc.)

according to published DPS comprised of annotation and portrayal catalogues, which include detailed symbology, portrayal and styling rules. Existing examples include the Topographic Map (TM at 1:50,000 or 1:100,000 scale) and the Joint Operations Graphic (JOG, 1:250,000 scale). Future examples will include the Tactical Pilotage Chart (TPC, 1:500,000), Operational Navigation Chart (ONC, 1:1,000,000) and Urban Maps (UM, 1:12,500 and larger). NSG and DGIWG members publish DPS documents to ensure system developers and map producers have well defined technical information to consistently develop applications and finish products to an approved specification.

5.3.2.5 Defence Vector Portrayal Standards

Dynamic vector portrayal standards are required within the military community, however, existing standards were designed for static hardcopy and raster representations which do not take advantage of the capability effectively and dynamically represent multiple map scales from a single dataset. There are many drivers supporting the need to fill the gap in portrayal standards including: the availability of significant global coverage of vector map data, improved processing and rendering capabilities within military systems, as well as improving bandwidth which offers the potential for updates to maps. These driving forces result in the potential for more current maps with a smaller data storage footprint, however standardised dynamic portrayal standards and implementation profiles are required to ensure a common operational picture. Rapid expansion of vector data in the commercial and Open Source communities has resulted in a variety of dynamic vector solutions, such as: Open Street Map, MapBox and Google Maps. Civil standards, specifying how to dynamically portray vector data, are evolving. DGIWG WSTP follows these activities for possible future implementation profiles.

5.3.2.6 Defence Web Service Standards

DGIWG established profiles and extensions for OGC web services to provide additional implementation guidance to improve interoperability. DGIWG profiles and extensions are managed by the Web Service Technical Panel. Review the WSTP Roadmap for a detailed discussion of geospatial service standards. Approved profiles exist for WMS, WFS, WMTS, WCS and CSW. Profiles for Web Processing Services (WPS) are in development.

5.3.2.7 Defence Graphics and Encoding Standards

The Defence community uses civil graphic standards such as TIFF, SVG, JPEG, etc. to create symbols (see 5.3.1.4). Apart from these civil formats, special formats for the military community have been developed such as; ARC Digitized Raster Graphics (ADRG), Compressed ADRG (CADRG), Controlled Image Base (CIB), GeoPDF (geomatic specialisation of PDF - a result of NGA's eChart initiative).

5.3.2.8 Defence Metadata Standards

DGIWG has established a metadata standard called DMF (DGIWG Metadata Foundation), based on ISO standards. It defines metadata elements to describe a resource (general information, data content, quality, etc). It also includes a metadata element pointing to the legend of the resource, if any. Data Quality referenced in DMF metadata might also be relevant to improve portrayal (e.g. show "no-data" or data with poor quality areas).

5.3.2.9 Defence Registers and Registries

ISO 19135-1:2015 defines a register as a set of files containing identifiers assigned to items with descriptions of the associated items. A register in its simplest form can be a list or table and can be applied to multiple concepts and parameters (e.g. datamodels, codelists, coordinate reference systems, etc). Registries are an information system in which one or more registers are maintained. Registries may include the software and web service that holds and disseminates the organisation's registers.

The DGIWG S01 Portrayal Service activity created the DGIWG Portrayal Registry Service Interface Specification [DGIWG 118] which defined a collection of indexed portrayal information, which acts as a central authority and can be accessed by users (human or software agents) to retrieve visualisation data and enable consumers to produce a consistent visualisation across distributed system domains. The DGIWG Register Maintenance Procedures [DGIWG 915], provides a framework which specifies how a DGIWG registry or register shall be maintained. In practice, development of robust and multi-part registers hosted and maintained in a common registry in DGIWG has been limited to isolated registers, therefore integration and development of web services has not started in earnest.

6. Technology Considerations

Technology has a disruptive effect on how geospatial information is shared and visualised. Over time, technology has opened the cartographic process to mass generation of unique products leveraging expertly extracted data and high-end information technology. Both technology and data availability have allowed end users to participate in geospatial visualisation without constraints. While continuing to support common visual outputs necessary for defence operations, portrayal must also support alternative visualisation techniques that spawn from multiple data sources, a variety of processing systems and analytic applications. Technology and the tech savvy users require advanced portrayal options. Producers must move beyond the simple provisioning of standard products or standard computer graphics that are based upon the legacy map production paradigm. As the availability of geospatial services is exposed to a broader non-specialised user base, it is imperative to provide platform agnostic adaptive portrayal standards and services. Without an adaptive approach, poorly developed and competing portrayal solutions will continue to persist and confound end users.

6.1. Existing

6.1.1 Hardcopy Data Products

The primary current implementation of portrayal is in support of hardcopy and associated raster representation development. Commercial, open-source and custom proprietary GIS systems are used to develop these products which are then provided as raster content to servers, computers and devices via network communication or external drive delivery. Hardcopy products are generated through complex printing processes or via on-site plotters.

The complex symbology used for the generation of hardcopy products and associated raster representations is designed for visualisation at a fixed scale or within a narrow scale band. These maps are designed to maximise the content that can be read at the particular product scale. Most commercial solutions used for production of these hardcopy and raster products use portrayal solutions with limited interoperability. Open-Source solutions offer portrayal solutions but have limitations with the rendering of some complex styles and portrayal rules.

The construction of effective visual products begins with vector data which goes through a complex process of data pre-processing, refinement, de-confliction of overlapping features and labelling. Hardcopy products are either plotted or delivered as a raster product in a variety of formats. Currency of the maps suffers because this production process is laborious and time consuming.

6.1.2 Computing and Display Environment

Printed and digital displays have different technical limitations that affect how data can be represented. Digital displays have different properties such as size, resolution, ambient light properties and colour gamut. These properties impact the suitability of some portrayal rules and styles for different computing environments leading to a need for some customisation. Production systems are often high-end processing systems, configured with mature GIS and graphics software and robust capacities for processing, rendering, storing, printing and network sharing. Use of digital display devices continues to expand in defence. Information

is provided to lower echelons on diverse computing and display environments. These environments include; high-end GIS systems, thick client computers with robust processing and network access, thin client computers with reduced client processing capacity, and hand-held devices, such as mobile phones, tablets and navigation devices often operating with significant communications and processing constraints. Portrayal development needs to account for the targeted end user capabilities and limitations and provide tailorable solutions to computing systems constrained by bandwidth, storage and computing capacity. These portrayal solutions also need to be tailorable for visualisation over a variety of imagery including sand, snow and lush vegetation.

6.1.3 Web Services for Geospatial Display

Web services are becoming more common. They offer the flexibility to provide desired content at a variety of scales from the same service. Portrayal symbols and rules have not been defined to fully leverage the capabilities of web services, so users often work with limited portrayal information available within their organisation which is built into proprietary software or found in Open Source Projects such as Open Street Map (OSM). The WMS, WMTS and WFS currently provide varied but limited capability to portray feature information. Where capabilities exist, implementations may have service interoperability in order to exchange information but lack portrayal interoperability to display that information. Web services need to provide more robust server and client portrayal capabilities. The web service technology is mature but lacks standards and governance in application.

6.1.4 Proliferation of Open Source Data

Access to civil, commercial and open source geospatial information on the internet has expanded data availability of geospatial data to the general public and to defence users. These data sources provide a variety of dynamic vector based solutions, such as OSM, MapBox and Google Maps. Managing and integrating these sources is a challenge, with portrayal required to provide common symbology of data from diverse sources in multiple formats and schema.

6.1.5 Disconnected / Intermittent / Limited Bandwidth (DIL) Users

For many defence users, continuous connection to a web service is impractical for reasons of limited bandwidth or intermittent or constrained connectivity. The GeoPackage standard described in detail in the encoding formats chapter can provide a possible solution for at least some of the problems related to the use case described above. Portrayal capabilities will need to adapt to constraints in operating environments and system limitations to tailor portrayed information to defence users and clients.

6.2. Emerging

6.2.1 Bundling Data and Delivery Containers, GeoPackage and OGC Web Service Context

Simple containers are being implemented to bundle and manage data for efficient delivery to address requirements for common data and operational display and off-line provisioning of data for DIL-constrained users. To facilitate tailoring and delivery of data, several approaches including GeoPackage, OGC Web Service (OWS) context documents and Common Object Model containers are advancing at varying levels of maturity and

implementation. While much of the early development of these delivery mechanisms were focused on raster content, vector implementations are starting to mature as well and will require portrayal to fully realise the advantages of vector content.

6.2.2 Vector Tiling

Tiling services provide spatially referenced data divided into small manageable tiles. Raster tiling of images and maps is fairly mature. Vector tiling does not have a well-defined standardised solution, however, some implementations such as MapBoxTiles (MBTiles) exist and OGC and industry are investigating additional solutions. Vector tiles have the potential to improve rendering speed of large vector datasets by only processing data in or near the displayed area. To provide usable and relevant vector information, vector tiling needs to mature to address generalisation, portrayal symbols and rules applicable to unique tiles.

6.2.3 Geospatial Analytics

The drive for dynamic portrayal is focused on delivering more useful information directly to the end user and decision maker. Commercial solutions allow for real-time updates that can provide networked or client-based analytics such as routing or line of sight to help them understand additional geospatial context directly from the data without reliance on trained GIS users. While most analytics output a mixture of text, graphic and geospatial references, their geospatial representation has traditionally fallen outside the core portrayal activities where user-defined portrayal can provide different and conflicting views. Portrayal standard's efforts should allow users easy access to common portrayal outputs and symbology and, by incorporating emerging analytics-derived portrayal, enable them to be managed as tailored, custom views.

6.2.4 Plug and Play, Code Reuse and Modular Design

Modularity and agile design are spurring a rapid pace of change in information technology. Plug and play encourages loose coupling of components to rapidly swap out capabilities for new designs, offering performance enhancement in speed, rendering, complexity and/or efficiency. Leveraging modularity and reuse will benefit portrayal developers to provide more agile symbology, rules and encodings in new applications to meet the diverse mission requirements and systems designs of their defence geospatial enterprise. A flexible design and agile governance process would support rapid insertion of new solutions and replication and reuse for portrayal solutions across different Communities of Interest.

6.2.5 Chained Services

Robust network or cloud connectivity permits the hosting of web-based services and applications that can execute discrete functions on demand. An emerging approach is to chain multiple services and online data offerings to provide a cumulative effect. For instance, Web feature portrayal service capabilities envision successfully combining these OGC OWS context documents, executable OGC WPS processes and on-line data sources into an interoperable process for dynamic display.

6.2.6 3D Portrayal

3D display technology is rapidly expanding for both high fidelity and generic users. The internet gaming community and the defence modelling and simulation community are

demanding higher quality 3D portrayal while simple 3D globe applications are proliferating in desktop and mobile devices. As life cycle replacement of older systems is planned, more and more GIS and mission command systems are adopting 3D solutions and demanding more from visualisation than simply draping 2D imagery, features and symbology over a 3D terrain mesh. Efforts to mature portrayal capabilities must provide more accurate location information and COP visualisation to display objects on, above or below surface level.

6.2.7 Semantics, Ontologies and Linked Data

Technologies associated with semantics, ontologies and linked data allow automated associations across entities and databases. These technologies along with WPS would facilitate online portrayal services accessing vector databases, portrayal registries with symbology and rules. From a geospatial portrayal perspective, this could be applied to dynamically associate a feature to corresponding symbology without direct mapping between symbology and the schema. This schema agnostic approach could support queries in the user's preferred context without knowing the structure of the underlying data.

6.2.8 Cloud Computing

Cloud computing enables infrastructure builders to scale computing and storage resources up and down in a flexible way. Cloud computing services enable lightweight clients to access powerful processing services hosted at remote locations. Future Portrayal Registries could be hosted as Cloud resources to enable the user community to access approved symbology sets, portrayal rules and labelling definitions to consistently render geospatial data on mobile devices.

7. Geospatial Information - Future State

A common (standard) topographic map display across all coalition mission command systems and devices is fundamental to planning and conducting operations. Therefore, there is a need for a dynamic map portrayal standard that is applied across all DGIWG and NATO Nations. The standard will specify a common means to symbolise and digitally portray topographic map information consistently across all coalition/national systems and include all echelons and computing systems. Dynamic portrayal of vector data and more formal data product specifications for hardcopy products and associated raster representations will be closely aligned to consistently provide geospatial information to DGIWG nations and enable a common operational picture that efficiently provides rich and query-able content.

Upon completion of the portrayal roadmap activities over the four year program (2019-2023), the envisioned end-state is that DGIWG members will have a standard on digital map portrayal that improves geospatial interoperability, enhancing common and shared situational awareness to commanders and war-fighters via the provision of a common foundation map for all digital COPs. Digital mapping will be displayed clearly, accurately and in a timely manner across coalition members. Mission Command digital COP and other platforms will display common, authoritative mapping as the foundation layer for shared situational awareness across nations and echelons.

7.1. Target Objectives

7.1.1 Symbology for Common Operational Picture

Portrayal capabilities are essential for the employment of Geospatial Information and a collaborative environment is crucial to enable standardisation for the exchange of Geospatial Information. In portrayal, standardisation implies more than common encoding and technological interfaces. Standardisation also requires shared data formats and schema, common symbology to represent geographic features and portrayal rules to provide common operational picture and tailored views based on operational requirements and IT system constraints. Symbols need to be intuitive or look like current military and commercial symbols. Soldiers and partnered agencies need to understand the map symbols when viewing on hand held devices. Symbols need to scale with the scale of the map & stay geographically accurate within the bounds of cartographic license. The map needs to look crisp on screen and print clearly to scale. The objective of providing enhanced portrayal of geospatial data to support the COP provides DGIWG members key operational capabilities to include:

- Gain and maintain situational awareness and facilitate mission command in the initial stages of any contingency.
- Maintain a common operating picture between command posts and forward elements:
 - Provide common geospatial foundation data on which staff can overlay information and analytical layers.
 - Provide geospatial information for the Recognized Environmental Picture (REP).

- Create an understanding of the environment:
 - Catalogue and query data with reference to the capacity of air and sea ports, road and rail infrastructure, river infrastructure and land use to gain a clear picture of the region.
- Operate in multiple and diverse communications environments:
 - Robust enterprise environments with robust internet connectivity to support web services and desktop solutions.
 - Command post environments with limited wired connectivity.
 - Tactical environments without wire connectivity.
 - DIL environments (disconnected, intermittent and limited bandwidth).

7.1.2 Dynamic Vector Portrayal

Vector portrayal target objectives provide the basis for developing symbology, registry and rendering standards and profiles in OGC, DGIWG and other organisations. Developing compliant capabilities will be implemented in national GIS systems. Standardised dynamic vector-based map portrayal capabilities will be provided using geospatial web services to digitally serve vector-based maps to national and coalition partner geospatial, intelligence and mission command clients to represent an integrated trusted/timely coalition digital map (Fig 2). To make a seamless transition from static hardcopy map to digital display, the symbology in dynamic vector-based maps should reflect the same symbols in static hardcopy map products and associated raster representations where possible.

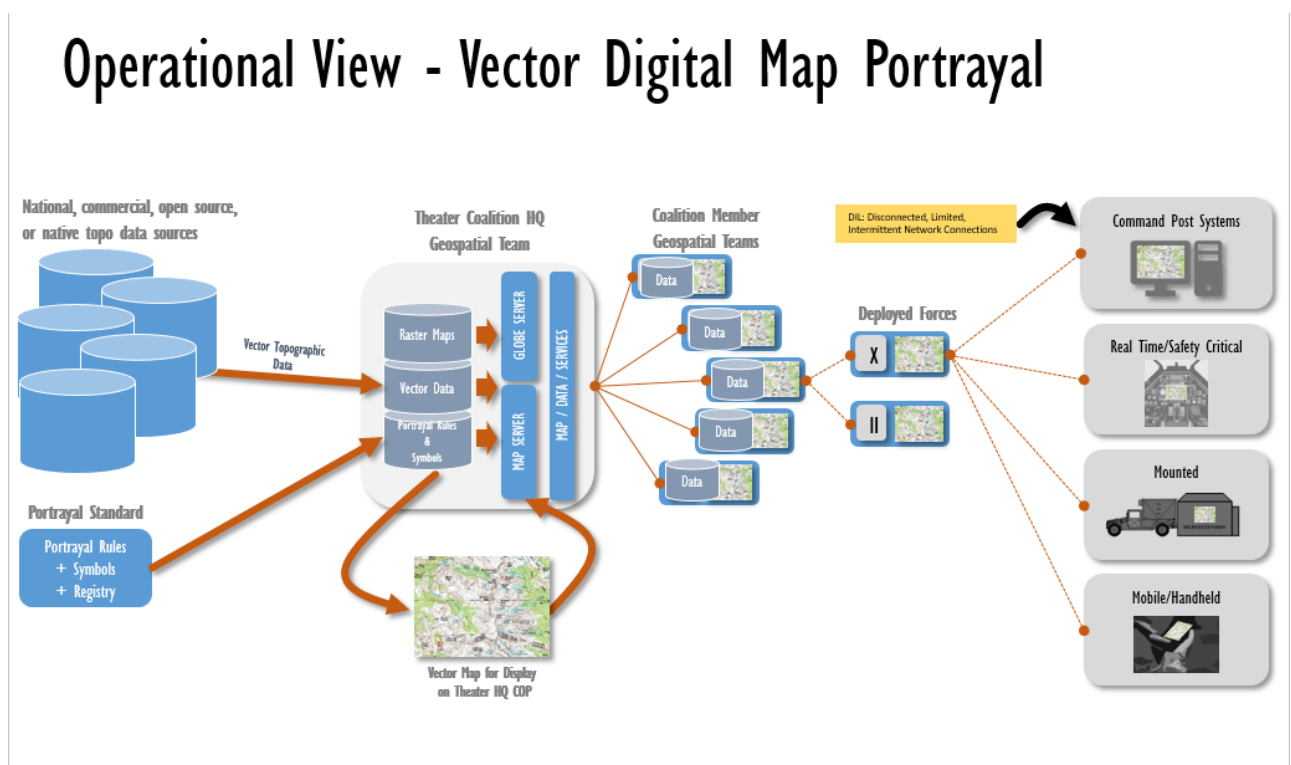


Figure 2 Dynamic Vector-Based Map Portrayal

These dynamic vector-based maps will provide similar displays to the existing hardcopy products and associated raster representations. However, the dynamic nature of these maps will provide access to additional feature information and provide the ability to dynamically update and render topographic information at varying scales, as well as tailor portrayal to the user's client capability and information requirements. Dynamic vector map portrayal capabilities must support multiple and diverse communications environments and satisfy user requirements at three distinct levels of complexity with tailorable symbology:

- Complex portrayal systems (e.g. thick clients) support expert users with portrayal sufficient for rendering, visualization and analysis, closely aligned to raster specifications.
- Generalized portrayal systems (e.g. command post thin clients) support mid-level users with simplified and optimized symbology for efficient network display using grouped feature concepts, basic patterns and lines to minimize symbol drawing time.
- Simple portrayal systems (e.g. DIL or mobile systems) support disadvantaged users with limited display capability using very few patterns and basic, intuitive symbols employing a reduced volume of critical features.

Dynamic vector-based map portrayal requires both common portrayal content and a portrayal repository or registry.

7.1.3 Common Portrayal Content

Central to any standard portrayal capability is the development of symbols and portrayal rules to be applied to content for clear, consistent and coherent visualisation.

- Portrayal information in the form of symbols and rules:
 - Must be available for exchange among the DGIWG members and its partners.
 - Must be easily maintained and expanded upon as new requirements for Geospatial Intelligence visualisation emerge.
 - Must be consistent with international standards.
 - Must be accessible through web-services for use in a web-centric environment and available for download to support non-networked applications.
 - Must be able to visualise and query portrayal content by database elements, keywords and tags to allow for improved discovery, application and adaption/revision of symbols and rules.
 - Must be accessible to users via standards-based applications.
 - Must be open, non-proprietary and machine readable.
 - Must be in technology and vendor-agnostic formats to allow common input and output.
- Symbols must be:
 - Harmonised between digital and hard copy in scale bands.
 - Familiar, clearly identifiable and intuitive.
 - Machine readable and available for online use by the user and developer communities.

- Portrayal rules, styling and rendering must:
 - Provide readability over diverse imagery from different regions of the world.
 - Be in formats and encodings accessible and available online.
 - Use OGC geospatial web services (WMS, WFS, WMTS), related portrayal standards (SE, SLD) and common formats (e.g. SVG, PNG, GeoCSS).
 - Ensure interoperable exchange between GIS and mission command systems.
 - Provide ability to interpret map data and display variation at different scales (global to urban scales).
 - Ensure portrayal processes that are de-conflicted and harmonised with NATO APP 6 or MIL-STD-2525x military symbology processes.
 - Provide clearly identifiable and intuitive symbols.
 - Provide simple symbology (e.g. point of interest type icons) for quick situational awareness.
 - Ensure interoperable exchange between all GIS and military command systems regardless (vendor agnostic input and output).
 - Provide symbols and styles for lines, areas patterns and labelling rules to display readable geospatial data in scale-appropriate symbology from global to urban scales.

7.1.4 Portrayal Register and DGIWG Registry

In addition to common content in portrayal rules and symbols, digital vector portrayal also requires an accessible and sharable warehouse where the symbols and rules can be accessed to enable consistency across joint, coalition and service systems. An overarching DGIWG registry should address both requirements for a management capability (for agencies to manage portrayal in a federated and authoritative way) and also requirements for dissemination or exploitation to provide an environment easily exploitable by systems and users. Initially, this may be in multi-part registers hosted in a static registry providing a common repository where the symbols and rules are stored, accessed and managed for use in development of operational implementations. Objectively, a more robust portrayal register would be provided as part of an expanded DGIWG registry and would allow web service enabled access for dynamic visualisation and content update. The DGIWG Portrayal Registry Service Interface Specification [DGIWG 118] provides a sound point of reference but needs to be reassessed for currency, validated against objectives and technologies and revised as required. The DGIWG Register Maintenance Procedures [DGIWG 915] describes procedures to populate, manage and maintain portrayal content.

A portrayal register in a DGIWG registry would provide a central authority of machine-readable symbology, portrayal rules and metadata for vector data portrayal.

- Common objective attributes of multi-part portrayal registers include:
 - Provide machine-readable symbols and portrayal rules.
 - Maintain portrayal information in a digital, system agnostic format.
 - Management procedures and technical controls for content display.

- Portrayal processes that are query-able and de-conflicted or harmonised with NATO APP-6 or MIL-STD-2525x military symbology processes.
- Core functions include:
 - Allow users to discover and retrieve symbols and portrayal rules.
 - Support operational systems to provide a common operating picture with vector data.
 - Provide common portrayal and symbology for system developers (geospatial and mission systems).
 - Provide a governance framework for common digital symbology and promote improved standards for symbology portrayal.
 - Portrayal rules support common vector data formats and schema.
 - Aligned with and incorporate DPS for hardcopy products (e.g. TM, JOG).
 - Compliant with open standards, contain elements to support multiple encodings and flexibility to support anticipated standards evolution.
 - Manage updates and maintenance.
- Additional technical capabilities include:
 - Allow dynamic applications at varied scales for diverse platforms.
 - Provide web-based service interfaces.
 - Expansible for use and reuse by multiple organisations and COIs.
 - Easily integrated with other systems, clients and applications.
 - Interoperable exchange between all GIS and military command systems regardless (vendor agnostic input and output).
 - Real time dynamic query, rendering and portrayal.
 - Support for complex symbology.
 - Store and apply symbols and rules for a standardised COP.
 - Combine symbols and rules on demand for a user-defined picture (allow custom profiles to meet operational needs).
 - May be implemented as a single registry or a family of registries.
 - Supports a diverse set of users, including developers, for hard copy and digital portrayal, geospatial experts, WFS providers, users and application developers.
 - Open and available to other communities of interest to replicate process and improve efficiencies of complementary symbology and portrayal rules.
 - Support the generation of DPS and reference documents to support user community.
 - Provide a downloadable open font family to support feature entity labelling on products by web servers, handheld devices and disconnected users.

7.1.5 Feature Portrayal Service

OGC WMS defines mandatory and optional capabilities for a map service. One optional construct in WMS is to provide a Feature Portrayal Service (FPS) as shown in Fig 3. An FPS design has loosely coupled component servers which can symbolise feature data from any WFS to which it is directed, and GML data that is provided inline. Realising an FPS requires concurrently implementing several existing standards and services. This includes; WMS, WFS, SLD, a portrayal register and a Catalogue Service (CSW). To realise this objective, the DGIWG Portrayal Registry Service Interface Specification [DGIWG 118] requires updating and implementing to provide the register and catalogue capabilities. DGIWG register constructs need to be expanded to address more than static or deliberate access and maintenance of content within portrayal and other registers to provide for dynamic interaction between developers and users with register content.

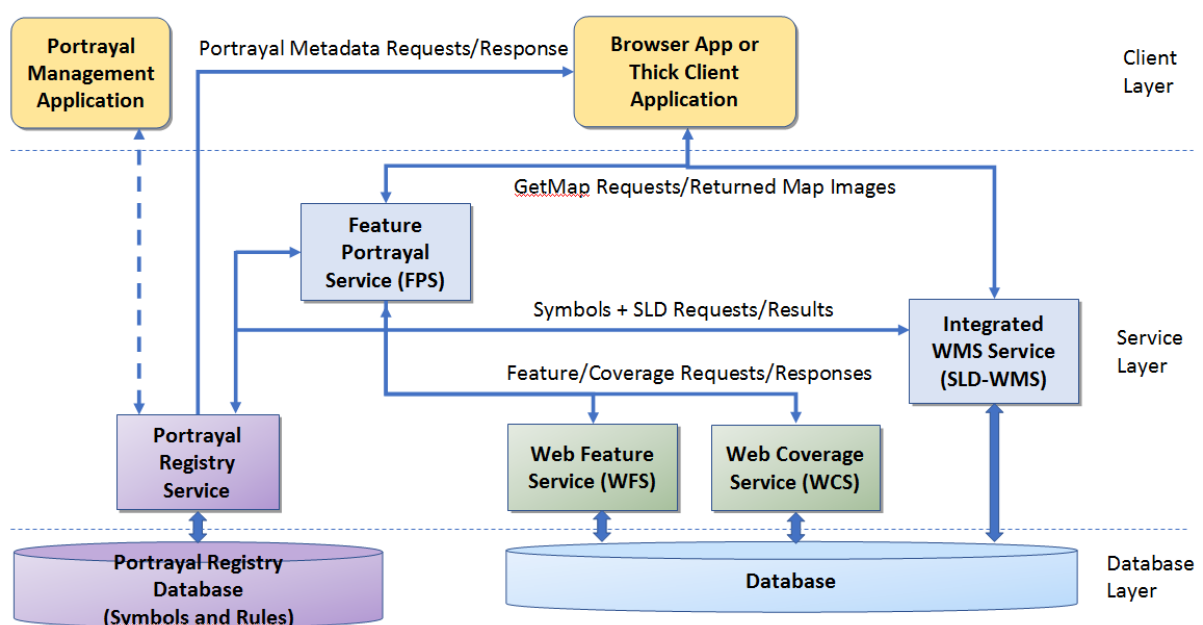


Figure 3 Feature Portrayal Service

7.1.6 3D Portrayal

Interoperability for both raster and vector portrayal should support both 2D and 3D portrayal capabilities. Many current GIS and mission command systems primarily use 2D visualisation, especially desktop systems in Command Posts (CPs). 3D globes are becoming more common. Efforts towards mature portrayal capabilities will ensure solutions for both 2D and 3D portrayal as vector features have more accurate location information. COP visualisation requirements will include the display of objects on, above, or below surface level.

7.1.7 Tailored Portrayal

Common symbols and rules provide the means to support the COP and ensure users have the same visualisation of geospatial information. In certain circumstances, different users will require tailored portrayal. This tailored portrayal should draw from the same symbols and rules wherever feasible to maintain consistency but allow for specialised symbology and

selection of data visualised to meet operational, environmental, or technical requirements. While a preferred or directed portrayal is critical to the COP, other visualisation should be permitted in standards, procedures and policy.

Profiles for specific content portrayal will use the same data and symbols but allow for a user defined picture that is sharable and understandable and also maintains characteristics described in the common portrayal section. The portrayal register should maintain distinct portrayal profiles containing the rules for when and how the profile is invoked and the alternative objects, symbols and rules to portray. Developing these profiles would be a shared responsibility of the users, system owners and symbol developers and would require governance procedures. User-defined or tailored portrayal profiles will be necessary to account for specific operational use cases, environmental concerns and technical computing constraints:

- Display user-defined content for analytics (routing, line of sight analysis), specialised communities (intelligence, fires, engineers) and sensitive/controlled operations (special forces).
- Simple symbology (e.g. Point of Interest (PoI) type icons) for situational awareness.
- Provide the capability to turn features on and off and bring features in at different scales for operational needs.
- Provide unique portrayal to account for display to support diverse computing systems (e.g. desktop, mounted, hand held) and accommodate constraints of specific computing systems (bandwidth, compute capacity).
- Provide unique rules or symbols to allow clients and applications to symbolise data on devices in a disconnected environment.
- Provide unique rules for rendering to adjust for differing background imagery (change colours style between arid, forested, urban, etc.).
- Provide unique rules or symbols to allow portrayal in different user environments (day v night conditions, red light v blue-green light conditions, etc.).
- Available as a web service or export/offline provisioning.

7.2. Geospatial Content

Portrayal requires content, rules and symbols. The content consists of vector datasets, representing geospatial features, and the portrayal rules and symbol sets which describe how those features are to be displayed. Mapping tables linking data and symbols and product content, where there are specific rules and symbols, are applied to vector data to create finished portrayal products.

7.2.1 Vector Datasets

DGIWG-defined and directed datasets will be available and recommended for portrayal activities. At the same time, an open portrayal approach should be usable by additional national, open source, or specialised datasets when properly aligned and mapped to DGIWG symbols and portrayal rules.

7.2.2 Symbol Sets and Portrayal Rules

Dynamic vector portrayal identifies the common portrayal content requirements for symbols and rules. To realise this objective, DGIWG needs to define, document and publish common symbol and portrayal rule-sets and to establish a multi-part register to enable developers and users to access and apply the rules to available datasets. The symbology and portrayal approach, formats and encodings shall be open, sharable and made available to other COIs (e.g. METOC, COP, Aeronautical, etc) to replicate processes and improve efficiencies.

7.2.3 Hardcopy and Raster Portrayal Products

Hardcopy Products and associated raster representation will continue to be produced as specified in DGIWG, NATO, or National Data Product Specifications. DGIWG will maintain and review DPS for the following products:

- Defence Topographic Map for 1:50,000 Scale (DTM50)
- Defence City Map (DCM)
- Defence Joint Operation Graphic (Air) (DJOG(A))

7.2.4 Vector Portrayal Procedures

To properly select and apply symbols and rules to features, proper linkage and mapping of data aligned to symbols must be established. DGIWG will provide and maintain for the DGIWG, managed datasets and symbology COIs. Other mappings are encouraged to be developed by the dataset owner or COI and shared to improve common portrayal and may be hosted with the DGIWG register. Concepts and capabilities to define common object groups (such as the VMST's Product Object work) will facilitate and enable this mapping.

7.3. Geospatial Services

Direct users of portrayal capabilities are map producers, web service creators, and standards and application developers that require portrayal rules and symbols to create products and services, harmonise symbology and create applications that support war-fighter needs. To provide raster products and visually portray vector data, common OGC web services are used. These services include Web Map Service (WMS), Web Feature Service (WFS) and Web Map Tile Service (WMTS). Portrayal services will comply with these standards and DGIWG profiles as well as enabling future OGC portrayal standards, formats and encodings.

As a portrayal register is realised, a robust Catalogue and Information Model will be required to register, query and request elements. The Catalogue Service for the Web (CSW) ebXML Registry Information Model (ebRIM) is presently specified to provide this capability for basic services in the DGIWG Portrayal Register specification but other alternatives such as a Semantic Registry Information Model (SRIM) should be considered. Additionally, Web Processing Service (WPS) may be paired with the catalogue and register to provide a dynamic web portrayal service.

The Portrayal Technical Panel will coordinate the use of OGC web services with the DGIWG Web Service Technical Panel.

7.4. Standardisation Initiatives

Current portrayal standards are contained in PDF documents, focus on hardcopy products for individual scale bands and are not easily implemented. Current implementations tend to be national or vendor specific and are not broadly shared across communities of interest. To rectify this shortcoming, DGIWG needs to engage with civil standards organisations that also support the development of defence implementation profiles. Additionally, symbol sets and portrayal rules should be developed and published for use across DGIWG members to support both static portrayal products and dynamic vector-based portrayal processes. A dynamic interplay between civil standards, defence profiles and DGIWG implementations is necessary to ensure that standards are suitable for implementation and maintainable. Use of these standards and profiles allows expansion based on new requirements for geospatial intelligence visualisation that emerge with increased implementation and advancements in technology.

7.4.1 Civil Standards

DGIWG needs to be engaged in civil standards development to share lessons learned from prior and ongoing DGIWG portrayal efforts. Monitoring civil standards will allow DGIWG to guide and prioritise encoding specifications for update and revision within defence standards activities.

- **OGC SE and SLD**

OGC is planning to revise and update SE and SLD. Their current intent is to focus on a modular Symbology Encoding standard that establishes critical requirements in the core document and outlines a unifying conceptual model for portrayal. From this core, additional specifications will be tailored to formats and encodings (e.g. GML (probably revised SLD), JSON, etc).

- **OGC GeoPackage**

Early implementations of OGC GeoPackage have identified the need to improve specifications and best practices for providing portrayal information for packaged vector data. Presently, complete symbology and portrayal rules could be included as a related extension to GeoPackage, provided as an online service or pre-staged on the client to facilitate proper portrayal of the vector information. Various approaches have distinct design and cost implications. OGC has various ongoing innovation initiatives to better support portrayal.

- **3D Portrayal Standards**

Several OGC and community efforts are evolving to define portions of the 3D portrayal process. A unifying conceptual model to include basic 3D terrain and exchange models as well as 3D symbology and rendering needs to be developed.

- **Vector Tiling**

Raster tiling of images and maps is quite mature but parallel processes for vector tiling (to include scales, generalisation and portrayal symbols and rules) are not well defined. OGC and industry are investigating solutions and several vendor specific

implementations are in use. Once this technology matures and is standardised, it could leverage portrayal registers.

7.4.2 Defence Standards

In addition to improving civil standards, DGIWG needs to document implementation specifications and profiles to support portrayal objectives.

- **DGIWG Web Symbol Sets and Portrayal Rules**

The Portrayal Panel is completing a web symbology project which documents the symbols approved by DGIWG. Symbol sets will be maintained and governed by the COI (e.g. topography, military symbology and hydrography). DGIWG standardisation will define both the content of symbol sets and rules and the development and conformance requirements for symbol set and portrayal rules to guide expansion to, and compatibility with, additional COI.

- **DGIWG Registry and Portrayal Register**

Expanding both DGIWG 915 and DGIWG 118 is required along with the development of portrayal registers and the population and management of portrayal content. The DGIWG portrayal register would include the DGIWG web symbol sets, portrayal rules and enabled physical implementations. An expanded and web-service enabled registry framework would also allow COI or DGIWG members to establish parallel or subsidiary registry services which are conformant to a master registry as part of a federated registry approach.

- **DGIWG Portrayal Web Services**

This builds on the DGIWG Web Symbol Sets and Portrayal Rules and on the DGIWG Portrayal Register to document specifications for web services providing dynamic vector data portrayal. These services will incorporate OGC web services and DGIWG profiles and be coordinated with the Web Service Technical Panel.

- **DGIWG Data Product Specifications**

DGIWG and NGA have an existing project to regularly review and update DPS for core DGIWG Standards. This management process needs to be continued and embedded in roadmap activities.

8. Program Plan

8.1. Portrayal Technical Panel (P4)

The PTP coordinates portrayal activities within DGIWG and ensures coordination with civilian standardisation bodies and military customers regarding the portrayal of Geospatial Information.

Its aims are:

- To maintain this document (i.e. the DGIWG Portrayal Roadmap) through annual revision.
- To develop, update and maintain symbol sets and portrayal rules both for static portrayal products and dynamic portrayal of vector-based data.
- To develop and maintain a portrayal register serving as an accessible and sharable warehouse from which the symbols and rules can be accessed.
- To monitor developments in portrayal standards and technology to identify when additional PTP projects should be initiated. Priority monitoring should be on updates to OGC portrayal standards and application of portrayal in emerging geospatial processes such as 3D portrayal, portrayal in GeoPackage and portrayal with vector tiles, SLD-WMS Feature Portrayal Service, and portrayal test and validation.

8.2. Current Projects

8.2.1. P4.01: Symbology for Web Service Environment

This project is developing a standard for the portrayal of vector data published through Web Services. The project should:

- Identify scale bands which features should be portrayed in.
- Recommend symbology designs for the content and build a symbol library based on recommended formats.
- Create draft standardisation documentation outlining the recommendations.
- Create a demonstrator service to test the recommendations and refine the standard.

The deliverables of the project are:

- Symbology Spreadsheet which provides the details of the scale bands, content and portrayal for creating a service.
- Symbol Library which provides the encoding of the symbols.
- Best Practice Document which provides guidance and recommendations in portraying data through a web service.
- Demonstrator = a prototype implementation of the standard.

Additional work will be dedicated to the development of sRGB colour token values, “equivalent” to the CMYK colour token values used in DTM50 DPS, for application in web services. The sRGB colour definition will be based upon the International Colour Consortium

(ICC) colour profile of sRGB ISO/IEC 61966-2-1:1999. USA and FRA will partner to provide expertise and resources.

The initial output of P4.01 documents web symbology derived from available raster DPS and best represents the web symbology suited for complex GIS systems as identified in section 7.1.2. Additional refinement of web symbology to create more generalised symbology for networked clients and simplified symbology for disadvantaged users is required.

8.2.2. P1.03: City Map Hardcopy DPS

The goal of the project is the definition of a data product specification for a city hardcopy map with scales 1:10,000 and 1:5,000. It collaborates closely with VMST for the content description and Portrayal Technical Panel to define the representation.

The role of the PTP in the project is to:

- Identify appropriate symbology and labelling rules for hardcopy city maps.
- Provide unique symbology aligned to the Product Object and Symbol Object approach developed by the VMST.

FRA is the lead for this activity in the PTP as it has practical experience with this product. Other participants include the CZE, GBR, ITA and USA.

8.2.3. P1.05: DJOG(A) DPS

The role of the PTP in the project is to:

- Identify appropriate symbology and labelling rules for hardcopy DJOG(A).
- Provide unique symbology aligned to the Product Object and Symbol Object approach developed by the VMST.

8.2.4. P4.05: Portrayal Repository/Database

The project shall:

- Develop a database schema for MS Access.
- Migrate symbology dealt by the PTP from Excel spreadsheets into the database.
- Create guidelines to establish roles, responsibilities and maintenance rules.

8.3. Envisioned Projects

8.3.1. P4.03: DGIWG Implementation Guide for General Symbology Encoding

Existing Symbology Encoding standards such as SE have been proven to be insufficient for DGIWG Portrayal requirements. DGIWG has documented a number of issues regarding SLD and SE. These are captured in an OGC discussion paper produced by DGIWG (OGC 17-059). Moreover, the DGIWG community does not have common implementations of SE in SLD documents. Thus, this project is to provide a guide for general symbology encoding. The project should:

- Examine approaches to meeting the DGIWG Portrayal requirements in a system agnostic way.

- Develop and publish guidance for portrayal definition using existing Standards (SE together with SLD).
- Input DGIWG and OGC references.
- DGIWG 908: DGIWG Portrayal Roadmap.
- DGIWG 909: DGIWG Web Services Roadmap.
- OGC Portrayal Concept Development Study (17-094r1).
- OpenGIS Symbology Encoding Implementation Specification 1.1 (05-077r4).
- DGIWG 112: DGIWG Web Map Service (WMS) 1.3 Profile – Revision, 2017-11-28, https://portal.dgiwg.org/files/?artifact_id=68226&format=pdf
- OpenGIS Styled Layer Descriptor Profile of the Web Map Service Implementation Specification 1.1 (05-078r4).

8.3.2. Portrayal Register

This project will conduct all efforts to make a common portrayal register an implemented and accessible capability available to all DGIWG members. The project should:

- Review and assess current and emerging capabilities and standards related to registries, including catalogues, encodings, and information models (e.g. ebRIM, SRIM).
- Expand on portrayal database project to document requirements for register items (individual lists and tables) for symbols, rules, encodings and linkages. It will incorporate advancements in standards and technology and reflect current and future operational requirements.
- Create a physical implementation of the portrayal register to serve as a web-enabled repository supporting the search and discovery of portrayal symbols and rules.
- Populate the register with validated symbols and rules.
- In coordination with the Web Services and Vector Maintenance Technical Panels, provide a DGIWG web portrayal service demonstrator.
- Establish governance procedures for the maintenance, review and update of the register in compliance with DGIWG 915.
- Conduct periodic reviews of register design and standards to incorporate emerging requirements and alternative solutions (e.g. new encodings, 3D).
- Provide a framework for other communities of interest to replicate processes and rules to improve common approaches to portrayal.

Input DGIWG references:

- DGIWG 118
- DGIWG 915
- DGIWG White paper on Registry and Registers
- P4.05 Portrayal Repository/Database

8.3.3. Dynamic Portrayal Specification

This project will define a specification to achieve the dynamic portrayal objectives outlined in the roadmap. Other existing and proposed projects are necessary predecessor tasks required to provide sufficient normative direction for mandatory and optional requirements to achieve dynamic portrayal, such as:

- Integrate web symbology and portrayal register outputs into a standard describing how to use these and other resources to provide consistent dynamic portrayal across DGIWG members.
- Define conformance classes for a range of dynamic portrayal alternatives. Include a simple class with GIS server providing portrayal based on defined symbology and rules and a more robust class for full interactive and transactions feature portrayal service across multiple partner nations.
- Incorporate current and emerging OGC symbology and web service standards.
- Allow for multiple encoding options providing a common core symbology and ruleset.
- Define procedures for dynamic portrayal profiles to include a standard COP profile and optional user defined profiles.

9. Dependencies

The DGIWG Portrayal panel must consider current and upcoming works regarding portrayal within civilian standardisation bodies such as ISO and OGC, as well as vector data schemas, metadata and web services within the Defence community (e.g. other DGIWG technical panels – VMST, Metadata Panel, Web Services Panel and NATO).

Currently, the Portrayal Technical Panel closely cooperates with VMST to develop data product specifications for hardcopy maps (DTM50 and DCM) and with Web Services to prepare machine-readable symbology for web service environment.

Annex A – Acronyms and Abbreviations

(Informative)

2D	Two Dimensional
3D	Three Dimensional
ADRG	ARC Digitized Raster Graphics
AGeoP	Allied Geospatial Publication
AIS	Aeronautical Information Service
AML	Additional Military Layers
API	Application Programming Interface
APP	Allied Procedural Publication
BMP	Bitmap
C2	Command and Control
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance
CADRG	Compressed ARC Digitized Raster Graphics
CartoCSS	Cartography Cascading Style Sheets
CEO	Chief Executive Officer
CIB	Controlled Image Base
CGM	Computer Graphic Metafile
CMYK	Cyan, Magenta, Yellow, and Key (or Black)
COI	Community of interest
COP	Common Operational Picture
CP	Command Post
CPS	Coverage Portrayal Services
CSS	Cascading Style Sheets
CSS3	Cascading Style Sheets 3
CSW	Catalogue Service for the Web
DCM	Defence City Map
DGIF	Defence Geospatial Information Framework
DGIWG	Defence Geospatial Information Working Group
DGFCD	Defence Geospatial Feature Concept Dictionary
DGIM	Defence Geospatial Information Model
DGRWI	Defence Geospatial Real-World Object Index
DGSB	Defence Geospatial Standards Baseline
DIL	Disconnected / Intermittent / Limited Bandwidth
DIPWG	Digital Information Portrayal Working Group

DJOG(A)	Defence Joint Operation Graphic (Air)
DMF	DGIWG Metadata Foundation
DPS	Data Product Specification
DTM50	Defence Topographic Map for 1:50,000 Scale
DWG	Domain Working Group [OGC]
ebRIM	Electronic Business Registry Information Model
ECDIS	Electronic Chart Display and Information System
ENC	Electronic Navigational Chart
EPS	Encapsulated PostScript
FD	Final Draft
FPS	Feature Portrayal Services
GAWG	Geospatial Aeronautical Working Group
GeoCSS	Geography Cascading Style Sheets
GEOINT	Geospatial Intelligence
GeoJSON	Geospatial JavaScript Object Notation
GeoPDF	Geospatial Portable Document Format
GeoTIFF	Geospatial Tagged Image File Format
GGDM	Ground-Warfighter Geospatial Data Model
GIF	Graphics Interchange Format
GIS	Geographic Information System
GML	Geography Markup Language
GMWG	Geospatial Maritime Working Group
GRWG	Geospatial Requirements Working Group
GSIP	Geospatial Intelligence (GEOINT) Structure Implementation Profile
HTML	Hypertext Markup Language
HTML5	Hypertext Markup Language 5
ICAO	International Civil Aviation Organization
ICC	International Colour Consortium
IEC	International Electrotechnical Commission
IERHWG	Information Exchange Requirements Harmonization Working Group
IGN	Institut Geographique National
IHO	International Hydrographic Organization
ISO	International Organization for Standardization
ISO/TC211	ISO Technical Committee 211 (Geographic Information/Geomatics)
IT	Information Technology
JFC	Joint Forces Command
JGSWG	Joint Geospatial Standards Working Group

JOG	Joint Operations Graphic
JPEG	Joint Photographic Experts Group
JSON	JavaScript Object Notation
JSP	Joint Symbology Panel
KML	Keyhole Markup Language
MBTiles	MapBoxTiles
MC	Military Committee
METOC	Meteorological and Oceanographic
MGCP	Multinational Geospatial Co-Production Program
MGHMO	Military Geographic and Hydrometeorologic Office
MoD	Ministry of Defence
MS	Microsoft
NAS	NSG Application Schema
NATO	North Atlantic Treaty Organization
NGA	National Geospatial-Intelligence Agency
NGB	NATO Geospatial Board
NGFCD	NATO Geospatial Feature Concept Dictionary
NGIF	NATO Geospatial Information Framework
NGIM	NATO Geospatial Information Model
NGRWI	NATO Geospatial Real-World Object Index
NSG	National System for Geospatial Intelligence
OGC	Open Geospatial Consortium
ONC	Operational Navigation Chart
OSM	Open Street Map
OTF	Open Type Font
OWS	OGC Web Services
PDF	Portable Document Format
PNG	Portable Network Graphics
PoI	Point of Interest
PTP	Portrayal Technical Panel
RD	Ratification Draft
REP	Recognized Environmental Picture
SARP	Standards and Recommended Practices
SCOTS	Standards-based Commercial-Off-The-Shelf
SE	Symbology Encoding
SLD	Style Layer Descriptor
SQL	Structured Query Language

sRGB	standard Red Green Blue
SRIM	Semantic Registry Information Model
STANAG	Standardization Agreement
STD	Standard
SVG	Scalable Vector Graphics
SWG	Standards Working Group
TC	Technical Committee
TDS	Topographic Data Store
TIFF	Tagged Image File Format
TM	Topographic Map
TPC	Tactical Pilotage Chart
UI	User Interface
UN	United Nations
USA	United States of America
VMST	Vector Model and Schema Team
W3C	World Wide Web Consortium
WCPS	Web Coverage Processing Service
WCS	Web Coverage Service
WECDIS	Warship Electronic Chart Display and Information System
WFS	Web Feature Service
WG	Working Group
WMS	Web Map Service
WMTS	Web Map Tile Service
WPS	Web Processing Service
WSTP	Web Services Technical Panel
XHTML	Extensible Hypertext Markup Language
XML	eXtensible Markup Language
XPM	X PixMap

Annex B - Summary of activities

(Informative)

Standardisation activity			Action ¹	Description	Status
Identifier	Name	Date			
P4.01	Symbology Spreadsheet for Web Service Environment	2018-12-31	Test and evaluate	To be prepared for ballot soon.	In Work
P4.05	Portrayal Database	2018-12-31	Develop		In Work
P1.03	Symbology Spreadsheet for Defence City Map	2019-06-30	Develop		In Work
P1.05	DJOG-A	2019-12-31	Develop		In Work
