DGIWG 254

Defence Raster Product Implementation Profile

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Abstract:	This standard, for Raster map products, supports defence requirements for the creation and exchange of a wide range of raster cartographic products. It defines a multi-scale grid system for standardized products, the associated structure, tiling-scheme, the data and metadata content and encodings (GeoTIFF, GMLJP2 and NSIF) that are to be used.
Copyright:	

i. Contributing organizations

Nation	Parent organization
France (Lead Nation)	Institut Géographique National (IGN)
Sweden	Military Geographic Service
Australia	Australian Geospatial-Intelligence Organisation
Turkey	General Command of Mapping
USA	National Geospatial-Intelligence Agency
Spain	Cartographic Coordination Unit

ii. Revision history

Key dates and milestones

Date	Release	Primary clauses modified	Description
2018-09-07	0.1.0	All	1st draft review
2019-03-26	0.2.0		2nd draft review
2019-08-28	0.3.0		Consolidation of draft after DGIWG Technical Panel, April 2019, and Discussion papers on summer 2019.
2019-10-14	0.4.0		Consolidation of draft after DGIWG Technical Panel, October 2019
2019-12-02	0.5.0		Intermediate working draft
2020-01-14	0.6.0		Final draft (for submission to ballot)
2020-04-15	0.7.0		Updated version with proposed resolution of DGIWG ballot comments
2020-05-11	0.8.0		Updated version after Editing committee 8 May 2020
2020-06-12	1.0	Table 4 in 6.3.2 and Annex C-4 i/	Added ARC parameters for 7.5k scale (300 dpi)

iii. Future work items

Addition of an extension for Polar zone parameters

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Introduction

The Implementation Profile for Defence Raster Product (DRP) describes the data content, structure and metadata requirements required to create a suite of Raster Map products covering the full range of scales for Defence raster cartographic products (Land and Air). Maritime products are out of scope, as there are specific requirements and standards for maritime maps.

The scales covered by this profile include all standardized scales between 1:5M and 1:5k, as well as ad hoc scales for urban maps or specific scanned maps.

The intent of this profile is to increase the level of interoperability with and between organizations producing and using raster maps, ensuring state of the art performance for data exchange / access and data display, and provide the necessary metadata to document sources and lineage, quality, and security handling information.

The raster products described in this implementation profile are typically used for mission planning, terrain representation, navigation systems and other applications in the military context.

Raster maps (scanned maps or rasterized topographic products) are often associated with other Geospatial products to provide enhanced visualization capabilities for operations, analysts and mission planners.

It should be noted that this document provides the parameters valid only for non-polar zones. An extension for polar zones is to be added.

1 Scope

This implementation profile for Raster map products has been developed to support defence requirements for production and exploitation of a wide range of raster cartographic products (Land and Air only), both covering the standardized scales for rasterized or scanned maps, or ad hoc scales (for example for urban raster maps). The objective is the interoperability between Defence implementations of raster cartographic products (and their specifications) for allied nations to support various usages such as mission planning, C3I theater battle management, electronic maps in field systems and military hand held devices.

This profile specifies the multi-scale grid system (for standardized products, between 5M to 5k), content for raster maps and metadata (according to DMF), structure and tiling-scheme, according to standardized reference systems and projections, as well as delivery according to the DGIWG standardized encodings (GeoTIFF, GMLJP2 and NSIF) for Raster Map products in support of storage, access, exploitation and exchange.

It should be noted that this document provides the parameters valid only for non-polar zones. An extension for polar zones is to be added.

2 Conformance

Any application, system, raster map product specification or raster dataset claiming conformance to this implementation profile shall meet the criteria for data conformance provided in the abstract test suite, as specified in Annex A.

One Core conformance class and three specific conformance classes are specified in Annex A:

- **Core**: applicable to all DRP products and derived specifications: General common requirements
  See section A.1
- **ARC**: applicable to DRP ARC products
  See section A.2
- **UTM**: applicable to DRP UTM products
  See section A.2
- **LCC**: applicable to DRP LCC products
  See section A.4

DRP ad hoc products will only adhere to the Core conformance class, and may conform to other requirements if their reference system is based on ARC or UTM or LCC (see section A.5).

3 Normative References

The following normative documents contain provisions that, through reference in this text, constitute provisions of this profile.

International Standards

ISO 639-2:1998 Codes for the representation of names and languages – Part 2: Alpha-3 code

ISO 19111:2019 Geographic information – Spatial referencing by coordinates

ISO 19115-1:2014 Geographic information – Metadata – Part 1: Fundamentals

ISO 19123-2:2018 Geographic information -- Schema for coverage geometry and functions -- Part 2: Coverage implementation schema (or OGC Coverage Implementation Schema ("CIS") v1.0.1, formerly named GML 3.2.1 Application Schema - Coverages ("GMLCOV") – OGC#09-146r2)

NATO MC 0296/3**,** NATO Geospatial Policy, dated 31 October 2016

STANAG 2211 ED 7, Geodetic Datums, Projections, Grids and Grid References

STANAG 2215 ED 7,Evaluation of Land maps, Aeronautical charts and Digital Topographic data

DGIWG – 114: DGIWG Metadata Foundation, Version 2.0.0, 12 July 2017

DGIWG – 108: GeoTIFF Profile for Georeferenced Imagery, Version 2.3, January 2020

DGIWG – 104: DGIWG Profile of JPEG 2000 for Georeferenced Imagery, Version 1.0.0, 4 February 2014

DGIWG – 104(2): DGIWG Profile of JPEG 2000 for Georeferenced Imagery, Version 2.1.1, January 2020

DGIWG – 101: Profile of ISO 19131 - Geographic Information - Data product specification, Version 1.0.0, 5 April 2018

DGIWG – 016, DIGEST Support Document 3 - The ARC System, 30 April 2001 (available here)

OGC PDF Georegistration Encoding Best Practice Version 2.2 (OGC# 08-139r3), January 2011

National Standards

NGA.STND.0036_1.0.0_WGS84, Department of Defense World Geodetic System 1984: Its Definition and Relationships with Local Geodetic Systems, 8 July 2014

NGA.STND.0037_2.0.0_GRIDS, Universal Grids and Grid Reference Systems, 28 February 2014

NGA.SIG.0012_2.0.0_UTMUPS, Implementation Practice – The Universal Grids and the Transverse Mercator and Polar Stereographic Map Projections, 25 March 2014 (available here)

MIL-PRF-32283, Enhanced Compressed Raster Graphic (ECRG), 21 February 2008 (available here)

4 Terms and definitions, and abbreviated terms

4.1 Terms and definitions

Terms and definitions have been taken from the references cited in the Normative References (section 3) and the Bibliography.

The following terms and definitions are provided for ensuring proper understanding of the key terms used in this document.

4.1.1 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

[ISO 19131:2007]

NOTE: A data product specification provides a description of the universe of discourse and a specification for mapping the universe of discourse to a dataset. It may be used for production, sales, end-use or other purposes.

4.1.2 dataset

identifiable collection of data

NOTE A dataset may be a smaller grouping of data which, though limited by some constraint such as spatial extent or feature type, is located physically within a larger dataset. Theoretically, a dataset may be as small as a single feature or feature attribute contained within a larger dataset. A hardcopy map or chart may be considered a dataset.

[ISO 19115-1:2014]

4.1.3 dataset series

collection of datasets sharing common characteristics

[ISO 19115-1:2014]

NOTE The datasets in a series may have been derived from the same sensor or platform, or may adhere to a common product specification. They typically share the same geometry (e.g. grid or TIN).

4.1.4 product unit

elementary raster map component of the product / dataset

NOTE: This corresponds to the resource unit (as called by DMF) in which the raster map component composing the dataset collection is made available.

4.1.5 raster graphics (also raster map)

numeric representation of a two-dimensional image that represents a topographic map; these are either replicas of graphic products that are scanned, or a representation of an equivalent topographic vector product at an equivalent scale, according to a sampling resolution**.**

4.1.6 tessellation

partitioning of a space into a set of conterminous **geometric objects** having the same dimension as the space being partitioned

NOTE 1: A tessellation composed of congruent regular polygons or polyhedra is a regular tessellation. One composed of regular, but non-congruent polygons or polyhedra is semi-regular tessellation. Otherwise, the tessellation is irregular.

[ISO 19123:2005]

NOTE 2: Tiling is used as a synonym of tessellation. In this document, tiling is the external tiling that partitions the data space into a set of tiles resulting into the equivalent set of datasets / files that have manageable size (see 11.5).

4.1.7 tile

A rectangular array of points on the reference grid, registered with and offset from the reference grid origin and defined by a width and height

NOTE The tiles which overlap are used to define tile-components.

[ISO/IEC 15444-1]

4.1.8 tiling

See tessellation, 4.1.6

4.2 Abbreviated terms

ARC	Equal Arc-Second Raster Chart
BIIF	Basic Image Interchange Format [ISO/IEC 12087-5]
CE90	Circular Error measured at the 90% confidence interval
CMYK	Cyan, Magenta, Yellow and Key (or Black**)**
CRS	Coordinate Reference System
DMF	DGIWG Metadata Foundation
DPI	Dots Per Inch
DRP	Defence Raster Product
EPSG	European Petroleum Survey Group
GeoTIFF	Geographic Tagged Image File Format
GML	Geography Markup Language
GMLJP2	GML in JPEG 2000
GPHICS	Resource Graphics
GSD	Ground Sample Distance
ISO	International Organization for Standardization
IEC	International Electrotechnical Commission
JPEG	Joint Photographic Experts Group
JPEG 2000	Wavelet compression standard defined by the Joint Photographic Experts Group in 2000 [ISO 15444-1]
JP2	JPEG 2000 file format [ISO 15444-1]
LCC	Lambert Conic Conformal
LZW	Lempel-Ziv-Welch compression algorithm
LE90	Linear Error measured at the 90% confidence interval
MGRS	Military Grid Reference System
NATO	North Atlantic Treaty Organization
NITF	National Imagery Transmission Format
NSIF	NATO Secondary Imagery Format [STANAG 4545]
OGC	Open Geospatial Consortium
PNG	Portable Network Graphics
RGB	Red, Green, Blue
RPF	Raster Product Format [MIL-STD-2411]
SLD	Style Layer Descriptor
TC211	Technical Committee 211
UoM	Unit of Measure
UPS	Universal Polar Stereographic
UTM	Universal Transverse Mercator
WGS 84	World Geodetic System 1984
XML	eXtensible Markup Language

5 Applicability and use

This profile provides a framework for interoperable and consistent multi-scale raster map data product specifications, in support of raster map storage, access, exploitation and exchange of standardized products. It applies to raster map data product specifications and to raster map data.

DRP products / data may be derived from digital sources (either Vector products such as DPS DTM 50k after rasterization, or other raster products such as US ECRG), or from analogue paper maps after scanning. A DRP product may contain a number of raster map components, also called product units.

The purpose of this document is to specify the data characteristics, format and metadata of DRP products /data for producers, users and implementers, and provide subsequent conformance clauses.

Note: In this document, the decimal separator is the decimal comma, in accordance with the DGED specification (and usage outside the UK and USA).

6 Data content and structure

6.1 General Description

This DRP specification document incorporates the following key features and capabilities.

- Standardized raster products aligned to a multi-Scale system from Level 0 to 5 (see Table 1 hereafter) with two instances (Geographic / Angular grids or Cartographic / Metric grids) based on WGS 84 horizontal CRS with one of the three following projections:
    - Geographic / Angular grids in ARC system – see presentation in Annex C (and DGIWG DIGEST ARC system Support document) for Land topographic raster maps between 250k and 5k; this reference system may also be used for aeronautical charts (e.g. ONC – 1M scale, TPC – 500k scale and JOG-A – 250k scale): DRP ARC;
    - Cartographic / Metric grids in UTM datum Land topographic raster maps between 250k and 5k: DRP UTM;
    - Cartographic / Metric grids in Lambert Conformal Conic Projection, which may be used for aeronautical charts (e.g. GNC – 5M scale, JNC – 2M scale, ONC– 1M scale, TPC – 500k) : DRP LCC
- Ad hoc products with ad hoc scales, where CRS may be:
    - either in ARC or UTM, to facilitate exploitation with other standardized scale products : DRP ARC or UTM, with ad hoc scales and/or not aligned with the DRP standardized products;
    - or using specific CRS and projection, which should be considered as exceptions.
      DRP ad hoc products are for specific production or production or in crisis conditions, when it is not possible to go through the regular production process.
- A set of standardized resolutions / pixel spacings:
    - 254 dpi (100 microns) or 300 dpi, which are the recommended resolutions in raster domain;
    - or 600 dpi, being aimed at raster for hard-copy products only (Plotter quality);
      Note: 1200 dpi raster are aimed at highest resolution hard-copy products (and out of the DRP range for raster) (Print quality).
- Quality constraints on horizontal accuracy specified for each scale level.
- Use of metadata for raster cartographic data as specified by DMF version 2.0, as specified in annex B.
- Compression
    - Use of JPEG 2000 compression (in near-lossless mode with compression ratio between 1:12 and 1:20) which is the recommended option in most cases in terms of volume of data (file size) and display speed;
    - or lossless compression (such as LZW or DEFLATE or Packbits) in association with the use of colormap (to encode pixel value on 8 bits, thus allowing less than 255 colours).
- Use of one DGIWG encoding standard for raster, being preferably either one of these 4 options:
    - GMLJP2 standard for encoding, in case of JPEG 2000 compression, on basis of DGIWG GMLJP2 profile

- or GeoTIFF format if uncompressed data or use of lossless compression such as LZW or Deflate or Packbits (usually of limited efficiency in terms of compression ratio), on basis of DGIWG GeoTIFF profile;
- or NATO Secondary Imagery Format (NSIF) encoding with JPEG 2000 compression, with visually lossless compression, on basis of ECRG product specification.

Geo-enabled PDF may also be used for raster products to be used as hard-copy products.

Note: Specification of ARC and UPS in polar zones is not included in this document; it will be addressed by a dedicated extension of this DRP standard.

The DRP data structure is a uniform, orthogonal grid-based raster model, supporting a wide range of scales for rasterized or scanned maps from Level 0 up to 5, according to the NATO levels of geospatial information (cf. [NATO MC 0296/3, NATO Geospatial Policy], as follows.

Table 1: NATO Levels of Geospatial Information (for maps)

Level	Map scale (S)
0	S ≤ 1:1 000 000
1	1:1 000 000 < S ≤ 1: 250 000
2	1:250 000 < S ≤ 1: 50 000
3	1:50 000 < S ≤ 1:25 000
4	1:25 000 < S ≤ 1: 5 000
5	S > 1:5 000

DRP Geographic ARC products, at a given scale, provide a seamless coverage of raster maps within the same ARC zone: the edges of contiguous source maps are indistinguishable, except by color variations that are due to the differences between the colors or patterns in original source graphics. The data from each dataset abuts the data of neighboring datasets exactly to provide unbroken coverage. Gaps in coverage exist where the source coverage does not exist (for example over large expanses of water at large scales). The boundaries of the distribution datasets are not required to coincide with the source map edges. However, the East-West distortion is large in comparison to most grid systems (see section 3.5 in DIGEST Support Document for ARC system).

DRP UTM/UPS products, as well as LCC products, are valid only on the associated zone or area as specified by the individual projection. Therefore the seamless coverage capability is limited to the extent of the zone or area covered by the individual projection.

6.2 Raster resolution / pixel spacing

The minimum resolution of DRP products shall be 254 dpi, but higher resolutions such as 300 dpi and 600 dpi are allowed.

Raster Resolution (dpi)	**254**	**300**	**600**
Equivalent raster pixel spacing (microns)	100	84,67	42,33

This pixel resolution may be the resolution of the scanner, or result from the sampling process in the generation of the raster / rasterized product.

6.3 Grid Structure and raster resolution

The uniform regular grid structure is the data model used for raster data, known as Rectified Grid Coverage according to the Coverage Implementation Schema (ISO 19123-2 or OGC CIS 1.0.1 whose namespace is GMLCOV). This grid structure is composed of the map pixels which are the rectangular (or square) elements, to cover the raster map coverage.

This Coverage encapsulation of the Rectified / regular grid structure is optional and may be implemented for some encodings (or not).

Note: The Coverage Implementation Schema presently handles the following encodings: GeoTIFF and JPEG 2000/GMLJP2 (and CF-netCDF3.0, unused in this document).

To fit into the file size constraints, the grid structure is tessellated into square or rectangular tiles, each tile being encoded into a single file (see figure below).

The grid structure is georeferenced by its origin (upper left or lower left corner) and its offsets which are the equivalent pixel size (in meters or decimal degrees) in terrain space in the 2 directions (rightwards and downwards). The grid structure (and its resolution in raster space – usually provided in dots per inch –, with square pixels for DRP products) is georeferenced and associated to the terrain according to 2 different correspondence methods between raster resolution and terrain resolution (or pixel equivalent size), pending on type of grid:

- **either projected / metric, based on the following simple relationship:**

  Terrain Pixel size (m) = Maps scale factor * equivalent raster pixel size (m) corresponding to a given resolution.

  Raster pixels therefore also represent a square area on Terrain.

  The number of pixels per raster file unit, or Tile, is by design an integer number.

- **or Geographic based on angular coordinates definition** (for DRP ARC products), defined on the basis of 2 integer parameters called A(ZT) = Pixel number along standard parallel and B(Z) = Pixel number along the meridian (round the earth) which vary with Latitude zone according to the ARC specification, and result in an approximate equivalent pixel size in meters.

  The terrain pixel size is in this case equal to 360 degrees divided by A(ZT) longitudinally, or by B(Z) latitudinally. It is measured in arc seconds.

  The number of pixels per square degree is by design an integer number, and per raster unit, or Tile. The Tile size may be a square degree if the resulting file size is within the file size constraint, or a sub-divider of the square degree.

  The resulting scale is approximate (it is not an integer number).

Note: Unless explicitly specified (or due to any producer constraint), DRP data pixels are surface area primitives whose location coordinates are defined at the center of each pixel. This is consistent with the usual conventions in the OGC and TC211 standards, as well as in GML encodings.

In both cases for standardized DRP products, the origin of each grid is derived from the origin of the zone (usually South-West corner of the zone), by the affine rectilinear function based on tile size and tile number / offset in both directions, as illustrated by the figure below and corresponding formulae. Ad hoc DRP products may have an origin not aligned as such, depending on the design choice of the producer.

DRP raster products shall use the following raster resolution: either 254 dpi or 300 dpi.

DRP raster products aimed at hard copy may use 600 dpi resolution or higher for output to printers. However this should not be used for data exchange or data access to end-users as it results in bigger

files by a ratio of 4, than for 300 dpi resolution, and lower performance of systems. This resolution should only be used for producers or users requiring such a high resolution for printing.

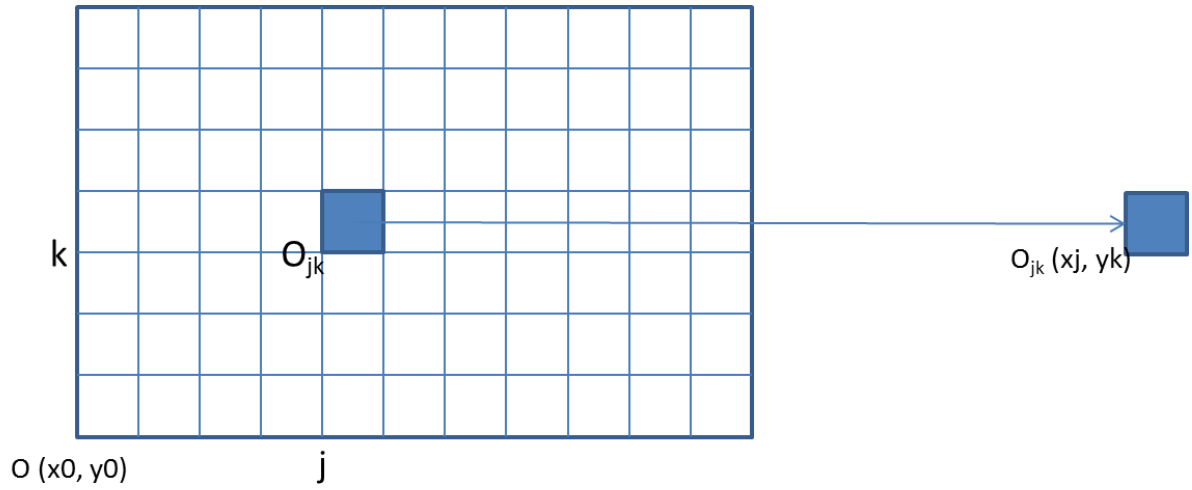

Figure 1: DRP grids and tiling scheme (individual grid / raster shown as Blue square)

With: $x_j = x_0 + j*T$, $y_k = y_0 + k*T$, where T is tile size (in terrain coordinates unit – meter or decimal degrees)

Note: In the case of this figure, the origin of the grid is the lower-left corner of the grid.

DRP grid records are structured in row major order such that the sequential order of the data within each record comprises a row of data for which the horizontal coordinates of each pixel for that row has the same northing coordinate value. The records are sequenced north to south (1 to n) by a distance Δy, such that the first record in the dataset is the northern most row and subsequent records are the rows sequentially ordered to the south. The first pixel value in a record is the western most pixel for that row / record with subsequent pixel values progressing west to east a distance Δx. The last pixel value in the dataset is the pixel in the south-eastern most location.

6.3.1 Multi-scale Grids for UTM/UPS or LCC projected standardized DRP products

The projected grids and their terrain pixel size depend on the raster resolution (in dpi) and the map scale.

The following table provides the pixel size in raster domain and corresponding terrain pixel size (valid for both directions) for the scales of the standardized DRP projected products, as well as the number of pixels per 100 kilometres which is frequently used for tile size (another usual dimension is 50km) for Land topographic raster maps.

Table 2: Multi-scale Grids and resolutions for UTM or LCC projected standardized DRP products

Raster Resolution (dpi)		254	300	600		254	300	600
Map Scale		Pixel size (terrain in m)				Number of pixels / 100 km		
LCC projection	5M	500	423,333	211,667		200	236,2	472,4
	2M	200	169,333	84,667		500	590,5	1181,1
	1M	100	84,667	42,333		1000	1181,1	2362,2
	500k	50	42,333	21,167		2000	2362,2	4724,4
LCC or UTM/UPS	250k	25	21,167	10,583		4000	4724,4	9448,8
UTM/UPS projection	100k	10	8,467	4,233		10000	11811,0	23622,0
	50k	5	4,233	2,117		20000	23622,0	47244,1
	25k	2,5	2,117	1,058		40000	47244,1	94488,2
	12,5k	1,25	1,058	0,529		80000	94488,2	188976,4
	10k	1	0,847	0,423		100000	118110,2	236220,5
	7,5k	0,75	0,635	0,318		133333,3	157480,3	314960,6
	5k	0,5	0,423	0,212		200000	236220,5	472440,9

This table shows that the resolution of 254 dpi provides an integer pixel size (on terrain) and an integer number of pixels per tile. For higher raster resolutions (300 dpi or 600 dpi), the number of pixels per tile is rounded to the closest integer value.

The 254 dpi raster resolution is currently the most widely used for raster projected products, and is recommended for DRP projected products, unless a higher resolution such as 300 dpi is preferred.

6.3.2 Multi-scale Grids for Geographic ARC standardized DRP products

The grids for Geographic ARC DRP products and their terrain pixel size depend on the raster resolution (in dpi) and the map scale and are precisely related to the definition of the values for A(ZT) and B(Z) for each raster resolution.

This specification is based on recommendations for the consistent definition of the values for A(ZT) and B(Z) for the full range of DRP ARC products between the scales of 1:1M and 1:5k, for the 2 raster resolutions of 254 dpi and 300 dpi. The definition of these A(ZT) and B(Z) parameters ensures an integer number of pixels per square degree, in both directions (N-S and E-W), in each ARC zone.

For each map / chart scale, a constant latitudinal (row) and longitudinal (column) pixel interval shall exist in each ARC zone, as explained in Annex C, depending on the scale of product.

For the scales of the standardized projected DRP ARC products and raster resolution of 254 dpi and 300 dpi, the following 2 tables provides a synthetic view of the DRP specifications for ARC products:

- the latitudinal and longitudinal numbers of pixels and number of pixels in the 1st ARC zone from the equator (it is provided for other zones in Annex C).
- the corresponding terrain pixel size North to South and West to East (approximate due to distortion within each ARC zone), as well as the number of pixels per square degree (in both directions for latitude and longitude) which is frequently used for tile size (other usual dimensions being 30 minutes or 15 minutes tile sizes) for Land topographic raster maps.

For more details, please refer to Annex C-3 (for 254 dpi) and Annex C-4 (for 300 dpi).

It should be noted that this specification also allows the US ECRG set of specifications for ARC parameters (254 dpi), as well as the specifications for 1:1M scale at 300 dpi raster resolution, please refer to Annex C-4.

Table 3: Multi-scale Grids and resolutions for ARC standardized DRP products (254 dpi)

Map Scale (approximate)	**B(Z)**	**A(ZT) (1st ARC zone)**	**Number of pixels /°d (lat.)**	**Pixel size (m) (N-S)**	**Number of pixels /°d (long.) in 1st ARC zone**	**Pixel size (m) (E-W) (Std parallel 1st ARC zone)**
1M	403200	368640	1120	99,23	1024	100,06
500k	806400	737280	2240	49,61	2048	50,03
250k	1612800	1474560	4480	24,81	4096	25,01
100k	4032000	3686400	11200	9,92	10240	10,01
50k	8064000	7372800	22400	4,96	20480	5,00
25k	16128000	14745600	44800	2,48	40960	2,50
12,5k	32256000	29491200	89600	1,24	81920	1,25
10k	40320000	36864000	112000	0,99	102400	1,00
7,5k	51609600	47923200	143360	0,78	133120	0,77
5k	80640000	73728000	224000	0,50	204800	0,50

Table 4: Multi-scale Grids and resolutions for ARC standardized DRP products (300 dpi)

Map Scale (approximate)	B(Z)	A(ZT) (1st ARC zone)	Number of pixels /°d (lat.)	Pixel size (m) (N-S)	Number of pixels /°d (long.) in 1st ARC zone	Pixel size (m) (E-W) (Std parallel 1st ARC zone)
1M	472320	437760	1312	84,70	1216	84,26
500k	944640	875520	2624	42,35	2432	42,13
250k	1889280	1751040	5248	21,18	4864	21,06
100k	4723200	4377600	13120	8,47	12160	8,43
50k	9446400	8775200	26240	4,24	24320	4,21
25k	18892800	17510400	52480	2,12	48640	2,11
12,5k	37785600	35020800	104960	1,06	97280	1,05
10k	47232000	43776000	131200	0,85	121600	0,84
7,5k	62975880	5836720	174933	0,64	162132	0,63
5k	94464000	87552000	262400	0,42	243200	0,42

These two tables show that the number of pixels per degree is different between the two directions, and that the pixel size is not exactly the same in the two directions. Subsequently, pixel sizes **shall be documented** in the metadata.

For 600 dpi raster resolution, the values of the A(ZT) and B(Z) parameters may be derived from Table 4 by multiplying the values by factor of 2, as well as for the resulting number of pixels per square degree latitudinally and longitudinally. Conversely, the pixel sizes should be divided by 2 in the two directions.

Note: Producers may adjust these A(ZT) and B(Z) parameters for specific constraints, and corresponding pixels sizes and number of pixels per square degree, and must document the pixel sizes in the metadata.

For a DRP ARC product dataset, the predefined reference origin is the pixel at the southwest corner of the one degree cell in which the southwest corner of the geographic data is located. The origin must be evenly divisible by the point spacing (GSD) to ensure alignment between datasets. If the point spacing is specified as {Δφ, Δλ} and the southwest corner of dataset with which it is associated is {φ, λ} then point location coordinates will be defined at {φ+ j*Δφ, λ+ i*Δλ}.

Where the values i and j are integer values of points in the Longitude and Latitude direction (respectively), +i*Δλ signifies an easterly direction from the origin and +j*Δφ signifies a northerly direction from the origin. (See Figure 2).

When the tiling scheme is different from square degrees, the reference origin pixel is at the southwest corner of its tile, whose location is deduced from the formulae provided in Figure 1.

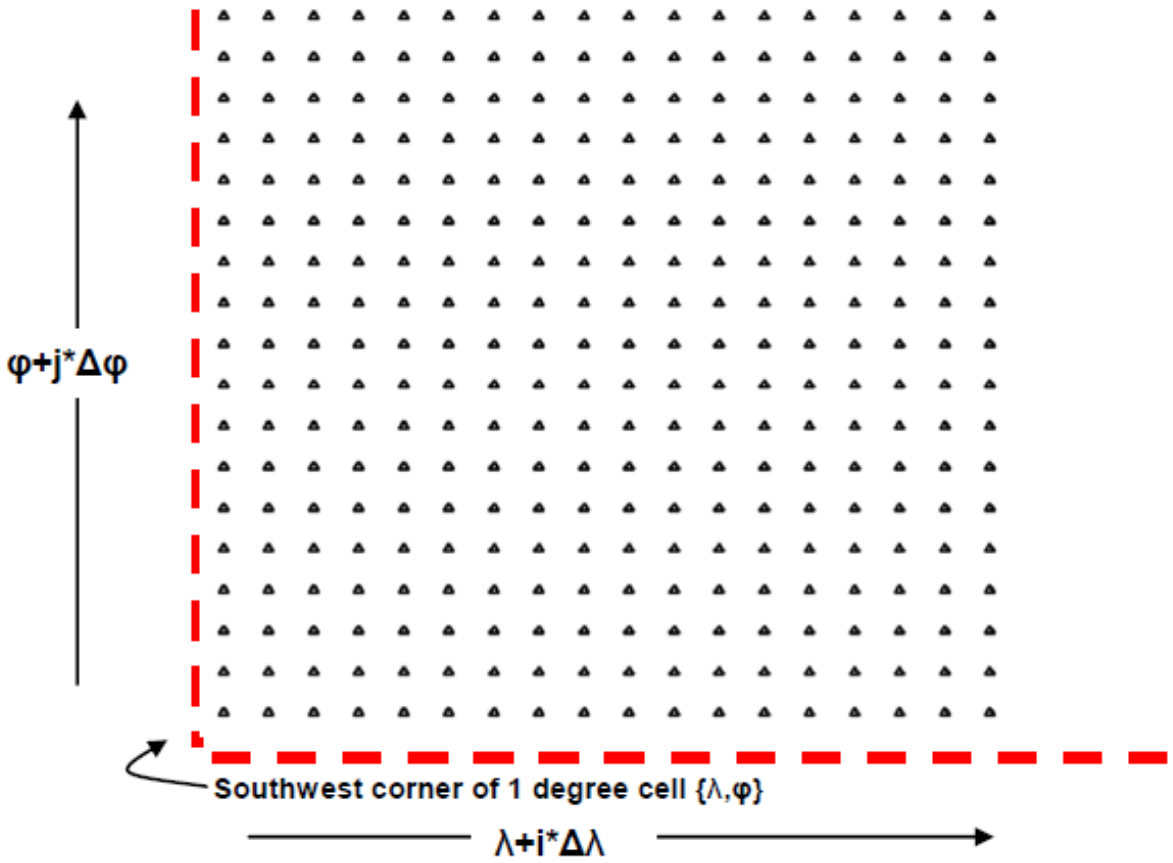

Figure 2: Example of Origin and Point Locations for DRP Data

6.3.3 Grids for ad hoc DRP products

DRP ad hoc products may have diverse characteristics, to cater to all specific raster productions that may adhere to the Core requirements of this specification:

- specific Tiling scheme and grid alignment, not consistent with the 2 previously defined schemes: this is to allow ad hoc product on a constrained zone of interest, such as a city map.
- specific scale, to align on the source map or use a scale adjusted to the specific zone to be produced.
- specific reference system / projection, to align on the source map.

Depending on the type of projection (if any) or reference system, the scale, terrain resolution(s) and relevant parameters (e.g. A(ZT) and B(Z) if ARC projection is used) must be documented, as in the ad hoc DRP specification. The DRP product metadata should also capture this information to have a self-sufficient product documentation within each DRP data.

6.4 Horizontal Spatial Extent

The horizontal spatial extent of DRP standardized products varies based on a number of factors. These factors can include but are not limited to spatial resolution, geographic location, customer requirements and file size limitations. Typically, as the scale denominator of the DRP product decreases, the horizontal spatial extent decreases in size.

DRP standardized products are either on the ARC geographic system or on a cartographic projection (UTM or LCC) and primarily cover large geospatial areas (nominally region sized). DRP products are typically tiled[1] to allow them to be joined seamlessly. DRP Geographic datasets and tiles within a dataset shall be horizontally adjacent.

DRP standardized ARC products base tiling scheme is based on square degrees or multiple of square degrees for small scale. However, at higher scales, recommended tiling-schemes in this specification are 30'x30', 15'x15' or 6'x6'.

DRP standardized cartographic products base tiling scheme is based on square 100 km x 100km between scales 1:50k and 1:25k or smaller for higher scales. For Global or aeronautic maps, the tile size may be up to 5000 km in each direction.

Refer to section 11.5 for estimation of DRP standardized products extent and subsequent size of individual files / tiles.

6.5 Horizontal Spatial resolution

6.5.1 Horizontal spatial resolution for standardized DRP cartographic products

Standardized DRP cartographic products have 11 standardized scales as defined by Table 5 below.

Table 5: Horizontal spatial resolutions for projected standardized DRP products

Raster Resolution (dpi)		**254**	**300**	**600**
Map Scale		**Pixel size (terrain in m) - GSD**		
LCC projection	5M	500	423,333	211,667
	2M	200	169,333	84,667
	1M	100	84,667	42,333
	500k	50	42,333	21,167
LCC or UTM	250k	25	21,167	10,583
UTM projection	100k	10	8,467	4,233
	50k	5	4,233	2,117
	25k	2,5	2,117	1,058
	12,5k	1,25	1,058	0,529
	10k	1	0,847	0,423
	7,5k	0,75	0,635	0,318
	5k	0,5	0,423	0,212

[1] Not to be confused with internal encoding format sub-block which is sometimes referred to as internal tiling.

6.5.2 Horizontal spatial resolution for standardized DRP ARC products

Standardized DRP ARC products have 9 standardized scales as defined by table 6 below.

Table 6: Horizontal spatial resolutions for ARC standardized DRP products

Raster Resolution (dpi)	**254**		**300**		**600**	
Map Scale (approximate)	**Pixel size (m) GSD (N-S)**	**Pixel size (m) GSD (E-W) (Std parallel 1st ARC zone)**	**Pixel size (m) GSD (N-S)**	**Pixel size (m) GSD (E-W) (Std parallel 1st ARC zone)**	**Pixel size (m) GSD (N-S)**	**Pixel size (m) GSD (E-W) (Std parallel 1st ARC zone)**
1M	99,23	100,06	84,7	84,26	42,35	42,13
500k	49,61	50,03	42,35	42,13	21,18	21,06
250k	24,81	25,01	21,18	21,06	10,59	10,53
100k	9,92	10,01	8,47	8,43	4,24	4,21
50k	4,96	5,00	4,24	4.21	2,12	2,11
25k	2,48	2,50	2,12	2,11	1,06	1,05
12,5k	1,24	1,25	1,06	1,05	0,53	0,53
10k	0,99	1,00	0,85	0,84	0,42	0,42
7,5k	0,78	0,77	TBD	TBD	TBD	TBD
5k	0,50	0,50	0,42	0,42	0,21	0,21

6.6 Legend

Legend information shall be provided **at least for each map series** and addressed by DMF metadata. Legend information need not be duplicated for each dataset, but the metadata associated to each dataset must refer to the applicable legend information (at collection or dataset level).

Legend information may be provided by image or graphics files, and also symbols:

- Image legend files shall be encoded in PNG or JPEG or TIFF
- Graphics legend may be encoded in XML/SLD, allowing to handle various types of legends for raster map products (aeronautical, topographic land maps, city maps …) and in order to facilitate exploitation of the legend files, including symbols and their associated information
- Symbols shall be encoded in PNG.

The cartographic legend file documented in XML should provide the following information for each symbol, allowing the presentation of the legend as a table of symbols:

- Type of symbol object: point, linear, surface, text
- Feature code of object represented by the symbol
- List of discriminating attributes for this object

- Name of symbol (English)
- Local name of symbol
- File name or IID for symbol.

Legend files must be provided under the _USERS subdirectory (see section 11.2) of the corresponding dataset or collection of datasets.

Legend information must be documented under DMF metadata, under a Resource Graphics element (GPHICS), with GPHICS description = ‘Legend’.

6.7 Other auxiliary files

Other files may be provided:

- Overview or quicklook file (size below 512x512) in JPEG, in same folder as its product unit; overview file should be documented under DMF metadata, under a Resource Graphics element (GPHICS), with GPHICs description = ‘Overview.
- Extents / footprints of all included product units,
- Thumbnail file in JPEG, in the _USERS folder,
- Quality information (including lineage) that are addressed by DMF metadata,
- Users file that may be grouped in the _USERS Folder. This may include footprints (in GML or Shapefile).

7 Reference systems

7.1 Horizontal Reference system

The Horizontal reference datum for DRP shall be World Geodetic System (WGS 84). Allowed reference systems for standardized products are:

- WGS 84 Geographic 2D (unprojected), as identified by EPSG code 4326, for DRP Arc products,
- WGS 84 and UTM projection or UPS in Polar areas,
- Lambert Conformal Conic (for scales between 5M and 500k).

Other reference systems are allowed for DRP ad hoc products.

DRP data shall conform to the unit of measure specified for the Horizontal CRS, that is decimal degrees for geographic and meter for UTM.

The horizontal CRS shall be encoded in the data file (according to the encoding standard used) and in the associated DRP metadata. This information shall be consistent.

7.2 Vertical Reference system

The vertical datum for a DRP product is the same as the vertical datum of the source graphic or data.

8 Data quality

DRP quality characteristics are defined by the following factors:

- scale and corresponding pixel spacing: according to table 5 and (respectively table 6) for standardized projected (respectively ARC) products,
- dataset lineage,
- absolute horizontal accuracy,
- relative horizontal accuracy,
- completeness of data (percentage of missing pixels)

- conformity of the product
- actuality of data, with mapping of updated zones (if any)
- quality reports on source and quality zones (if any).

This information must be provided in the metadata, with a detailed description of quality and source zones.

An annexed Quality folder (_QUALITY) shall provide for each raster map element (also called product unit):

- cartography of source zones (in GML or Shapefile)
- cartography of quality zones (in GML or Shapefile)
- cartography of updated zones (in GML or Shapefile)

Absolute horizontal accuracy depends on absolute horizontal accuracy of the original (source) data from which it was derived:

- either source vector product: absolute horizontal accuracy is then equal to the one of the source
- or on absolute horizontal accuracy of source paper map or chart: horizontal accuracy is then equal to the one of the source plus or minus one-half pixel with respect to the source.

9 Data lineage

9.1 Source data

The source data for DRP production is obtained from one of the following:

- either a topographic vector map, such as MGCP Topographic Maps or MGCP Derived Graphics portraying MGCP (or the emerging DGIWG DTM50 DPS) data by means of the associated symbology,
- or paper maps or charts through scanning,
- or another raster product, e.g. ASRP through an adequate transformation.

Any map information that is included in these data sources at the time of DRP production may be included for distribution.

Description of data sources used for DRP data shall be provided in metadata (in DMF/ Source of the Resource – RSSRC).

9.2 Data processing

9.2.1 Pixel values and color space

DRP will contain valid pixel values and may contain null (no-data) values. For DRP raster data, pixel values may be encoded in:

- unsigned 24 bit integers: Red, Green Blue (8 bits-per-band), or YCbCr (Luminance, Chroma Blue, Chroma Red),
- unsigned 8 bit integers: entries in the Colormap (when colormap is used).

CMYK (cyan, magenta, yellow and key (black)) may also be used for raster aimed at hard-copy, in PDF format.

Null (No-Data) values are used for transparent pixels. The Null value, when used, will be specified according to the encoding standard used for data delivery and should be documented in the DRP metadata (SpecialCell mechanism). Recommended values are the White Color (RGB = (255, 255, 255), as Black is often present for toponymy / graphics annotations, or Black Color (RGB = (0, 0, 0).

- in the metadata (in DMF GRCINF.specialCell element),
- in the file format, depending of encoding format capability (for example with GDAL_NODATA tag in GeoTIFF format, or <swe:nilValues> in the rangeType description in case of GMLJP2 v2).

Transparency information is required when padding is used and may be provided by:

- JPEG 2000 products, an additional alpha channel;
- GeoTIFF products, use of No data value (see DGIWG GeoTIFF profile) or a transparency mask (in 2nd IFD (Image File Directory).

Radiometric fidelity for source or product raster: the red, green, and blue (RGB) pixels of the DRP products are representations of the colors:

- from the source map or chart: color differences among maps and charts are not removed in the process of scanning the charts. The producer may process some radiometric equalization to smoothen radiometric discontinuities within a DRP product.
- as specified by the Portrayal and annotations specifications for Vector product source for vector features and annotations. Note: these specifications usually use printing specifications for Color spaces such as CMYK or Pantone colors, that should be converted to the RGB (or YCbCr) color space.
- from the original digital raster product: a color space transformation may apply.

In all cases, this should be documented in Lineage metadata.

9.2.2 Spatial reduction / filtering

There is no DRP designated spatial reduction for raster data. The source data can be edge sharpened to reduce smoothing which can occur at scan time. An edge sharpening algorithm is recommended for scanned source.

10 Data maintenance

DRP datasets will be maintained and updated as requirements dictate. Data maintenance criteria will vary by data level. Each product should mention the maintenance date in its metadata (DMF RSMTNC maintenanceDate element, where RSMTNC is the Resource Maintenance element in DMF).

11 Data product delivery

11.1 Introduction

DRP products may be delivered through diverse use cases, such as:

- on file media (CDROM, USB key, etc.). The full structure of the DRP product is duplicated on the media,
- through web services,
- through file synchronization services.

DRP products may use various encoding formats for Raster map data, including GeoTIFF, GMLJP2 and NITF/NSIF, which is used by ECRG product specification, GMLJP2 and ECRG using JPEG 2000 compression. When delivering hard copy products, GeoPDF may also be used.

To facilitate ingestion and processing of DRP products, the file structure and file naming conventions for geospatial datasets, their associated metadata files and annexed resources (such as quality information) must be defined and documented and file names should be meaningful to humans (see section 11.3).

11.2 DRP Product structure

Specific instructions should be documented in a Product Specific Guidance document for DRP products. The Product Specific Guidance should instantiate the various capabilities provided by this specification, identify conformance classes that are applicable and provide specific requirements, including the detailed naming rules.

DRP products shall be delivered with a “table of content” mechanism, describing the content and structure of products (addressing files and folders). This table of content could be provided in a XML file, to document the file structure for both human and information system consumption.

Additional detailed information on delivery, quality and description of product is provided within the DRP metadata file (XML) and therefore the file name need not duplicate this content. Information indicated in the file name must align with the information provided by the metadata. In case of any inconsistency, the metadata information prevails. Therefore, applications accessing datasets should utilize the metadata.

A DRP product may contain a single dataset or a collection of datasets corresponding to tiles, according to the tiling scheme (specified in 11.5).

A DRP collection of datasets includes:

- the Table of content XML file, providing the Product structure and file organisation should be provided by a “table of content” file (e.g. in XML), conformant with the Product specific Guidance.
- a Raster Collection metadata set in accordance with DMF for collection resource, with RSTYPE set to ‘series’.
- The set/collection of datasets, usually arranged in a hierarchical directory/subdirectory structure.
- A _QUALITY subdirectory (if any at collection level), containing all collection quality information: quality areas, quality layers (if any). These quality elements resources must be addressed by DRP metadata (see section 8).
- A _USERS subdirectory, containing all information related to Usage and User, including Legend, footprints of the product units (for each raster map element) and auxiliary files for the collection. These Usage/User elements resources must be addressed by the DRP metadata (this includes legend elements which are requested).

Each DRP raster product unit includes:

- the DRP raster data file, in a standardized encoding format, as specified in 11.4.

- a DRP dataset GML instance (optional), based on the GMLCOV for Rectified Grid Coverage, providing the Coverage description of the raster data (Rectified grid). In case the DRP GML instance is present, it shall reference the DRP dataset metadata set in its metaDataProperty.
- its associated Raster dataset metadata set in accordance with DMF for dataset resource, with RSTYPE set to 'dataset' (if metadata is in an external file). This metadata may otherwise be embedded / included in an XML section in the DRP raster data file.
- A _QUALITY subdirectory, containing all quality information (see section 8): source zones, quality areas, quality layers (if any). These quality elements resources must be addressed by the DRP metadata.
- A _USERS subdirectory, containing all information related to Usage and User, including Legend files (e.g. XML/SLD, associated symbols, or image files) – unless using the Legend of the collection - and thumbnail for the dataset. These Usage/User elements resources must be addressed by the DRP metadata (this includes legend elements which are requested).

NOTE 1: Legend information need not be duplicated for each dataset (common legend information may be shared between all datasets in the collection), but the metadata associated to each dataset must refer to the applicable legend information (at collection or dataset level) – as stated in section 6.6.

NOTE 2: The metadata document / file and the raster data file are both constrained by specific requirements in terms of metadata or information on the data. Consequently, some information items are redundant in these two components of a "Raster dataset" and should be populated consistently. To avoid additional redundancy of information, the DRP GML instance information (if present) is specified with the minimum level of information required by the GMLCOV model. However, the constraints of GMLCOV schema require the provision of some information (e.g. CRS, UoM).

Packaging of the various elements of a DRP product is not specified here: producers may choose zip or any other archiving or packaging tool. This should be indicated in the Product specific guidance.

11.3 File naming convention

The DRP specification handles a wide range of cartographic raster products, for aeronautical or land maps, as well as urban and adhoc maps. The file naming convention may vary in NATO, multi-national or national context, and depending on aeronautical or land maps series, urban maps, or adhoc products.

Product specific guidance specification should clarify:

- the maps series and sheet designations, scale, edition, and nation or body responsible for the product, in the case of standardized aeronautical or land map products,
- for urban and adhoc products, identification of usage, scale and covered area (nation, region, city), reference system (ARC, UTM, LCC), and edition.

In the NATO context, AGeoP-08.4 "NATO Geospatial Metadata Profile – NATO specifications for identification of hard copy land maps, aeronautical charts and image plans" provide information on Series, Sheet and Edition designation. STANAG 3689 "Place name spelling on maps and charts" provides the rules for identification of sheets.

Filenames should be unique and is achieved using the following:

- a producing agency or nation identifier as part of the name (that may be added as the last subfield of the filename). Country code must be based on ISO 3166.
- a producer allocated unique identifier (this may be an agency naming construct as indicated below).

Producer naming construct should contain the following information, whose presence depends on the type of product:

- Series designation (if any), or 3-letter ISO country code(s) identifying the covered zone
- Sheet designation (if any) or Map name: number, name, or combination thereof. The map name should be written using Upper Camel Case to concatenate words as necessary. Hyphen and numbers should be used if several sheets are necessary to cover a Zone identified by a its main location, e.g. London-1.
- Scale code: last 6 zeros replaced by M, or last 3 zeros replaced by 'k'. For 12,5k and 7,5k scales, the scale is written in full, e.g. 12500. Scale code may be omitted in case of series, for which the scale is well-known.
- MGRS code (UTM) zone (+hemisphere) or GEOREF code (for ARC products)
- Source data type[2] coded by 1 alphanumeric character
  R = Rasterized from Vector source
  S = Scanned from paper map
  T = Transformed from another digital raster map.
- Filenames should also indicate the security classification: c = security classification (T, S, C, R, U), as required by national or NATO rules.
- Edition of product (which is to be handled at the producer or nation or other body level). Note that nations may use different edition numbers for the same sheet.
- Producer code: Producer Organisation (or Nation), identified by 3-letter code (STANAG 1059).

The maximum length of a filename is 64 characters.

A separator is used between each information field in the file name construct. The recommended separator is character '_'. Hyphen is used to indicate a subfield composed of a number of codes (e.g. FRA-DEU for a map covering an area on these 2 countries).

Filename extension shall follow the file extension rules specified by the encoding standard for the DRP product (.tif, .jp2/jpx or .ntf) and the associated metadata file extension shall be .xml.

Examples:

JOG-A_NI-18-04_250k_GJPE_R_U_01_NGA.jp2: a JOG-AIR 250k map on Beaufort, North Carolina (GEOREF code is GJPE).

IRQ_AlBasrah-1_25k_RJCA__R_U_01_FRA.jp2: an adhoc map on AlBasrah province in Iraq, in ARC (GEOREF code is RJCA).

FRA_Ile-De-France-1_31UDQ_125k_R_U_01_IGN.tif

Legend file names shall be identified as:

- <Product_Identifier>_LEG(i).jpg for images, i being image index in case of several images.
- <Product_Identifier >_LEG(i).sld for symbology in SLD, i being symbology element index in case of several legend elements.
- or in a similar way for other legend encoding.

where <Product_Identifier> is the identifier of the DRP product, according to one of the above.

Overview file names shall be identified as: <Product_Identifier>_QLK(i).jpg,

Thumbnail file names shall be identified as: <Product_Identifier>_THU.jpg.

[2] The source data information is provided in a simple way by this code; detailed information on source must be provided by metadata.

11.4 Encoding options and compression

Encoding standards options for DRP raster products are as follows:

- **GMLJP2** with JPEG 2000 compression (**according to DGIWG GMLJP2 profile**): GMLJP2 v2.1 profile is recommended (the older version GMLJP2 v1 is allowed). Visually-lossless compression with a compression ratio between 1:12 and 1:20 is recommended. Lossless compression is also allowed, but compression ratio is limited (between 1:2 and 1:3). In this case, colormap may be used (which allows encoding of pixels values on 8 bits instead of 24).

  JPEG 2000 has tiling (in image and transform spaces – the latter being called precinct) and scalable capabilities, as well as streaming (with JPIP protocol, as specified in ISO 15444-9). As a result, it has superior access / display performance and limited bandwidth environments.

  Annex D provides additional recommendations for adjusting JPEG 2000 compression and codestream for such raster products.

  Note: GMLJP2 is handled by the WCS 2.0 web service.

- **GeoTIFF** (**according to DGIWG GeoTIFF profile**), either uncompressed or using lossless compression (LZW or LZ77 (DEFLATE) or Packbits), which are efficient on flat-color areas. In this case, the use of colormap is recommended to code each pixel on 8 bits (less than 255 colours, one being used for No_Data value) – to provide an equivalent compression ratio of 3.

  Note: It is important to note that all map sheets of a series should always have the same color table.

  GeoTIFF has a limited tiling capability, and no streaming capability. As a result, exploitation of the data needs the full file to be transferred and the display time of big files is perceived as too long.

- **NSIF** (STANAG 4545), visually-lossless JPEG 2000 compression with a compression ratio between 1:12 and 1:20 is recommended. A ratio of 1:20 is specified by the ECRG specification (MIL-PRF-32283), based on the frame size of 2304 x 2304 pixels. Refer to Appendix D of BPJ2K01.10 for a description of NSIF preferred JPEG2000 Encoding.

  This encoding option has the same scalable and streaming capabilities as the previous GMLJP2 / JPEG 2000.

  The recommendations in Annex D for JPEG 2000 parameters also apply.

  Note: WCS 2.0 is unable to handle NITF/NSIF format (at this date).

Note: Producers and users should be aware that the georeference of pixels (centroïd or corner of pixel – usually upper-left corner) depends on capabilities of encoding standard (e.g. GeoTIFF with use of GTRasterTypeGeoKey, or GMLJP2, this latter using the centroïd convention for the pixels).

Geo-enabled PDF format is allowed for hard-copy products, on the basis of OGC PDF Georegistration Encoding Best Practice. DGIWG offers no guidance for implementing Geo-enabled PDF.

11.5 Tiling

Tiling is the organisation of DRP products according to a regular tessellation of space into individual raster frames (and resulting raster files). The tiling scheme and the resulting tiles are a different mechanism than the “internal tiling” capability provided by encoding standards such as JPEG 2000 or TIFF/GeoTIFF. It is sometimes called “external tiling” which is the object of this section.

The aim of tiling is to partition the raster space into frames / files which fit technological constraints on file size and memory used when handling each individual frame / file. This constraint depends on

compression and encoding standard, as well as end-user system(s) constraints. In this specification, two file size constraints are recommended, 0.5 Gb or 1 Gb.

DRP tiling scheme shall be with no overlap: in other words, neighbour tiles are joint with no overlap pixels (remember that DRP raster pixels are surfaces (squares or rectangles)). DRP tiles are squared, i.e. tile size apply to both directions.

For medium scales (i.e. 50k), the tiling scheme is on a square degree basis (for ARC products), or 100km x 100km (for projected products).

For smaller scales, the tiling scheme is based on multiples of the square degree (for ARC products), or 100km x 100km (for projected products).

For larger scales (1:25k and above), several tiling schemes are recommended to match the file size constraint (0.5 Gb or 1 Gb).

DRP Tiling scheme specifications are provided in the following table, also indicating the recommended scales at which tile sizes are recommended to be used. It should be noted that raster tiles are bigger than usual paper / hard-copy maps, to take advantage of encoding standard and associated technology (decoder) capabilities. The scales addressed are the standardized DRP scales: 5M, 2M, 1M, 500k, 250k, 100k, 50k, 25k, 12,5k, 10k, 7,5k and 5k. The tile size indicator (t) is an integer number between 0 and 9, as follows:

Table 7: DRP products Tiling and use by standardized DRP products

Tile Size	Tile Size		Standardized DRP recommended scales
	Geo ARC	Projected UTM/LCC	
Indicator	minutes	km	
0		5000	5M (GNC)
1	20°d	2000	2M (JNC), 5M, 1M, 500k
2	10°d	1000	1M (ONC), 2M, 500k
3	240 = 4°d	500	500k (TPC), 250k, 100k
4	120 = 2°d	200	250k (JOG), 100k, 50k, 25k
5	60 = 1°d	100	100k, 50k, 25k, 12,5k
6	30’	50	25k, 12,5k
7	15’	25	12,5k, 10k, 5k
8	7,5’ (7’30")	12,5	12,5k, 10k, 7,5k
9	3’	5	7,5k, 5k

Annex E provides estimates of the file sizes, depending on the tile sizes.

11.6 Security

Security metadata capture is required to comply with the DGIWG or NATO profile rules depending on the metadata’s intended audience. Security metadata will use national or NATO security markings.

Individual DRP data and supporting files may have different security classifications and markings but when provided as one dataset or combined, the results shall be marked with the highest security level of the individual datasets.

12 Product metadata

The DRP product metadata specification is based on DMF metadata for Raster Map data as specified in Annex B, for discovery, catalogues and Raster map delivery purposes.

DRP product metadata are associated to the DRP raster data (at collection or individual raster map element – or product unit) and may be encoded:

- either in an external XML metadata file,
- or in XML metadata document embedded in DRP raster data file.

Note 1: The GMLCOV Rectified Grid coverage that may be associated with the DRP Raster is encoded in a GML document, the metaDataProperty of this feature will reference the metadata file or resource.

Note 2: For external metadata (as well as GMLCOV description of the DRP Rectified Grid Coverage, in any), association between data and metadata shall be done either by sharing the same file basename or uuid. Grouping mechanisms such as zip may prevent the data from becoming separated from the metadata (see section 11.2).

DRP metadata elements (mandatory and recommended optional) for describing any raster map dataset provide the basis for the elements specified in Annex B.

DRP product quality should be reported for a pre-defined registered data quality measure (Regulated Quality Element) for commonly-used data quality measures or for an unregistered quality measure (Unregulated Quality Element) when the measure is too specific to proceed to its registration. For both the 'regulated' and 'unregulated' measures, either the result of the evaluation is a conformance, quantitative, descriptive, or coverage result (see DMF). If two results are reported, one of them must be a conformance result.

The coverage result is an instance of CoverageResult of a Regulated Quality Report (DMF) and used to report quality evaluation results on quality zones.

Quality reporting metadata for any DRP dataset should include, at a minimum, a completeness percentage and absolute horizontal accuracy of the dataset. Both require quantitative results. The completeness percentage shall be reported via the CompletenessCommission quality measure and the absolute horizontal accuracy of the dataset shall be reported via the AbsoluteExternalPositionalAccuracy of the Regulated Quality Report quality measure (DMF), based on the corresponding ISO DQ_CompletenessCommission and DQ_AbsoluteExternalPositionalAccuracy.

The conformance quality reporting metadata is required in all cases and it is recommended to provide the result of the quality control test regarding conformance to this specification, as indicated in Annex A. When quality control is not available, the result will be False, with explanation ='Conformity to Product Specification: Not tested'.

Additional metadata elements not described in the DMF can be included in the elevation dataset's metadata in accordance with extension rules specified in DMF section B.3. Such extensions should be applied to a dedicated DMF requirement class. The additional elements may represent a profile of the DMF, and described either within each metadata instance document, or within an online resource (i.e. a registered profile).

Reference to an online registry of metadata elements is a more efficient method, particularly when an entire class of extended elements are required (e.g. a country or organization-specific extension to the ISO MD_SecurityConstraints class) to accommodate additional security requirements within a classification system.

Annex A
Abstract Test Suites
(normative)

Any application or system or raster map product specification or raster dataset claiming conformance to this implementation profile shall meet the following criteria for data conformance. For application or system, this applies to the data that is produced. For a product specification, this applies to the requirements and conformance tests.

A.1 DRP Core

A.1.1 Use of the DRP grid structure, either for geographic or projected cartographic products and standardized raster resolutions

As specified in introduction of Section 6.2.

Use of 254 dpi or 300 dpi (except for printing purposes where 600 dpi may be used).

A.1.2 Alignment of CRS with DRP geographic products or cartographic datum for DRP projected products

As specified in Section 7.1 - Horizontal Reference system. Adhoc products may use other Horizontal systems.

As mentioned in Section 7.2 - Vertical Reference system for Vertical Reference system (this can only be tested by the producer).

A.1.3 Data quality and horizontal spatial resolution

Datasets shall conform to the requirements specified in section 8. An absolute horizontal accuracy estimate shall be reported for each dataset, as well as actuality of data by use of DRP metadata (see Section 12 and Annex B).

Horizontal resolution shall conform to Table 5: Horizontal spatial resolutions for projected standardized DRP products or Table 6: Horizontal spatial resolutions for ARC standardized DRP products, pending the case (geographic ARC or projected).

A.1.4 DRP product structure

As specified in Section 11.2.

This includes Legends and auxiliary files, as described in sections 6.6 and 6.7. respectively.

A.1.5 DRP file naming conventions

As specified in Section 11.3. the files naming conventions are recommendations and file naming may differ.

A.1.6 DRP encoding

Implementation shall follow the rules provided for DRP encoding in section 11.4 and on the basis of one of the specified encoding standards: GeoTIFF, GMLJP2 or NSIF. This includes the encoding of null values.

Requirements in Section 9.2.1 Pixel values and color space also apply.

Geo-enabled PDF for raster products is also allowed for hard-copy products.

A.1.7 DRP Security

Implementation shall follow the rules provided for security marking and security metadata in section 11.6.

A.1.8 DRP metadata

Implementation shall follow the principles provided for DRP metadata in section 12 and the rules specified in Annex B.

A.2 DRP Standardized ARC products

A.2.1 Alignment of CRS with WGS84 Geographic 2D and ARC system

WGS84 Geographic 2D is to be used as the horizontal reference system (EPSG code 4326), see section 7.1.

ARC system zones as specified in Annex C.

A.2.2 Alignment with DRP ARC grids

As specified in Section 6.3.2

A.2.3 Alignment with DRP ARC tiling scheme

As specified in Section 11.5 and Table 7: DRP products Tiling and use by standardized DRP products.

A.3 DRP Standardized UTM products

A.3.1 Alignment of CRS with DRP UTM datum

WGS84 UTM is to be used as the horizontal reference system (see EPSG registry for applicable codes), see section 7.1.

A.3.2 Alignment with DRP UTM grids

As specified in Section 6.3.2.

A.3.3 Alignment with DRP UTM tiling scheme

As specified in Section 11.4 and Table 7: DRP products Tiling and use by standardized DRP products.

A.4 DRP Standardized LCC products

A.4.1 Alignment of CRS with DRP LCC datum

WGS84 LCC is to be used as the horizontal reference system (see EPSG registry for applicable codes), see section 7.1.

A.4.2 Alignment with DRP LCC grids

As specified in Section 6.3.2.

A.4.3 Alignment with DRP LCC tiling scheme

As specified in Section 11.4 and Table 7: DRP products Tiling and use by standardized DRP products.

A.5 DRP Adhoc products

A.5.1 Alignment with DRP Adhoc grids

As specified in Section 6.3.3.

Annex B
DRP Metadata Specification
(normative)

This DRP metadata specification is specified by the following table based on DMF (on the basis of ISO TC211 metadata standards), and serves to define the model for DRP minimum required metadata.

The last two elements in the table provide the DRP maximum occurrence and Value Domain values as specified for DRP on basis of DMF. The Obligation, Maximum Occurrence, and Value Domain requirement for each element is derived from DMF (and based on ISO), with any additional constraints on the corresponding DMF element indicated in the table.

In the Obligation column uses the following letters:

- 'M' indicates that the metadata element is DRP mandatory,
- "O" indicates that the element is DRP optional,
- "C" indicates that the element is DRP mandatory under the condition provided.

The obligation letter code is in bold text when the DRP obligation exceeds the DMF obligation (i.e. when the DMF obligation has been changed from optional to conditional or mandatory for DRP).

The Max Occur (Maximum Occurrence) column is simply an indication of whether the DMF allows one or multiple instances (N) of the element to be included in the metadata file. The contents of the Value Domain column indicate the allowed values for the element. For most elements, these are presented as DMF-defined basic types, complex types and codelists, but DRP-specific constraints on the domain may be specified.

Table 8: DRP Core Metadata

ID	**Name** DMF ID (Requirement Class)	Definition	Obligation	Max Occur	Value Domain
1	**Metadata Set identifier** MDSID (Core)	unique identifier for this metadata file	**M**	1	String NOTE: DMF recommends a unique identifier (e.g. UUID or URI or URL).
2	**Parent metadata file identifier** MDPTMD (Common)	file identifier of the metadata to which this metadata is a subset (child)	**C / if parent metadata file exists**	1	Parent Metadata Reference
3	**Metadata language** MDDLOC (Core) + language	language used for documenting metadata	**M**	1	Locale Language Codelist Default value: 'eng' Note: If additional languages are used MDTLOC should be used to capture these.
4	**Metadata character set** MDDLOC (Core) + encoding	character coding standard used for the metadata	**M**	1	Locale Character Set Codelist fixed to 'utf8'

Table 8: DRP Core Metadata (continued)

ID	Name DMF ID (Requirement Class)	Definition	Obligation	Max Occur	Value Domain
5	**Metadata Translation** MDTLOC (Common)	locale in which some metadata elements may be translated	O	N	Locale
6	**Metadata date stamp** MDDATE (Core)	date that the metadata was created	**M**	1	Date
7	**Metadata point of contact** MDRPTY (Core)	identification of, and means of communication with, person(s) and organizations associated with the metadata	**M**	N	Responsible Party (minimum is) party.organisation party.role Otherwise capture all party elements. Note: The party.role is usually defaulted to pointOfContact.
8	**Metadata standard name** MDSTD (Core) + title	name of the metadata standard (including profile name) used	**M**	1	'urn:dgiwg:metadata:dmf'
9	**Metadata standard version** MDSTD (Core) + version	version (profile) of the metadata standard used	**M**	1	'2.0'
10	**Metadata security constraint level** MDSCST (Common) + level	security classification level of the metadata	**C / required if presence of metadata security constraint**	1	Security Constraint Level Classification Level Codelist
11	**Metadata security constraint system** MDSCST (Common) + system	national or international system used to classify the metadata	**C / required if presence of metadata security constraint level (**MDSCST level)	1	Security Constraint System String String value is expected to be a 3-character country code from STANAG 1059, unless not available.
12	**Metadata releasability Addressee** MDREL (Defence)	establishes a body to which the metadata can be released	O	N	String (a 3-character country code from STANAG 1059 when available).
13	**Metadata legal constraint** MDLCST (Common)	provides a means to express a set of legal constraints applicable to the metadata	**C / legal constraints exist**	N	Legal Constraint

Table 8: DRP Core Metadata (continued)

ID	Name DMF ID (Requirement Class)	Definition	Obligation	Max Occur	Value Domain
14	**Metadata maintenance frequency** MDMFRQ (Common)	information on the frequency with which changes and additions are made to the metadata after the initial metadata is completed	O	1	Frequency Codelist
15	**Dataset title** RSTITLE (Core)	name by which the cited resource is known	**M**	1	Free Text (see DMF recommendation for RSTITLE)
16	**Dataset alternate title** RSALT (Common)	short name, informal name, or name in another language by which the dataset is known	O	1	Free Text
17	**Abstract describing the dataset** RSABSTR (Core)	brief narrative summary of the content of the dataset Note: The abstract should include human-readable information to explain the product specificity.	**M**	1	Free Text **Recommendation**: DRP (Defence Raster Product) Version 1.0 + additional information as necessary describing the dataset
18	**Collection Tiling Scheme** GPHICS (Common) +name +description	reference to a graphic that provides a description of the collection's tiling scheme	**C / if RSTYPE= series and tiling scheme is defined**	1	Browse Graphic name (file name) String or URI and description = 'TilingScheme'
19	**Dataset purpose** RSPURP (Core)	A summary of the intentions with which the dataset was developed	O	1	Free Text
20	**Metadata type code** RSTYPE (Core)	This is the type code of the resource described by the metadata (here dataset or series/collection)	**M**	1	Resource Type Codelist Value = 'dataset', or 'series' for a collection
21	**Metadata type name** RSTYPN (Core)	This is the type name of the resource described by the metadata (here dataset or series/collection)	**C / RSTYPE = series**	1	Free Text 'Collection' (e.g. when Eng. Is used)
22	**Dataset edition** RSED (Core)	version identifier of the resource	O	1	String
23	**Dataset edition date** RSEDDAT (Core)	reference date of this edition of the resource	O	1	Date
24	**Dataset identifier** RSID (Core)	value uniquely identifying an object within a namespace	**M**	N	Identifier: UUID
25	**Name of Resource Series** RSSERI (Core)	When the resource pertains to a series, this is the name of the series.	**C / when dataset is a member of a series**	1	String

Table 8: DRP Core Metadata (continued)

ID	Name DMF ID (Requirement Class)	Definition	Obligation	Max Occur	Value Domain
26	**Resource Sheet Name** RSSHNA (Core)	When the resource pertains to a series, this is the name or identifier of the resource as part of the series.	**C / when dataset is a member of a series**	1	String
27	**Keywords** RSKWDS (Core)	commonly used word(s) or formalized word(s) or phrase(s) used to describe the subject. Note: It is strongly recommended to use keywords from an identified thesaurus.	**M**	N	Controlled Vocabulary
28	**Resource Spatial Resolution** RSSRES (Core) + equivalentScale	Factor which provides a general understanding of the density of spatial data in the resource. Level of detail expressed as the scale of a comparable hardcopy map or chart.	**M**	1	equivalentScale (Integer)
29	**Dataset language** RSDLOC (Core) + language	language used within the dataset	**M**	1	Locale Language Language Codelist
30	**Dataset character set** RSDLOC (Core) + encoding	character coding standard used for the dataset	**M**	1	Locale Encoding Character Set Codelist
31	**Spatial representation type** RSRPTP (Core)	method used to spatially represent geographic information	**M**	1	Spatial Representation type Codelist Fixed to “grid”
32	**Dataset type** DGITYP (Core)	information about the type of geospatial information provided by the dataset	**M**	1	Geospatial Information Type Codelist Fixed to “mapCoverage”
33	**Dataset georeferencing level** RSGFLV (Core)	level of georeferencing of the dataset	O	1	Georeferencing Level Codelist georectified
34	**Dataset level** RSDTLVL (Core)	method of categorizing resolution bands of digital geographic data by equivalence to paper map scales	O	1	String
35	**Dataset topic category** RSTOPIC (Core)	main theme(s) of the dataset	**M**	**1**	Topic Category Enumeration ‘imageryBaseMapsEarthCover’

Table 8: DRP Core Metadata (continued)

ID	Name DMF ID (Requirement Class)	Definition	Obligation	Max Occur	Value Domain
36	**Dataset theme** RSTHEME (Core)	provides more precise thematic information enabling discovery of the dataset	O	N	Thematic Codelist GlobalEarthCover or LandSurveyRealEstate or AirspaceRoutes or OperationsEvents (pending type of product)
37	**Dataset environment description** RSENVD (Data)	information on producer's processing environment, including items such as the software, the computer operating system, file name, and the dataset size.	O	1	Free text
38	**Value type** GRCINF (Data) + contentType	type of information represented by the cell value	**M**	1	Coverage Content Type CodeList Fixed to "image"
39	**Content Information of the Coverage** GRCINF (Data) + range	description of the attribute described by the measurement value	**M**	1	Range Provision of id, type (integer), bitsPerValue (e.g. 8) and description of bands (e.g. RGB)
40	**Special Cell** GRCINF (Data) +specialCell	cell playing a specific role (e.g. no data) in the coverage.	O	1	Special Cell Values e.g. White (255, 255, 255) (no data or Black (0, 0, 0)) Recommendation: use and document this element when dataset contains Null values.
41	**Geographic location of the dataset (by coordinates)** RSEXT/boundingBox (Core)	geographic position (spatial extent) of the dataset as a bounding box	**O** **Constraint**: at least one of RSEXT/boundingBox and RSEXT/boundingPolygon elements shall be used.	N	Geographic Box (Extent) NOTE: RSEXT/boundingBox may be repeated if the area covered is discontinuous
42	**Dataset positional extent** RSEXT/boundingPolygon (Core)	the boundary enclosing the dataset, given as a set of (x,y) WGS84 coordinates of a polygon, with the last point replicating the first	**O** **Constraint**: at least one of RSEXT/boundingBox and RSEXT/boundingPolygon elements shall be used.	1	Polygon (Extent)

Table 8: DRP Core Metadata (continued)

ID	Name DMF ID (Requirement Class)	Definition	Obligation	Max Occur	Value Domain
43	**Dataset vertical extent** RSEXT/verticalExtent/ minz, maxz and verticalCRS (Core)	vertical domain of the dataset The minimum and maximum vertical value contained in the dataset.	**M**	1	Extent Vertical Extent Integer Default value for verticalCRS is **http://www.opengis.net/def/crs/EPSG/0/4979** (height above WGS84 ellipsoid) Note: minz and maxz are expressed in meters (as integer values, according to DMF 2.0)
44	**Coordinate reference system – horizontal** RSRSYS (Core)	Horizontal reference system used in the dataset	**M**	1	Identifier code URI or Anchor
45	**Dataset status** RSSTAT (Common)	Information about the status of the dataset	O	1	Status Codelist
46	**Dataset reference date** RSDATE (Core) +date +type	reference date for the cited dataset	M	N	Reference Date
47	**Dataset originator** RSRPTY (Core)	party that created the dataset	**M**	1	ResponsibleParty (role = originator)
48	**Dataset point of contact** RSRPTY (Core)	party that can be contacted for inquiries regarding or acquisition of the dataset	O	N	ResponsibleParty (role = pointOfContact) Note: Should be present if different from Originator
49	**Maintenance frequency** RSMTNC (Common) + maintenanceFrequency	frequency with which changes and additions are made to the resource after the initial resource is completed	O	1	Maintenance Information maintenanceFrequency Frequency Codelist
50	**Dataset classification** RSSCST (Core) + level	name of the handling restrictions on the resource	**C / required if presence of dataset security constraint**	1	Security Constraint Level Classification Level Codelist
51	**Dataset classification system** RSSCST (Core) + system	national or international system used to classify the dataset	**C / required if presence of dataset classification (**RSSCST level)	1	Security Constraint system String String value is expected to be a 3-character country code from STANAG 1059, unless not available.

Table 8: DRP Core Metadata (continued)

ID	Name DMF ID (Requirement Class)	Definition	Obligation	Max Occur	Value Domain
52	**Dataset releasability** RSREL (Defence)	provides a means to express a set of releasability information applicable to the dataset	O	N	Releasability
53	**Dataset use limitations** RSUSE (Core)	provides a means to express general use limitations (limitations not implied by security or legal constraints) of the dataset	O	N	Free Text
54	**Dataset legal constraints** RSLCST (Core)	restrictions and legal prerequisites for accessing and using the resource	**C / legal access/use constraints exist?**	N	Legal Constraint
55	**Dataset lineage** RSLING (Core)	information about the source, the method of data capture, and any information on the transformation, conversion, or resampling that has been applied to the data, if available	**M**	1	Free Text **Recommendation**: should be documented: - Sources: General type of resource (e.g. map series designation) - Process step: General processing and Reference to documentation (ex. scan and processing characterization) - Data quality: General statement on quality / Warning if unofficial data
56	**Source of the Resource** RSSRC (Common)	This element provides information about the source data used in creating the resource.	O	0..N	Source
57	**Resource Process Step** RSPRST (Common)	This element provides information about an event or transformation in the life of a resource including the process used to maintain the resource	O	0..N	Process Step In case of scanned map, the scanning process should documented
58	**Dataset Regulated quality report** RSRQR (Common)	Information related to the result of regulated quality evaluation of the dataset, as follows (58-1 to 58-3), following pre-defined registered data quality measures.	**M**	1..N	Regulated Quality Report
58-1	**Dataset quality report** RSRQR (Common) – Absolute Horizontal Accuracy	Information related to the result of a quality evaluation of the dataset on absolute horizontal accuracy (CE90)	**M**	1	Regulated Quality Report identifier.code = "http://dgiwg.org/metadata/qualityMeasure/ACE" qtyResult.unit = 'metre' qtyResult.result (Float) = Result of the quality measure

Table 8: DRP Core Metadata (continued)

ID	Name DMF ID (Requirement Class)	Definition	Obligation	Max Occur	Value Domain
58-2	**Dataset quality report** RSRQR (Common) – Relative Horizontal Accuracy	Information related to the result of a quality evaluation of the dataset on relative horizontal accuracy (RelCE90)	O	1	Regulated Quality Report identifier.code = "http://dgiwg.org/metadata/qualityMeasure/RelCE90" qtyResult.unit = 'metre' qtyResult.result (Float) = Result of the quality measure
58-3	**Dataset quality report** RSRQR (Common) - Completeness Percentage of missing items	Information related to the result of a quality evaluation of the dataset on completeness: ratio of missing pixels (on uncovered zones)	O	1	Regulated Quality Report identifier.code = " http://dgiwg.org/metadata/qualityMeasure/missRate" qtyResult.unit = 'percent' qtyResult.result (Float) = Result of the quality measure Example: 0 (if dataset is complete)
58-4	**Dataset quality report** RSRQR (Common) - Conformity	Information related to compliance with DRP specification	**M**	1	Regulated Quality Report identifier.code = 'http://dgiwg.org/metadata/qualityMeasure/ProdSpecComp ' cnfResult.conformance = *TRUE or FALSE* cnfResult.explanation = 'Conformity to Product Specification' or 'Conformity to Product Specification: Not tested' (if not tested) cnfResult.specification.title = 'Defence Raster Product Implementation Profile' cnfResult.specification.referenceDate.date = '2018-05-xx' cnfResult.specification.referenceDate.type = publication cnfResult.specification.version = '1.0'
58-5	**Dataset quality report** RSRQR (Common) - Cartography of source zones	Cartography of source zones (defined by their boundaries in GML or Shapefile)	O	1	Regulated Quality Report identifier.code = "http://www.dgiwg.org/metadata/qualityMeasure/CSZ" covResult should contain the geometry of the source zones (vector geometry codelist code = surface)
58-6	**Dataset quality report** RSRQR (Common) - Cartography of quality zones	Cartography of horizontal quality zones (defined by their boundaries in GML or Shapefile)	O	1	Regulated Quality Report identifier.code = "http://www.dgiwg.org/metadata/qualityMeasure/CQZ" covResult should contain the geometry of the horizontal quality zones (vector geometry codelist code = surface)

Table 8: DRP Core Metadata (continued)

ID	Name DMF ID (Requirement Class)	Definition	Obligation	Max Occur	Value Domain
58-7	**Dataset quality report** RSRQR (Common) - Cartography of updated zones	Cartography of updated zones of the raster map (defined by their boundaries in GML or Shapefile)	O	1	Regulated Quality Report identifier.code = "http://www.dgiwg.org/metadata/qualityMeasure/CUZ" covResult should contain the geometry of the updated zones (vector geometry codelist code = surface)
59	**Dataset Unspecified quality report** RSUQR (Common)	Information related to the result of a quality evaluation of the dataset, result of an unspecified quality evaluation. **NOTE**: any other DRP detailed quality information on specific quality areas, or per pixel, such as quality areas.	O	N	Unregulated Quality Report
60	**Dataset source** RSSRC (Common)	information about the source data used in creating the dataset	**M**	N	Source
61	**Dataset intended usage** RSSPUS (Common)	brief description of ways in which the resource(s) is/are currently or has been used	O	N	Usage
62	**Dataset distribution format** RSDFMT (Core)	name of the data distribution format(s) and version of the format (date, number, etc.) and also file decompression technique if any.	**M**	**N**	Format
63	**Online resource** RSONLLC (Core)	information about on-line sources from which the dataset, specification or community profile name and extended metadata elements can be obtained	**M**	N	Online Location
64	**Dataset distribution unit** RSUD (Data)	a description of the unit (tiles, layers, geographic areas, etc.) in which the data is available	O	1	Free Text
65	**Dataset transfer size** RSTS (Data)	estimated size of a unit in the specified transfer format, expressed in megabytes. The transfer size is > 0.0	O	1	Float
66	**Dataset offline distribution** RSOFDM (Data)	information about offline media through which the dataset can be obtained	O	N	Medium

Annex C
DRP Geographic ARC product parameters

Annex C-1. Introduction

The Equal Arc-Second Raster Chart/Map system, usually known as the ARC System, is a special grid system covering the entire ellipsoid of the World Geodetic System 1984. It provides a rectangular coordinate system based on 18 latitudinal zones. In this “very simple” system and projection (in non-polar zones), the meridians and parallels are equidistant straight parallel lines, the two sets of lines are supposed to be orthogonal. As a result, there is a significant distortion in the longitudinal direction (East-West) is large in comparison to most grid systems.

These allow an image-dependent relative coordinate system to be used with individual raster maps. The design objective of ARC is to provide graphic data in a manner as seamless as possible, and to permit direct display with a simple representation of directions.

This Annex documents two sets of ARC parameters which are consistent (within each set) between the set of scales that are covered: the DRP proposed sets at 254 dpi and 300 dpi, and the ECRG set at 254 dpi and at 300 dpi (only for scale 1:1M). These sets of parameters are recommended, but producers may prefer other set of ARC parameters, due to specific constraints.

Annex C-2. ARC zones system

The ARC system specifies 9 zones per hemisphere (i.e. 18 zones) as follows:

Table 9: ARC system zone

Northern Zones	Latitude Range	Southern Zones	Latitude Range
Zone 1	0°N to 32°N	Zone 10 (*Zone A*)	0°S to 32S°
Zone 2	32°N to 48°N	Zone 11 (*Zone B*)	32°S to 48S°
Zone 3	48°N to 56°N	Zone 12 (*Zone C*)	48°S to 56S°
Zone 4	56°N to 64°N	Zone 13 (*Zone D*)	56°S to 64S°
Zone 5	64°N to 68°N	Zone 14 (*Zone E*)	64°S to 68S°
Zone 6	68°N to 72°N	Zone 15 (*Zone F*)	68°S to 72S°
Zone 7	72°N to 76°N	Zone 16(*Zone G*)	72°S to 76S°
Zone 8	76°N to 80°N	Zone 17 (*Zone H*)	76°S to 80S°
Zone 9 (Polar)[3]	80°N to 90°N	Zone 18 (Zone J) (Polar)[3]	80°S to 90S°

Note: **This document only addresses the non-polar zones. Polar zones are to be addressed in a DRP polar zones extension.**

Zones 10 to 17 are sometimes called Zones A to H (respectively), Zone 18 being called Zone J.

[3] Not addressed by this specification

Theoretically, the projection used to convert (latitude, longitude) is the Equi-rectangular projection in the non-polar zones (as explained in the DIGEST support document for ARC system). However, as the coordinate system for ARC products is geographic (2D), there is no need to process any projection.

In each ARC zone, the longitudinal pixel size (E-W) depends on each arc zone. To minimize the longitudinal distortion within an ARC zone, the longitudinal pixel size in a given zone is computed on the basis of the parallel length measured at the ***standard latitude***, which is an intermediate latitude between the two latitude limits of the zone, defined in such a way as to minimize the error (between stretch and shrink) within the zone when latitude varies (see DIGEST support document for ARC system). The following table provides the standard latitude values for the 18 zones.

Table 10: Standard Latitudes of the ARC Non-Polar Zones

Northern Zones	Standard Latitude	Southern Zones	Standard Latitude	Standard parallel (m)
Zone 1	22,94791772°N	Zone 10	22,94791772°S	36884683,4
Zone 2	41,12682127°N	Zone 11	41,12682127°S	30142987,4
Zone 3	52,28859923°N	Zone 12	52,28859923°S	24461860,6
Zone 4	60,32378942°N	Zone 13	60,32378942°S	19790863,0
Zone 5	66,09421768°N	Zone 14	66,09421768°S	16194258,4
Zone 6	70,10896259°N	Zone 15	70,10896259°S	13594406,3
Zone 7	74,13230145°N	Zone 16	74,13230145°S	10923203,2
Zone 8	78,17283750°N	Zone 17	78,17283750°S	8187398,3

For each map or chart scale, a constant longitudinal (column) and latitudinal (row) pixel interval shall exist in each ARC zone, based on 2 parameters, A(ZT) = Pixel number along the standard parallel (o in 360° longitude) and B(Z) = Pixel number along the meridian (or in 360° latitude), whose values depend on the intended scale of the product and the pixel size (in dpi).

As the delivery unit (tile/file) for raster map is the square degree (if file size is acceptable as such) or a set of square degrees, the values specified for each of these two parameters are such that they can be divided by 360.

Therefore, the values proposed in the DGIWG DIGEST support document for the ARC system are not retained, and are adjusted according to this principle in the following section as the DRP ARC specification. The set of parameters of the US ECRG specification are also indicated as an alternate option.

Annex C-3. DRP ARC products – Set of ARC parameters for scales 1:1M to 1:5k (254 dpi)

The computation of the A(ZT) & B(Z) values is based on the additional constraint that the number of pixels per square degree in both directions must be multiple of 16, for 1:1M scale, as well as for all scales, where the values are deduced from the 1:1M scale values on the basis of their scale ratio.

a. DRP ARC product at scale 1:1M parameters (254 dpi)

The following table provides the parameters for DRP 1:1M ARC product, and the size of a 1° x 1° DRP raster (in pixels), for each ARC zone.

Table 11: DRP 1:1M ARC product: parameters and size in pixels in ARC zones (254 dpi)

ARC Zone	1 and A	2 and B	3 and C	4 and D	5 and E	6 and F	7 and G	8 and H
	Lat <=32	32< Lat <=48	48< Lat <=56	56< Lat <=64	64< Lat <=68	68< Lat <=72	72< Lat <=76	76< Lat <=80
A(ZT)	368640	305280	247680	201600	161280	138240	109440	80640
size (pixels)/ 1° longitude	1024	848	688	560	448	384	304	224
E-W Pixel Size (m)	100,06	98,74	98,76	98,17	100,41	98,34	99,81	101,53
B(Z)	403200							
size (pixels)/ 1° latitude	1120							
N-S Pixel size (m)	99,23							

A DRP 1:1M 1°x1° product unit maximum size is 1024 pixels (horizontally) x 1120 pixels (vertically).

b. DRP ARC product at scale 1:500k parameters (254 dpi)

The following table provides the parameters for DRP 1:500k ARC product, and the size of a 1° x 1° DRP raster (in pixels), for each ARC zone.

Table 12: DRP 1:500k ARC product: parameters and size in pixels in ARC zones (254 dpi)

ARC Zone	1 and A	2 and B	3 and C	4 and D	5 and E	6 and F	7 and G	8 and H
	Lat <=32	32< Lat <=48	48< Lat <=56	56< Lat <=64	64< Lat <=68	68< Lat <=72	72< Lat <=76	76< Lat <=80
A(ZT)	737280	610560	495360	403200	322560	276480	218880	161280
size (pixels)/ 1° longitude	2048	1696	1376	1120	896	768	608	448
E-W Pixel Size (m)	50,03	49,37	49,38	49,08	50,21	49,17	49,90	50,77
B(Z)	806400							
size (pixels)/ 1° latitude	2240							
N-S Pixel size (m)	49,61							

A DRP 1:500k °x1° product unit maximum size is 2048 pixels (horizontally) x 2240 pixels (vertically).

c. DRP ARC product at scale 1:250k parameters (254 dpi)

The following table provides the parameters for DRP 1:250k ARC product, and the size of a 1° x 1° DRP raster (in pixels), for each ARC zone.

Table 13: DRP 1:250k ARC product: parameters and size in pixels in ARC zones (254 dpi)

ARC Zone	1 and A	2 and B	3 and C	4 and D	5 and E	6 and F	7 and G	8 and H
	Lat <=32	32< Lat <=48	48< Lat <=56	56< Lat <=64	64< Lat <=68	68< Lat <=72	72< Lat <=76	76< Lat <=80
A(ZT)	1 474 560	1221120	990720	806400	645120	552960	437760	322560
size (pixels)/ 1° longitude	4 096	3392	2752	2240	1792	1536	1216	896
E-W Pixel Size (m)	25,01	24,68	24,69	24,54	25,10	24,58	24,95	25,38
B(Z)	1612800							
size (pixels)/ 1° latitude	4480							
N-S Pixel size (m)	24,81							

A DRP 1:250k °x1° product unit maximum size is 4096 pixels (horizontally) x 4480 pixels (vertically).

d. DRP ARC product at scale 1:100k parameters (254 dpi)

The following table provides the parameters for DRP 1:100k ARC product, and the size of a 1° x 1° DRP raster (in pixels), for each ARC zone.

Table 14: DRP 1:100k ARC product: parameters and size in pixels in ARC zones (254 dpi)

ARC Zone	1 and A	2 and B	3 and C	4 and D	5 and E	6 and F	7 and G	8 and H
	Lat <=32	32< Lat <=48	48< Lat <=56	56< Lat <=64	64< Lat <=68	68< Lat <=72	72< Lat <=76	76< Lat <=80
A(ZT)	3686400	3052800	2476800	2016000	1612800	1382400	1094400	806400
size (pixels)/ 1° longitude	10240	8480	6880	5600	4480	3840	3040	2240
E-W Pixel Size (m)	10,01	9,87	9,88	9,82	10,04	9,83	9,98	10,15
B(Z)	4032000							
size (pixels)/ 1° latitude	11200							
N-S Pixel size (m)	9,92							

A DRP 1:100k ARC 1°x1° product unit maximum size is 10240 pixels (horizontally) x 11200 pixels (vertically).

e. DRP ARC product at scale 1:50k parameters (254 dpi)

The following table provides the parameters for DRP 1:50k ARC product, and the size of a 1° x 1° DRP raster (in pixels), for each ARC zone.

Table 15: DRP 1:50k ARC product: parameters and size in pixels in ARC zones (254 dpi)

ARC Zone	1 and A	2 and B	3 and C	4 and D	5 and E	6 and F	7 and G	8 and H
	Lat <=32	32< Lat <=48	48< Lat <=56	56< Lat <=64	64< Lat <=68	68< Lat <=72	72< Lat <=76	76< Lat <=80
A(ZT)	7372800	6105600	4953600	4032000	3225600	2764800	2188800	1612800
size (pixels)/ 1° longitude	20480	16960	13760	11200	8960	7680	6080	4480
E-W Pixel Size (m)	5,00	4,94	4,94	4,91	5,02	4,92	4,99	5,08
B(Z)	8064000							
size (pixels)/ 1° latitude	22400							
N-S Pixel size (m)	4,96							

A DRP 1:50k ARC 1°x1° product unit maximum size is 20480 pixels (horizontally) x 22400 pixels (vertically).

f. DRP ARC product at scale 1:25k parameters (254 dpi)

The following table provides the parameters for DRP 1:25k ARC product, and the size for a 1° x 1° raster data (in pixels), for each ARC zone.

Table 16: DRP 1:25k ARC product: parameters and size in pixels in ARC zones (254 dpi)

ARC Zone	1 and A	2 and B	3 and C	4 and D	5 and E	6 and F	7 and G	8 and H
	Lat <=32	32< Lat <=48	48< Lat <=56	56< Lat <=64	64< Lat <=68	68< Lat <=72	72< Lat <=76	76< Lat <=80
A(ZT)	14745600	12211200	9907200	8064000	6451200	5529600	4377600	3225600
size (pixels)/ 1° longitude	40960	33920	27520	22400	17920	15360	12160	8960
E-W Pixel Size (m)	2,50	2,47	2,47	2,45	2,51	2,46	2,50	2,54
B(Z)	16128000							
size (pixels)/ 1° latitude	44800							
N-S Pixel size (m)	2,48							

A DRP 1:25k ARC 1°x1° product unit maximum size is 40960 pixels (horizontally) x 44800 pixels (vertically).

g. DRP ARC product at scale 1:12,5k parameters (254 dpi)

The following table provides the parameters for DRP 1:12,5k ARC product, and the size for a 30' x 30' raster data tiles (in pixels), for each ARC zone.

Table 17: DRP 1:12,5k ARC product: parameters and size in pixels in ARC zones (254 dpi)

ARC Zone	1 and A	2 and B	3 and C	4 and D	5 and E	6 and F	7 and G	8 and H
	Lat <=32	32< Lat <=48	48< Lat <=56	56< Lat <=64	64< Lat <=68	68< Lat <=72	72< Lat <=76	76< Lat <=80
A(ZT)	29491200	24422400	19814400	16128000	12902400	11059200	8755200	6451200
Size (pixels)/ longitude (30')	40960	33920	27520	22400	17920	15360	12160	8960
E-W Pixel Size (m)	1,25	1,23	1,23	1,23	1,26	1,23	1,25	1,27
B(Z)	32256000							
Size (pixels)/ latitude (30')	44800							
N-S Pixel size (m)	1,24							

A DRP 1:12,5k ARC 30'x30' product unit maximum size is 40960 pixels (horizontally) x 44800 pixels (vertically).

h. DRP ARC product at scale 1:10k parameters (254 dpi)

The following table provides the parameters for DRP 1:10k ARC product, and the size for a 30' x 30' raster data tiles (in pixels), for each ARC zone.

Table 18: DRP 1:10k ARC product: parameters and size in pixels in ARC zones (254 dpi)

ARC Zone	1 and A	2 and B	3 and C	4 and D	5 and E	6 and F	7 and G	8 and H
	Lat <=32	32< Lat <=48	48< Lat <=56	56< Lat <=64	64< Lat <=68	68< Lat <=72	72< Lat <=76	76< Lat <=80
A(ZT)	36864000	30528000	24768000	20160000	16128000	13824000	10944000	8064000
Size (pixels)/ longitude (30')	51200	42400	34400	28000	22400	19200	15200	11200
E-W Pixel Size (m)	1,00	0,99	0,99	0,98	1,00	0,98	1,00	1,02
B(Z)	40320000							
Size (pixels)/ latitude (30')	56000							
N-S Pixel size (m)	0,99							

A DRP 1:10k ARC 30'x30' product unit maximum size is 51200 pixels (horizontally) x 56000 pixels (vertically).

i. DRP ARC product at scale 1:7,5k parameters (254 dpi)

The following table provides the parameters for DRP 1:7,5k ARC product, and the size for a 15' x 15' raster data tiles (in pixels), for each ARC zone.

Table 19: DRP 1:5k ARC product: parameters and size in pixels in ARC zones (254 dpi)

ARC Zone	1 and A	2 and B	3 and C	4 and D	5 and E	6 and F	7 and G	8 and H
	Lat <=32	32< Lat <=48	48< Lat <=56	56< Lat <=64	64< Lat <=68	68< Lat <=72	72< Lat <=76	76< Lat <=80
A(ZT)	47923200	40550400	33177600	25804800	22118400	18432000	14745600	11059200
Size (pixels)/ longitude (15')	33280	28160	23040	17920	15360	12800	10240	7680
E-W Pixel Size (m)	0,77	0,74	0,74	0,77	0,73	0,74	0,74	0,74
B(Z)	51609600							
Size (pixels)/ latitude (15')	35840							
N-S Pixel size (m)	0,78							

A DRP 1:7,5k 15'x15' product unit maximum size in pixels is 33280 pixels (horizontally) x 35840 pixels (vertically).

j. DRP ARC product at scale 1:5k parameters (254 dpi)

The following table provides the parameters for DRP 1:5k ARC product, and the size for a 15' x 15' raster data tiles (in pixels), for each ARC zone.

Table 20: DRP 1:5k ARC product: parameters and size in pixels in ARC zones (254 dpi)

ARC Zone	1 and A	2 and B	3 and C	4 and D	5 and E	6 and F	7 and G	8 and H
	Lat <=32	32< Lat <=48	48< Lat <=56	56< Lat <=64	64< Lat <=68	68< Lat <=72	72< Lat <=76	76< Lat <=80
A(ZT)	73728000	61056000	49536000	40320000	32256000	27648000	21888000	16128000
Size (pixels)/ longitude (15')	51200	42400	34400	28000	22400	19200	15200	11200
E-W Pixel Size (m)	0,50	0,49	0,49	0,49	0,50	0,49	0,50	0,51
B(Z)	80640000							
Size (pixels)/ latitude (15')	56000							
N-S Pixel size (m)	0,50							

A DRP 1:5k 15'x15' product unit maximum size in pixels is 51200 pixels (horizontally) x 56000 pixels (vertically).

Annex C-4. DRP ARC products – Set of ARC parameters for scales 1:1M to 1:5k (300 dpi)

The computation of the A(ZT) & B(Z) values is based on the additional constraint that the number of pixels per square degree in both directions must be multiple of 16, for 1:1M scale, as well as for all scales, where the values are deduced from the 1:1M scale values on the basis of their scale ratio.

a. DRP ARC product at scale 1:1M parameters (300 dpi)

The following table provides the parameters for DRP 1:1M ARC product, and the size of a 1° x 1° DRP raster (in pixels), for each ARC zone.

Table 21: DRP 1:1M ARC product: parameters and size in pixels in ARC zones (300 dpi)

ARC Zone	1 and A	2 and B	3 and C	4 and D	5 and E	6 and F	7 and G	8 and H
	Lat <=32	32< Lat <=48	48< Lat <=56	56< Lat <=64	64< Lat <=68	68< Lat <=72	72< Lat <=76	76< Lat <=80
A(ZT)	437760	357120	288000	236160	190080	161280	132 480	97920
size (pixels)/ 1° longitude	1216	992	800	656	528	448	368	272
E-W Pixel Size (m)	84,26	84,41	84,94	83,80	85,20	84,29	82,45	83,61
B(Z)	472320							
size (pixels)/ 1° latitude	1312							
N-S Pixel size (m)	84,70							

A DRP 1:1M 1°x1° product unit maximum size is 1216 pixels (horizontally) x 1312 pixels (vertically).

b. DRP ARC product at scale 1:500k parameters (300 dpi)

The following table provides the parameters for DRP 1:500k ARC product, and the size of a 1° x 1° DRP raster (in pixels), for each ARC zone.

Table 22: DRP 1:500k ARC product: parameters and size in pixels in ARC zones (300 dpi)

ARC Zone	1 and A	2 and B	3 and C	4 and D	5 and E	6 and F	7 and G	8 and H
	Lat <=32	32< Lat <=48	48< Lat <=56	56< Lat <=64	64< Lat <=68	68< Lat <=72	72< Lat <=76	76< Lat <=80
A(ZT)	875520	714240	576000	472320	380160	322560	264960	195840
size (pixels)/ 1° longitude	2432	1984	1600	1312	1056	896	736	544
E-W Pixel Size (m)	42,13	42,20	42,47	41,90	42,60	42,15	41,23	41,81
B(Z)	944640							
size (pixels)/ 1° latitude	2624							
N-S Pixel size (m)	42,35							

A DRP 1:500k °x1° product unit maximum size is 2432 pixels (horizontally) x 2624 pixels (vertically).

c. DRP ARC product at scale 1:250k parameters (300 dpi)

The following table provides the parameters for DRP 1:250k ARC product, and the size of a 1° x 1° DRP raster (in pixels), for each ARC zone.

Table 23: DRP 1:250k ARC product: parameters and size in pixels in ARC zones (300 dpi)

ARC Zone	1 and A	2 and B	3 and C	4 and D	5 and E	6 and F	7 and G	8 and H
	Lat <=32	32< Lat <=48	48< Lat <=56	56< Lat <=64	64< Lat <=68	68< Lat <=72	72< Lat <=76	76< Lat <=80
A(ZT)	1751040	1428480	1152000	944640	760320	645120	529920	391680
size (pixels)/ 1° longitude	4864	3968	3200	2624	2112	1792	1472	1088
E-W Pixel Size (m)	21,06	21,10	21,23	20,95	21,30	21,07	20,61	20,90
B(Z)	1889280							
size (pixels)/ 1° latitude	4480							
N-S Pixel size (m)	21,18							

A DRP 1:250k °x1° product unit maximum size is 4864 pixels (horizontally) x 4480 pixels (vertically).

d. DRP ARC product at scale 1:100k parameters (300 dpi)

The following table provides the parameters for DRP 1:100k ARC product, and the size of a 1° x 1° DRP raster (in pixels), for each ARC zone.

Table 24: DRP 1:100k ARC product: parameters and size in pixels in ARC zones (300 dpi)

ARC Zone	1 and A	2 and B	3 and C	4 and D	5 and E	6 and F	7 and G	8 and H
	Lat <=32	32< Lat <=48	48< Lat <=56	56< Lat <=64	64< Lat <=68	68< Lat <=72	72< Lat <=76	76< Lat <=80
A(ZT)	4377600	3571200	2880000	2361600	1900800	1612800	1324800	979200
size (pixels)/ 1° longitude	12160	9920	8000	6560	5280	4480	3680	2720
E-W Pixel Size (m)	8,43	8,44	8,49	8,38	8,52	8,43	8,25	8,36
B(Z)	4723200							
size (pixels)/ 1° latitude	13120							
N-S Pixel size (m)	8,47							

A DRP 1:100k ARC 1°x1° product unit maximum size is 12160 pixels (horizontally) x 13120 pixels (vertically).

e. DRP ARC product at scale 1:50k parameters (300 dpi)

The following table provides the parameters for DRP 1:50k ARC product, and the size of a 1° x 1° DRP raster (in pixels), for each ARC zone.

Table 25: DRP 1:50k ARC product: parameters and size in pixels in ARC zones (300 dpi)

ARC Zone	1 and A	2 and B	3 and C	4 and D	5 and E	6 and F	7 and G	8 and H
	Lat <=32	32< Lat <=48	48< Lat <=56	56< Lat <=64	64< Lat <=68	68< Lat <=72	72< Lat <=76	76< Lat <=80
A(ZT)	8755200	7142400	5760000	4723200	3801600	3225600	2649600	1958400
size (pixels)/ 1° longitude	24320	19840	16000	13120	10560	8960	7360	5440
E-W Pixel Size (m)	4,21	4,22	4,25	4,19	4,26	4,21	4,12	4,18
B(Z)	9446400							
size (pixels)/ 1° latitude	26240							
N-S Pixel size (m)	4,24							

A DRP 1:50k ARC 1°x1° product unit maximum size is 24320 pixels (horizontally) x 26240 pixels (vertically).

f. DRP ARC product at scale 1:25k parameters (300 dpi)

The following table provides the parameters for DRP 1:25k ARC product, and the size for a 1° x 1° raster data (in pixels), for each ARC zone.

Table 26: DRP 1:25k ARC product: parameters and size in pixels in ARC zones (300 dpi)

ARC Zone	1 and A	2 and B	3 and C	4 and D	5 and E	6 and F	7 and G	8 and H
	Lat <=32	32< Lat <=48	48< Lat <=56	56< Lat <=64	64< Lat <=68	68< Lat <=72	72< Lat <=76	76< Lat <=80
A(ZT)	17510400	14284800	11520000	9446400	7603200	6451200	5299200	3916800
size (pixels)/ 1° longitude	48640	39680	32000	26240	21120	17920	14720	10880
E-W Pixel Size (m)	2,11	2,11	2,12	2,10	2,13	2,11	2,06	2,09
B(Z)	18892800							
size (pixels)/ 1° latitude	52480							
N-S Pixel size (m)	2,12							

A DRP 1:25k ARC 1°x1° product unit maximum size is 48640 pixels (horizontally) x 52480 pixels (vertically).

g. DRP ARC product at scale 1:12,5k parameters (300 dpi)

The following table provides the parameters for DRP 1:12,5k ARC product, and the size for a 30' x 30' raster data tiles (in pixels), for each ARC zone.

Table 27: DRP 1:12,5k ARC product: parameters and size in pixels in ARC zones (300 dpi)

ARC Zone	1 and A	2 and B	3 and C	4 and D	5 and E	6 and F	7 and G	8 and H
	Lat <=32	32< Lat <=48	48< Lat <=56	56< Lat <=64	64< Lat <=68	68< Lat <=72	72< Lat <=76	76< Lat <=80
A(ZT)	35020800	28569600	23040000	18892800	15206400	12902400	10598400	7833600
Size (pixels)/ longitude (30')	48640	39680	32000	26240	21120	17920	14720	10880
E-W Pixel Size (m)	1,05	1,06	1,06	1,05	1,06	1,05	1,03	1,05
B(Z)	37785600							
Size (pixels)/ latitude (30')	52480							
N-S Pixel size (m)	1,06							

A DRP 1:12,5k ARC 30'x30' product unit maximum size is 48640 pixels (horizontally) x 52480 pixels (vertically).

h. DRP ARC product at scale 1:10k parameters (300 dpi)

The following table provides the parameters for DRP 1:10k ARC product, and the size for a 30' x 30' raster data tiles (in pixels), for each ARC zone.

Table 28: DRP 1:10k ARC product: parameters and size in pixels in ARC zones (254 dpi)

ARC Zone	1 and A	2 and B	3 and C	4 and D	5 and E	6 and F	7 and G	8 and H
	Lat <=32	32< Lat <=48	48< Lat <=56	56< Lat <=64	64< Lat <=68	68< Lat <=72	72< Lat <=76	76< Lat <=80
A(ZT)	43776000	35712000	28800000	23616000	19008000	16128000	13248000	9792000
Size (pixels)/ longitude (30')	60800	49600	40000	32800	26400	22400	18400	13600
E-W Pixel Size (m)	0,84	0,84	0,85	0,84	0,85	0,84	0,82	0,84
B(Z)	47232000							
Size (pixels)/ latitude (30')	65600							
N-S Pixel size (m)	0,85							

A DRP 1:10k ARC 30'x30' product unit maximum size is 60800 pixels (horizontally) x 65600 pixels (vertically).

i. DRP ARC product at scale 1:7,5k parameters (300 dpi)

The following table provides the parameters for DRP 1:7,5k ARC product, and the size for a 20' x 20' raster data tiles (in pixels), for each ARC zone.

Table 29: DRP 1:7,5k ARC product: parameters and size in pixels in ARC zones (300 dpi)

ARC Zone	1 and A	2 and B	3 and C	4 and D	5 and E	6 and F	7 and G	8 and H
	Lat <=32	32< Lat <=48	48< Lat <=56	56< Lat <=64	64< Lat <=68	68< Lat <=72	72< Lat <=76	76< Lat <=80
A(ZT)	58367520	47616120	38400480	31488480	25344360	21503880	17664480	13056120
Size (pixels)/ longitude (20')	54044	44089	35556	29156	23467	19911	16356	12089
E-W Pixel Size (m)	0,6322603	0,6339603	0,6383583	0,63010534	0,640764	0,63406332	0,62029507	0,62911331
B(Z)	62975880							
Size (pixels)/ latitude (20')	58311							
N-S Pixel size (m)	0,64							

A DRP 1:7,5k 20'x20' product unit maximum size in pixels is 54044 pixels (horizontally) x 58311 pixels (vertically).

j. DRP ARC product at scale 1:5k parameters (300 dpi)

The following table provides the parameters for DRP 1:5k ARC product, and the size for a 15' x 15' raster data tiles (in pixels), for each ARC zone.

Table 30: DRP 1:5k ARC product: parameters and size in pixels in ARC zones (300 dpi)

ARC Zone	1 and A	2 and B	3 and C	4 and D	5 and E	6 and F	7 and G	8 and H
	Lat <=32	32< Lat <=48	48< Lat <=56	56< Lat <=64	64< Lat <=68	68< Lat <=72	72< Lat <=76	76< Lat <=80
A(ZT)	87552000	71424000	57600000	47232000	38016000	32256000	26496000	19584000
Size (pixels)/ longitude (15')	60800	49600	40000	32800	26400	22400	18400	13600
E-W Pixel Size (m)	0,42	0,42	0,42	0,42	0,43	0,42	0,41	0,42
B(Z)	94464000							
Size (pixels)/ latitude (15')	56000							
N-S Pixel size (m)	0,42							

A DRP 1:5k 15'x15' product unit maximum size in pixels is 60800 pixels (horizontally) x 56000 pixels (vertically).

Annex C-5. ECRG ARC products – Set of parameters for scales 1:1M to 1:50k

The A(ZT) & B(Z) values and table values are copied from the ECRG specification (see [MIL-PRF-32283]). The values are supposed to be multiple of 2304, which is the size of the EPF frames for ECRG products in 254 dpi resolution, or multiple of 2724, for ECRG products in 300 dpi resolution (see AnnexC-1.f). The lines "size (pixels) / 1° longitude (resp. latitude) are provided and illustrates that there is no integer number of pixels per degree.

a. ECRG ARC product at scale 1:1M parameters (254 dpi)

The following table provides the parameters for ECRG 1:1M ARC product, and the size of a 1° x 1° ECRG raster (in pixels), for each ARC zone.

Table 31: ECRG 1:1M ARC product: parameters and size in pixels in ARC zones (254 dpi)

ARC Zone	1 and A	2 and B	3 and C	4 and D	5 and E	6 and F	7 and G	8 and H
	Lat <=32	32< Lat <=48	48< Lat <=56	56< Lat <=64	64< Lat <=68	68< Lat <=72	72< Lat <=76	76< Lat <=80
A(ZT)	369 792	302592	245760	199296	163200	137088	110208	82560
size (pixels)/ 1° longitude	1027,2	840,5	682,7	553,6	453,3	380,8	306,1	229,3
E-W Pixel Size (m)	99,87	99,90	100,0	99,84	99,78	99,79	99,68	99,84
B(Z)	400896							
size (pixels)/ 1° latitude	1113,6							
N-S Pixel size (m)	99,77							

An ECRG 1:1M 1°x1° maximum product unit size is 1027 pixels (horizontally) x 1114 pixels (vertically).

b. ECRG ARC product at scale 1:500k parameters (254 dpi)

The following table provides the parameters for ECRG 1:500k ARC product, and the size of a 1° x 1° ECRG raster (in pixels), for each ARC zone.

Table 32: ECRG 1:500k ARC product: parameters and size in pixels in ARC zones (254 dpi)

ARC Zone	1 and A	2 and B	3 and C	4 and D	5 and E	6 and F	7 and G	8 and H
	Lat <=32	32< Lat <=48	48< Lat <=56	56< Lat <=64	64< Lat <=68	68< Lat <=72	72< Lat <=76	76< Lat <=80
A(ZT)	739 200	605184	491520	398208	326784	274560	220032	164736
size (pixels)/ 1° longitude	2053,3	1681,1	1365,3	1106,1	907,7	762,7	611,2	457,6
E-W Pixel Size (m)	49,96	49,95	50	49,97	49,83	49,83	49,93	50,04
B(Z)	800256							
size (pixels)/ 1° latitude	2222,9							
N-S Pixel size (m)	49,98							

An ECRG 1:500k 1°x1° maximum product unit size is 2053 pixels (horizontally) x 2223 pixels (vertically).

c. ECRG ARC product at scale 1:250k parameters (254 dpi)

The following table provides the parameters for ECRG 1:250k ARC product, and the size of a 1° x 1° ECRG raster (in pixels) , for each ARC zone..

Table 33: ECRG 1:250k ARC product: parameters and size in pixels in ARC zones (254 dpi)

ARC Zone	1 and A	2 and B	3 and C	4 and D	5 and E	6 and F	7 and G	8 and H
	Lat <=32	32< Lat <=48	48< Lat <=56	56< Lat <=64	64< Lat <=68	68< Lat <=72	72< Lat <=76	76< Lat <=80
A(ZT)	1 478 784	1210368	983040	796800	653184	548736	440448	329856
size (pixels)/ 1° longitude	4107,7	3362,1	2730,7	2213,3	1814,4	1524,3	1223,5	916,3
E-W Pixel Size (m)	24,97	24,98	25	24,97	24,93	24,93	24,94	24,99
B(Z)	1602048							
size (pixels)/ 1° latitude	4450,1							
N-S Pixel size (m)	24,97							

An ECRG 1:250k ARC 1°x1° maximum product unit size is 4108 pixels (horizontally) x 4450 pixels (vertically).

d. ECRG ARC product at scale 1:100k parameters (254 dpi)

The following table provides the parameters for ECRG 1:100k ARC product, and the size of a 1° x 1° ECRG raster (in pixels), for each ARC zone.

Table 34: ECRG 1:100k ARC product: parameters and size in pixels in ARC zones (254 dpi)

ARC Zone	1 and A	2 and B	3 and C	4 and D	5 and E	6 and F	7 and G	8 and H
	Lat <=32	32< Lat <=48	48< Lat <=56	56< Lat <=64	64< Lat <=68	68< Lat <=72	72< Lat <=76	76< Lat <=80
A(ZT)	3 696 768	3025920	2457600	1991808	1632152	1372032	1100928	824448
size (pixels)/ 1° longitude	10268,8	8405,3	6826,7	5532,8	4533,8	3811,2	3058,1	2290,1
E-W Pixel Size (m)	9,99	9,99	10,00	9,99	9,97	9,97	9,98	10,00
B(Z)	3870720							
size (pixels)/ 1° latitude	11123,2							
N-S Pixel size (m)	9,99							

An ECRG 1:100k ARC 1°x1° maximum product unit size is 10269 pixels (horizontally) x 11123 pixels (vertically).

e. ECRG ARC product at scale 1:50k parameters (254 dpi)

The following table provides the parameters for ECRG 1:50k ARC product, and the size of a 1° x 1° ECRG raster (in pixels), for each ARC zone.

Table 35: ECRG 1:50k ARC product: parameters and size in pixels in ARC zones (254 dpi)

ARC Zone	1 and A	2 and B	3 and C	4 and D	5 and E	6 and F	7 and G	8 and H
	Lat <=32	32< Lat <=48	48< Lat <=56	56< Lat <=64	64< Lat <=68	68< Lat <=72	72< Lat <=76	76< Lat <=80
A(ZT)	7 393 152	6051840	4915200	3983232	3266688	2744448	2201472	1648512
size (pixels)/ 1° longitude	20 536,5	20 536,5	20 536,5	20 536,5	20 536,5	20 536,5	20 536,5	20 536,5
E-W Pixel Size (m)	5,00	5,00	5,00	5,00	4,98	4,98	4,99	5,00
B(Z)	8007168							
size (pixels)/ 1° latitude	22242,1							
N-S Pixel size (m)	5,00							

An ECRG 1:50k ARC 1°x1° maximum product unit size is 20537 pixels (horizontally) x 22242 pixels (vertically).

f. ECRG ARC product at scale 1:1M parameters (300 dpi)

The following table provides the parameters for ECRG 1:1M ARC product, and the size of a 1° x 1° ECRG raster (in pixels), for each ARC zone.

Table 36: ECRG 1:1M ARC product: parameters and size in pixels in ARC zones (300 dpi)

ARC Zone	1 and A	2 and B	3 and C	4 and D	5 and E	6 and F	7 and G	8 and H
	Lat <=32	32< Lat <=48	48< Lat <=56	56< Lat <=64	64< Lat <=68	68< Lat <=72	72< Lat <=76	76< Lat <=80
A(ZT)	437202	357752	290560	235626	192950	162078	130298	97610
size (pixels)/ 1° longitude	1214,45	993,76	807,11	654,52	535,97	450,22	361,94	271,14
E-W Pixel Size (m)	84,47	84,5	84,58	84,44	84,39	84,41	84,31	84,45
B(Z)	473976							
size (pixels)/ 1° latitude	1316,6							
N-S Pixel size (m)	84,39							

An ECRG 1:1M 1°x1° maximum product unit size is 1214 pixels (horizontally) x 1317 pixels (vertically).

Annex D
JPEG 2000 recommendations for DRP

ISO/IEC 15444-1:2016 Information technology -- JPEG 2000 image coding system: Core coding system
ISO/IEC 15444-2:2004 Information technology -- JPEG 2000 image coding system: Extensions

Introduction

JPEG 2000 is strongly recommended for the compression of DRP products, as it provides superior compression performance and faster access to zones of interest within big/huge[4] raster files with a scalable standard for compression and encoding, allowing streaming capabilities (via JPIP / ISO/IEC 15444-9).

When using JPEG 2000, it is recommended that producers take advantage of the capabilities of JPEG 2000 and its associated decoder/decompressor for handling data access to a region of interest within the codestream, or raster view at lower resolution level, and to minimize external tiling in several frames / files by specifying frames of “relatively big” dimensions. JPEG 2000 software works efficiently – with fast data access - with files up to 4 Gb (compressed), the only issue then being the memory consumption resource. Subsequently, it is recommended to limit the compressed DRP product to about 0.5 Gb (and avoid compressed files above 1 Gb).

For DRP products using JPEG 2000 compression, two options are available (see section 11.4):

- use of GMLJP2 standard, on basis of **DGIWG GMLJP2 profile**, based on JP2 and/or JPX file format (as specified in ISO/IEC 15444-1 / resp. ISO/IEC 15444-2), where GML provides the georeference information by use of the Rectified Grid Coverage element.
- use of JPC Compressed codestream only (as specified in ISO/IEC 15444-1) when used on ECRG standard. In this case, the JPC Compressed codestream is contained within the NSIF/NITF 2.1 described by the Image Segment Sub-header in Section 0. NSIF provides the georeference information.

DRP products: recommended JPEG 2000 parameters

Note: The following compression recommended parameters are presently indicative; tests on a set of DRP products samples are necessary to confirm these parameters.

- JPEG 2000 Part 1 Profile 1 Compliant (the main constraint is that Tiling/Blocking <= 1024), which allows to handle files up to 4 Gb, unless the size of the product file requires to use Profile 2 (in this case Tiling/Blocking > 1024 and usually equal to 2048).
- 2 compression modes:
  - visually-lossless:
    20:1 Compression (0.4 bit-per-pixel-per band - bpppb)
    Or 12:1 Compression (2 bits-per-pixel)
    9-7I Irreversible wavelet Transformation (for visually-lossless mode), which implements ICT (Irreversible Component Transform),
    Note: Transformation to YCbCr colorspace is always used for 9-7I transform
  - lossless; in this latter case, a colormap may be used (thus allowing to encode pixel values on 8 bits instead of 24)

[4] Within the context of this document, files sizes measured in gigabytes are considered ‘huge’.

5-3R (Reversible Component Transformation)
Note: in this case, compression ratio depends on the data (usually between 2 and 3).

- 5 decomposition layers => 6 viewing resolutions
- 5 quality layers (0.03125, 0.0625, 0.125, 0.25, 0.4 bpppb), or more
- Precinct Size 256x256 for highest resolution levels, 128x128 for lower resolution level
- Code-Block Size : 64x64 (or 32x32)
- Tiling (optional). Note: Tiling is necessary for use of streaming with JPEG 2000 codestream.
  - Either no tiling, i.e Tile Size = Frame Size, i.e. no tiles within an image
  - or tile size = 1024 (or 2048 in order to reduce Tile index – and thus accelerate initial loading of tile index)
  - or tile size = 2048 (if the use of Profile 2 is needed on huge files).
- Codestream order:
  - RPCL (Resolution Position Component Layer). RPCL accelerates access to codestream regions of interest when navigating or zooming in the image.
  - LRCP (Layer Resolution Component Position). LRCP facilitates direct access to a specific resolution level in the codestream.
- Use of PLT (Packet Length Tile) Marker (optional). This facilitates random access within JPEG 2000 codestream (used by most implementations).
- In case of Tiling, use of TLM (Tile-part Lengths) Marker (optional) (most implementations do not use).

Optionally, the two following markers may be used to facilitate access in case of a low transfer rate:

- SOP (Start Of Packet): facilitates synchronisation on codestream transfer flow
- EPH (End of Packet Header): this facilitates random access and error detection on the codestream transfer flow.

Annex E
DRP file size estimates

Annex E-1. DRP Standardized ARC products: Tiling Scheme and file size estimates

The following table provides maximum file size estimates for DRP standardized ARC Geographic products (in Zone 1), with total number of pixels par tile, and approximate file size for JPEG 2000 visually-lossless compression (compression ratio 1:20) for raster resolution equal to 254 dpi.

Table 37: DRP Standardized ARC products: Tiling Scheme and file size estimates

Scale	File Coverage / Extent	Number of files/tiles in a square degree	Number of pixels per tile (Zone 1)	File Size estimate (uncompressed) (Mb)	File Size estimate (compressed at ratio 1:20) (Mb)
1M	20°d x 20°d		**4,59E+08**	**1313**	**65,6**
	10°d x 10°d		1,15E+08	328	16,4
	4°d x 4°d		1,84E+07	52,5	2,6
500k	20°d x 20°d		**1,84E+09**	**5250**	**262,5**
	10°d x 10°d		**4,59E+08**	**1313**	**65,6**
	4°d x 4°d		7,34E+07	210,0	10,5
250k	10°d x 10°d		**1,84E+09**	**5250**	**262,5**
	4°d x 4°d		**2,94E+08**	**840**	**42,0**
	2°d x 2°d		7,34E+07	210,0	10,5
100k	4°d x 4°d		**1,84E+09**	**5250**	**262,5**
	2°d x 2°d		**4,59E+08**	**1313**	**65,6**
	1°d x 1°d	1	1,15E+08	328,1	16,4
50k	2°d x 2°d		**1,84E+09**	**5250**	**262,5**
	1°d x 1°d	1	**4,59E+08**	**1313**	**65,6**
25k	2°d x 2°d		7,34E+09	21000	1050,0
	1°d x 1°d	1	**1,84E+09**	**5250**	**262,5**
	30 min x 30 min	4	**4,59E+08**	**1313**	**65,6**
12,5k	1°d x 1°d	1	7,34E+09	21000	1050,0
	30 min x 30 min	4	**1,84E+09**	**5250**	**262,5**
	15 min x 15 min	16	**4,59E+08**	**1313**	**65,6**
10k	30 min x 30 min	4	**2,87E+09**	**8203**	**410,2**
	15 min x 15 min	16	**7,18E+08**	**2051**	**102,5**
5k	15 min x 15 min	16	**2,87E+09**	**8203**	**410,2**

Annex E-2. DRP Standardized Projected products: Tiling Scheme and file size estimates

The following table provides maximum file size estimates for DRP projected products, with total number of pixels par tile and approximate file size for JPEG 2000 visually-lossless (compression ratio 1:20).

Table 38: DRP Standardized projected products: Tiling Scheme and file size estimates

Scale	File Coverage / Extent	Number of pixels per tile	File Size estimate (uncompressed) (Mb)	File Size estimate (compressed) (Mb)
5M	5000 km x 5000km	1,00E+08	286,10	14,31
2M	5000 km x 5000km	6,25E+08	1788,14	89,41
1M	2000 km x 2000km	4,00E+08	1144,41	57,22
500k	2000 km x 2000km	1,60E+09	4577,64	228,88
	1000 km x 1000km	4,00E+08	1144,41	57,22
250k	2000 km x 2000km	6,40E+09	18310,55	915,53
	1000 km x 1000km	1,60E+09	4577,64	228,88
	500 km x 500km	4,00E+08	1144,41	57,22
100k	500 km x 500km	2,50E+09	7152,56	357,63
	200 km x 200km	4,00E+08	1144,41	57,22
50k	200 km x 200km	1,60E+09	4577,64	228,88
	100 km x 100km	4,00E+08	1144,41	57,22
25k	200 km x 200km	6,40E+09	18310,55	915,53
	100 km x 100km	1,60E+09	4577,64	228,88
	50 km x 50km	4,00E+08	1144,41	57,22
12,5k	100 km x 100km	6,40E+09	18310,55	915,53
	50 km x 50km	1,60E+09	4577,64	228,88
	25 km x 25km	4,00E+08	1144,41	57,22
10k	50 km x 50km	2,50E+09	7152,56	357,63
	25 km x 25km	6,25E+08	1788,14	89,41
5k	25 km x 25km	2,50E+09	7152,56	357,63
	12,5km x 12,5km	6,25E+08	1788,14	89,41

Annex F
Bibliography

1. ISO 19123:2005 Geographic information - Schema for coverage geometry and functions
2. BIIF Profile for JPEG 2000 Version 01.10 (BPJ2K01.10) Document: ISO/IEC JTC1/SC24 N 3111 (Registered item) 15 April 2009