



*“Delivering Military Advantage through multi-national geospatial interoperability”*

# **DGIWG 909**

## **Web Services Roadmap**

**Edition: 3.0**

**Date: 23 October 2023**

**Document Type:** ENT

**Publication Date:** 25 October 2023

**Edition:** 3.0

**Document Date:** 23 October 2023

**Document status:** DGIWG Publication

**Responsible Party:** DGIWG

**Audience:** This document is approved for public release and is available on the DGIWG website, <https://www.dgiwg.org/>

**Abstract:** This document summarises the development and maintenance activities that the DGIWG P5 Web Services Panel will be undertaking in the next 24 months as well a technical assessment of emerging trends and concepts that are relevant to the Defence Geospatial community.

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## ii. Executive Summary

This document describes the aims and objectives of the DGIWG Web Services Technical Panel (P5) outlining its current and planned activities and deliverables within the short, medium, and long-term time horizons.

The document complements the DGIWG Geospatial Reference Architecture and other DGIWG Panel Roadmaps in supporting the DGIWG Program of Work.

The document is reviewed and updated annually to ensure currency.

### iii. Contributing participants

Nation	Parent Organisation
AUT	Federal Ministry of Defence and Sports, Institute of Military Geography (IMG)
DEU	Bundeswehr Geoinformation Centre (BGIC)
FIN	Finnish Defence Geospatial Centre
FRA	Institut national de l'information géographique et forestière (IGN) Direction Générale de l'Armement (DGA)
GBR	UK MOD STRATCOM, Defence Science and Technology Labs (DSTL)
SWE	Defence Materiel Administration
USA	National Geospatial-Intelligence Agency (NGA)

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### v. Revision history

Date	Edition	Primary clauses modified	Description
09 Oct 2019	2.1.0 ENT	09 October 2019	
14 Nov 2021	2.2 (WD)	Original Document	New roadmap template initial population by WSTP
11 Apr 2023	3.0 (WD)	Original Document	New roadmap template fully populated by WSTP
21 Apr 2023	3.0 (FP)	Original Document	New roadmap template fully populated by WSTP
October 2023	3.0 (DP)	DGIWG Publication. All Clauses. Final draft revised and harmonized. P0 Quality Control completed	Edition 3.0 replaces edition 2.1 published in July 2019

## 1 Introduction<sup>1</sup>

1.1 The DGIWG Web Services Technical Panel (WSTP) (P5) fosters the discovery, retrieval, exchange, and use of geospatial data and products by creating and maintaining open standards and implementation profiles for geospatial web services. The Panel address the technical issues related to:

- Geospatial information services
- Service architectures and supporting network interfaces
- Data exchange formats
- Where possible, public domain standards based on ISO and OGC standards will be used or profiled.

## 2 Scope<sup>2</sup>

2.1 The Web Services Roadmap (P5) summarises the development and maintenance activities that the DGIWG P5 team will be undertaking in the next 24 months as well a technical assessment of emerging trends and concepts that are relevant to the Defence Geospatial community. The technical assessments provide DGIWG a brief understanding and view of:

- What the trends are and how they work
- Potential trend benefits to the Defence Geospatial community
- Potential trend effects on the DGRA
- An indication of the maturity level of the trends i.e. is it just emerging or is mature enough to warrant further consideration and development by DGIWG.

2.2 The technical assessment takes both a medium (3-5 year) and long term (6-10 year) view of the trends, their development and potential impact on the Defence Geospatial community.

2.3 This document has the following key sections:

- **Target Architecture:** Description of what the preferred architecture for the medium term looks like and the long-term architecture might look like.
- **Current Responsibilities:** Summarising P5 maintenance responsibilities for existing DGIWG documents.

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<sup>1</sup> The text comes from DGIWG 931 Business Manual Paragraph 6.2 and the respective Purpose clauses.

<sup>2</sup> The text comes from DGIWG 931 Business Manual Paragraph 6.2 and the respective Scope clauses.

- **Current and Planned Activities:** Summary of P5 planned technical work for the next 24 months.
- **Emerging Concepts and Associate Standards:** An assessment of emerging technical trends and their potential benefit to the Defence Geospatial community.

## 3 References

### 3.1 DGIWG Documents

- 3.1.1 DGIWG 933, DGIWG Geospatial Reference Architecture (DGRA), 2022
- 3.1.2 DGIWG Requirements Tracker, 2022
- 3.1.3 DGIWG 902, Program of Work (PoW), 2022
- 3.1.4 DGIWG 930, Business Manual, 2022
- 3.1.5 DGIWG 904, Defence Geospatial Standards Baseline (DGSB)

### 3.2 Open Geospatial Consortium (OGC) references

- 3.2.1 OGC, OGC API's The Building Blocks for Location, (Access Apr 2023) <https://ogcapi.ogc.org/>

## 4 Terms and abbreviations

Table 1: List of abbreviations and acronyms

Acronym	Definition
API	Application Programming Interface
DGIWG	Defence Geospatial Information Working Group
DGRA	Defence Geospatial Reference Architecture
EDR	Environmental Data Retrieval
ESM	Elevation Surface Model
NATO	North Atlantic Treaty Organisation
OGC	Open Geospatial Consortium
PoW	Program of Work
SOA	Service Oriented Architecture
WCS	Web Coverage Service
WFS	Web Feature Service
WMS	Web Map Service
WMTS	Web Map Tile Service
WPS	Web Processing Service
WSTP	Web Services Technical Panel

## 5 Target Vision

5.1 Spatial information is an essential component of most decision support systems. It provides the basis for users to analyse anything based on its location on the earth. However, many information communities often find it difficult to locate and retrieve required spatial information in a reliable and acceptable form. The diverse nature of geospatial data formats and access methods poses a major challenge for geospatial information sharing especially across a large and complex user community such as the Defence Geospatial domain. With the ever-increasing need for reliable access to up-to-date geospatial information, the OGC have developed and maintained a suite of approaches and generic standards based on a Service Oriented Architecture (SOA). These enable the interoperable sharing and dissemination data using standardised web services and APIs. The OGC is itself a diverse community, and its standards therefore need to work across many different domains' functional communities. To enable this, the standards need to be flexible. However, this flexibility can lead to problems with interoperability. To overcome this, communities such as DGIWG have sought to profile<sup>3</sup> the OGC standards to ensure that they are implemented consistently throughout their community.

The DGIWG WSTP is responsible for ensuring that the Defence community has a consistent suite of interoperable standards and approaches that it can use to enable interoperability and share geospatial data/services. The panel ensures the standards and a blueprint for how they should be utilised together to enable interoperability are captured in the DGRA [1]. Without the successful implementation and widespread use of standardised approaches, and services the seamless sharing of geospatial data/services will continue to be a problem for the international defence community.

## 6 Current Responsibilities

WSTP is responsible for the maintenance and update of a few of DGIWG's standards profiles and documents. A full list of these and their update date can be found in Annex A of this document.

## 7 Current and Planned Activities<sup>4</sup>

This Section of the document contains a summary of the technical work being undertaken by the P5 WSTP.

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<sup>3</sup> A Profile is A collection of standards, with parameters, options, classes, or subsets, necessary for building a complete computer system, application, or function. An implementation case of a more general standard or set of standards. OGC - <https://www.ogc.org/ogc/glossary/p>

<sup>4</sup> Content of the tables in section have been extracted from the DGIWG POW [2]

## 7.1 Maintenance Work

7.1.1 The following table lists the DGIWG documents that P2 plans to review in the next 24 months.

Table 1 - Maintenance Activities

Doc ID	Name	Task summary	Document type (Standard, Profile Guidance note etc)	Due Date
112	Defence Profile of OGC's Web Map Service 1.3 - Revision	P5 to review and if appropriate update	Standard Profile	10/2023
119	Defence Profile of OGC's Web Coverage Service 2.0	P5 to review and if appropriate update	Standard Profile	04/2024
122	Defence profile of OGC's Web Feature Service 2.0	P5 to review and if appropriate update	Standard Profile	04/2024
124	Defence Profile of OGC's Web Map Tile Service 1.0	P5 to review and if appropriate update	Standard Profile	10/2023
125	Defence Profile of OGC's Catalogue Service for the Web 2.0	P5 to review and if appropriate update	Standard Profile	04/2024
909	DGIWG Web Services Roadmap	P5 to review and if appropriate update	Roadmap	04/2023

## 7.2 Development Work

7.2.1 A summary of the technical development work that P5 WSTP will be undertaking in the next 24 months.

Table 2 - Development Activities

Req. No.	Task Name	Task summary	Customer	Output (Standard, Profile Guidance note, White paper etc.)	Due Date
56	GeoPackage	Address new requirements for DGIWG GeoPackage (version 2)	MN/ NATO	TBD	04/2025
76	Web Processing Service (WPS) Profile	A profile of the OGC WPS standard	MN/ NATO	Profile	04/2024
NN	API White paper	Scoping the use of APIs in the military domain	DGIWG	White Paper	10/2023
99	Environmental Data retrieval (EDR) profile	A profile of the OGC EDR API	MN	Profile	04/2024



## 8 Emerging Concepts and Associate Standards

### 8.1 Medium Term Assessment

The key trends identified by the P5 WSTP which are in scope of its responsibilities, more mature, and therefore likely to affect the defence geospatial community and require further work by DGIWG in the next 3-5 years are as follows.

#### 8.1.1 Definite Trend 1: Application Programming Interface (API)

- **Description:** According to the OGC, an interface definition that permits invoking services from application programs without knowing details of their internal implementation. The OGC is currently developing a family of standards that are based on the OGC's traditional suite of standards (WCS, WMS, WFS etc) which define resource-centric APIs that take advantage of modern web development practices but can't be easily accessed by traditional OGC non-API standards. The OGC's API standards are being developed as building blocks that allow assembly of novel APIs for web access to geospatial content [3]. This approach leverages the OpenAPI<sup>5</sup> standard to structure its APIs and ensure that they are developed in a consistent way.
- **Benefits and relevance to the Geospatial Defence Community:** There are potentially numerous benefits when utilising API's.
  - **Efficiency:** When access is provided to an API, the content generated can be published automatically and is available for every channel. It allows it to be shared and distributed more easily.
  - **Integration:** APIs allow content to be embedded from any site or application more easily. This guarantees more fluid information delivery and an integrated user experience.
  - **Automation:** With APIs, computers rather than people can manage the work. Through APIs, agencies can update workflows to make them quicker and more productive.
  - **Cost:** Tools can be delivered more quickly and cheaply than with existing, more traditional approaches.

The benefits of adopting APIs are attractive to technology reliant communities such as defence. However, defence's ability to adopt new technologies can be limited as it has to balance the cost and time required for the integration with existing systems. This will change as APIs are more widely adopted by mainstream IT and vendors. In the coming years, the use of APIs will likely become the de facto approach to sharing geospatial data services and tools.

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<sup>5</sup> The OpenAPI Specification (OAS) (previously known as Swagger) defines a standard, language-agnostic interface to RESTful APIs which allows both humans and computers to discover and understand the capabilities of the service without access to source code, documentation, or through network traffic inspection. <https://swagger.io/specification/>

- **Level of Maturity:** This is a mature trend, ready for adoption by the defence community. DGIWG is currently working on an API whitepaper and has started developing a profile of the OGC Environmental Data Retrieval API standard. APIs will also be adopted by the DGIWG Geospatial Reference Architecture (DGRA)

#### 8.1.2 Definite Trend 2: GeoPackage extensions

- **Description:** GeoPackage is an OGC open standard and is a platform-independent, portable, self-describing, compact format for transferring geospatial information within a SQLite database. The primary role of a GPKG is to store multiple GIS data (layers) in a single file.
- **Benefits and relevance to the Geospatial Defence Community:** The existing DGIWG GeoPackage profile includes both extensions/restrictions of the underpinning OGC standard, as well as system requirements to enable interoperability by appropriately configuring existing software. This includes descriptions for a set of conventions for storing the following data types:
  - Vector features and tiles;
  - Tiled matrix sets of imagery and raster maps at various scales; and
  - Gridded Data

Additional extensions including portrayal and symbology as well as computational and dissemination mechanisms etc. are being developed, and will foster the provision of geospatial information.

- **Level of Maturity:** DGIWG has already developed a profile of the OGC GeoPackage 1.3.1 standard. Several new requirements regarding possible extensions of this profile have been submitted to DGIWG by the community and will be addressed in the near future.

#### 8.1.3 Definite Trend 3: Web service discovery technologies

- **Description:** Providing the means to publish and search for geospatial information and services is key to utilizing the full potential of service-oriented architectures. This includes, but is not limited to, the ability to publish and search collections of descriptive information (metadata) for data, services, and related geospatial information resources in a standardized way. DGIWG has defined a profile for the OGC Catalogue for the Web (CSW) Standard. As new requirements and use cases for the automated publication and discovery of standardised Geospatial Metadata are being stated by the community, DGIWG investigates and defines means to satisfy these requirements. Possible solutions are profiles of OGC API records, SpatioTemporal Asset Catalog (STAC) or portal solutions.
- **Benefits and relevance to the Geospatial Defence Community:** Having standardized interfaces and metadata will help users to publish, find and utilize geospatial data and services more efficiently.

- **Level of Maturity:** While some solutions are already mature for DGIWG to address, there are requirements that need to be defined in more detail together with the community to find the best approach.

#### 8.1.4 Definite Trend 3: Vector Tiles

- **Description:** Tiles are packets of geographic data, packaged into pre-defined, roughly square shaped 'tiles' for transfer over the web. This is an emerging method for delivering styled web maps, combining certain benefits of pre-rendered raster map tiles with vector map data. As with the widely used raster tiled web maps, map data is requested by a client as a set of 'tiles' corresponding to square areas of land of a pre-defined size and location.
- **Benefits and relevance to the Geospatial Defence Community:** Compared to an un-tiled vector map, the data transfer is reduced because only data within the current viewport, and at the current zoom level needs to be transferred. The GIS clipping operations can be performed in advance as the tile boundaries are pre-defined. This in turn means that tiled vector data can be packaged up and distributed, without needing any kind of GIS system available to serve data.
- **Level of Maturity:** Mapbox has defined an open standard for vector map tiles called 'vector-tile-spec' which uses Google protocol buffers for space-efficient data serialisation. Web Mercator is the projection of reference, but vector tiles may be used to represent data with any projection and tile extent scheme. Esri has also an implementation of vector tiles.

## 8.2 Long Term Assessment

The key trends identified by the P5 WSTP are unlikely to affect the Defence Geospatial community in the near term but are likely to require further work by DGIWG in the next 6-10 years are as follows.

#### 8.2.1 Long Term Trend 1: Using digital ledgers such as Blockchain<sup>6</sup> for geospatial data assurance in distributed environments

- **Description:** A blockchain is a system of sharing information in a way that makes it impossible to change. It does this by maintaining a digital record of transactions that is duplicated across the entire network of ledgers. This makes it difficult or impossible to hack or cheat the system. The unchangeable nature of a blockchain digital ledger has led to it being readily adopted by institutions interested in maintaining security such as Bitcoin repositories and major banks. Recently, the geospatial community have been exploring the use of blockchain for improving the way it manages and collects geospatial data by using digital

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<sup>6</sup> A blockchain is essentially a digital ledger that is duplicated and distributed across the entire network of computer systems on the blockchain. Each block in the chain contains a cryptographic hash of the previous block, which makes blockchain transactions irreversible once they are recorded.

ledger or using geospatially enabled blockchain solutions that use a crypto-spatial coordinate system to add an immutable spatial context that enable systems to record and validate the spatial location of a transaction.

- **Benefits:** There are numerous benefits from utilising blockchain API's, including:
  - **Reduced Costs:** digital ledgers are often easier to and cheaper to implement than more traditional security mechanisms.
  - **Improved security:** By storing data across its peer-to-peer network, the blockchain eliminates risks that come with data being held centrally.
- **Relevance to the Geospatial Defence Community** The use of blockchains could provide the GEOINT community assurances for the security management and update of feature level data in complex distributed environments.
- **Level of Maturity:** Whilst digital ledger technology is fairly mature, its application within the geospatial domain is relatively immature. P5 will monitor its development.

## ANNEX A      Artefact Responsibility

Table A1 contains a list of completed DGIWG documents and artefacts that the WSTP is responsible for maintaining. (**Note** this table is extracted from the DGIWG POW and should not be updated in isolation)

Table A 1: Artefacts for which P5 is responsible

Doc No.	Document Title	Published Date	Edition Date	Review Cycle	Review by date
112	Defence Profile of OGC's Web Map Service 1.3 - Revision	2018/03/09	2017/11/28	2 years	10/2023 new version
119	Defence Profile of OGC's Web Coverage Service 2.0	2018/03/09	2017/11/28	2 years	04/2024 start review
122	Defence profile of OGC's Web Feature Service 2.0	2019/11/06	2019/10/30	3 years	04/2024 start review
124	Defence Profile of OGC's Web Map Tile Service 1.0	2018/03/09	2017/10/17	2 years	10/2023 new version
125	Defence Profile of OGC's Catalogue Service for the Web 2.0	2018/03/09	2018/03/01	3 years	04/2024 start review
126	DGIWG GeoPackage Profile 1.3.1 Ed.1	2023/09/22	2023/09/22	2 years	09/2025 start review
909	DGIWG Web Services Roadmap	2019/10/17	2019/10/09	yearly	04/2023 new version