



DGIWG 906

METADATA ROADMAP

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| 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 nation needs. The document places special emphasis on 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> |
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Introduction

Organizations providing geospatial information must enable its discovery, evaluation and use. In today's environment this is typically accomplished through a set of web services, which may interface with multiple networks to allow discovery and retrieval of the information. Successful discovery will depend on the metadata content of the geospatial information and on the specific functions provided by web services. Search functions are based on specific functional requirements, and may be initiated via a variety of mechanisms ranging from structured menus to free text fields.

Metadata is used to describe resources (e.g. dataset, series, services, etc.) in terms of certain well-defined attributes, such as resource topic category, resource title, or geographic extent of the resource. This description allows users to search for keywords, names and phrases in particular contexts or in structured searches. For example, an organization's name might be associated with a specific role with regard to the data, such as 'responsible party' or 'distributor'. Such associations, combined with the use of 'controlled vocabularies' (i.e. standardised lists of terms, such as abbreviations for countries or code lists for categories) and standardised formats for values (e.g. for dates or geographic extents) can greatly improve the efficiency of discovery, evaluation and use of information.

Efficiency in retrieving relevant and accurate information is critical. Decision makers must have access to the best available information. In order to improve the discovery, evaluation and use of information within and among the allied nations, the metadata descriptions of the various resources must share a common form and meaning. With the increasing number of types and sources of geospatial information and the multitude of discovery and exploitation tools available, the defence community will increasingly require standardized metadata terminology and registers to capture values (e.g. code lists). In order to address this need, the military community will leverage and use, to the largest degree practical, geographic standards from the ISO 19xxx series.

i. Contributing participants

The following nations participated in the development of this document: Canada, Czech Republic, Denmark, France, Germany, Italy, the Netherlands, Turkey, United Kingdom, and the United States.

ii. Document points of contact

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iii. Revision history

| Date | Edition number | Primary clauses modified | Description |
|-------------|-----------------------|---------------------------------|---|
| 2014-11 | WD | | Initial working draft of the DGIWG MD Roadmap. The document is a revision of the 'DGIWG Metadata Vision, Ed. 1.3.2, published in 2013.' |
| 2015-10 | FD | | Final Draft approved by DGIWG Technical Panel, September 2015, and submitted for publication. |
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| 2016-12 | 2.1 WD | | Draft of edition 2.1 |
| 2017-01 | 2.1 FD | | Final Draft approved by DGIWG Technical Panel, March 2017. |
| 2017-12 | 2.2 WD | | Draft of edition 2.2 based on Bucharest discussions |
| 2018-03 | 2.2 FD | | Final draft submitted for vote |

1. Scope

This document establishes the strategic direction that will guide the DGIWG, and its member organizations and associates, in addressing standardization deficiencies and efforts in the area of metadata. It describes the present state of geospatial interoperability across the civil and defence user communities and establishes a future state of goals and objectives by which associated standardisation activities are based. Key factors used included: user requirements, relevant standards (published or in work), and emerging technologies.

2. Purpose

DGIWG is the multi-national body responsible for providing advice and policy recommendations on geospatial standardisation issues to the national defence organizations of its member nations. A key objective of the DGIWG is to promote and facilitate standards-based solutions, which facilitate the efficient and effective exchange of geospatial information for those nations engage in coalition exercises and operations.

DGIWG's program of work includes the delivery of standards-based solutions for metadata and respective implementation criteria and guidance. The metadata program managers work collaboratively with members of the Defence Community to assess operational requirements and provide solutions for implementation in Defence architectures and system, with special focus on those used by NATO and NATO Nations for NATO lead operations.

The benefactors from DGIWG activities regarding metadata are DGIWG nations and associates (e.g. MGCP, NATO, EU GISMO, EUMS, etc.), and the general military community.

3. Normative references

OGC 07-006r1, **CSW 2.0.2**, *OpenGIS® Catalogue Services Specification 2.0.2*, OGC, 2007

OGC 07-045, **CSW 2.0.2 ISO AP**, *OpenGIS® Catalogue Services Specification 2.0.2 - ISO Metadata Application Profile, Version 1.0*, OGC, 2007

OGC 07-110r4, **CSW 2.0.2 ebRIM AP**, *CSW-ebRIM Registry Service - Part 1: ebRIM profile of CSW, Version 1.0.1*, OGC, 2009

OGC 13-084r2, **OGC I15 (ISO19115 Metadata) Extension Package of CS-W ebRIM Profile 1.0**, OGC, 2014

DGIWG 704 - *DGIWG Catalogue Service Profile Edition 1.0, 29 August 2007 (obsolete, under revision)*

ebRIM, *ebXML Registry Information Model, Version 3.0, Oasis Standards, 2 May 2005*

<http://docs.oasis-open.org/regrep-rim/v3.0/>

ISO 639-2:2016 *Codes for the representation of names of languages - Part 2: Alpha-3 code*

ISO 3166-1:2013, *Codes for the representation of names of countries and their subdivisions – Part 1: Country codes*

ISO 8601: 2004, *Data elements and interchange formats -- Information interchange -- Representation of dates and times*

ISO 15836: 2009, *Information and documentation – The Dublin Core metadata element set*

ISO/TS 19103:2015, *Geographic information – Conceptual Schema Language*

ISO 19107:2003, *Geographic information – Spatial Schema*

ISO 19108:2002 and Cor1:2006, *Geographic information – Temporal Schema*

ISO 19109:2015, *Geographic information -- Rules for application schema*

ISO 19110:2005 and Amd.1:2011, *Geographic information – Methodology for feature cataloguing*
(Replaced by ISO 19110:2016)

ISO 19110:2016, *Geographic information -- Methodology for feature cataloguing*

ISO 19113¹:2002, *Geographic information – Quality principles*

ISO 19114¹:2003, *Geographic information – Quality evaluation procedures*

ISO 19115¹:2003, *Geographic information – Metadata*

ISO 19115-1:2014, *Geographic information — Metadata – Part1: Fundamentals*

ISO 19115/Cor.1:2006, *Geographic information – Metadata, Technical Corrigendum 1*

ISO 19115-2:2009, *Geographic information — Metadata – Part2: Extensions for imagery and gridded data* (under revision process)

ISO/TS 19115-3:2016, *Geographic information -- Metadata -- Part 3: XML schema implementation for fundamental concepts*

ISO 19119:2005 and AMD1:2008, *Geographic information – Services* (replaced by **ISO 19119:2016**)

ISO 19119:2016, *Geographic information – Services*

ISO/TS 19130:2010, *Geographic information -- Imagery sensor models for geopositioning*

ISO/TS 19130-2:2014, *Geographic information -- Imagery sensor models for geopositioning -- Part 2: SAR, InSAR, lidar and sonar*

ISO 19135:2005, *Geographic information – Procedures for item registration* (replaced by ISO 19135-1:2015)

ISO 19135-1:2015, *Geographic information -- Procedures for item registration -- Part 1: Fundamentals*

ISO/TS 19135-2:2012, *Geographic information - Procedures for item registration -- Part 2: XML schema implementation*

ISO/TS 19138¹:2006, *Geographic information – Data quality measures*

ISO/TS 19139:2007, *Geographic information - Metadata - XML schema implementation* (under review, partly replaced by ISO 19115-3:2016)

ISO/TS 19139-2:2012, *Geographic information - Metadata - XML schema implementation - Part2: Extensions for imagery and gridded data*

ISO 19157:2013, *Geographic information – Data quality*

ISO/TS 19157-2:2016, *Geographic information -- Data quality -- Part 2: XML schema implementation*

¹ ISO 19113, ISO 19114, ISO 19138 and ISO 19115 are superseded respectively by ISO 19157:2013 and ISO 19115-1:2014.

4. Terms, definitions, and abbreviations

4.1. Definitions

4.1.1. Catalogue

collection of items or an electronic or paper document that contains information about the collection of items (ISO 10303-227:2005, definition 3.3.10)

4.1.2. Dataset

identifiable collection of data [ISO 19115-1:2014]

4.1.3. Dataset series

collection of datasets sharing common characteristics [ISO 19115-1:2014]

4.1.3. Metadata

data describing resources [ISO 19115-1:2014]

4.1.4. Register

set of files containing identifiers assigned to items with descriptions of the associated items (ISO 19135-1)

4.1.5. Registry

information system on which a register is maintained (ISO 19135-1)

4.1.6. Registry service

service that provides access to a register

4.1.7. Resource

identifiable asset or means that fulfils a requirement (ISO 19115-1:2014)

EXAMPLES : Dataset, dataset series, service, document, activity, software, person or organization.

4.2. Abbreviations

| | |
|--------------|--|
| CSW (= CS-W) | Catalogue Service for the Web |
| DGIWG | Defence Geospatial Information Working Group |
| DCAT | Data Catalogue Vocabulary |
| DMF | DGIWG Metadata Foundation |
| DWG | Domain Working Group |
| ebRIM | ebXML Registry Information Model |
| EU GISMO | Geospatial Information to Support Decision Making in Operations |
| EUMS | European Union Military Staff |
| FMN | Federated Mission Networking (NATO) |
| INSPIRE | Infrastructure for Spatial Information in the European Community |
| ISO | International Organization for Standardization |
| IHO | International Hydrographic Organization |
| IMWG | Imagery Working Group |

| | |
|--------|--|
| JGSWG | Joint Geospatial Standards Working Group (formerly IGeoWG) |
| JISR | Joint Intelligence, Surveillance and Reconnaissance |
| MGCP | Multinational Geospatial Co-production Program |
| NCMS | NATO Core Metadata Specification |
| NGMP | NATO Geospatial Metadata Profile |
| NMF | NSG Metadata Foundation |
| NMRR | NATO Metadata Registry and Repository |
| NNEC | Network Enabled Capability (NATO) |
| NSG | National System for Geospatial Intelligence (US) |
| MT02 | DGIWG maintenance Team for metadata registers |
| OGC | Open Geospatial Consortium |
| P3 | DGIWG Metadata Technical Panel |
| P5 | DGIWG Web Service Technical Panel |
| RDF | Resource Description Framework |
| SRD | STANAG Related Document |
| STANAG | Standardization Agreement |
| TRD | Technical Reference Document |
| TREx | TanDEM-X High Resolution Elevation Data Exchange Program |
| UML | Unified Modeling Language |
| WMO | World Meteorological Organization |
| XML | eXtensible Mark-up Language |
| XSL | eXtensible Stylesheet Language |
| XSLT | eXtensible Stylesheet Language Transformations |

5. Metadata Standardization – present state

5.1. Civil

5.1.1. ISO TC211 conceptual metadata standards

The following paragraphs present “generation 1” and “generation 2” of ISO standards related to metadata. The definitions for generation 1 and 2 are included in the following chapters. All of the DGIWG metadata works are based on ISO TC211 conceptual metadata standards. Generation 1 standards served as the base for developing the DMF 1.0, whereas the DMF 2.0 leverages generation 1 and 2 standards.

These standards include both abstract/content standards and implementation/encoding standards. Content standards use UML conceptual diagrams to illustrate the relations among metadata elements and a data dictionary to define the element conditionality, data type, and domains. Implementation standards define implementation in XML.

5.1.1.1. Mature metadata standards: generation 1

The standards cited below constitute a set of mature metadata standards, referred to as “generation 1” in this document. These standards cross-reference concepts from one another and should be used as a common set of standards when addressing metadata requirements and solutions.

- 1) ISO 19115 (and its corrigendum 1) specifies a conceptual schema for geospatial information metadata organized into several metadata sections (e.g. identification, quality, constraints, etc.). It includes a quality UML Model based on ISO 19113 and ISO 19114.
- 2) ISO 19115-2 extends ISO 19115 to support imagery and gridded data specific requirements.
- 3) ISO 19119:2005 extends ISO 19115 and defines a full conceptual schema for geospatial service metadata. It is the reference metadata standard for geospatial services.
- 4) The conceptual schema for geospatial metadata defined through ISO 19115, ISO 19115-2 and ISO 19119 are based on the following foundation standards:
 - ISO/TS 19103 defines the conceptual schema language and specifies a set of basic types widely used in the ISO 19100 series of standards;
 - ISO 19107 defines a set of geometric primitives used in ISO 19115, for example, to describe the spatial extent of a metadata resource; and
 - ISO 19108 defines a set of temporal primitives used in ISO 19115, for example, to describe the temporal extent of a metadata resource. ISO 8601 is used for the expression of dates and times.
- 5) The implementation of ISO 19115, ISO 19115-2 and ISO 19119 involves the implementation of those foundation standards (19103, 19107 and 19108). ISO 19110 defines the structure of a feature catalogue (entity/attributes) that can be referred to within an ISO 19115/ISO 19115-1 record.
- 6) Some widely known civilian profiles for the ISO metadata standards are listed below:
 - WMO Core Metadata Profile 1.3 (15 January 2013). This is the Core metadata profile of the civilian METOC (Meteorology and Oceanography) Community, which contains few metadata elements. The DGIWG Metadata Foundation standard (DGIWG - 114) is covering all of them;
 - INSPIRE Directive (and INSPIRE Metadata Regulation);
 - North American Profile (NAP);
 - Australian and New Zealand (ANZLIC) Metadata Profile;
 - UK GEMINI; and
 - Metadata Spanish Core (NEM).

5.1.1.2. New metadata standards: generation 2

As “generation 1” standards reference each other, the revision of some of them implies the need to revise the whole set of standards, leading to the establishment of a “generation 2”.

- 1) ISO 19115, its corrigendum and the service metadata model of 19119 have been revised into the new ISO 19115-1 Metadata Fundamentals, published in 2014. The revision of ISO 19115 to ISO 19115-1 did not include the extension/addition information of 19115-2.
- 2) ISO 19157 – Data Quality, published in 2013, revises, merges and harmonises the quality standards ISO 19113, ISO 19114 and ISO 19135-1:2015, *Geographic information -- Procedures for item registration -- Part 1: Fundamentals*

ISO/TS 19135-2:2012, Geographic information - Procedures for item registration -- Part 2: XML schema implementation

- 3) *ISO/TS 19138* (which specifies the structure of data quality measures, and provides a set of standardised measures within a register). Moreover, the data quality UML models defined in ISO 19115:2003 have been removed from the revision of ISO 19115 and are now described in ISO 19157.
- 4) ISO 19115-2 is under revision. The scope of this standard has been redefined as “acquisition and processing metadata”.

During the revision of ISO 19115-2, it has been stated that the coverage result part should go to ISO 19157. An amendment to ISO 19157 is under development to include this part. (Its name is; Amd. 1: Geographic information -- Data Quality -- Amendment 1: Describing data quality using coverages).

- 6) ISO 19119 was revised without metadata elements definitions, as they have been included in ISO 19115-1, in 2016. ISO 19119:2016 only includes service specification definition.
- 7) ISO 19110 was revised with the inclusion of additional capabilities to manage multilingualism in feature catalogues.

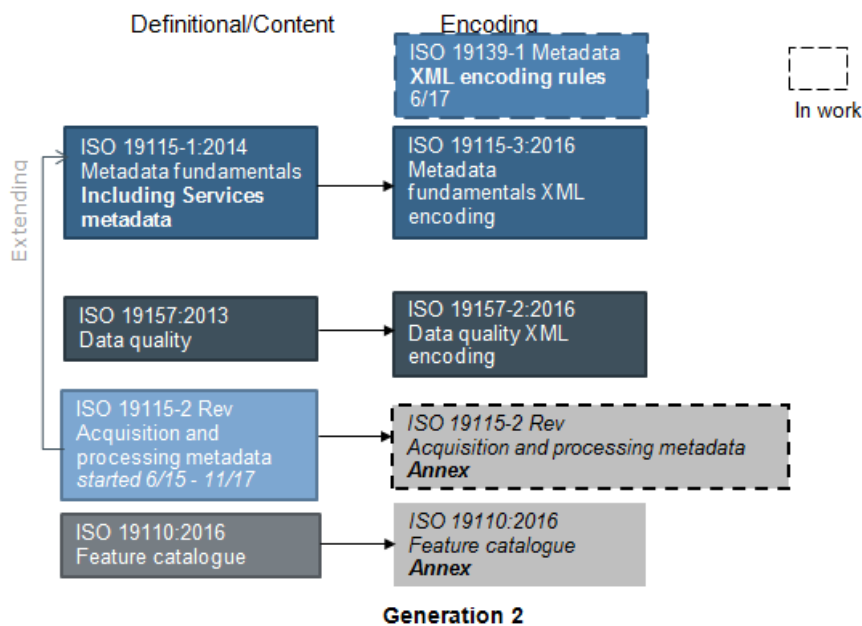
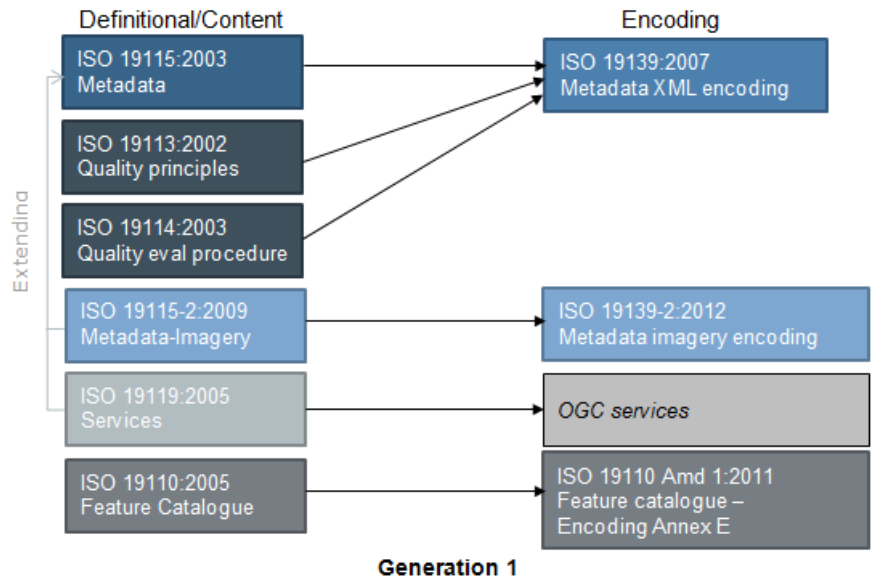
5.1.1.3. Migration from generation 1 to generation 2

Care has been taken in the establishment of generation 2 standards, to maintain conceptual backward compatibility with generation 1 standards.

The migration from ISO 19115:2003 to the revised ISO 19115-1:2014 is thought to be a migration from generation 1 to generation 2, which means to migrate from the set (ISO 19115 + ISO 19115-2 + ISO 19119) to the set (ISO 19115-1 + ISO 19157 + a future revision of ISO 19115-2).

Annex H of ISO 19115-1 describes modifications applied in the UML model from ISO 19115 to ISO 19115-1. This work has not been done for the data quality model transferred to ISO 19157.

The following figure illustrates changes between these two ISO generations.



5.1.2. ISO TC211 Metadata Implementation (Encoding) Standards

ISO encoding standards specify the XML format and rules used to create and validate the output metadata records.

ISO/TS 19139 defines a set of encoding rules which can generally be applied to any of the spatial conceptual standards. It proposes an XML Schema Implementation of ISO 19115 and the parts of the conceptual foundation standards involved when implementing ISO 19115. Schemas are available here: <http://www.isotc211.org/schemas/2005/>.

ISO/TS 19115-3:2016, defines the XML schema implementation for ISO 19115-1. It includes a resource XSLT transformation to ease the migration from ISO 19115 to 19115-1. All ISO 19139 XML can be translated to ISO 19115-3 without content loss. The ISO TC211 XML Management Group has developed several transforms that facilitate migration of metadata from ISO 19139 to ISO 19115-3. These transforms are freely available and can be downloaded from the ISO website: <http://standards.iso.org/iso/19115/resources/transforms/ISO19139>.

No encoding was originally provided by ISO for the previous version of the ISO 19119 standard. It had been generated by OGC in the OGC 07-045 document. Now that service metadata elements are included in ISO 19115-1, the encoding is included in ISO/TS 19115-3:2016.

ISO 19139-2 defines the XML schema implementation of ISO 19115-2. To allow the use of ISO 19115-2 metadata elements with ISO 19115-1 metadata element before ISO 19115-2 rev is published, ISO/TS 19115-3:2016 has also included this encoding.

ISO 19157-2:2016 defines the XML implementation for ISO 19157:2013.

OGC 07-045, CSW **2.0.2 ISO** proposes an XML Schema Implementation of ISO 19119 based on ISO/TS 19139 encoding rules. ISO/TS 19139 also proposes a standard encoding of Coordinate Reference System catalogues, unit of measures catalogues, and code list catalogues.

ISO XML Maintenance group (XMG) has recently stated that XML encodings should not be part of separate standards but should be included as an annex of the conceptual standard. Thus, ISO 19110:2016 includes an annex referencing the XML schemas.

5.1.3. Dublin Core

Dublin Core is an international initiative focusing on discovery aspect of metadata for general information. The initiative has gained a broad cross-sectoral support. The Dublin Core Metadata Element Set was published as the **ISO 15836:2009** standard and has been confirmed in 2014.

The wide use of Dublin Core does not limit the importance of sector-specific metadata standards such as **ISO 19115**². Metadata repositories of spatial resources are generally not set up to address discovery-only requirements and Dublin Core metadata elements will not satisfy the wide range of requirements of the geo communities.

However, the interface between Geospatial-Intelligence community and the rest of the military communities has to be considered. It is fundamental that the existence of the geospatial resources be known by non-geographers. In this respect, Dublin Core certainly has a role to play. Indeed it provides a core set of general metadata elements, all of them having a mapping with ISO 19115 so with geo metadata standards. For this reason, Dublin Core is taken into account for DGIWG metadata.

5.1.4. CSDGM

The FGDC (Federal Geographic Data Committee) is an US inter-ministerial body, responsible for assisting in the development and implementation of the objectives of the executive order to develop, implement, and promote standards.

The FGDC NSDI (National Spatial Data Infrastructure) is the national infrastructure for the US geographic information. This initiative consists of the following complementary components:

- the development of a network, largely computerized, facilitating the sharing of spatial data resources (Clearinghouse);
- the development of mechanisms for producers to describe the data they hold through metadata; and
- the definition of the base fabric geographic information to be widely available to potential users.

The specification of the FGDC metadata content, the CSDGM (Content Standard for Digital Geospatial Metadata, 1998), has become a reference standard recognized by many nations. However its use is no longer recommended within FGDC, which promotes migration to ISO standards.

² In CEN (European Standardisation Committee) a mapping/extension of Dublin Core has been made with the purpose of handling geographic information. This initiative has been abandoned with the development of INSPIRE.

This work does not influence DGIWG metadata works and there have not been any requirement/need to provide a mapping/transformation between CSDGM and DMF.

5.1.5. Earth Observation Metadata profile of Observations & Measurements

This OGC metadata specification has been developed by the ESA (European Space Agency), based on ISO 19156:2011-Geographic information -- Observations and measurements (O&M2.0), which defines a model for Observation and Measurements. It addresses metadata requirements to describe earth observation data. The implementation is based on GML. This work has been taken into account for the definition of the DMF sensor metadata elements.

5.1.6. GeoDCAT-AP

DCAT is an RDF vocabulary designed to facilitate interoperability between data catalogues published on the Web. GeoDCAT-AP is a European initiative providing an extension of DCAT-AP for describing geospatial datasets, dataset series, and services. It provides an RDF syntax binding for the union of metadata elements defined in the core profile of ISO 19115:2003 and those defined in the framework of the INSPIRE Directive. Its basic use case is to make spatial datasets, data series, and services searchable on general data portals, thereby making geospatial information better searchable across borders and sectors. This can be achieved by the exchange of descriptions of data sets among data portals.

As other similar initiatives exist in different places, OGC Metadata DWG has decided to write a White Paper on the geo extensions of DCAT-AP.

This new form of metadata could be an opportunity for DGIWG to do outreach to the Semantic Web communities.

5.1.7. Standard service specifications

OGC 07-006r1, **CSW 2.0.2** is the reference service specification for discovery, evaluation, and use. It proposes an XML encoding based on a profile of Dublin Core which is suitable for discovery. More generally, a service compliant to the base OGC 07-006r1, **CSW 2.0.2** will address discovery requirements. It is necessary to use OGC 07-006r1, **CSW 2.0.2** application profiles to go further:

- OGC 07-045, **CSW 2.0.2 ISO** is an ISO 19115/ISO 19139 application profile of OGC 07-006r1, **CSW 2.0.2**. It is based on an ISO/TS 19139 compliant encoding of **ISO 19115** and **ISO 19119**. It addresses evaluation requirements and is applicable in this context.
- The CSW-ebRIM Registry Service defines an application profile of **OGC 07-006r1, CSW 2.0.2** based on the ebRIM information model. ebRIM is a generic metamodel standardized in the OASIS (Organization for the Advancement of Structured Information Standards) consortium that can be instantiated for the discovery of various types of resources: metadata, sensor descriptions, feature catalogues, etc. These instances must be standardized in Extension Packages. An Extension Packages for ISO 19115/19119 (I15) and Earth Observation metadata have also been published.

See DGIWG – 909, Web Services Roadmap, for more information.

CSW 3.0 was published in 2016 but an application profile is not yet available.

There is currently no application profile based on ISO 19115-3.

5.1.8. Register standards

5.1.8.1. ISO 19135-1

This standard describes Procedures for item registration. ISO 19135-1:2015 revises ISO 19135:2005. It includes description of the management procedures.

5.1.8.2. ISO/IEC 11179-x

This suite of standards has been established jointly by the ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission). It is not specific to geo. It includes:

- Part 1: Framework (this part describes general concepts and how other parts interact with each other).
- Part 2: Classification
- Part 3: Registry metamodel and basic attributes
- Part 4: Formulation of data definitions
- Part 5: Naming and identification principles
- Part 6: Registration

All those parts describe different components to set up a metadata register (MDR).

5.1.9. Registers and Code Lists

A set of code lists is usually used to harmonise the content of metadata:

- ISO 19115 and ISO 19115-1 use code lists for some metadata elements to harmonise the content of the metadata.
 - Note: New elements from ISO 19115-1 code lists have been added to DMF only if a need was foreseen and not systematically.
- Country codes are defined by ISO 3166-1 and STANAG 1059 ed 8 (under revision).
- Language codes are defined by:
 - ISO 639-2 (3-letter codes). ISO 639-2 defined both bibliographic and terminology letter code. STANAG 2586, DGIWG Metadata Foundation and INSPIRE are using the bibliographic form of ISO 639-2.
 - ISO 639-1 also defined 2-letter codes for languages.
- The IANA (Internet Assigned Numbers Authority) is maintaining a register of character set codes (<http://www.iana.org/assignments/character-sets>).
- ISO 4217 defines a currency code list (e.g. dollar, euro, etc.).
- EPSG (European Petroleum Survey Group <https://www.epsg-registry.org/>) and OGC are maintaining units of measures and coordinate reference systems registers.

5.2. Defence

5.2.1. Defence Metadata Specifications

- **NATO Core Metadata Specification (NCMS)**, published early 2015, replaced the former NATO Discovery Metadata Specification (NDMS). The NCMS Common Layer is primarily based on the elements defined in ISO 15836:2009 as the Dublin Core Metadata Element Set. The NCMS Security Layer provides the metadata elements for capturing information about the classification and releasability of a resource as part of a confidentiality label in accord with STANAG 4774, Confidentiality Metadata Label Syntax. An Information Lifecycle Support Layer contains elements that additionally support information management functions. The Joint ISR Community utilized the NCMS/NDMS as de-facto baseline for its Joint ISR Trial Unified Vision 2014 core metadata harmonization initiative, which developed metadata mappings between various community of interest metadata models, including the NATO Standard ISR Library Interface (NSILI) Metadata Model, which is used by NATO Coalition Shared Data (CSD) Systems, and the Intelligence Projects Integration Working Group (IPIWG) Metadata Model, which is used by the Battlefield Information Collection and Exploitation System (BICES).

It is of importance that DGIWG Metadata be mapped to the NATO Core Metadata, in order to prepare for interoperability with a wider community than just GEO. A limited mapping from DMF to NCMS has already been realised.

- The **STANAG 4559 NATO Standard ISR Library Interface (NSILI)** provides a standard interface and metadata catalogue for querying and accessing distributed ISR product libraries maintained by NATO and NATO Nations. From its very beginnings as standard imagery library interface, STANAG 4559 has expanded the interface and data model for discovery and retrieval of more general ISR data, including distributed repositories of Ground Moving Target Indicator (GMTI) data, Synthetic Aperture Radar (SAR) data, Electro Optical (EO) imagery, Infra-Red (IR) imagery, Motion Imagery (MI), as well as exploitation products, Collection and Exploitation Plans, and others. In its newest edition STANAG 4559 will also support streaming data and Joint ISR workflow artefacts. Today's NSIL Interfaces and Services are the main enablers of NATO's Coalition Shared Data and Joint ISR initiatives.
- The **Intelligence Projects Integration Working Group (IPIWG) Metadata Schema** is the agreed standard to be used in the exchange of Metadata Library Cards between the Intelligence Domains of the NATO Wide Intelligence Architecture. The domains are not required to use this metadata set internally, provided that they translate to or from the agreed standard for cross-domain exchange. The IPIWG metadata are organised into groups called layers, i.e. Card, Common, Intel, Imagery, RFI and Extension Layers. To enable discovery and retrieval of products across all domains, library cards that conform to the Intelligence Exchange Schema (IES) are exchanged via the Central Card Catalogue (CCC). The BICES Group Executive (BGX), formerly known as NATO BICES Agency (NBA), is currently responsible for the provision and maintenance of the CCC on behalf of the NATO Metadata Group of Experts (MGEX).
- The **Geospatial Maritime Working Group (GMWG)** is responsible for the Additional Military Layers initiative to add supplementary information to nautical charts. Those AML also include feature and dataset metadata. It is necessary to ensure by coordinating with this group that DMF and those metadata are consistent.
- The ad-hoc **Geospatial Aeronautical Working Group (GAWG)** will also consider using NGMP metadata to exchange aeronautical data.

5.2.2. Defence profiles of the ISO metadata standards

- **DGIWG – 114, DGIWG Metadata Foundation (DMF)** is the DGIWG metadata specification. Version 1.0.1 was published end-2014. It is applicable to all DGIWG datasets, series, products, services and projects. Version 2.0 has been published mid- 2017. It includes Sensor elements and an implementation according to generation 2 of ISO metadata standards.
- **STANAG 2586 – NATO Geospatial Metadata Profile (NGMP)**: defined by NATO JGSWG (ex-IGeoWG) with support of DGIWG, it addresses NATO Command Structure requirements. It is also a profile of DMF. Security and releasability labelling within NGMP are however not consistent with the future STANAG 4774 – Confidentiality Metadata Label Syntax. NGMP is the metadata standard applicable for NGIF datasets and series. It includes both XML and ESRI shapefile implementation. A new version has been developed with minor changes (code list updates). The new edition of STANAG 2586 (edition B) states that DMF 2.0 should be used for NATO needs. This has required the establishment of a guideline document explaining how to use DMF 2.0 within the NATO context, published as SRDs.
- **MGCP Metadata Specification** was revised mid-2013. In MGCP, the main changes from MGCP TRD3 Metadata specification to MGCP TRD4 Metadata Specification concerns Feature Level metadata. Some metadata elements that were provided at feature level are

now provided at Tile (subregion) Level. At Feature Level, some metadata information were renamed to align with DGIWG Feature Data Dictionary (DFDD) 2010-2.

5.2.3. Example of military national metadata standards/profiles

- **Geospatial Metadata (Canada):** The Government of Canada developed a Standard for Geospatial Data that mandates all federal departments to conform to ISO 19115 for Geographic Information Metadata, ISO 19128 for Geographic Information Web Map Server Interface, and the North American Profile (NAP) of ISO 19115:2003 Geographic Information Metadata. The Department of National Defence performed a crosswalk mapping of its metadata against the NATO STANAG 2586, the NATO Geospatial Metadata Profile (NGMP), and concluded that CAN is compliant with the standard and uses more mandatory metadata elements than what are identified in the STANAG. Canada will be in a position to comply with STANAG 2586 when it is updated with the DMF in the future.
- **NMF (U.S. NSG Metadata Foundation³):** This metadata profile has been developed by NGA through its Metadata Focus Group. A gap analysis has been conducted between NMF 2.1 and NGMP in the scope of NGIF. The result of this analysis is that NGMP should be used for NGIF metadata (dataset and series level).
- **MGMP (UK MOD Geospatial Metadata Profile):** The UK has developed a profile of DMF called MGMP and the current version is version 2.0.

5.2.4. Defence metadata services

More information about Catalogue services and project P5.2 CSW is to be found within the DGIWG Web Service (P5) Roadmap.

5.2.5. Defence metadata registers and code lists

DMF and NGMP both defined a set of code lists for standardised vocabularies. A large part of these code lists come from ISO and most of the remaining ones are NATO specific.

The NMRR, controlled and exploited by NCIA, is the NATO Metadata Registry and Repository. It is a registry tool used to store reference information (xml schemas, documents, etc.) within NATO. It also includes a Vocabulary Register part aiming to store different metadata concepts and providing tools to facilitate mapping between different concepts.

³ NMF is part of the US National System for Geospatial Intelligence (NSG)

6. Technology considerations

6.1. Existing

The efficient use of metadata depends on the exchange and encoding format of the metadata. XML based encoding, such as ISO 19139, enables the use of interoperability tools which allow for schema transformations like xslt, or quality and conformity checks using XML schemas (xsd) and schematrons (for example a stand-alone application like CatMDEdit or a web-based application like INSPIRE geportal enable user to check the validity of their metadata according to one standard). XML is also the format used by OGC Web Services.

However, the XML syntax makes it difficult to read for human-users and the development of user-friendly applications and software is therefore required to facilitate the establishment of metadata, as well as its discovery and viewing. For example, the existing implementations of catalogue services are GeoNetwork, ESRI metadata editor, etc. which enable the collection of metadata conformant to ISO standards.

Sometimes, instead of developing management tools enabling the exploitation of XML metadata, organizations may choose to use another encoding for their metadata. For example, ESRI Shapefile implementation was required for NGMP by the NATO Command Structure. One of the disadvantages of an ESRI SHAPEFILE implementation is that they flatten the structure of the conceptual metadata model causing multiplicity and domain issues, implying loss of information, no support for XML based transformations and no support for mainstream-IT data validation mechanisms. Further, ESRI SHAPEFILES do not efficiently support developments as addressed in section 6.2. Recently, within the CN/PN process of NATO, an ESRI SHAPEFILE implementation or an Esri geodatabase has been proposed for metadata, partly based on NGMP requirements.

6.2. Emerging

6.2.1. Emerging formats

In addition to the format described in the previous section, some other emerging formats can also be considered to encode metadata. For example, JSON (JavaScript Object Notation) is a format which is more and more common in a web context that could be considered for metadata as well. Other technologies from the semantic web could also be considered (e.g. DCAT).

6.2.2. Unique Resource Identifiers and Semantic Web

Some other important developments related to metadata are the use of unique resource identifiers schemes, ontologies and Linked Data. These developments are key for an efficient and consistent management of metadata. Moreover, together they provide a mechanism that would significantly enhance semantic interoperability between different information domains. The recommendations of the ISO AdHoc group on metadata management highlight the need for uniquely identifiable metadata elements, using permanent and resolvable identifiers. It also stresses the very important role of registers and organisational embedding of ISO19135-1 for metadata management.

6.2.3. Building Information Modeling

BIM includes a 3D building model that allows management of the building. BIM itself is not new but it is more and more coordinating with geographic information. As any data concept it includes metadata and future work might be to consider those metadata and see how they are aligned with geo-metadata.

6.2.4. Augmented reality

Augmented reality is a way to represent the data that is more and more used and that can have many applications within Defence. This way to integrate different sources of data necessary requires strong and precise metadata. It might also require dynamic metadata.

7. Metadata standardization - future state

7.1. Target objectives

To ensure an efficient usage of metadata within DGIWG and the DGIF, several constituents are needed: one metadata specification (DMF), one Catalogue Service enabling the discovery and evaluation of metadata and a set of registers and a registry to support management of metadata and user metadata knowledge.

7.1.1. Short-term vision (2 years)

Concerning DMF, the challenge is now to encourage DMF implementation within the nations through the development of DMF-specific tools such as metadata editors or validators. Such tools would allow a wider and more operational use of DMF.

7.1.2. Mid-term vision (5 years)

DMF use within nations must continue to be pushed by DGIWG.

In the meantime the development and usage of a DGIWG metadata catalogue along with metadata registers and a registry, managed accordingly to DGIWG 915 Register Maintenance Procedure, are crucial both for user and management activities regarding metadata, and proper exploitation of the DGIF infrastructure. This subject is a key point that has to be dealt with in a short to mid-term by DGIWG.

7.1.3. Long-term vision (10 years)

In the long term, DMF must be truly regarded as the “foundation” of all DGIWG standards for metadata. It is of great importance that the coordination with other Defence Partners (i.e. NATO, MGCP, EU GISMO) lead to the emergence of consistent standards among the different communities. It is also an objective to encourage software vendors to enable user-friendly use of the DMF (collecting, conformance testing, validation, editing, etc.) through extensions or specific tools.

7.2. Geospatial content

7.2.1. Feature level metadata

Metadata has traditionally been worked and applied to dataset and services, however there is a growing need for metadata at the feature and attribute levels in the context of MGCP and DGIF. A feature/attribute level metadata schema harmonized between MGCP and DGIF would enhance interoperability of data content between military organizations.

Feature level metadata is also an area that will increase with the development of enabling Web Services to combine data from different sources. Each individual data element will need its own metadata, and the resulting dataset should also have an aggregated metadata set. Rules will need to be established, first to define the feature level metadata, then to generate an aggregated metadata set for the dataset.

7.2.2. Product specification

Even if a general metadata specification is applied, the use of this general metadata specification should be specialized for each product. Thus, product specification should not only contain description of the content of the data but also description of the content of the metadata. DGIWG profile of ISO 19131 includes a part called “metadata”. This part should reference the last version of DMF and add recommendations on which elements to be used, with which cardinality, value domains or specific values if applicable. Metadata panel will need to provide help and advices to product specification team to write this metadata part.

7.2.3. Product object concept

The Product Object Specification concept has originally been introduced to fulfill Portrayal Catalogue generation needs. However, this concept might include in future anything needed to generate a Product Specification, including metadata (see 7.2.2). Coordination work is foreseen to incorporate metadata aspects with this concept.

7.2.4. Ontologies

Geospatial concepts content is more and more described as ontologies. This new trend tend to relegate “traditional metadata” in the background, even if they still include metadata concepts. This evolution should be followed by DGIWG metadata panel to assess metadata needs within this domain.

7.3. Geospatial services

A Catalogue Web Service enabling the query and return of DMF metadata elements is required to enable efficient usage of the DMF.

A registry service is also required to be able to publish and maintain metadata fundamentals.

7.4. Standardization initiatives

7.4.1. Civil standards

7.4.1.1. ISO TC211 metadata works

ISO 19139 is being revised to separate the general encoding rules from the XML schema for metadata. The result will include in a new technical specification ISO 19139-1.

These works about implementation standards are crucial for the implementation of ISO 19115-1 and have to be adopted by DGIWG.

ISO 19115-2 is also being revised, with a possible relationship with P3.01 (metadata for sensors) works. XML schemas for the revision will be directly embedded in ISO 19115-2.

ISO 19165 – Preservation of digital data and metadata is another new work item, which is out of the scope for DGIWG.

7.4.1.2. OGC metadata works

OGC metadata works are related with Catalogue Services (see DGIWG P5 Web Services Roadmap).

The current project “Geospatial User Feedback” aims to define an extension to ISO 19115-1 and 19157, in order to enable users to store their feedback on web available data using a catalogue service. The interest for DGIWG and DGIWG nations still have to be evaluated.

7.4.2. Defence standards

7.4.2.1. NATO metadata works

Coordination has been established between the DGIWG Metadata Technical Panel and the JISR.

Future information sharing in NATO (NNEC, FMN) requires a robust mechanism that will control and guarantee information security, integrity and releasability across federated IT-networks. The fundamental concept of “confidentiality labelling”, as laid down in STANAG 4774 and STANAG 4778, is the realisation of the aforementioned requirement; both DGIWG and NATO JCG-ISR contributed in its development. It is anticipated that “confidentiality labelling” will evolve further, and DGIWG will need to safeguard its DMF standard to keep synchronised with STANAG 4774 and 4778, and other information security specifications within NATO.

Moreover, the STANAG NGMP is being revised. This new edition makes it important to consider a compliance with the NATO Confidentiality Metadata Label Syntax.

8. Program plan

8.1. DGIWG Metadata Technical Panel

The Metadata Technical Panel (P3) coordinates metadata activities within DGIWG and ensures coordination with civilian standardization bodies and military customers regarding metadata.

Its mission includes the following:

- To maintain (annual revision) of this document, the DGIWG Metadata RoadMap,
- To coordinate, contribute to, and support military requirements within the civilian standardization activities related to geospatial metadata through the DGIWG liaison with ISO/TC 211 and OGC. Currently, the focus is mainly on ISO TC211 projects (ISO 19115-2) and Defence DWG and Metadata DWG in OGC,
- To coordinate and provide support to DGIWG projects regarding metadata aspects. This coordination is a two way process:
 - This roadmap must take advantage of the work of the various DGIWG project teams that are addressing metadata issues; and
 - The activities in these project teams must also align with this roadmap.
- To provide support and ensure a coordination regarding standardization activities undertaken by other sectorial bodies (e.g. IHO, WMO) or other defence organizations (e.g. MGCP, NATO JCGISR IMWG, JGSWG (GIR Team), etc.):
 - Conducting a gap analysis and creating mapping documents with other profiles/standards in use in the military community.
- To determine, manage and revise the requirements for DMF, metadata profiles and metadata registers and revise them,
- To provide metadata best practices/guidelines for the use by the military community.

8.2. DGIWG Metadata Register

A Metadata Register Maintenance Team (MT02) has been established within DGIWG to:

- address the DGIWG requirements for a metadata register (identified in the D20 report) and new requirements expressed by the Metadata Technical Panel. It will be the “control body” to approve and/or reject proposals to the Metadata Registers
- create and maintain the appropriate metadata registers (structure and design), and if possible to be compliant with ISO 19135.

The presence of a metadata register is of great importance for an efficient management and usage of DGIWG Metadata. Metadata registers will provide a single source of information/content promoting syntactic/semantic interoperability of metadata elements across geospatial communities. It will also provide a responsive adjudication/deployment of metadata content.

A list of registers has been set up (data format, geographic extent, responsible party, codelists, data quality measures, uom, feature catalogue, product specification, keywords, thesaurus, coordinate reference systems, portrayal catalogue).

The register content can be populated before having a registry tool to access it. Register items can be translated by volunteering nations.

The Register Management Tool (RegManTool)⁴ software could be a basis for the establishment of the MT02 registry, with some adjustments and modifications to fulfill the DGIWG requirements.

The NMRR could also be a technical solution to host the register in a NATO context.

⁴ The RegMan Tool is a software which has been developed by Germany.

The DGIWG document 915 will be reviewed by the team to determine a solution for a metadata register.

8.3. Metadata for Sensors and Georeferenceable Imagery

The Metadata for Sensors and Georeferenceable Imagery project (P3-01) aims to define an extension of the DGIWG Metadata Foundation for sensors and georeferenceable imagery to support Geo and ISR community requirements regarding the description of georeferenceable and processed imagery with associated sensor acquisition metadata. The benefit is to be able to discover, compare images and assess the fitness for use of the image in a standardized way including the sensor acquisition metadata of interest for the user.

The DMF version 2.0, published mid-2017 includes this extension.

8.4. Expressed requirements

Requirements have been expressed by the DGIWG High Resolution Elevation product group (P2.01) to establish quality measures adapted to high resolution imagery data.

One requirement has been expressed by NATO to update NGMP. This requirement will be fulfilled in two steps. Firstly, for the short term, minor changes have been applied directly to AGeoP-08 in a new version (final draft published end 2015), and a guidance document will be set up for NATO, explaining how to create a Confidentiality Label out of NGMP metadata. Secondly, it is anticipated that the STANAG 2586 will refer to DMF 2.0. This will require the establishment of a guidelines document explaining how to use DMF 2.0 within the NATO context.

Some requirements have not yet been formally expressed such as the need for a GeoDCAT implementation of the DMF.

9. Dependencies

DGIWG Metadata works should take into account current and upcoming works regarding metadata within civilian standardization bodies such as ISO and OGC, and metadata initiatives within the Defence community (MGCP, TREx, NATO such as NATO IMWG, NMRR). It is crucial to coordinate with these communities to ensure that DMF is compliant with these initiatives and that DMF is also taken into account during these works.

DGIWG capability to host a metadata registry is crucial to strengthen metadata use. The DGIWG Namespace Identifier task is critical to develop and maintain the metadata registry.

DGIWG metadata usage will also be very dependent on having a metadata editor working to comply with DMF and a validation tool which checks that a metadata record is compliant with DMF or not. Such tools will make easy and help end-users while collecting and understanding metadata and will also contribute to the quality and hence interoperability of the metadata. Software tools could support DMF metadata, like they did for INSPIRE metadata. In this way one could view, collect, edit and validate a DMF compliant metadata by using a software tool.

Feedback on DMF use (what users (who populate metadata) understand from title, identifier, abstract, lineage statement, series etc.) is necessary to be able to ensure an appropriate collection of metadata fields. Guidelines could be written based on these potential feedbacks.

Common work has to be realized between the Metadata Technical Panel and the Web Services Technical Panel regarding the establishment of a Catalogue Service for DGIWG Metadata. Those works will include testing of the Catalogue Service with DMF metadata that could highlight needed improvement for DMF.

Coordination with the Vector and Model Schema Team will probably be necessary when dealing with Feature Level Metadata (future works).

Annex A (Informative)

Summary of activities

| Standardization activity | | | Action ⁵ | Description | Status |
|-----------------------------------|--|--|---------------------|--|--------|
| Identifier | Name | Date | | | |
| DGIWG - 114 | DGIWG Metadata Foundation 1.0.1 | 2014.11.21 | Use | This is the DGIWG Metadata specification for DGIWG metadata, on data and services level. It is applicable for all DGIWG projects and within the DGIWG Geospatial Information Framework (DGIF). | Closed |
| DGIWG - 114 | DGIWG Metadata Foundation 2.0 | April 2017 | Develop | Extend DMF to add a sensor metadata part plus other improvement(mapping with ISO 19115-1, improvement of services and quality part, XML encoding according to ISO 19115-3) | Closed |
| ADatP 4774 | Confidentiality Metadata Label Syntax | SD review planned for end 2016 | Assess | Provide comments to NATO, and use it to develop a mapping with the NATO Geospatial Metadata Profile and DMF 2.0 | Open |
| ADatP 4778 | Metadata Binding Mechanism for Information Sharing | 2017 | Assess | Provide comments to NATO in relation with the WSTP. | Open |
| | NATO Core Metadata Specification | 2014.07 | Assess | Establish a mapping with DMF and provide comments to NATO JISR | Closed |
| STANAG 2586 Ed A v 2.0 + AGeoP-08 | NATO Geospatial Metadata Profile | Ratification date 2016.02 | Use | | Closed |
| STANAG 2586 Ed B | NATO Geospatial Metadata Profile | Beginning of work Oct.2016 Planned end date : | develop | Define guidance instructions to use DMF within NATO Context. | Open |

⁵ Action is 1) assess, 2) develop, 3) modify, 4) test and evaluate, 5) use, 6) fade, 7) cancel (retire)

| Standardization activity | | | Action ⁵ | Description | Status |
|---|---|------------------------------|---------------------|--|----------|
| Identifier | Name | Date | | | |
| | | late-2017 | | | |
| NCMS | NCMS | 2014 | Assess | A limited mapping with NCMS has been done. | Closed |
| ISO 19115-1:2014 and ISO 19157 + their implementing standards | Metadata principles – Fundamentals Data Quality | Integrated in DMF 2.0 | Assess | Define the DMF implementation of ISO 19115-1 and ISO 19157. Add new elements from ISO 19115-1 and ISO 19157 if needed. | Closed |
| ISO 19115-2 | Metadata for imagery | Integrated in DMF 2.0 | Assess | Use as an input for DMF 2.0. Anticipate that DMF 2.0 could be used as inputs for the revision of ISO 19115-2. | Open |
| | Feature Level Metadata | | Assess | Coordination task for feature level metadata between MGCP TRD4 and DGIF/NGIF model | Foreseen |
| | GeoDCAT | | Assess | Participate to any international standardisation work on GeoDCAT Evaluate DMF against GeoDCAT | Foreseen |
| NMF part 3 version 1.1 | Metadata for Imagery and Gridded Data | 2014.06.20 | Assess | Gap analysis between DMF and NMF. Check if inputs may be found in NMF part 3 for P3.01. Answer is no. | Closed |
| NMF 2.1 | NSG Metadata Foundation | 2015 | Assess | Gap analysis between NGMP and NMF in the scope of NGIF. The result of this analysis is that NGMP should be used for NGIF metadata (dataset and series level). | Closed |
| | DGIWG metadata best practices/guidelines document | Beginning of work : mid-2016 | Develop | Best practices/guidelines document for the use of DMF and metadata for DGIWG nation | Open |
| DGIWG - 915 | DGIWG Metadata Register maintenance Procedure | Planned end date : mid-2018 | Use | Procedure document for the maintenance of the DGIWG metadata register | Open |
| | NATO Metadata Registry and Repository | Planned end date : 2018 | Assess | Study opportunities to store the register in the NMRR | Open |

| Standardization activity | | | Action ⁵ | Description | Status |
|--------------------------|--|------------------------------------|------------------------|--|----------|
| Identifier | Name | Date | | | |
| | Populate the register content, and maintain it. (Translation of register content to other languages is under responsibility of nations) | Maintenance activity : no end date | Assess | Populate the register as an Excel spreadsheet | Open |
| | DMF Tools | Beginning of work : mid-2017 | Assess/Develop/Support | DMF tools could include: -DMF editor -DMF validation tool -DMF transformation tool (e.g. between the 2 ISO generations) | Foreseen |
| DGIWG CSW profile | DGIWG CSW profile | Beginning of work : mid-2017 | Support | Support for CSW activities. Help to establish a CSW for DMF metadata. | Open |
| | DMF implementation state of play | Beginning of work : 2018 | Assess | Poll DGIWG nations to understand where they are with their metadata implementations | Foreseen |
| | Enriching NGMP | 2018 | | Address the needs for NGMP additions (mapping with STANAG 7123, shape file format) | Foreseen |